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# Doc 9869

# Performance-based Communication and Surveillance (PBCS) Manual

Second Edition, 2017

Approved by and published under the authority of the Secretary General

INTERNATIONAL CIVIL AVIATION ORGANIZATION

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# AMENDMENTS

Amendments are announced in the supplements to the *Products and Services Catalogue;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

## RECORD OF AMENDMENTS AND CORRIGENDA

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# FOREWORD

# HISTORICAL BACKGROUND

In 1983, the Council of the International Civil Aviation Organization (ICAO) established the Special Committee on Future Air Navigation Systems (FANS) which was tasked to study, identify and assess new technologies, including the use of satellites, and propose recommendations for the future development of air navigation for civil aviation. The FANS Committee determined that the development of new systems were required to overcome the limitations of conventional systems, thereby expanding air traffic management (ATM) capabilities on a global scale.

In September 1991, 450 representatives from eighty-five ICAO Member States and thirteen international organizations gathered at ICAO Headquarters in Montréal, Canada, for the Tenth Air Navigation Conference (AN-Conf/10) to consider and endorse the concept of a future air navigation system, as developed by the FANS Committee, that would meet the needs of the civil aviation community well into the next century. The FANS concept, which came to be known as the communications, navigation, surveillance/air traffic management (CNS/ATM) systems concept, involves a complex and interrelated set of technologies, dependent largely on satellites.

The endorsement of the CNS/ATM systems concept reached at AN-Conf/10 signalled the beginning of a new era for international civil aviation and paved the way for the activities related to the planning and implementation of new systems around the world.

The fourth meeting of the Aeronautical Mobile Communications Panel (AMCP/4, Montréal, April 1996) recognized the absence of objective criteria to evaluate communication performance requirements. The objective criteria needed were a set of values for parameters which would be based on the operational requirements for communication systems in the various phases of flight. The panel agreed that there was an urgent need to assess the existing technical options of communication systems against such a set of parameter values. The term “required communication performance (RCP)” type was used to denote a set of values for these parameters.

When reviewing the report of AMCP/4 in 1997, the Air Navigation Commission (ANC) tasked the Automatic Dependent Surveillance Panel (ADSP) (renamed in 2000 as the Operational Data Link Panel — OPLINKP) to develop the operational concept of RCP.

In 2001, the OPLINKP completed the document entitled *Concept of Required Communication Performance*, and the ANC solicited comments thereon from ICAO Member States. The comments received indicated broad support for the RCP concept. In light of the comments received, in 2002 the ANC amended the OPLINKP work programme to develop a *Manual on Required Communications Performance (RCP)* (Doc 9869) and, as necessary, Standards and Recommended Practices (SARPs) and procedures relating to the use of RCP in the provision of air traffic services.

In 2003, the Eleventh Air Navigation Conference (AN-Conf/11) endorsed recommendations to:

a) continue the development of SARPs, procedures and guidance material on RCP; and

b) investigate areas for further work including: determine the relationship of the RCP concept to separation studies and interoperability; standardize RCP types and allocations; ensure the adequacy of air traffic service (ATS) functions and procedures for new CNS/ATM environments; and establish requirements for safety performance monitoring.

The first meeting of the OPLINKP (OPLINKP/1, Montréal, September 2005) agreed on the proposed amendments to include a provision for RCP in Annex 6 — *Operation of Aircraft,* Annex 11 — *Air Traffic* Services, *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444), and the first edition of the *Manual on Required Communication Performance (RCP)* (Doc 9869).

In 2007, the ICAO North Atlantic (NAT) and Asia-Pacific (APAC) Regions began collaborating on the global issue of increased use and dependency of commercial communication services in the provision of air traffic services. The companies providing these services decided to eliminate certain components of the system for economic reasons that conflicted with the needs for aviation safety. The NAT and APAC Regions recognized that the issue should be examined at the global level, but due to urgency, also at the regional level, since communication is an integral part of regional implementation plans. Both regions held special meetings to address the issue.

By 2008, the NAT Systems Planning Group (SPG) concluded to develop an RCP Implementation Plan proposing to mandate RCP in the NAT Region by 2015. The NAT and APAC Regions also agreed to develop common guidance material, which became known as: the *Global Operational Data Link (GOLD) Manual* (Doc 10037), of which the second edition was published in April 2013; and the *Satellite Voice Guidance Material (SVGM)*, with the first edition published in July 2012.

In 2008, the ANC approved a work programme to reconvene the OPLINKP, and tasked the panel to update the *Manual on Required Communication Performance (RCP)* (Doc 9869) by taking into account significant advances by ICAO Member States and regions, in the areas of qualification and monitoring, commercial service contracts/agreements and operational approvals, thereby also avoiding the imposition of regional or State-specific criteria on aircraft operators and aircraft/avionics manufacturers.

In 2010, OPLINKP reconvened and agreed to develop an amendment to Doc 9869, renaming it to the *Performance-based Communication and Surveillance (PBCS) Manual*, and expanding its scope by incorporating parts of the GOLD and SVGM, and other material that was developed by the regions since 2007.

An RCP type, which had been used in the first edition to denote a set of values for specific parameters, is not used in the second edition. An RCP type provided a means for the AMCP to assess different technologies. However, a means was also needed to specify and allocate operational, functional, safety and performance criteria and ensure actual CNS/ATM system performance. As a result, the operational criteria and associated allocations are now included in globally accepted RCP specifications. In addition, the second edition of Doc 9869 includes required surveillance performance (RSP) specifications to provide the operational, functional, safety and performance criteria for surveillance capability.

The RCP and RSP specifications are described within the performance-based communication and surveillance (PBCS) framework, thereby providing the means to prescribe the appropriate RCP and RSP specifications and initially qualify different subsystems, as well as manage operational (end-to-end) system performance in continued operations.

The second meeting of the OPLINKP (OPLINKP/2, Montréal, October 2014) agreed on the proposed amendments to include provisions for PBCS in Annex 6, Annex 11, Annex 15, PANS-ATM (Doc 4444) and PANS-ABC (Doc 8400) and the second edition of Doc 9869.

The amendments to Annexes and PANS were adopted/approved by the Council with an applicability date of 10 November 2016 and a draft PBCS manual developed by the OPLINKP was updated aligning it with the final PBCS provisions in the Annexes and PANS.

## SCOPE AND PURPOSE

This manual provides guidance and information concerning PBCS operations and is intended to facilitate the uniform application of the SARPs contained in Annex 6, Annex 11, Annex 15, PANS-ATM (Doc 4444), PANS-ABC (Doc 8400) and, when necessary, the *Regional Supplementary Procedures* (Doc 7030).

This guidance material is also intended to improve safety and maximize operational benefits by promoting the PBCS concept and its general application to diverse and emerging technologies for communication and surveillance supporting ATM operations. The PBCS concept provides a framework for managing communication and surveillance performance in accordance with globally accepted RCP and RSP specifications.

The RCP and RSP specifications included are intended initially for automatic dependent surveillance — contract (ADS-C), controller-pilot data link communications (CPDLC) and satellite voice (SATVOICE) communications supporting ATM operations in airspace, where procedural separations are being applied. However, the PBCS concept allows for new RCP and RSP specifications for other purposes. For example, the manual could be updated to include a new RSP specification that is intended for automatic dependent surveillance – broadcast (ADS-B) supporting an ATM operation.

This second edition, formerly the *Manual on Required Communication Performance (RCP)*, was restructured as follows:

a) Background information, purpose of the manual and explanation of terms was moved from Chapter 1 to the “Foreword”.

b) Chapter 1 was renamed from “Introduction” to “Performance-based communication and surveillance (PBCS) concept”. This chapter provides information on the PBCS concept, including differences with performance-based navigation (PBN); the relationship of the PBCS concept to State safety management responsibilities; the PBCS framework; RCP and RSP specifications supporting ATM operations; and developing, applying and complying with an RCP/RSP specification.

c) Chapter 2 was renamed from “Overview of RCP” to “Developing an RCP/RSP specification”. This chapter provides guidance on developing an RCP/RSP specification, which includes operational criteria in terms of RCP/RSP times; RCP/RSP continuity; RCP/RSP availability; RCP/RSP integrity and associated functional and safety requirements; and allocations to different components of the system.

d) Chapter 3 was renamed from “Determining an RCP type” to “Applying an RCP/RSP specification”. This chapter provides guidance on applying an RCP/RSP specification, which includes the prescription of the communication and surveillance capability supporting specific ATM operations in specific airspace, associated operational approvals, and post-implementation monitoring.

e) Chapter 4 was renamed from “Prescribing an RCP type” to “Complying with an RCP/RSP specification”. This chapter provides guidance on establishing policies, procedures and criteria for State approvals and on complying with an RCP/RSP specification, which includes: initial compliance determination and State approvals for aircraft systems; air navigation services provider (ANSP) systems and aircraft operators; flight plan requirements; and continued operational compliance — PBCS monitoring programmes.

f) Chapter 5, which was entitled “Complying with an RCP type”, was incorporated into the above-mentioned Chapter 4.

g) Appendix A was renamed from “Glossary of terms” to “PBCS Implementation Plan — Checklist”. The glossary of terms was moved to the preliminary portion of the manual. Appendix A now includes guidance — and a checklist—that lists tasks and other aspects for consideration in the development of a local or regional PBCS implementation plan.

h) Appendix B was renamed from “Checklist for RCP application” to “RCP specifications”. The checklist was replaced by a new checklist that is contained in Appendix A. Appendix B now contains a “merged” version of the RCP specifications taken from the regional guidance material (GOLD and SVGM), Appendix B in each document. These specifications are considered a requirement when they are prescribed or guidance if applied only to PBCS monitoring programmes.

i) Appendix C was renamed from “Example of determining an RCP type” to “RSP specifications”. The example was deleted. Appendix C now contains a “merged” version of the RSP specifications taken from the regional guidance material (GOLD and SVGM), Appendix C in each document. These specifications are considered a requirement when they are prescribed or guidance if applied only to PBCS monitoring programmes.

j) A new Appendix D, “Post-implementation monitoring and corrective action (CPDLC and ADS-C),” was added. Appendix D contains the guidance on post-implementation monitoring at ANSP, regional and inter-regional levels, taken from GOLD, Appendix D. The material was simplified and is structured differently from that provided in the GOLD.

k) A new Appendix E, “Post-implementation monitoring and corrective action (SATVOICE),” was added. Appendix E contains the guidance on post-implementation monitoring at ANSP, regional and inter-regional levels, taken from the SVGM, Appendix D.

The following personnel and organizations should be familiar with relevant aspects of its contents: regulators, airspace planners, aircraft operators, flight operations officers/flight dispatchers, ANSPs, aeronautical stations, communication services providers (CSPs), satellite service providers (SSPs), radio operators, training organizations, regional/local monitoring entities, automation specialists and radio facilities, aircraft manufacturers and equipment suppliers.

The guidance supports the following activities:

a) States’ roles and responsibilities in relation to the following:

   1) safety oversight of air navigation services;

   2) operational approval (e.g. flight crew training and qualifications); and

   3) design approval of aircraft data link systems;

b) development of agreements and/or contractual arrangements between ANSPs and aircraft operators and their respective CSPs;

c) development of operational procedures; and

d) operational monitoring, analysis, and exchange of operational data among appropriate entities, such as regional monitoring entities, States, ANSPs, and CSPs.

## FUTURE DEVELOPMENTS

In order to keep this manual relevant and accurate, suggestions for its improvement regarding format, content or presentation are welcome. Any such recommendation or suggestion will be examined and, if found suitable, will be included in regular updates to the manual. Regular revision will ensure that the manual remains both pertinent and accurate. Comments on this manual should be addressed to:

The Secretary General
International Civil Aviation Organization
999 Robert-Bourassa Boulevard
Montréal, Quebec, H3C 5H7
Canada

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# TABLE OF CONTENTS

# PUBLICATIONS

*(referred to in this manual)*

**International Civil Aviation Organization (ICAO)**

Annex 1 — *Personnel Licensing*

Annex 4 — *Aeronautical Charts*

Annex 6 — *Operation of Aircraft*
Part I — *International Commercial Air Transport — Aeroplanes*
Part II — *International General Aviation — Aeroplanes*
Part III — *International Operations — Helicopters*

Annex 10 — *Aeronautical Telecommunications*
Volume II — *Communication Procedures including those with PANS status*
Volume III — *Communication Systems*

Annex 11 — *Air Traffic Services*

Annex 15 — *Aeronautical Information Services*

Annex 19 — *Safety Management*

*Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444)

*Procedures for Air Navigation Services — ICAO Abbreviations and Codes* (PANS-ABC, Doc 8400)

*Regional Supplementary Procedures* (Regional SUPPs, Doc 7030)

*Designators for Aircraft Operating Agencies, Aeronautical Authorities and Services* (Doc 8585)

*Aircraft Type Designators* (ICAO Doc 8643)

*Manual on Airspace Planning Methodology for the Determination of Separation Minima* (Doc 9689)

*Performance-based Navigation (PBN) Manual* (Doc 9613)

*Manual on a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive* (Doc 9574)

*Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the Use of a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive* (Doc 9937)

*Global Operational Data Link (GOLD) Manual* (Doc 10037)

*Satellite Voice (SATVOICE) Operations Manual* (Doc 10038)

*Manual on Monitoring the Application of Performance-based Horizontal Separation Minima* (Doc 10063)

**European Organisation for Civil Aviation Equipment (EUROCAE) and Radio Technical Commission for Aeronautics, Inc. (RTCA) documents**

*Safety and Performance Standard for Air Traffic Data Link Services in Oceanic and Remote Airspace* (Oceanic SPR Standard, RTCA DO-306/EUROCAE ED-122)

*Safety and Performance Standard for Air Traffic Data Link Services in Continental Airspace* (Continental SPR Standard, RTCA DO-290/EUROCAE ED-120, Change 1 and Change 2)

*Interoperability Requirements for ATS Applications Using ARINC 622 Data Communications* (FANS 1/A INTEROP Standard, RTCA DO-258A/EUROCAE ED-100A)

*Interoperability Requirements Standard for Aeronautical Telecommunication Network Baseline 1* (ATN B1 INTEROP Standard, RTCA DO-280B/EUROCAE ED-110B)

*Future Air Navigation System 1/A — Aeronautical Telecommunication Network Interoperability Standard* (FANS 1/A — ATN B1 INTEROP Standard, RTCA DO 305A/EUROCAE ED 154A)

*Safety, Performance and Interoperability Requirements Document for In-Trail Procedure in Oceanic Airspace* (RTCA DO 312/EUROCAE ED 159) and Supplement

# GLOSSARY

## DEFINITIONS

When the subsequent terms are used in this manual, they have the following meanings.

*Note.— Where an asterisk appears beside a term, the term has already been defined as such in Annexes and Procedures for Air Navigation Services (PANS).*

***Access number.*** The number used by the ATS unit, aeronautical station or aeronautical operational control (AOC) to access the network switch to contact an aircraft via SATVOICE.

****Active flight plan.*** See flight plan.

***Actual communication performance (ACP).*** The portion of communication transaction time that is monitored against the required communication monitored performance (RCMP) values provided by the RCP specification.

***Actual surveillance performance (ASP).*** The portion of surveillance data delivery time that is monitored against the required surveillance monitored performance (RSMP) values provided by the RSP specification.

****Aeronautical Information Publication (AIP).*** A publication issued by or with the authority of a State and containing aeronautical information of a lasting character essential to air navigation.

****Aeronautical mobile-satellite (route) service (AMS(R)S).*** An aeronautical mobile-satellite service reserved for communications relating to safety and regularity of flights, primarily along national or international civil air routes.

*Note.— AMS(R)S includes both voice and data. In this document, the use of AMS(R)S for voice communications is referred to as SATVOICE to reflect the operational use of the term in standard phraseology and messages.*

****Aeronautical mobile service (AMS).*** A mobile service between aeronautical stations and aircraft stations, or between aircraft stations, in which survival craft stations may participate; emergency position-indicating radio beacon stations may also participate in this service on designated distress and emergency frequencies.

****Aeronautical operational control (AOC).*** Communication required for the exercise of authority over the initiation, continuation, diversion or termination of flight for safety, regularity and efficiency reasons.

****Aeronautical station.*** *A land station in the aeronautical mobile service.* In certain instances, an aeronautical station may be located, for example, on board ship or on a platform at sea.

****Aeronautical telecommunication network (ATN).*** A global internetwork architecture that allows ground, air-ground and avionic data subnetworks to exchange digital data for the safety of air navigation and for the regular, efficient and economic operation of air traffic services.

****Air traffic control (ATC) clearance.*** Authorization for an aircraft to proceed under conditions specified by an air traffic control unit.

*Note 1.— For convenience, the term “air traffic control clearance” is frequently abbreviated to “clearance” when used in appropriate contexts.*

*Note 2.— The abbreviated term "clearance" may be prefixed by the words "taxi", "take-off", "departure", "en-route", "approach" or "landing" to indicate the particular portion of flight to which the air traffic control clearance relates.*

***Air traffic control (ATC) service.** A service provided for the purpose of:

a) preventing collisions:

1) between aircraft, and

2) on the manoeuvring area between aircraft and obstructions; and

b) expediting and maintaining an orderly flow of air traffic.

***Air traffic management (ATM).** The dynamic, integrated management of air traffic and airspace (including air traffic services, airspace management and air traffic flow management) — safely, economically and efficiently — through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground-based functions.

***Air traffic service (ATS).** A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service).

***Air traffic services unit (ATS unit).** A generic term meaning variously, air traffic control unit, flight information centre or air traffic services reporting office.

***Aircraft.** Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface.

***Aircraft address.** A unique combination of 24 bits available for assignment to an aircraft for the purpose of air-ground communications, navigation and surveillance.

***Aircraft identification.** A group of letters, figures or a combination thereof which is either identical to, or the coded equivalent of, the aircraft call sign to be used in air-ground communications, and which is used to identify the aircraft in ground-ground air traffic services communications.

*Note 1.— The aircraft identification does not exceed 7 characters and is either the aircraft registration or the ICAO designator for the aircraft operating agency followed by the flight identification.*

*Note 2.— ICAO designators for aircraft operating agencies are contained in Doc 8585.*

***Aircraft registration.** A group of letters, figures or a combination thereof which is assigned by the State of Registry to identify the aircraft.

*Note.— Also referred to as registration marking.*

***Appropriate authority.**

a) Regarding flight over the high seas: The relevant authority of the State of Registry.

b) Regarding flight other than over the high seas: The relevant authority of the State having sovereignty over the territory being overflown.

***Area navigation (RNAV) specification.** See navigation specification.

***ATC waypoint.*** A waypoint contained in Item 15 of the ICAO flight plan, or as amended by ATC.

*Note.— A waypoint inserted by the flight crew for purposes of conducting flight operations such as points of no return are not ATC waypoints.*

***ATM operation.*** An individual operational component of air traffic management.

*Note.— Examples of ATM operations include the application of separation between aircraft, the re-routing of aircraft, and the provision of flight information.*

****ATS surveillance service.*** Term used to indicate a service provided directly by means of an ATS surveillance system.

****ATS surveillance system.*** A generic term meaning variously, ADS-B, PSR, SSR or any comparable ground-based system that enables the identification of aircraft.

*Note.— A comparable ground-based system is one that has been demonstrated, by comparative assessment or other methodology, to have a level of safety and performance equal to or better than monopulse SSR.*

****Automatic dependent surveillance — broadcast (ADS-B).*** A means by which aircraft, aerodrome vehicles and other objects can automatically transmit and/or receive data such as identification, position and additional data, as appropriate, in a broadcast mode via a data link.

****Automatic dependent surveillance — contract (ADS-C).*** A means by which the terms of an ADS-C agreement will be exchanged between the ground system and the aircraft, via a data link, specifying under what conditions ADS-C reports would be initiated, and what data would be contained in the reports.

*Note.— The abbreviated term "ADS-contract" is commonly used to refer to ADS event contract, ADS demand contract, ADS periodic contract or an emergency mode*

****Call sign.*** The designator used to identify aeronautical stations, including ATS units, and aircraft in radiotelephony communications.

*Note.— See Annex 10, Volume II, 5.2.1.7 for Standards on defining call signs. For aircraft, the call sign is equivalent to the aircraft identification.*

***Caller line identification (CLI).*** A display of the identification of a caller to the recipient prior to answering the call.

*Note.— For the purposes of ATS communications, caller line identification to the flight crew is a display of facility name or the facility designator for the aeronautical station or ATS unit. For the ground user, it is a display of the aircraft identification.*

***Communication services provider (CSP).*** Any public or private entity providing communication services for general air traffic. The services would include those provided by a satellite service provider (SSP) through a contract or agreement

***Communication services.*** Aeronautical fixed and mobile services to enable ground-ground and/or air-ground communications for safety and regularity of flight.

***Compulsory reporting point.*** An ATC waypoint for which a position report is required by the aircraft.

****Control area (CTA).*** A controlled airspace extending upwards from a specified limit above the earth.

***Controller-pilot data link communications (CPDLC).** A means of communication between controller and pilot, using data link for ATC communications.

***CPDLC message.** Information exchanged between an airborne application and its ground counterpart. A CPDLC message consists of a single message element or a combination of message elements conveyed in a single transmission by the initiator.

***Current flight plan.** See flight plan.

***Data link initiation capability (DLIC).** A data link application that provides the ability to exchange addresses, names and version numbers necessary to initiate data link applications.

***Diagnostic rhyme test (DRT).** A test and scoring system for speech intelligibility using trained listeners to distinguish a standard set of word-pairs with initial consonants that sound somewhat similar. (ANSI/ASA S3.2-2009)

*Note.— Speech intelligibility is a vital factor in aeronautical safety communications. The DRT is specifically designed to test intelligibility of speech using trained listeners to distinguish a standard set of word-pairs with initial consonants that sound somewhat similar (e.g. goat/coat). They are played word-pairs processed through a condition (e.g. codec) under test and the success rate is scored. Intelligibility is largely dependent on consonant recognition; vowel recognition is less important. The target users for aeronautical communications are, as for the DRT listening panels, trained listeners (pilots, air traffic controllers) who use standard phrases.*

***Downlink message (DM).** A CPDLC message sent from an aircraft.

***Figure of merit (FOM).** An indication of the aircraft navigation system's ability to maintain position accuracy.

***Filed flight plan.** See flight plan.

***Flight crew member.** A licensed crew member charged with duties essential to the operation of an aircraft during a flight duty period.

***Flight identification.** A group of numbers, which is usually associated with an ICAO designator for an aircraft operating agency, to identify the aircraft in Item 7 of the flight plan.

***Flight information region (FIR).** An airspace of defined dimensions within which flight information service and alerting service are provided.

***Flight manual.** A manual, associated with the certificate of airworthiness, containing limitations within which the aircraft is to be considered airworthy, and instructions and information necessary to the flight crew members for the safe operation of the aircraft.

***Flight plan.** Specified information provided to air traffic services units, relative to an intended flight or portion of a flight of an aircraft.

A flight plan can take several forms, such as:

*Current flight plan (CPL).* The flight plan, including changes, if any, brought about by subsequent clearances. (ICAO)

*Note 1.— When the word "message" is used as a suffix to this term, it denotes the content and format of the current flight plan data sent from one unit to another.*

*Filed flight plan (FPL).* The flight plan as filed with an ATS unit by the pilot or a designated representative, without any subsequent changes. (ICAO)

*Note 2.— When the word "message" is used as a suffix to this term, it denotes the content and format of the filed flight plan data as transmitted.*

*Operational flight plan.* The operator's plan for the safe conduct of the flight based on considerations of aeroplane performance, other operating limitations and relevant expected conditions on the route to be followed and at the aerodromes concerned. (ICAO)

*Active flight plan.* The operational flight plan which is controlling the aircraft's progress in terms of route, speed and altitude.

***Free text message element.*** A message element used to convey information not conforming to any standardized message element in the CPDLC message set.

***Grade of service.*** The probability of a call being blocked or delayed for more than a specified interval, with reference to the busy hour when the traffic intensity is the greatest.

***Ground user.*** A term to refer to either the controller or the radio operator.

***Lateral deviation event (LDE).*** A type of event that triggers an ADS-C report when the absolute value of the lateral distance between the aircraft`s actual position and the aircraft`s expected position on the active flight plan becomes greater than the lateral deviation threshold.

***Level-range deviation event (LRDE).*** A type of event that triggers an ADS-C report when the aircraft`s level is higher than the level ceiling or the aircraft`s level is lower than the level floor.

*Note.— Sometimes referred to as altitude range change event or altitude range event.*

***Long-range communication system (LRCS).*** A system that uses satellite relay, data link, high frequency, or another approved communication system which extends beyond line of sight.

****Master minimum equipment list (MMEL).*** A list established for a particular aircraft type by the organization responsible for the type design with the approval of the State of Design containing items, one or more of which is permitted to be unserviceable at the commencement of a flight. The MMEL may be associated with special operating conditions, limitations or procedures.

***Maximum accumulated unplanned outage time.*** A value that defines the acceptable accumulated duration of unplanned outages that exceed the unplanned outage duration limit in a specified time period.

*Note.— Unplanned outages that are less than the unplanned outage duration limit are considered against the criterion for continuity.*

***Maximum number of unplanned outages.*** A value that defines the acceptable number of unplanned outages that exceed the unplanned outage duration limit in a specified time period.

*Note.— Unplanned outages that are less than the unplanned outage duration limit are considered against the criterion for continuity.*

****Minimum equipment list (MEL).*** A list which provides for the operation of aircraft, subject to specified conditions, with particular equipment inoperative, prepared by an operator in conformity with, or more restrictive than, the MMEL established for the aircraft type.

***Navigation specification.** A set of aircraft and flight crew requirements needed to support performance-based navigation operations within a defined airspace. There are two kinds of navigation specifications:

*Required navigation performance (RNP) specification.* A navigation specification based on area navigation that includes the requirement for performance monitoring and alerting, designated by the prefix RNP (e.g. RNP 4, RNP APCH).

*Area navigation (RNAV) specification.* A navigation specification based on area navigation that does not include the requirement for performance monitoring and alerting, designated by the prefix RNAV (e.g. RNAV 5, RNAV 1).

*Note 1.— The* Performance-based Navigation (PBN) Manual *(Doc 9613), Volume II, contains detailed guidance on navigation specifications.*

*Note 2.— The term RNP, previously defined as "a statement of the navigation performance necessary for operation within a defined airspace", has been removed from this Annex as the concept of RNP has been overtaken by the concept of PBN. The term RNP is now solely used in the context of navigation specifications that require performance monitoring and alerting, e.g. RNP 4 refers to the aircraft and operating requirements, including a 4 NM lateral performance with on-board performance monitoring and alerting that are detailed in Doc 9613.*

***NOTAM.** A notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.

***Operational approval.** An authorization which entitles an operator, owner or pilot-in-command to undertake or continue a flight operation. States may use the following methods to issue operational approvals:

*Approval.* An explicit action by the State of the Operator/State of Registry to authorize an application to undertake a proposal to modify a flight operation that has been submitted by, or on behalf of, an operator or owner. The approval attests to compliance with the applicable provisions.

*Specific approval.* An approval which is required to be documented in the operations specifications for commercial air transport operations or in the list of specific approvals for international general aviation operations.

*Acceptance.* A written or implicit acknowledgement of consensus by a State on a notification submitted by the operator. A State's approval is implicit if it does not issue a written response to the operator within a certain period of time following the submission of the notification.

*Note.— General aviation approvals may take the form of criteria established by the State of Registry which must be met by an operator, owner or pilot-in-command to undertake or continue a flight operation.*

***Operational communication transaction.** The process a human uses to initiate the transmission of an instruction, clearance, flight information, and/or request, and is completed when that human is confident that the transaction is complete.

***Operational flight plan.** See flight plan.

***Performance-based communication (PBC).** Communication based on performance specifications applied to the provision of air traffic services.

*Note.— An RCP specification includes communication performance requirements that are allocated to system components in terms of the communication to be provided and associated transaction time, continuity, availability, integrity, safety and functionality needed for the proposed operation in the context of a particular airspace concept.*

***Performance-based navigation (PBN).** Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.

*Note.— Performance requirements are expressed in navigation specifications (RNAV specification, RNP specification) in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept.*

***Performance-based surveillance (PBS).** Surveillance based on performance specifications applied to the provision of air traffic services.

*Note.— An RSP specification includes surveillance performance requirements that are allocated to system components in terms of surveillance to be provided and associated data delivery time, continuity, availability, integrity, accuracy of the surveillance data, safety and functionality needed for the proposed operation in the context of a particular airspace concept.*

***Personal identification number (PIN).** A secret numeric password shared between a user and a system that can be used to authenticate the user to the system.

*Note.— For the purposes of ATS communications, all PIN numbers are issued for the same purpose, as there is no PIN that grants higher priority or access than another. The priority of the call is determined by the dialling string and ground-initiated calling service used. Calling line identification (caller ID) is just a substitute for the radio operator not having to dial the PIN number for ground-initiated calls. When caller ID is implemented for the customer, then all calls made from the access numbers provided to the GES provider will not be prompted for a PIN when the call is placed to the aircraft. If the switch does not recognize the pre-defined caller ID list provided to the GES, then the caller will be prompted for the PIN code.*

***Pre-emption.** The immediate and automatic seizure of resources allocated to a lower-priority call. A higher priority call will interrupt communication resources being used by a lower priority communication to establish a connection without any indication or delay.

*Note.— If the intervening call is the same or lower, the current call will not be pre-empted and the intervening caller will get an indication that the line is not available. The effects of pre-emption can be minimized by multiple channels and conference calling, but not completely eliminated.*

***Priority level.** An indication of call precedence for ground-to-air or air-to-ground calls. Priority level may be used to establish pre-emption.

***Procedural control.** Term used to indicate that information derived from an ATS surveillance system is not required for the provision of air traffic control service.

***Procedural separation.** The separation used when providing procedural control.

***Public switched telephone network (PSTN).** A network of the world's public circuit-switched telephone networks. It consists of telephone lines, fibre optic cables, microwave transmission links, cellular networks, communications satellites, and undersea telephone cables, all interconnected by switching centres, thus allowing any telephone in the world to communicate with any other.

***Qualification.** The process through which a State, approval authority and applicant ensure that a specific implementation complies with applicable requirements with a specified level of confidence.

***Radio operator.** A person authorized by the appropriate authority to relay a radiotelephony communication between the ATS unit and the flight crew.

***RCP allocation.*** A portion of an RCP parameter value assigned to a specific component of the communication system.

*Note.— The different components of the system may include, for example, the ATS unit, the CSP, the aircraft system and the flight crew. An RCP allocation may also be a portion of an RCP parameter value that is used for monitoring (e.g. RCMP).*

***RCP answer/call performance.*** An RCP allocation that specifies the maximum time for when the flight crew receives an indication of an incoming call to when the parties on the call have completed the communication.

***RCP availability (A).*** An RCP parameter that specifies the required probability that an operational communication transaction can be initiated.

***RCP availability — aircraft ($A_{AIR}$).*** An RCP allocation that specifies the required probability that the aircraft system is serviceable for the relevant communication capability.

***RCP availability — CSP ($A_{CSP}$).*** An RCP allocation that specifies the required probability that the CSP systems are available to provide the required level of communication service, given the ATS unit's system is available.

***RCP availability — service ($A_{SERVICE}$).*** An RCP allocation that specifies the required probability that the ATS unit's system and the CSP systems are available to provide the required level of communication service.

***RCP continuity (C).*** An RCP parameter that specifies the minimum proportion of relevant operational communication transactions to be completed within the specified time, given that the service was available at the start of the transaction, where:

a) the minimum proportion is either 95 per cent that is used for statistical monitoring, or a proportion (e.g. 99.9 per cent) that is associated with the time after which the initiator is required to revert to an alternative procedure; and

b) the specified time represents the RCP transaction time or any allocation provided by the RCP specification.

*Note.— For any given allocation of the RCP transaction time, the RCP continuity remains constant and is referred to as "C for [allocation]", (e.g. C for RCMP, C for RCTP).*

***RCP initiator performance.*** An RCP allocation that specifies the maximum time for the controller to issue an ATC instruction and receive a response.

***RCP integrity (I).*** An RCP parameter that specifies the required probability that an operational communication transaction is completed with no undetected errors.

*Note.— While RCP integrity is defined in terms of the quality of the communication capability, the criterion is specified as a probability of malfunction on a per flight hour basis (e.g. $10^{-5}$), consistent with RSP and RNAV/RNP specifications.*

***RCP parameter.*** A performance characteristic that provides the basis for developing an RCP specification. The RCP parameters include RCP transaction time, RCP continuity, RCP availability and RCP integrity.

***RCP pilot operational response time (PORT).*** An RCP allocation that specifies the maximum time for the flight crew to recognize and respond to an ATC instruction.

***RCP queue/connect performance.*** An RCP allocation that specifies the maximum time allocated to the radio operator/aeronautical station system to organize and place the call either via a manual or automated dialling sequence.

***RCP transaction time.*** An RCP parameter that specifies the maximum time for the completion of a proportion of operational communication transactions after which the initiator should revert to an alternative procedure. Two values are specified:

a) RCP nominal time (TT). The maximum nominal time within which 95 per cent of operational communication transactions is required to be completed; and

b) RCP expiration time (ET). The maximum time for the completion of the operational communication transaction after which the initiator is required to revert to an alternative procedure.

***$RCTP_{AIR}$.*** An RCP allocation that specifies the maximum portion of RCTP for the aircraft system.

***$RCTP_{AS}$.*** An RCP allocation that specifies the maximum portion of RCTP for an aeronautical station's system for ground-ground communications with an ATS unit.

*Note.— $RCTP_{AS}$ includes two concurrent processes:*

*a) the aircraft and aeronautical station technically disconnect the call; which is assumed. Operationally, the call is disconnected when the flight crew and radio operator complete the call; and*

*b) the aeronautical station sends the response to the ATS unit via the ground-ground network; the performance is denoted by $RCTP_{AS}$.*

***$RCTP_{ATSU}$.*** An RCP allocation that specifies the maximum portion of RCTP for the ATS unit's system.

***$RCTP_{CSP}$.*** An RCP allocation that specifies the maximum portion of RCTP for the network, including CSP.

***$RCTP_{G/A}$.*** An RCP allocation that specifies the maximum portion of RCTP for the ground system, network and aircraft system to set up a ground-to-air call, as determined from when the last digit of the dialling sequence is finished to when the aircraft indicates an incoming call to the flight crew.

***Required communication monitored performance (RCMP).*** An RCP allocation that specifies the maximum time against which ACP is assessed.

****Required communication performance (RCP) specification.*** A set of requirements for air traffic services provision and associated ground equipment, aircraft capability, and operations needed to support performance-based communication.

***Required communication technical performance (RCTP).*** An RCP allocation that specifies the maximum technical time for relevant parts of the ATS unit's system, aeronautical station's system, the network systems and the aircraft system, for which there is no human contribution to the communication transaction performance.

****Required navigation performance (RNP) specification.*** See navigation specification.

***Required surveillance monitored performance (RSMP).*** An RSP allocation that specifies the maximum time against which ASP is assessed.

****Required surveillance performance (RSP) specification.*** A set of requirements for air traffic services provision and associated ground equipment, aircraft capability, and operations needed to support performance-based surveillance.

***Required surveillance technical performance (RSTP).*** An RSP allocation that specifies the maximum technical time for relevant parts of the ATS unit's system, aeronautical station's system, the network systems and the aircraft system, for which there is no human contribution to the surveillance data delivery performance.

***RSP allocation.*** A portion of an RSP parameter value assigned to a specific component of the surveillance system.

*Note.— The different components of the system may include, for example, the ATS unit, the CSP, the aircraft system and the flight crew. An RSP allocation may also be a portion of an RCP parameter value that is used for monitoring (e.g. RSMP).*

***RSP answer performance.*** An RSP allocation that specifies the maximum time for when the ground user receives an indication of an incoming call to when the ground user accepts the call.

***RSP availability (A).*** An RSP parameter that specifies the required probability that surveillance data can be provided.

***RSP availability — aircraft ($A_{AIR}$).*** An RSP allocation that specifies the required probability that the aircraft system is serviceable for the relevant surveillance service.

***RSP availability — CSP ($A_{CSP}$).*** An RSP allocation that specifies the required probability that the CSP/SSP systems are available to provide the required level of communication supporting surveillance services, given the ATS unit's system is available.

***RSP availability — service ($A_{SERVICE}$).*** An RSP allocation that specifies the required probability that the ATS unit's system and the CSP systems are available to provide the required level of surveillance service.

***RSP call performance.*** An RSP allocation that specifies the maximum time for when the ground user accepts an incoming air-to-ground call to when the parties on the call have completed the communication.

***RSP continuity (C).*** An RSP parameter that specifies the minimum proportion of relevant surveillance data to be delivered within the specified time, given that the service was available at the start of delivery, where:

a) the minimum proportion is either 95 per cent that is used for statistical monitoring, or a proportion (e.g. 99.9 per cent) that is associated with the time after which the surveillance data is considered overdue; and

b) the specified time represents the RSP data delivery time or any allocation provided by the RSP specification.

*Note.— For any given allocation of the RSP data delivery time, the RSP continuity remains constant and is referred to as "C for [allocation]", (e.g. for RSTP, C for $RSTP_{CSP}$).*

***RSP data delivery time.*** An RSP parameter that specifies the maximum time for a proportion of surveillance data deliveries from the time at which the aircraft reported its position to when the ATS unit receives the report. Two values are specified:

a) RSP nominal delivery time (DT). The maximum nominal time within which 95 per cent of surveillance data deliveries are required to be successfully delivered; and

b) RSP overdue delivery time (OT). The maximum time for the successful delivery of surveillance data after which time the initiator is required to revert to an alternative procedure.

***RSP initiator performance.*** An RSP allocation that specifies the maximum time for the flight crew to prepare a position report, from the time the aircraft was over its compulsory reporting point to when the call is initiated.

***RSP integrity (I).*** An RSP parameter that specifies the required probability that the surveillance data is delivered with no undetected error.

*Note 1.— Surveillance integrity includes such factors as the accuracy of time, correlating the time at aircraft position, reporting interval, data latency, extrapolation and/or estimation of the data.*

*Note 2.— While RSP integrity is defined in terms of the quality of the surveillance capability, the criterion is specified as a probability of malfunction using a per flight hour basis (e.g. $10^{-5}$), consistent with RCP and RNAV/RNP specifications.*

***RSP parameter.*** A performance characteristic that provides the basis for developing an RSP specification. The RSP parameters include RSP data delivery time, RSP continuity, RSP availability and RSP integrity.

***$RSTP_{A/G}$.*** An RSP allocation that specifies the maximum portion of RSTP for the ground system, network and aircraft system to set up an air-to-ground call as determined from when the last digit of the dialling sequence is finished to when the ground system indicates an incoming call to the receiving party.

***$RSTP_{AIR}$.*** An RSP allocation that specifies the maximum portion of RSTP for the aircraft system.

***$RSTP_{AS}$.*** An RSP allocation that specifies the maximum portion of RSTP for the aeronautical station's system for ground-ground communications with an ATS unit.

*Note.— $RSTP_{AS}$ includes two concurrent processes:*

*a) the aircraft and aeronautical station technically disconnect the call; which is assumed. Operationally, the call is disconnected when the flight crew and radio operator complete the call; and*

*b) the aeronautical station sends the surveillance data to the ATS unit via the ground-ground network; the performance is denoted by $RSTP_{AS}$.*

***$RSTP_{ATSU}$.*** An RSP allocation that specifies the maximum portion of RSTP for the ATS unit's system.

***$RSTP_{CSP}$.*** An RSP allocation that specifies the maximum portion of RSTP for the CSP.

***Satellite service provider (SSP).*** An entity or group of entities that provide, via satellite, aeronautical fixed services and/or aeronautical mobile services at least from the signal in space to/from aircraft, to the attachment point of the ground earth station (GES) to the ground communication services network.

***SATVOICE number.*** The number used to contact an aircraft or ground facility via SATVOICE.

*Note.— The SATVOICE number takes different forms:*

*a) after the access number has been dialled, the aircraft SATVOICE number is the ICAO aircraft address represented by an 8-digit octal code;*

*b) the ATS unit or aeronautical station SATVOICE number is a 6-digit short code or a PSTN direct dial number, which are published on aeronautical charts and in aeronautical information publications (AIPs or equivalent publications); and*

*c) AOC SATVOICE number is a PSTN direct dial number.*

***Standard message element.*** Part of a message defined in the PANS-ATM (Doc 4444) in terms of display format, intended use and attributes.

****State of Design.*** The State having jurisdiction over the organization responsible for the type design. (ICAO)

****State of Manufacture.*** The State having jurisdiction over the organization responsible for the final assembly of the aircraft.

***State of Registry.** The State on whose register the aircraft is entered.

*Note.— In the case of the registration of aircraft of an international operating agency on other than a national basis, the States constituting the agency are jointly and severally bound to assume the obligations which, under the Chicago Convention, attach to a State of Registry. See, in this regard, the Council Resolution of 14 December 1967 on Nationality and Registration of Aircraft Operated by International Operating Agencies which can be found in the* Policy and Guidance Material on the Economic Regulation of International Air Transport *(Doc 9587).*

***State of the Operator.** The State in which the operator's principal place of business is located or, if there is no such place of business, the operator's permanent residence.

***Surveillance data.** Data pertaining to the identification of aircraft and/or obstructions for route conformance monitoring and safe and efficient conduct of flight.

***Surveillance data delivery.** The process for obtaining surveillance data.

***Unplanned outage.** An outage for which no advance notification was provided to the appropriate parties.

***Unplanned outage duration limit.** A value applied to a given airspace that defines the maximum time for the duration of an unplanned outage at which time there is an operational impact.

***Unplanned outage notification delay.** The time from when the unplanned outage begins to when the ATS unit receives notification of the unplanned outage.

***Unplanned outage time.** The time from when an unplanned outage begins to when the ATS unit receives notification that the service has been restored.

***Uplink message (UM).** A CPDLC message sent from a ground system.

***Vertical rate change event (VRE).** A type of event that triggers an ADS-C report when the aircraft`s rate of climb or descent is greater than the vertical rate threshold.

***Waypoint change event (WCE).** A type of event that triggers an ADS-C report when there is a change in the next waypoint or the next plus 1 waypoint on the active flight plan.

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## ABBREVIATIONS AND ACRONYMS

When the following abbreviations are used in this manual, they have the meanings indicated below.

*Note.— Where an asterisk appears beside a term, the term has already been defined as such in Annexes and Procedures for Air Navigation Services (PANS).*

| | |
|---|---|
| ACARS | Aircraft Communication Addressing and Reporting System |
| ACL | ATS clearance (data link service) |
| ACM | ATS communications management (data link service) |
| ACP | Actual communication performance |
| ACTP | Actual communication technical performance |
| ADS | Automatic dependent surveillance (retained for reference with non-updated documents. This term would normally be used to refer to ADS-C) |
| *ADS-B | Automatic dependent surveillance – broadcast |
| *ADS-C | Automatic dependent surveillance – contract |
| AFN | ATS facilities notification |
| *AGL | Above ground level |
| *AIC | Aeronautical information circular |
| *AIP | Aeronautical information publication |
| AMC | ATS microphone check (data link service) |
| AMS | Aeronautical mobile service |
| *AMS(R)S | Aeronautical mobile-satellite (route) service |
| ANSP | Air navigation service provider |
| AOC | Aeronautical operational control |
| ASP | Actual surveillance performance |
| *ATC | Air traffic control |
| *ATM | Air traffic management |
| *ATN | Aeronautical telecommunication network |
| ATN B1 | Aeronautical telecommunication network baseline 1 (RTCA DO 280B/EUROCAE ED 110B) |

*Note.— ATN B1 generally means that the data link system on an aircraft, the ATS unit's system, and communication service provision comply with the standard as adapted by EUROCONTROL Specification on Data Link Services (EUROCONTROL-SPEC-0116). ATN B1 consists of the following data link applications:*

*a) context management (CM) for data link initiation capability (DLIC); and*

*b) limited CPDLC for ATS communications management (ACM), ATS clearance (ACL), and ATC microphone check (AMC).*

| | |
|---|---|
| *ATS | Air traffic service |
| ATSU | ATS unit |
| C | Continuity |
| CLI | Caller line identification |
| CM | Context management (data link application) |
| *CNS | Communications, navigation and surveillance |
| *CNS/ATM | Communications, navigation and surveillance/air traffic management |
| COM | Communications |
| *CPDLC | Controller-pilot data link communications |
| *CPL | Current flight plan |
| CRC | Cyclic redundancy check |

| | |
|---|---|
| CSP | Communication services provider |
| *CTA | Control area |
| DCPC | Direct controller-pilot communications |
| *DLIC | Data link initiation capability |
| DM | Downlink message |
| DRT | Diagnostic rhyme test |
| DT | Delivery time |
| ET | Expiration time |
| FANS | Future air navigation systems |
| FANS 1/A | Future air navigation system – initial (RTCA DO 258A/EUROCAE ED 100A, or previous standards that defined the FANS 1/A capability) |

*Note.— FANS 1/A generally means that the data link system on an aircraft, the ATS unit's system, and communication service provision comply with the standard. In certain cases, specific reference is made to a particular type of FANS 1/A aircraft as follows:*

*a) FANS 1/A+ means that the aircraft completely complies with Revision A of the standard, which includes message latency monitor; and*

*b) FANS 1/A ADS-C means that the aircraft complies with AFN and ADS-C applications, but does not include the CPDLC application.*

| | |
|---|---|
| *FIR | Flight information region |
| FMS | Flight management system |
| FOM | Figure of merit |
| FPL | Filed flight plan |
| *GES | Ground earth station |
| GOLD | Global Operational Data Link (Manual) |
| *HF | High frequency (3-30 MHz) |
| LDE | Lateral deviation event |
| LRCS | Long-range communication system |
| LRDE | Level-range deviation event |
| MAS | Message assurance |
| *MEL | Minimum equipment list |
| *MMEL | Master minimum equipment list |
| ORT | Operational requirements table |
| OT | Overdue delivery time |
| OT | Operational continuity |
| *PANS-ATM | Procedures for Air Navigation Services — Air Traffic Management (Doc 4444) |
| PBC | Performance-based communication |
| PBCS | Performance-based communication and surveillance |
| PBN | Performance-based navigation |
| PBS | Performance-based surveillance |
| PIN | Personal identification number |
| PORT | Pilot operational response time |
| POS | Position report message |
| PSTN | Public switched telephone network |
| RCMP | Required communication monitored performance |
| RCP | Required communication performance |
| RCP A | RCP availability |
| RCP $A_{AIR}$ | RCP availability — aircraft |
| RCP $A_{CSP}$ | RCP availability — CSP |
| RCP $A_{SERVICE}$ | RCP availability — service |

| | |
|---|---|
| RCP C | RCP continuity |
| RCP I | RCP integrity |
| RCTP | Required communication technical performance |
| RGS | Radio ground station |
| RNAV | Area navigation |
| RNP | Required navigation performance |
| RSMP | Required surveillance monitored performance |
| RSP | Required surveillance performance |
| RSP A | RSP availability |
| RSP $A_{AIR}$ | RSP availability — aircraft |
| RSP $A_{CSP}$ | RSP availability — CSP |
| RSP $A_{SERVICE}$ | RSP availability — service |
| RSP C | RSP continuity |
| RSP I | RSP integrity |
| RSTP | Required surveillance technical performance |
| RTF | Radiotelephone |
| *SARPs | Standards and Recommended Practices |
| SATCOM | Satellite communications (used only when referring generally to both voice and data satellite communication) |
| SATVOICE | Satellite voice communications |
| SSP | Satellite service provider |
| TT | RCP transaction time |
| UM | Uplink message |
| VDL | VHF data link Mode 0/A or Mode 2 |
| VDL M2 | VHF data link Mode 2 subnetwork |
| *VHF | Very high frequency (30-300 MHz) (ICAO) |
| VRE | Vertical rate change event |
| WCE | Waypoint change event |

# Chapter 1

# PERFORMANCE-BASED COMMUNICATION AND SURVEILLANCE (PBCS) CONCEPT

## 1.1 GENERAL

1.1.1 The performance-based communication and surveillance (PBCS) concept provides objective operational criteria to evaluate different and emerging communication and surveillance technologies, intended for evolving air traffic management (ATM) operations. Once these criteria have been established and accepted, implementation of a specific ATM operation including its technical and human performance may be evaluated against these operational criteria to assess their viability. The PBCS concept and guidelines provided in this manual are applicable to any air traffic services (ATS) system change that is predicated on communication and/or surveillance performance.

1.1.2 The PBCS concept is aligned with that of performance-based navigation (PBN). While the PBN concept applies required navigation performance (RNP) and area navigation (RNAV) specifications to the navigation element, the PBCS concept applies required communication performance (RCP) and required surveillance performance (RSP) specifications to communication and surveillance elements, respectively. Each RCP/RSP specification includes allocated criteria among the components of the communication and surveillance systems involved.

1.1.3 Where beneficial, RCP, RNP/RNAV and RSP specifications are applied to communication, navigation and surveillance elements to ensure that the operational system and its components perform in accordance with the specifications. Figure 1-1 provides an overview of the performance-based communications, navigation, and surveillance (CNS)/ATM model, which characterizes the relationship of the performance-based specifications among CNS elements supporting an ATM operation.

*Note 1.— While RCP and RSP specifications may be applied where beneficial, the PBCS concept is primarily intended for emerging technologies, and not traditional ones, such as HF voice communication or radar. As such, this edition has considered controller-pilot data link communications (CPDLC), automatic dependent surveillance — contract (ADS-C) and SATVOICE technologies, and may be revised to apply to other technologies, such as automatic dependent surveillance — broadcast (ADS-B), as experience is gained.*

*Note 2.— Similar to the PBN concept, security is beyond the scope of the PBCS concept. However, in some cases, the RCP and RSP specifications may include criteria to support mitigations from security threats. For example, the RCP and RSP specifications that may be applied to SATVOICE contain provisions for satellite service providers (SSPs) to oversee communication services providers (CSPs), in administering accounts to authorized subscribers with personal identification numbers (PIN) and priority level calling. Aircraft SATVOICE systems only route calls to the flight deck from authorized subscribers or alert the flight crew of the appropriate call priority for ATS communication.*

1.1.4 There are some differences between the PBCS concept and PBN concept:

a) the PBCS concept applies RCP and RSP specifications, which allocate criteria to ATS provision, including communication services, aircraft capability, and the aircraft operator; whereas the PBN concept applies RNP/RNAV specifications, which allocate criteria only to the aircraft capability and the aircraft operator; and

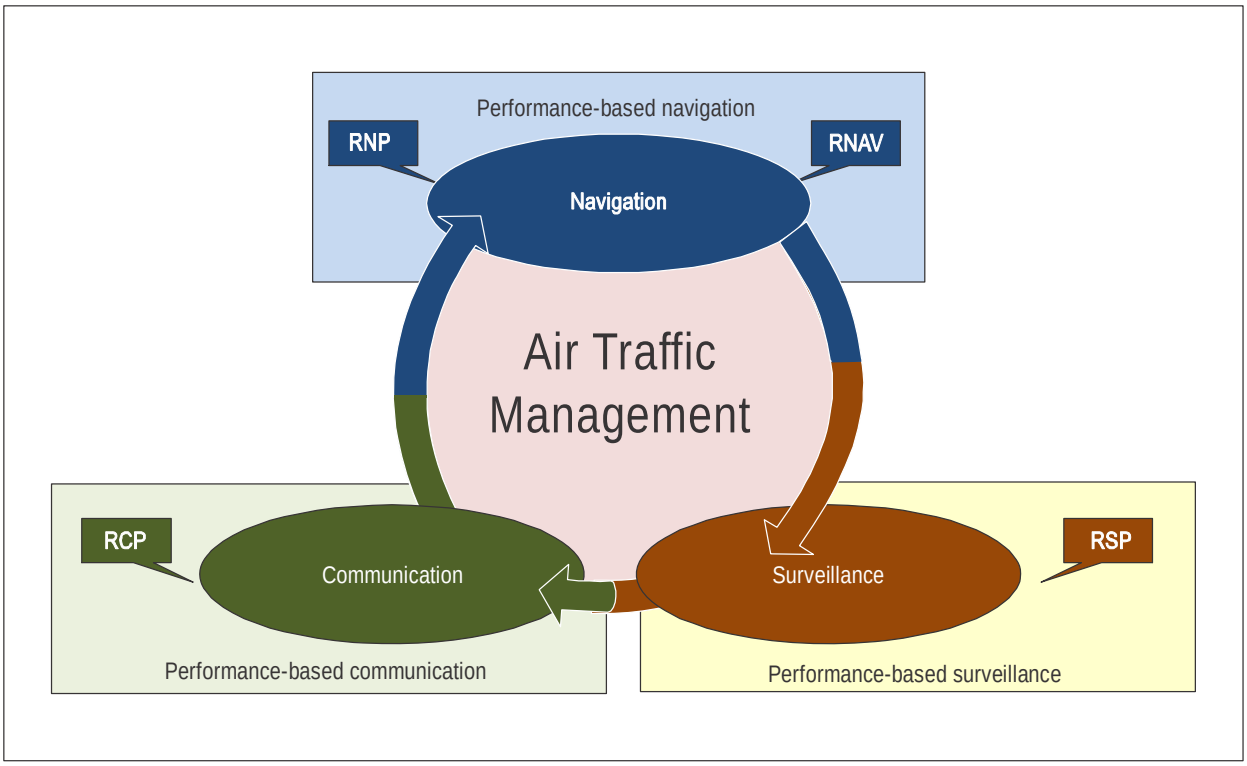


**Figure 1-1. Performance-based CNS/ATM model**

b) the PBCS concept includes post-implementation monitoring programmes, on a local and regional basis, with global exchange of information; whereas the PBN concept includes real time monitoring and alerting functionality in the aircraft capability.

*Note.— PBCS includes real time alerts (e.g. when a communication transaction expires or a position report is overdue) that are conceptually different than the PBN alerts (e.g. RNP UNABLE).*

## 1.2 THE PBCS FRAMEWORK

1.2.1 The PBCS concept provides a framework to apply RCP and RSP specifications to ensure acceptable levels of communication and surveillance capabilities and performance of an operational system. These specifications are applied using the following methods:

a) prescription (in accordance with Annex 11, PANS-ATM, *Regional Supplementary Procedures* (Doc 7030) and/or the Aeronautical Information Publication (AIP) (or equivalent publication)) of an RCP specification for a communication capability and/or an RSP specification for a surveillance capability, either of which is required for air traffic services (ATS) provision in a particular airspace;

b) operational approval (in accordance with Annex 6) to file the flight plan RCP/RSP capabilities, including aircraft equipage where RCP and/or RSP specifications are prescribed for the communications and/or surveillance capabilities supporting the ATS provision; and

c) local and regional monitoring programmes to assess actual communication and surveillance performance against RCP and RSP specifications, thereby determining corrective action, as applicable, for the appropriate entity.

*Note.— Consistent with the* PANS-ATM (Doc 4444), *4.4.1.4 and Appendix 2, Item 10, a communication or surveillance capability comprises the following elements: a) presence of relevant serviceable equipment on board the aircraft; b) equipment and capabilities commensurate with flight crew qualifications; and c) relevant approvals from the appropriate authority.*

1.2.2 The consistent definition and use of communication and surveillance capabilities is needed to apply the PBCS concept on a global basis, in order for States, ANSPs and operators (or airspace users) to acquire its benefit.

1.2.3 The PBCS concept applies to communication and surveillance capability performance. It therefore affects the provision of air traffic services and the aircraft operator's use of the services, including associated aircraft equipage. The PBCS concept is also intended to characterize the communication and surveillance capability, as well as its performance, through RCP and RSP specifications and ensure that systems meet these specifications.

## 1.3 RELATIONSHIP WITH STATE SAFETY MANAGEMENT RESPONSIBILITIES

1.3.1 Annex 19 — *Safety Management* requires States to establish and maintain a State safety programme (SSP) to proactively manage safety that supports the continued improvement of safety performance. The PBCS concept supports States in managing the safety performance with an effective means of implementing the SSP and safety oversight system.

1.3.2 The RCP and RSP specifications, one of the key elements of the concept, prescribes the functional, safety and performance requirements for all components of communication and surveillance systems. These components include the provision of air traffic services, including contracted communication and surveillance services, the aircraft operator and the aircraft systems.

1.3.3 States can use the specifications to evaluate the initial and ongoing compliance of these systems. In addition, the specifications serve to ensure that the entities involved commit to managing and monitoring the safety performance of communication and surveillance systems, which contribute to achieving an acceptable level of safety performance for the State.

1.3.4 The PBCS monitoring programmes required as part of the concept will support hazard identification as well as safety risk assessment and management. It also supports exchange of safety information on both a regional and global basis.

1.3.5 In accordance with Annex 19, States are also required to ensure that the following service providers under their responsibility implement a safety management system (SMS) and manage their interfaces with other organizations that can contribute to the safety of their products or services:

a) approved training organizations;

b) aircraft operators or helicopters authorized to conduct international commercial air transport;

c) organizations responsible for the type design or manufacture of aircraft, engines or propellers;

d) air traffic services providers; and

e) operators of certified aerodromes.

1.3.6 The importance of interface management for air traffic services providers and aircraft operators is highlighted in the PBCS concept. When communication and surveillance services are negotiated, as illustrated in Figure 1-2, the air traffic services provider and aircraft operators should establish proper mechanisms, such as administrative and legal arrangements. These mechanisms should ensure the initial and ongoing compliance, by the contracted CSP and SSP, with the functional, safety and performance requirements described in the RCP and RSP specifications.

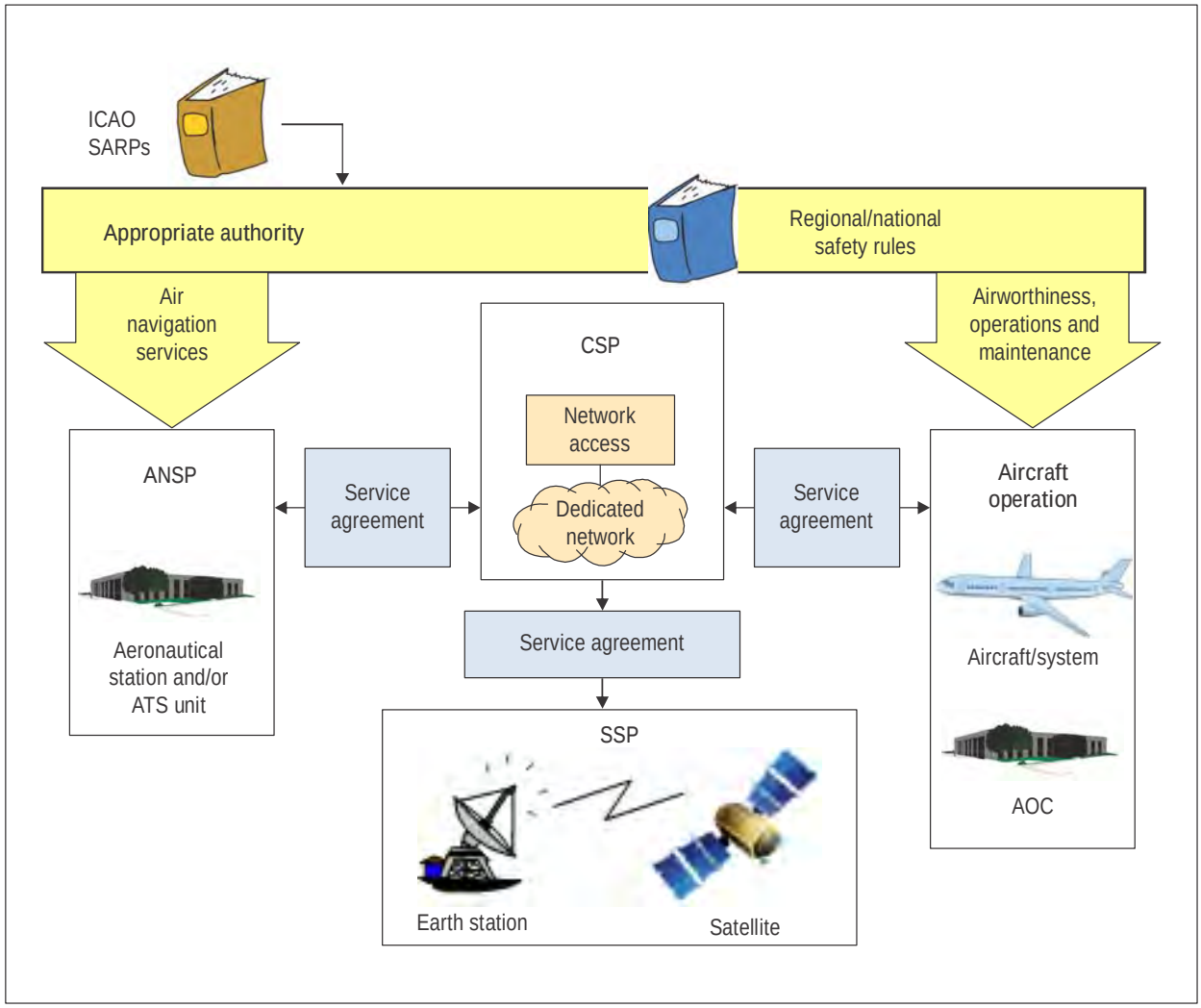


**Figure 1-2. Example of contracted communication and surveillance services**

## 1.4 RCP AND RSP SPECIFICATIONS SUPPORTING ATM OPERATIONS

1.4.1 To perform ATM operations within a performance-based airspace, functional, safety and performance criteria need to be specified for the applicable communication, navigation and/or surveillance (CNS) elements. RCP and RSP specifications, in conjunction with RNP/RNAV specifications, provide these criteria and are intended to facilitate the development of standards and procedures for ATM operations. This approach is essential to the evolution of operational concepts that use emerging technologies.

1.4.2 This manual , outlines considerations for assessing the risk of collision when determining separation minima within a target level of safety. When assessing the CNS criteria for a particular ATM operation, the risk of collision is affected by many factors such as navigation performance, route configuration, traffic density, surveillance, communication and air traffic control. Trade-offs in required performance among the CNS elements are therefore evaluated, and practical and technological constraints are taken into account to achieve the target level of safety.

1.4.3 This manual characterizes the relationship of communication and surveillance elements with the navigation element through the use of a communication and controller intervention buffer, referred to as tau (τ). Table 1-1 shows the relationship of the parameters of tau (τ) with RCP and RSP specifications, considering three different scenarios: normal communication and surveillance, non-normal communication (i.e. first communication transaction was not completed by a specified time) and non-normal surveillance (i.e. surveillance data was not delivered by a specified time and is now considered overdue).

*Note.— Table 1-1 was derived from RTCA DO-306/EUROCAE ED-122, 5.2.3.2, Table 5-5.*

**Table 1-1. Relationship of tau (τ) with RCP and RSP specifications**

| *Communication and controller intervention buffer, τ, parameter (Appendix 5)* | *Normal communication and surveillance* | *Non-normal communication* | *Non-normal surveillance* |
|---|---|---|---|
| Not considered part of τ.<br>The time for the system to deliver the surveillance data to the ATS unit. | Consideration for RSP specification. | Consideration for RCP specification. | Consideration for RSP specification. |
| The time for the controller to recognize the potential conflict and to devise an alternative means of separation (assumed to be achieved by a change of level in procedurally controlled airspace). | Not considered in RSP or RCP specification. | Not considered in RCP specification. | No time allocated for RSP specification. (Overdue position report.) |
| The time taken to communicate the instructions to the pilot via normal means of communication.<br>In the case of an overdue position report, the time taken to obtain the report via normal means of surveillance. | Consideration for RCP specification. | Consideration for RCP specification. | Consideration for RSP specification. (Time after which the controller initiates first attempt to obtain overdue position report.) |

| *Communication and controller intervention buffer, τ, parameter (Appendix 5)* | *Normal communication and surveillance* | *Non-normal communication* | *Non-normal surveillance* |
|---|---|---|---|
| The time taken to communicate the instructions to the pilot via alternative means of communication.<br>In the case of a first attempt to obtain overdue position report fails, the time taken for a second attempt via alternative means of surveillance. | Not applicable. | Consideration for RCP specification. | Consideration for RSP specification. (Time after which the controller initiates second attempt to obtain overdue position report. If no response received, the controller would have initiated communication with other aircraft.) |
| The time for the pilot to react and initiate an appropriate manoeuvre and the time for the aircraft to achieve a change of trajectory sufficient to ensure that a collision will be averted. | Not applicable. | Not applicable. | Not applicable. |
| Not considered part of τ. Communication time for the PORT and WILCO responses to the ATC instruction, which may be concurrent with manoeuvring the aircraft. | Consideration for RCP specification. | Consideration for RCP specification. | Not applicable. |

1.4.4 An RCP/RSP specification provides values for operational parameters that, when applied within a PBCS framework, ensures confidence that the operational communication and surveillance capabilities will be conducted in an acceptably safe manner. These operational parameters include RCP transaction time, RSP surveillance data delivery time, RCP/RSP continuity, RCP/RSP availability and RCP/RSP integrity. An RCP/RSP specification includes functional, safety and performance requirements that are associated with each of the operational parameters.

1.4.5 In addition, an RCP/RSP specification includes allocated criteria to system components based on technological dependencies. These allocations are used to:

a) assess the viability of different technologies in meeting operational requirements;

b) approve the provision of air traffic services supported by communication and/or surveillance systems;

c) determine the initiation of contingency procedures;

d) design, implement and qualify communication and/or surveillance services;

e) design, implement, qualify and approve aircraft type designs;

f) approve aircraft operators for PBCS operations; and

g) operationally monitor, detect and resolve non-compliant performance.

1.4.6 An RCP/RSP specification is globally harmonized and is applied to identical or similar ATM operations to reduce training requirements and errors resulting from confusion in operations across airspace boundaries. Global harmonization also facilitates the application of an RCP/RSP specification to components of the system that are global in nature, such as aeronautical mobile satellite services and ground-ground networks.

1.4.7 An RCP/RSP specification provides the basis to manage the performance of communication and surveillance capabilities. This is achieved by:

a) developing an RCP/RSP specification for one or more communication and surveillance capabilities on a global basis; then

b) applying an RCP/RSP specification related to one or more communication and surveillance system(s) within that airspace; and

c) complying with a prescribed RCP/RSP specification through initial compliance of the different system components individually, and local and regional monitoring programmes, which include ongoing assessments of the actual performance of communication and surveillance systems and corrective action.

## 1.5 DEVELOPING AN RCP/RSP SPECIFICATION

1.5.1 ICAO, in coordination with industry partners (e.g. the Radio Technical Commission for Aeronautics, Inc. (RTCA) /the European Organisation for Civil Aviation Equipment (EUROCAE)), develops a new RCP/RSP specification or revises an existing RCP/RSP specification to provide a set of operational requirements for communication and surveillance capabilities that are adequate for a new ATM operation. ICAO may also revise an existing RCP/RSP specification to provide a new set of allocations to the communication or surveillance system components as new technologies emerge. These system components encompass the provision of air traffic services, including contracted communication and surveillance services, the aircraft operator and the aircraft systems. Figure 1-3 provides an overview RCP/RSP specification development.

1.5.2 The operational requirements provided by an RCP/RSP specification are based on an assessment of operational communication transactions and operational surveillance data delivery for a specific ATM operation, taking into account human interactions, procedures and environmental characteristics. These operational requirements address the functions, performance and safety of a complete system which comprises interoperable system components.

1.5.3 The operational requirements of an RCP/RSP specification are not based on technological dependencies, although it is assumed that compliance of communication and surveillance capabilities to prescribed interoperability standards, including those applicable to communication medium types that support the capabilities, is in place.

1.5.4 Allocations to system components, however, which are also provided in an RCP/RSP specification, take into account technological dependencies. Nevertheless, it is not intended to promote an unrestricted number of alternative communication technologies for one ATM operation. An RCP/RSP specification is intended to be flexible, to the greatest extent practicable, taking into account aircraft equipage and operator requirements, interoperability, cost and other practical considerations.

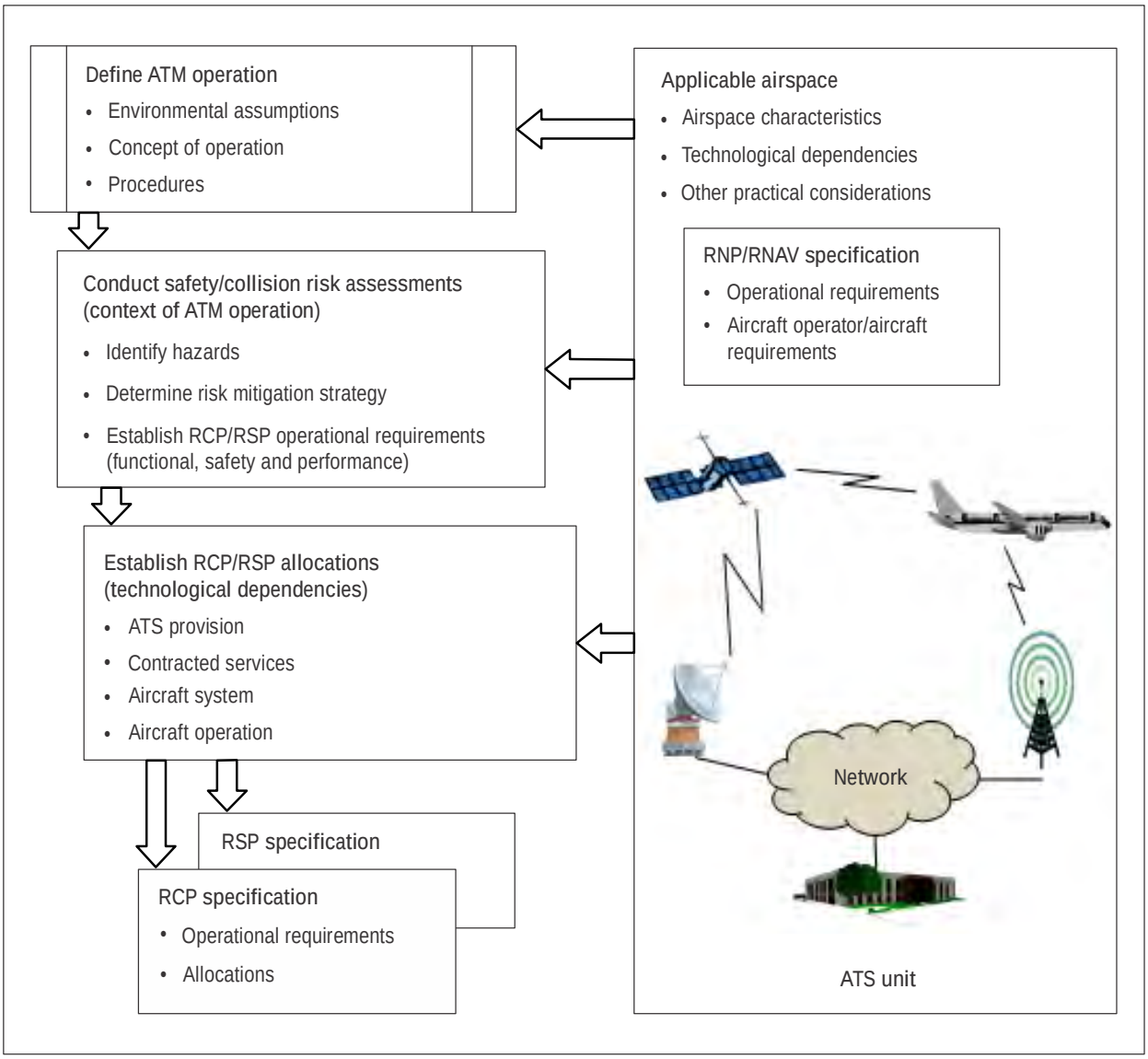


**Figure 1-3. Overview RCP/RSP specification development**

*Note.— Chapter 3 provides guidance on developing an RCP/RSP specification, including how to revise existing specifications, criteria for new specifications, operational assessment in the development of new specifications and application to one or more ATM operations.*

## 1.6 APPLYING AN RCP/RSP SPECIFICATION

1.6.1 ICAO identifies an RCP/RSP specification, as appropriate, to develop Standards and procedures for new ATM operations. States apply an RCP/RSP specification in support of applicable ATM operations. As such, the application of an RCP/RSP specification also requires safety oversight of air traffic services, operational approval, aircraft system design approval and post-implementation monitoring. Figure 1-4 provides an overview of an RCP/RSP specification application.

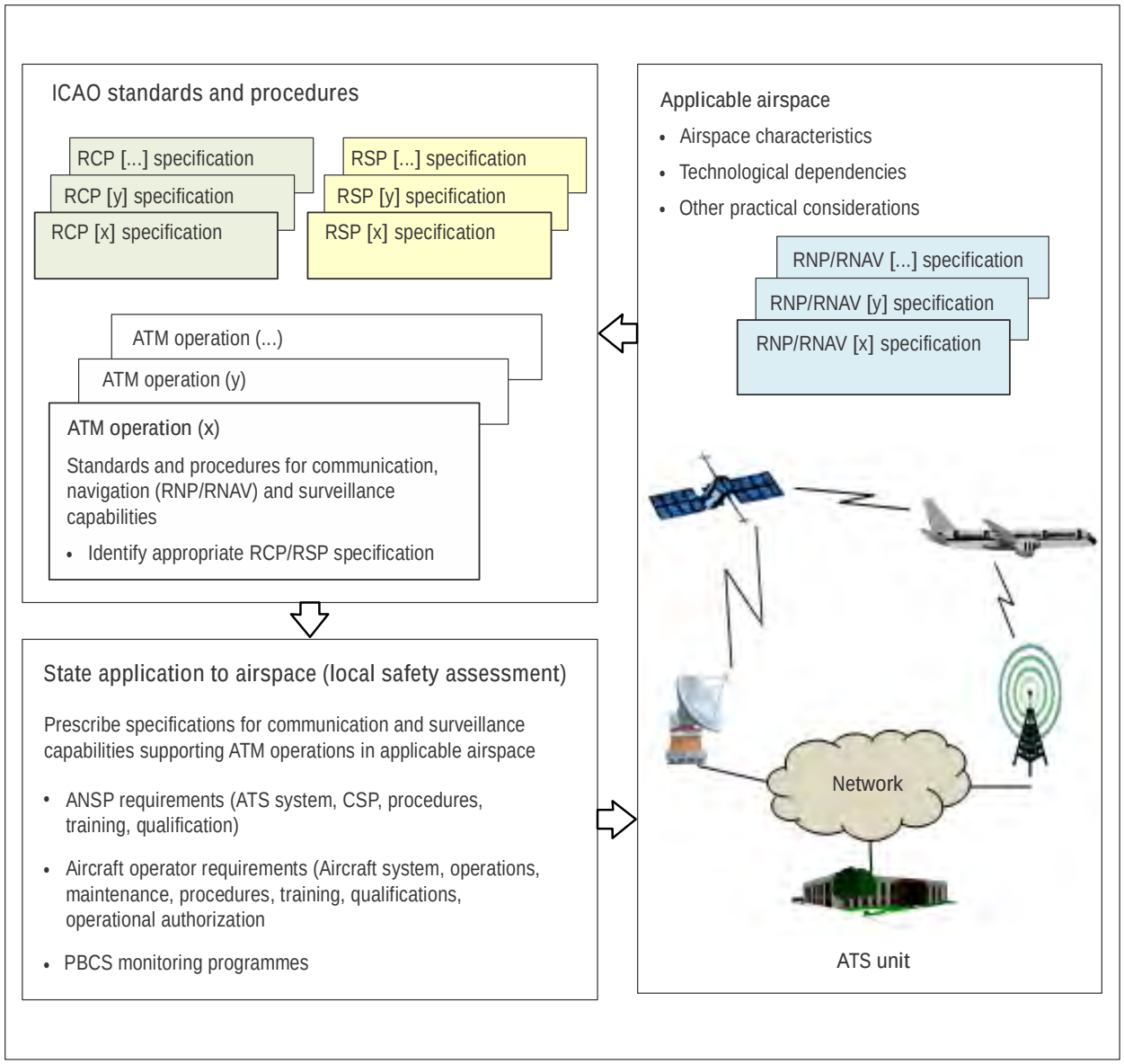


**Figure 1-4. Overview of RCP/RSP specification application**

1.6.2 States should prescribe an RCP and/or RSP specification based on the ATM operations that an ATS provider chooses to implement within that airspace. In cases where a safety-related change, including the implementation of a reduced separation minimum or a new procedure, is predicated on communication and surveillance performance, RCP and RSP specifications are prescribed. The approval of this change demonstrates that the criteria defined by the RCP and RSP specifications have been met.

1.6.3 When ATM operations within an airspace are predicated on communication and/or surveillance performance, the State prescribes RCP and RSP specifications for an airspace either locally or on the basis of a bilateral, multilateral or regional air navigation agreement, if applicable.

1.6.4 To perform certain ATM operations, States may require a combination of voice/data communication and surveillance capabilities applicable to the prescribed RCP and RSP specifications. Data communication and surveillance capabilities allow for the integration of operational capabilities in order to exchange information between an ATS unit's system and an aircraft system. Data communication and surveillance capabilities can also provide functional integration (e.g. loading CPDLC messages on the flight deck and ATS conformance monitoring using ADS-C reports) with the aircraft's system or an ATS unit's system.

1.6.5 RCP and RSP specifications can be applied to communication and surveillance capabilities in an airspace or to support an ATM operation. Examples of such applications include:

a) a defined airspace (e.g. North Atlantic or Pacific Regions) for safety or to support application of a 5-minute or 55.5 km (30 NM) longitudinal separation minimum;

b) a fixed ATS route (e.g. between Sydney, Australia, and Auckland, New Zealand);

c) random track operations (e.g. between Hawaii and Japan); or

d) a volume of airspace (e.g. a block altitude on a specified route).

1.6.6 When a State prescribes an RCP/RSP specification, the RCP/RSP specification indicates the requirements for communication and surveillance capabilities supporting the ATM operation, including procedures, aircraft equipage, airspace infrastructure, flight plan filing and post-implementation monitoring programmes.

1.6.7 The application of a given separation minimum within a volume of airspace may require that a single RCP and/or single RSP be specified. However, the State can prescribe multiple RCP and RSP specifications within a given airspace. For example, the State may prescribe one RCP specification, applicable to the normal means of communication appropriate for the controller's intervention capability to apply the separation minimum, and prescribe another RCP specification to a new communication technology that supports an alternative means of communication when the normal means of communication fails.

1.6.8 The State can prescribe different RCP and RSP specifications for different airspace depending on ATM operations. For example, an RCP specification applicable in terminal area airspace may differ from the RCP specification for en-route or oceanic airspace.

1.6.9 In cases where ATM operations are not predicated on communication or surveillance performance, it can be beneficial for the State to apply RCP and RSP specifications, if only to provide a basis for post-implementation monitoring programmes (i.e. the specifications are not prescribed).

*Note.— Chapter 3 provides guidelines for applying RCP and RSP specifications to communication and surveillance capabilities.*

## 1.7 COMPLYING WITH AN RCP/RSP SPECIFICATION

1.7.1 When the State prescribes an RCP/RSP specification for communication or surveillance capability, the ANSP and the aircraft operator should show that the provision of air traffic services and use of the service comply with the specifications to achieve and maintain the required communication and surveillance performance. Figure 1-5 provides an overview of RCP/RSP specification compliance.

1.7.2 Compliance with an RCP/RSP specification may be achieved in various ways: the State provides policies and guidance on acceptable means through which the ANSP and the aircraft operator show compliance with RCP and RSP specifications, both initially and in continued operations, to support approvals.

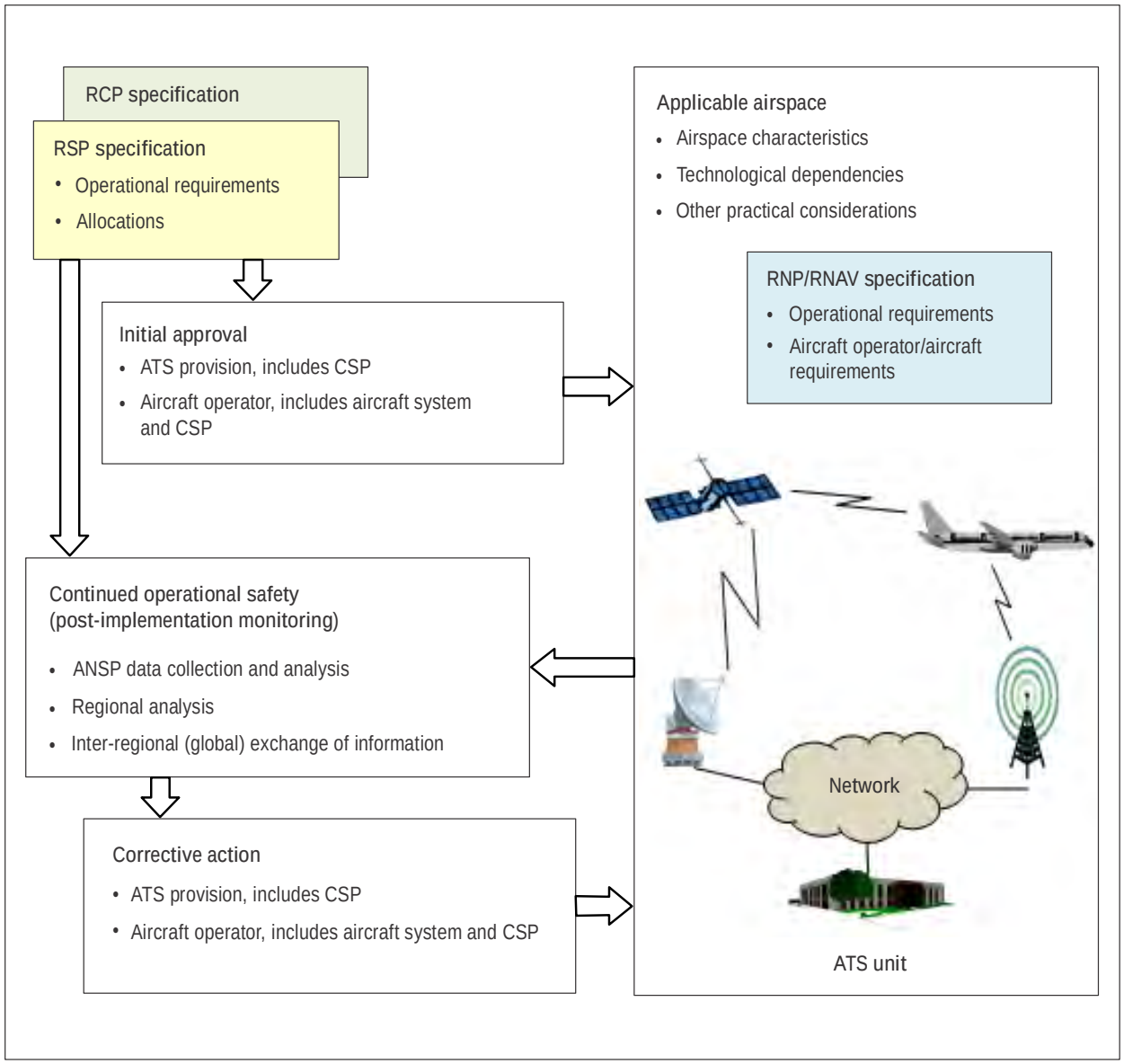


**Figure 1-5. Overview of RCP/RSP specification compliance**

1.7.3 The initial compliance with RCP and RSP specifications occur at different times for each system component; the processes for these approvals and the parties involved (described below) are both different. Generally, the initial compliance is determined as follows :

a) the ANSP complies in accordance with applicable national regulations by demonstrating that the necessary procedures and training, systems, and related contracted services comply with the RCP and RSP specifications appropriate for the specified ATM operations and airspace; and

b) the aircraft operator complies in accordance with applicable regulations from the State of the Operator or State of Registry by demonstrating that the necessary procedures and training, aircraft systems, maintenance and related contracted services comply with the RCP and RSP specifications

appropriate for specified aircraft types/systems in its fleet. For the aircraft system, the operator complies by presenting a certificate of approval obtained by the aircraft or equipment manufacturer from the State of Design or through bilateral or multilateral airworthiness agreements.

*Note.— The State of the Operator would be applicable to commercial air transport operations (Annex 6, Part I and Part III, Section II). The State of Registry would be applicable to general aviation operations (Annex 6, Part II and Part III, Section III).*

1.7.4 For continued operations, the ANSP establishes a local monitoring programme to collect and analyse operational data, ensuring that the infrastructure and the aircraft operators within its airspace continue to meet the appropriate RCP and RSP specifications. A regional monitoring programme may also be established to analyse performance at the regional level. Aircraft operators, CSPs, SSPs and other stakeholders participate in the ANSP monitoring programmes in accordance with operational approvals or service agreements.

1.7.5 The scope of local and regional monitoring programmes includes analyses on an operator basis, taking into account individual aircraft, aircraft types/systems and various infrastructure and technological dependencies (e.g. subnetwork types, subnetwork routing policies, frequencies), all of which are factors in evaluating communication or surveillance performance.

1.7.6 When a monitoring programme detects non-compliance, it is reported to the appropriate parties for corrective action.

*Note.— Chapter 4 provides guidelines for complying with RCP and RSP specifications and reporting non-compliance to the appropriate parties.*

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# Chapter 2

# DEVELOPING AN RCP/RSP SPECIFICATION

## 2.1 NEED ASSESSMENT FOR AN RCP/RSP SPECIFICATION

2.1.1 Figure 2-1 provides a synopsis for assessing the need for a required communication performance (RCP) /required surveillance performance (RSP) specification in a particular airspace. The potential need for an RCP/RSP specification is two-fold:

a) the operational introduction of one or more new air traffic management (ATM) operations may prescribe an RCP/RSP specification (e.g. the introduction of reduced lateral and longitudinal separation minima or trajectory-based operations); and

b) the introduction of a new communication media technology may require an evaluation against the existing RCP/RSP specification (e.g. the use of SwiftBroadband services over satellite communication (SATCOM)).

2.1.2 For some ATM operations, both controller-pilot data link communications (CPDLC) and automatic dependent surveillance — contract (ADS-C) applications are used as enablers. In most cases, both CPDLC and ADS-C applications use the same new technology; in such cases, the need for both the RCP and RSP specifications needs to be assessed.

2.1.3 An assessment of operational communication and surveillance services should consider the following:

a) airspace characteristics (e.g. separation minima, spacing criteria and capacity limits);

b) ATM operations (e.g. dynamic arrival procedure, crossing flight paths, or in-trail climb/descent procedure); and

c) operational system performance (e.g. navigation, flight management, flight data processing, and decision support tools for the controller and the flight crew).

2.1.4 An RCP/RSP specification needs to be determined in the context of the relevant airspace characteristics, operational capabilities and system performance. Trade-offs can be, and are, made to take advantage of existing fleet equipage and air traffic services provisions. For example, if an operator/aircraft is eligible for RNP 4 operations when implementing a 50 NM longitudinal separation minimum, the interval for ADS-C periodic position reports is 32 minutes. If an operator/aircraft was only eligible for RNP 10 operations, the separation minimum can still be implemented, but the interval for ADS-C periodic position reports is 27 minutes, which increases the number of position reports and associated costs. The operator, however, would not incur any costs to upgrade to RNP 4 operations, since the service provisions would need to allow for variations in these performance trade-offs.

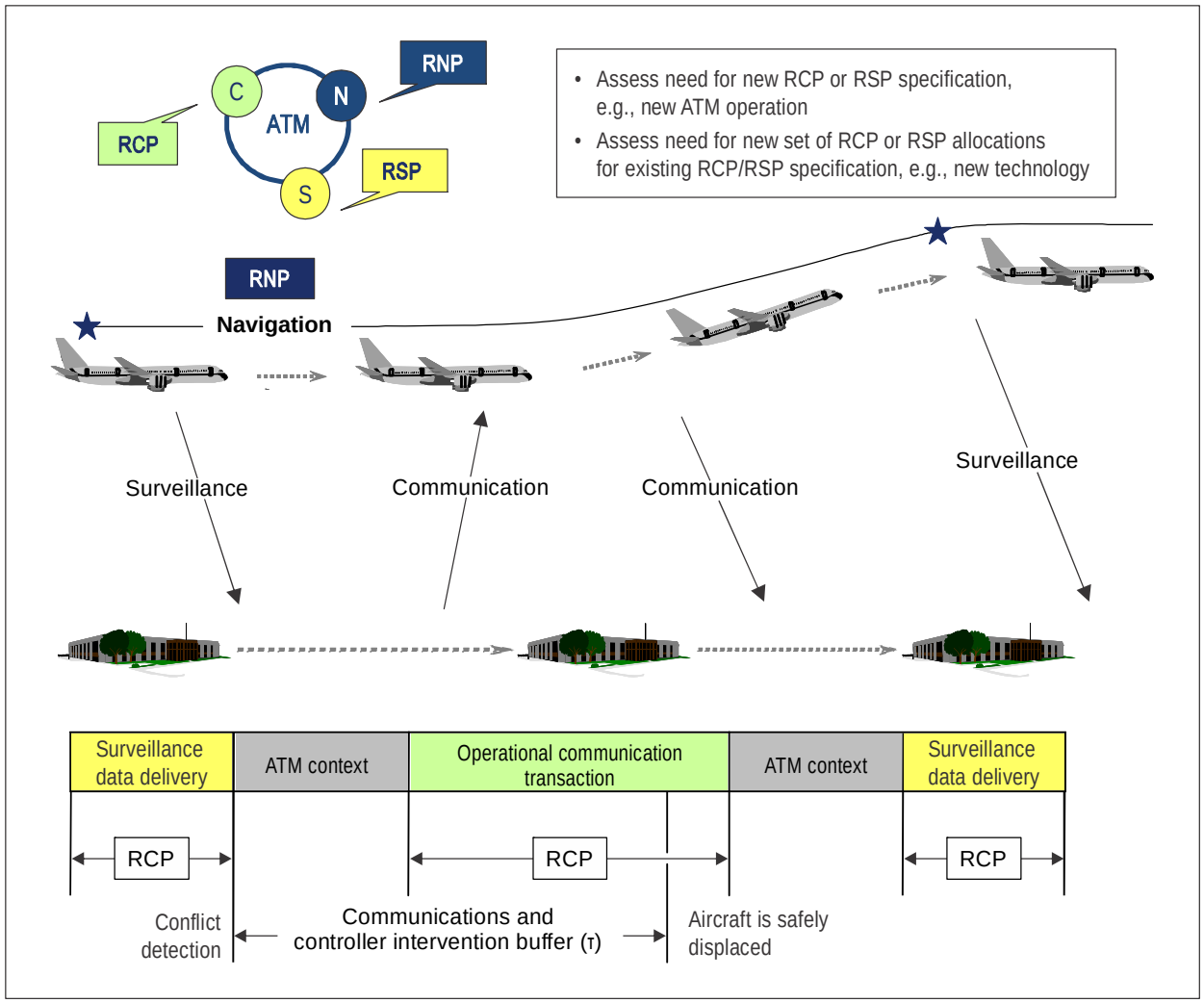



**Figure 2-1. Operational context of communication and surveillance capability and performance**

2.1.5 Given the airspace characteristics and other capabilities and performances, the RCP/RSP specification is used to characterize the communication and surveillance capabilities and performances that need to exist for the controller/system to first — detect an out-of-conformance, second — intervene and third — resolve a conflict. It should not be implied that all communication and surveillance capabilities need to meet the RCP/RSP specification. However, in addition to the RCP/RSP specification applicable to the intervention capability, other RCP and/or RSP specifications may be appropriate for specific operations that require different performance characteristics. For example, this dependency may be related to:

a) functional differences in the means of communication or surveillance, such as between voice and data (i.e. providing interactive capability versus providing air-ground automation integration capability);

b) an increase in communications due to an increase in airspace capacity (e.g. when increasing airspace capacity, the controller depends on a CPDLC and ADS-C to maintain an acceptable workload and suitable performance of the very high frequency (VHF) voice communication to intervene in time-critical situations); and

c) a contingency procedure in the event that normal communication systems fail (e.g. when implementing a separation minimum predicated on communication and surveillance performances, the contingency procedure requires an alternative means of communication that enables the controller to establish communications with an aircraft after the normal means fail to obtain position information and intervene, as necessary).

2.1.6 In cases where an RCP/RSP specification is applied to a normal means of communication, it may be necessary to apply a different RCP/RSP specification to the alternative means of communication or surveillance. This different RCP/RSP specification may be appropriate when employing emerging technologies for the alternate means of communication or surveillance to ensure that it performs as expected.

## 2.2 RCP SPECIFICATIONS

### 2.2.1 General

2.2.1.1 The operational requirements of an RCP specification apply to the controller's communication and intervention capability. These requirements also define parameter values for operational (end-to-end) RCP transaction times, RCP continuity, RCP availability and RCP integrity, as well as their allocated values (e.g. required communication monitored performance (RCMP), required communication technical performance (RCTP) and, when applicable, human performance). An underlying assumption in the application of RCP is the compatibility and interoperability of the supporting system components, in accordance with interoperability standards.

2.2.1.2 An RCP specification is identified by a designator (e.g. RCP 240) to simplify the RCP designator naming convention and to make the RCP transaction time readily apparent to airspace planners, aircraft manufacturers and operators. The designator represents the maximum communication transaction time after which the initiator should revert to an alternative procedure (or RCP expiration time).

2.2.1.3 Figure 2-2 shows an RCP specification model for which the same operational (end-to-end) performance applies, but with two different sets of RCP allocations (CPDLC and SATVOICE). Although different communication technologies may lead to different allocated values, they still yield the same end-to-end result. The performance of the technical systems is known as the required communication technical performance (RCTP).

2.2.1.4 As is illustrated in Figure 2-2, using CPDLC, the communication transactions are allocated to the following components:

a) controller (initiator) — composition of the instruction and recognition of the response; and

b) required communication monitored performance (RCMP), which is further allocated to:

1) pilot operational response time (PORT); and

2) required communication technical performance (RCTP).

2.2.1.5 With CPDLC, the operational (end-to-end) communication transaction performance parameters apply to the actual performance associated with:

a) the controller's human-machine interaction (HMI) design and procedures; and

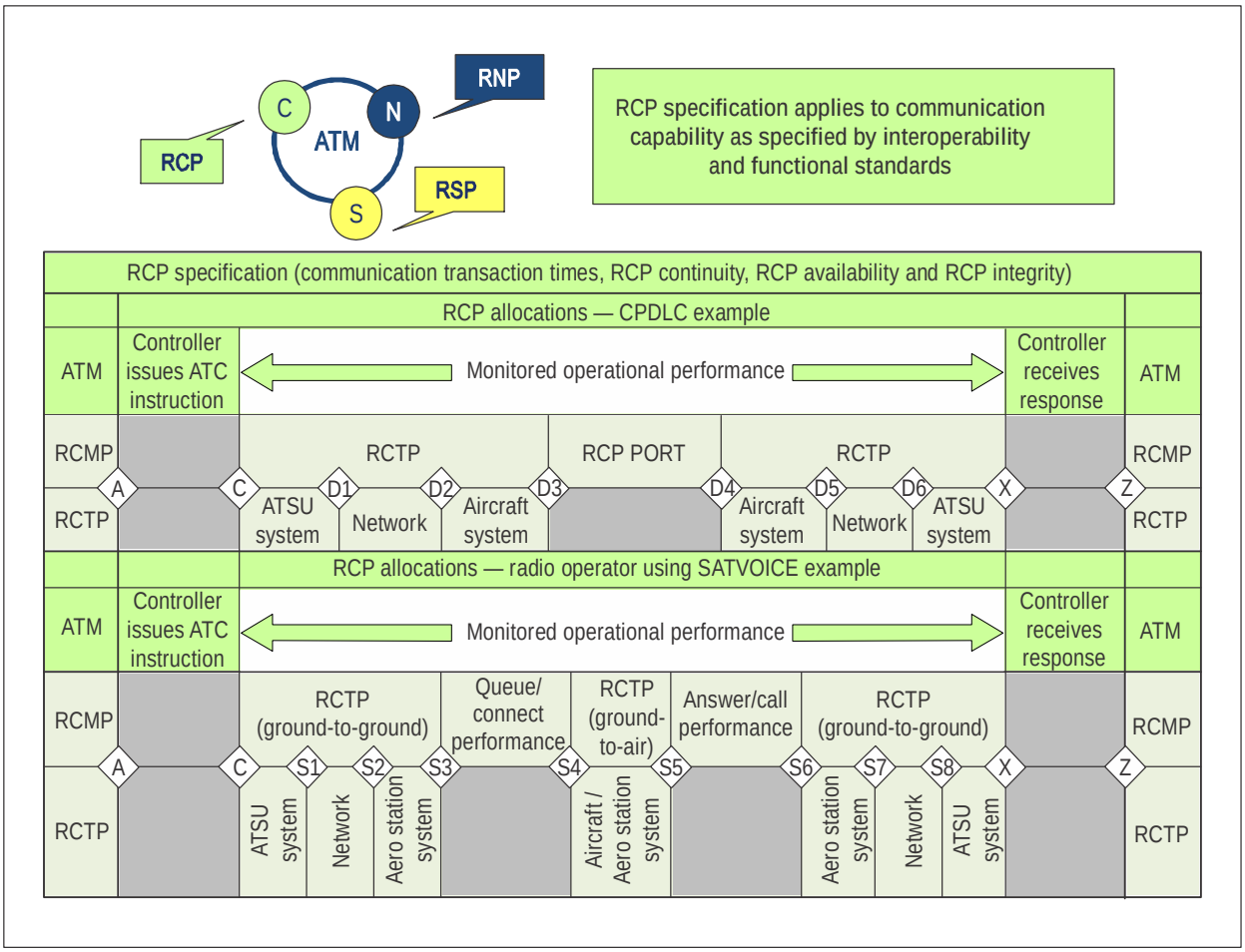



**Figure 2-2. RCP specification model**

b) the communication transaction beginning when the controller sends the instruction to the aircraft, and ending when the controller receives an indication of the WILCO response (RCMP). RCMP is a pseudo end-to-end transaction time parameter against which the ACP is measured during post-implementation monitoring. The allocations allow for further assessment of:

1) actual communication technical performance (ACTP); and

2) pilot operational response time (PORT), which includes the flight crew's HMI design and procedures.

2.2.1.6 Since certain routine messages do not pertain directly to the controller intervention capability, a subset of communication transaction types, as defined in Appendix D for CPDLC and Appendix E for SATVOICE, are used to assess the critical system data transit delay.

2.2.1.7 An operational communication transaction is the process used by a human to send an instruction, a clearance, flight information, and/or a request, and is completed when that human is confident that the transaction is complete.

2.2.1.8 The contribution of the human toward communication performance can be significant, since they are a key player in this transfer of information between sender and receiver.

2.2.1.9 Additionally, data communication meeting the prescribed RCP specification can provide the capability to communicate clearances and instructions without the need for a voice read back.

2.2.1.10 The RCP specification should include the necessary operational, functional, safety and performance criteria, for example:

a) a specific message set or phraseology, transaction types and intended use;

b) the interactive capability of voice communication;

c) the air-ground integration capability of data communication;

d) times to indicate non-compliant performance and procedures when such indications occur;

e) positive assurance of the flight crew's receipt of an instruction, clearance or request or the controller's receipt of a request/flight information; and

f) party-line and/or broadcast capability, multiple recipients of the same instruction, clearance or information (e.g. such as transmitting and receiving on-guard frequencies).

2.2.1.11 The set of requirements for an RCP specification are based on the following parameters:

a) *RCP transaction time.* The maximum time for the completion of the operational communication transaction after which the initiator should revert to an alternative procedure;

b) *RCP continuity.* The minimum proportion of operational communication transactions to be completed within the specified RCP transaction time, given that the service was available at the start of the transaction;

c) *RCP availability.* The required probability that an operational communication transaction can be initiated; and

d) *RCP integrity.* The required probability that an operational communication transaction is completed with no undetected errors.

*Note.— While RCP integrity is defined in terms of the quality of the communications capability, the criterion is specified as a probability of malfunction on a per flight hour basis (e.g. $10^{-5}$), consistent with an RNAV/RNP specification.*

2.2.1.12 Table 2-1 lists RCP specifications, also provided in Appendix B. Currently, the number of specifications is limited to two (RCP 240 and RCP 400) in airspace where procedural separation is applied. Other RCP specifications may be added, pending the introduction of new ATM operations or the use of new communication technologies.

2.2.1.13 RCP 240 may be applied to maintain the performance for normal means of communication, which supports controller intervention capability in procedurally controlled airspace, where the separation minimum applied is predicated on communication performance.

**Table 2-1. RCP specifications**

| *RCP specification* | *RCP transaction time (seconds)* | *RCP continuity (probability)* | *RCP availability (probability)* | *RCP integrity (acceptable rate/flight hour)* |
|---|---|---|---|---|
| RCP 240 | 240 | 0.999 | 0.999<br>0.9999 (efficiency)<br>*(see Note 3)* | $10^{-5}$ |
| RCP 400 | 400 | 0.999 | 0.999 | $10^{-5}$ |

*Note 1.— The results of safety assessments and further information on RCP 240 and RCP 400 are contained in RTCA DO-306/EUROCAE ED-122. Additional RCP specifications will be validated by a safety assessment, data collection and/or other means prior to inclusion.*

*Note 2.— When a unit of measure other than the "per flight hour" is used to specify RCP specification values for integrity, the conversion process will need to be validated. For example, when data are analysed on a "per transaction" basis, or on a "per sector" basis, the average number of transactions per flight hour or the average number of flight hours per sector hour, respectively, will need to be validated for the specific implementation.*

*Note 3.— The values for availability are based on a safety assessment, taking into account assumptions about the environment, such as mitigating procedures for failed communication and contingencies. For RCP 240, an additional and more stringent value has been assigned, based on the operational effect of frequent losses of the service in providing an efficient and orderly flow of air traffic. Two values are used to determine corrective action when the service availability degrades below the assigned value. The corrective action may vary depending on whether the criterion is for safety or for efficiency.*

2.2.1.14 RCP 400 may be applied to maintain the performance for emerging technology (e.g. satellite voice) used to provide normal means of communication supporting controller intervention capability in procedurally controlled airspace, where the separation minimum applied is based on position reporting at compulsory reporting points. RCP 400 may also be applied to maintain the performance required for emerging technologies used to provide alternative means of communication, that may be required in combination with the normal means of communication, to which RCP 240 is applied.

*Note.— RCP specifications were derived from intervention capabilities used in collision risk modelling* (Manual on Airspace Planning Methodology for the Determination of Separation Minima *(Doc 9689)), aircraft performance characteristics, conflict detection and resolution capability,* Procedures for Air Navigation Services — Air Traffic Management *(PANS-ATM, Doc 4444), RTCA/EUROCAE Standards, and other factors.*

### 2.2.2 RCP transaction time and allocations

2.2.2.1 There may be multiple operational communication transactions that support an ATM operation. These transactions are therefore assessed to determine which is the most stringent. The value for the RCP transaction time is based on the time needed to complete the most stringent transaction for controller intervention.

2.2.2.2 The assessment would take into consideration the time needed to safely execute the contingency procedure and can include simulations, demonstrations, operational trials and analysis of empirical data applicable to the RCP communication transaction times for the ATM operation.

2.2.2.3 For separation assurance, the RCP transaction time can be determined by collision risk modelling. Collision risk modelling considers the RCP transaction times in the communications and controller intervention buffer supporting separation assurance. Figure 2-1 illustrates the operational communication transaction in the context of communications and controller intervention buffer.

2.2.2.4 In practice, the RCP transaction time is specified for a nominal continuity and for an operational continuity (ET). The time associated with the operational continuity is called expiration time (ET), as it is associated with the time the controller takes action upon receiving an alert provided by the expiration of the ground timer. These times, indicated below, are directly associated with RCP continuity requirements for the controller's communication and intervention capability:

a) the TT value is used for statistical analysis during post-implementation monitoring and is not monitored in real time. The TT value is known as the nominal time (i.e. the time at which 95 per cent of the communication transactions in a data sample are completed). Other statistical values, such as mean and average time values, may be considered in local assessments. If the system does not meet the TT value, appropriate action should be taken to identify and rectify the source(s) of performance deterioration to improve performance to an acceptable level before providing the ATM operation predicated on RCP;

b) the ET value is monitored in real time for each transaction by the ATC system. When a response to an ATC instruction has not been received within the ET value, the ATC system provides an indication to the controller for appropriate action. The ET value is associated with a continuity requirement of 0.999 (99.9 per cent), which was determined by an operational safety assessment, in accordance with DO 264/ED 78A. In this case, the operational safety assessment concluded that, in the worst case scenario, a frequent occurrence of this indication to the controller (i.e. that a WILCO response has not been received by the ET value) could result in a significant increase in controller workload. This is considered to be a "Class 4" hazard. The corresponding safety objective is that the occurrence of a WILCO response exceeding the ET value is no greater than $10^{-3}$ (or 99.9 per cent of WILCO responses are received within the ET value); and

c) the time values at 95 per cent and at the operational continuity criterion (e.g. 99.9 per cent) apply to the communication transaction, operational performance (RCMP), PORT, and RCTP. It should be noted that only the "RCMP time value at the operational RCP continuity criterion" portion has an expiration timer.

2.2.2.5 For example, Appendix B contains the RCP 240 specification, including the allocated RCP transaction time values. Compliance with the times specified for the controller to compose the message and to access the response after receipt of indication is shown by analysis, simulations, safety and human factors assessments. Compliance with the requirements for the remainder of the transaction, referred to as RCMP, is shown by contracts and/or service agreements for communication services and post-implementation monitoring of CPDLC transactions requiring a WILCO response. Allocated requirements associated with ACTP and PORT aid in determining initial compliance and further assessment when ACP does not meet the requirements for RCMP.

*Note.— Further information on RCP 240 and means of compliance are contained in Chapter 4 and Appendix B of this manual.*

### 2.2.3 RCP continuity and allocations

2.2.3.1 The value for the RCP continuity parameter is associated with the actual communication performance of the expiration value of RCP and is selected based on the results of an operational hazard and performance assessment.

2.2.3.2 The operational hazard assessment should include a severity-of-effects analysis of detected errors within the communication transactions. Detected errors include, but are not limited to:

a) the transaction exceeding RCP transaction time (ET);

b) one or more messages within the transaction are corrupted, misdirected, directed out-of sequence or lost, and cannot be corrected to complete the transaction within the RCP transaction time; and

c) detecting loss of the communication service or aircraft capability to use the service while transactions are pending completion.

2.2.3.3 An acceptable operational RCP continuity value should be determined based on an analysis of the severity and the probability of communication transactions with detected errors. As stated in 2.2.2.4, the operational safety assessment for RCP 240 classified the effects of identified hazards on ATS services, such as controller workload, as "minor", which equates to a probability of a malfunction less frequent than $10^{-3}$, or a 0.999 success rate (99.9 per cent).

2.2.3.4 From a performance perspective, RCP continuity is associated with the required level of usability. This places a maximum on the number of interrupted transactions after which it becomes annoying or less productive from a usability viewpoint to use CPDLC.

2.2.3.5 A nominal RCP continuity value (TT) is specified to assess the performance at 95 per cent. Other statistical values, such as mean and average time values, may be considered in local assessments.

2.2.3.6 The values for RCP continuity remain the same (95 per cent and 99.9 per cent) for all allocations (e.g. operational performance (RCMP), PORT, and RCTP).

### 2.2.4 RCP availability and allocations

2.2.4.1 RCP availability (RCP A) is a system requirement associated with the communication service at the disposal of the flight crew and controller. RCP A is the required probability of a functioning communication system, measured over a period of time.

2.2.4.2 RCP A is defined as the ratio between the time the system is actually available for service (actual service time) and the time the system is planned for service (actual service time + unplanned outage time), (i.e. RCP A = actual service time/actual service time + unplanned outage time).

2.2.4.3 In a given airspace, RCP A is specified in terms of the RCP availability for the communication service (RCP $A_{SERVICE}$), which comprises the RCP availability for the ATS unit (RCP $A_{ATSU}$) and the RCP availability for the CSP(RCP $A_{CSP}$), and the RCP availability for the aircraft system (RCP $A_{AIR}$). Therefore:

a) RCP $A_{SERVICE}$ = RCP $A_{ATSU}$ x RCP $A_{CSP}$; and

b) RCP A = RCP $A_{SERVICE}$ x RCP $A_{AIR}$.

2.2.4.4 In order for the communication service to be available, the ATS unit's system, any CSP's service and any aircraft system on which it is dependent, must be available.

2.2.4.5 The RCP A value is selected based on the results of an operational hazard and performance assessment. This assessment should include a severity-of-effects analysis of the detected loss of the communication service. Detected loss includes, but is not limited to:

a) loss of communications for multiple aircraft; and
b) loss of communications for a single aircraft.

2.2.4.6 A criterion should be determined for the probability of an inability to initiate a transaction based on the severity-of-effects analysis.

2.2.4.7 From a performance (efficiency) perspective, RCP availability is affected by aircraft operators, ANSP expectations, and the confidence that the communications service is available.

*Note.— If a service outage is declared in the midst of a transaction, causing a continuity failure, the failure is only counted against availability and is excluded from the continuity measurement. This is because it is anticipated that most service outage durations will be more than the expiration time.*

2.2.4.8 The value for RCP A is based on the acceptable rate of detected inability to initiate a transaction.

2.2.4.9 RCP availability for the aircraft (RCP $A_{AIR}$) is the required probability that the aircraft system is serviceable for the relevant communication capability. It is the ratio between the time the aircraft system is actually in operation (actual time of operation) and the time the aircraft system is planned for being in operation (actual time of operation/actual time of operation + unplanned outage time).

2.2.4.9.1 The aircraft system providing the communication functionality is comprised of various components (including the radio that is accessing the different communication subnetworks). Since no system is perfect, the aircraft system has a failure rate, expressed on a per flight hour basis (e.g. 7E-4/flight hour). The reciprocal of failure rate is actual time of operation (1/failure rate = actual time of operation) and represents the average number of flight hours between two failures as shown in Figure 2-3.

2.2.4.9.2 The communication system failure duration (unplanned outage time) for the aircraft corresponds to the duration of a flight, which should be taken into account in the availability computation. From this, RCP $A_{AIR}$ can be derived (i.e. actual time of operation/actual time of operation + unplanned outage time).

2.2.4.9.3 When the communication service is dependent on an aircraft system, the RCP $A_{AIR}$ for that system typically determines the number of similar components (redundancy) that are required for installation on the aircraft. The number of similar components needed in any given architecture for the aircraft system will depend on the component availability.

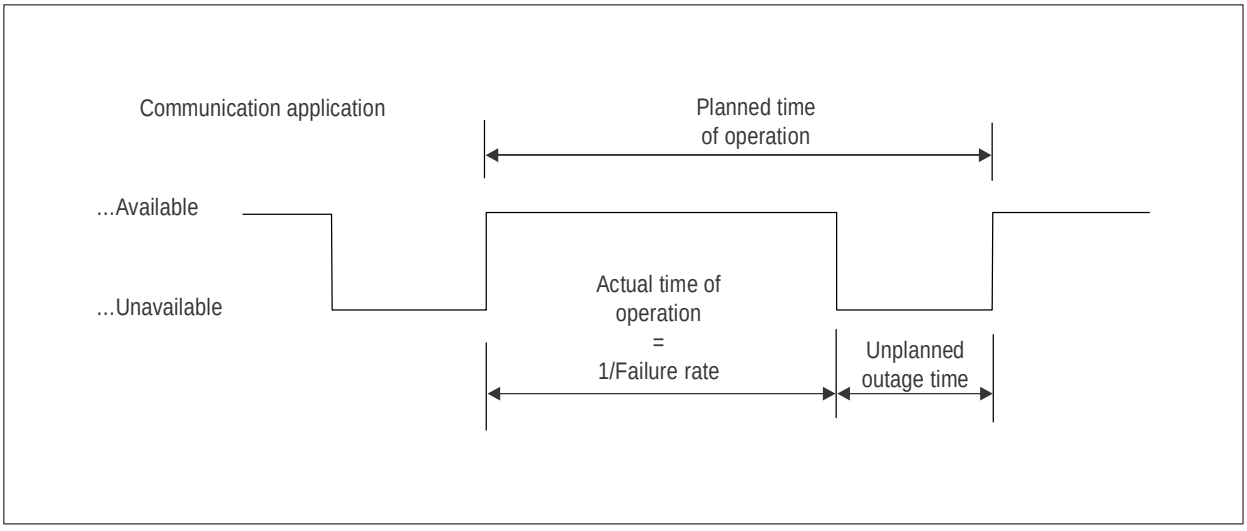



**Figure 2-3. RCP availability — aircraft (RCP $A_{AIR}$)**

2.2.4.10 RCP availability for the air traffic service (RCP $A_{SERVICE}$) is the probability that the system is in service within a planned service area for planned hours of operation, and is measured over a period of time. It is the ratio between the time during which the ATS unit and CSP systems are actually in service (actual service time) and the time the ATS unit and CSP systems are planned for being in service (actual service time + unplanned outage time).

3.2.4.10.1 RCP $A_{SERVICE}$ is only evaluated over the ATS unit and CSP.

2.2.4.10.2 If the CSP or ATS unit is not available for communications service provision, then the ATS unit will have to cease ATM operations predicated on the service and apply an alternative procedure.

2.2.4.10.3 A service outage counts against RCP $A_{SERVICE}$ regardless of whether any aircraft are located in the service area. The RCP $A_{SERVICE}$ requirements (RCP $A_{CSP}$ and RCP $A_{ATSU}$) are specified in terms of unplanned outage duration limit, maximum number of unplanned outages (exceeding the duration limit) per year, maximum accumulated unplanned outage time in minutes/year and unplanned outage notification delay.

2.2.4.11 Figure 2-4 provides an overview of relationships among the parameters specified for RCP/RSP service availability.

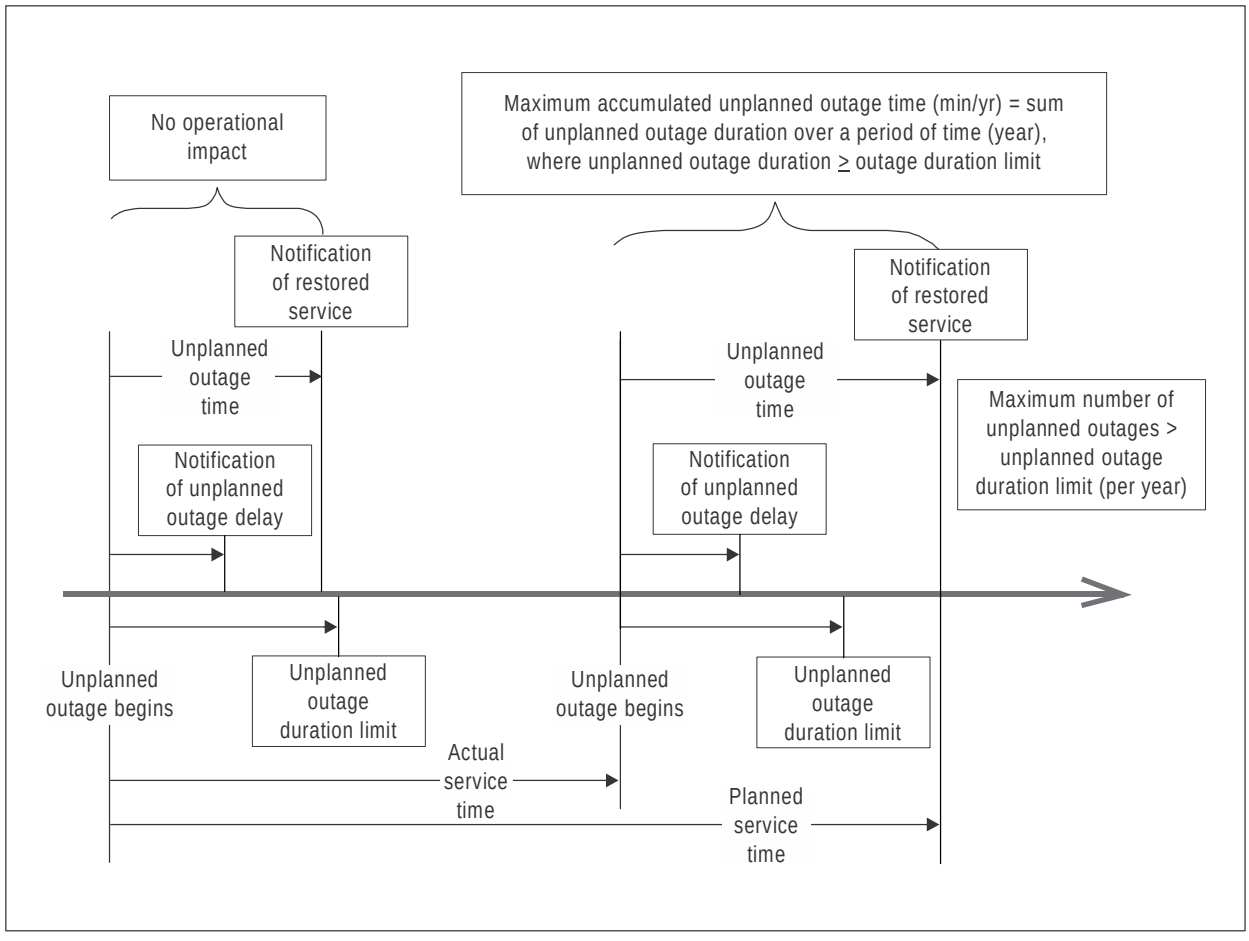



**Figure 2-4. Overview of relationship of RCP/RSP service availability parameters**

2.2.4.12 As an example, Appendix B contains the RCP 240 specification, including the values for RCP availability and allocations. The RCP availability requirement of 99.99 per cent for efficiency is specifically a value for consideration in local assessment (i.e. within a specific centre). The RCP availability requirement of 99.9 per cent was determined based on an operational safety assessment (per DO-264/ED-78A) that classified the effect of loss of service as “minor” provided procedural mitigations are in place to transition to a different separation minimum (those not predicated on RCP 240 performance). The RCP availability requirements for safety should determine whether reduced separations requiring RCP 240 are applied.

2.2.4.12.1 For RCP 240, RCP availability is ensured initially in contract/service agreements with the CSP and approval of aircraft CPDLC equipment. Post-implementation monitoring evaluates service availability from unplanned outage events on a per centre basis, if the outage exceeds 10 minutes and if it affects multiple aircraft. The service availability requirements are allocated exclusively to the CSP, and assume that failed CPDLC components within the ANSP would not significantly contribute to loss of the CPDLC service.

2.2.4.13 When the operational system does not meet the RCP availability requirements, the ANSP may consider local factors, such as whether the reduced separation minimum is applied between pairs of suitably-equipped aircraft or on tracks, to determine the appropriate mitigation and/or action. See also RTCA DO-306/EUROCAE ED-122 for examples of other factors.

*Note.— Guidance on means of compliance and RCP specifications are contained in Chapter 4 and Appendix B, respectively.*

### 2.2.5 RCP integrity and allocations

2.2.5.1 The value for the RCP integrity parameter is selected based on the results of an operational hazard assessment. This assessment should include a severity-of-effects analysis of communication transactions with undetected errors. Undetected errors include, but are not limited to:

a) corruption of one or more messages within the transaction;

b) misdirection of one or more messages within the transaction;

c) delivery of messages in an order that was not intended;

d) delivery of a message after the RCP transaction time; and

e) loss of service or interruption in a communication transaction.

*Note.— Undetected loss of service is associated with integrity because it is “undetected”. In some operational scenarios, it is conceivable that a network could have failed with no indication provided to the users of the system.*

2.2.5.2 A criterion should be determined for the probability of communication transactions occurring with undetected errors based on the severity-of-effects analysis.

2.2.5.3 The value for the RCP integrity parameter is the acceptable probability of communication transactions with undetected errors.

2.2.5.4 The RCP integrity requirements are specified in terms of probability of malfunction (i.e. failure instead of quality of service) on a per flight hour basis. For RCP 240, the probability of malfunction shall be less frequent than $10^{-5}$ per flight hour. The RCP integrity requirements were determined based on an operational safety assessment (per DO 264/ED 78A) that classified the effects of undetected message corruption, misdelivery and other misleading anomalous system behaviour as “major”. These requirements are allocated to system components in terms of safety and performance.

2.2.5.5 RCP integrity is demonstrated by procedures, design assurance, design features and system architecture characterized by interoperability standards (e.g. RTCA DO-258A/EUROCAE ED-100A for FANS 1/A) and safety and performance requirements (SPR) standards (e.g. RTCA DO-306/RTCA ED-122 for oceanic/remote airspace).

2.2.5.6 Some examples include:

a) RTCA DO-258A/EUROCAE ED-100A, which employs a cyclic redundancy check (CRC) algorithm that is implemented in the CPDLC and ADS-C application (RTCA DO-178C/EUROCAE ED-12C level C software) to eliminate the potential risk of undetected corruption of message content and message address caused by communication services as required by the SPR standard;

b) specification of a safety requirement, requiring the ATS unit to correlate flight plan information with the information provided in the logon request from the aircraft to ensure that the CPDLC connection with the aircraft is legitimate; and

c) specification of a safety requirement, requiring the flight crew/aircraft system to provide correct aircraft identification in the logon request.

2.2.5.7 There may be operational situations where problems affecting system integrity are discovered post-implementation. These problems should be reported to the appropriate performance-based communication and surveillance (PBCS) monitoring entity and/or authorities to determine the appropriate action to be taken. If such problems are systematic, additional actions may be recommended to remove the source of the problem. A systematic problem is identified when the accumulation of similar reports increase over time.

## 2.3 SELECTING THE RCP SPECIFICATIONS

2.3.1 Once all the safety and operational requirements are identified, the RCP specification meeting these requirements is selected from Table 2-1.

2.3.2 Separate analyses of different ATM operations may result in the need to apply a number of different RCP specifications.

*Note.— Guidance on prescribing an RCP specification in these situations is contained in Chapter 3.*

## 2.4 RSP SPECIFICATIONS

### 2.4.1 General

2.4.1.1 The operational requirements of an RSP specification apply to the surveillance services and define parameter values for surveillance data transit times, RSP continuity, RSP availability and RSP integrity, as well as allocated values (e.g. required surveillance monitored performance (RSMP), required surveillance technical performance (RSTP) and, when applicable, human performance). When applying RSP, it is assumed that that the supporting system components are compatible and interoperable, in accordance with interoperability standards.

2.4.1.2 An RSP specification is identified by a designator (e.g. RSP 180) in order to simplify the designator naming convention and to make the required surveillance data delivery time readily apparent to airspace planners, aircraft manufacturers and operators. The designator represents the value for the surveillance data delivery time when the surveillance data delivery is considered overdue.

2.4.1.3 Figure 2-5 shows an RSP specification model with two different sets of allocations (ADS-C and SATVOICE), but for which the same operational (end-to-end) performance applies. Different technologies may lead to different allocated values, although they yield the same end-to-end values. As such, the performance of the technical systems is known as RSTP. It should be noted that in the case of ADS-C usage, the position report is generated without flight crew action, while SATVOICE usage via a radio operator requires flight crew action.

2.4.1.4 The operational surveillance data transit parameters apply to the actual performance of the surveillance data delivery from when the aircraft is at the position, to when the ATS unit/controller receives the surveillance data (e.g. ADS-C report delivery).

2.4.1.5 The actual performance is associated with the surveillance data delivery from the time associated with the aircraft's position provided with the data, to the time when the ATS unit receives the data (referred to as actual (operational) surveillance performance (ASP)). Post-implementation monitoring continues to assess ASP.

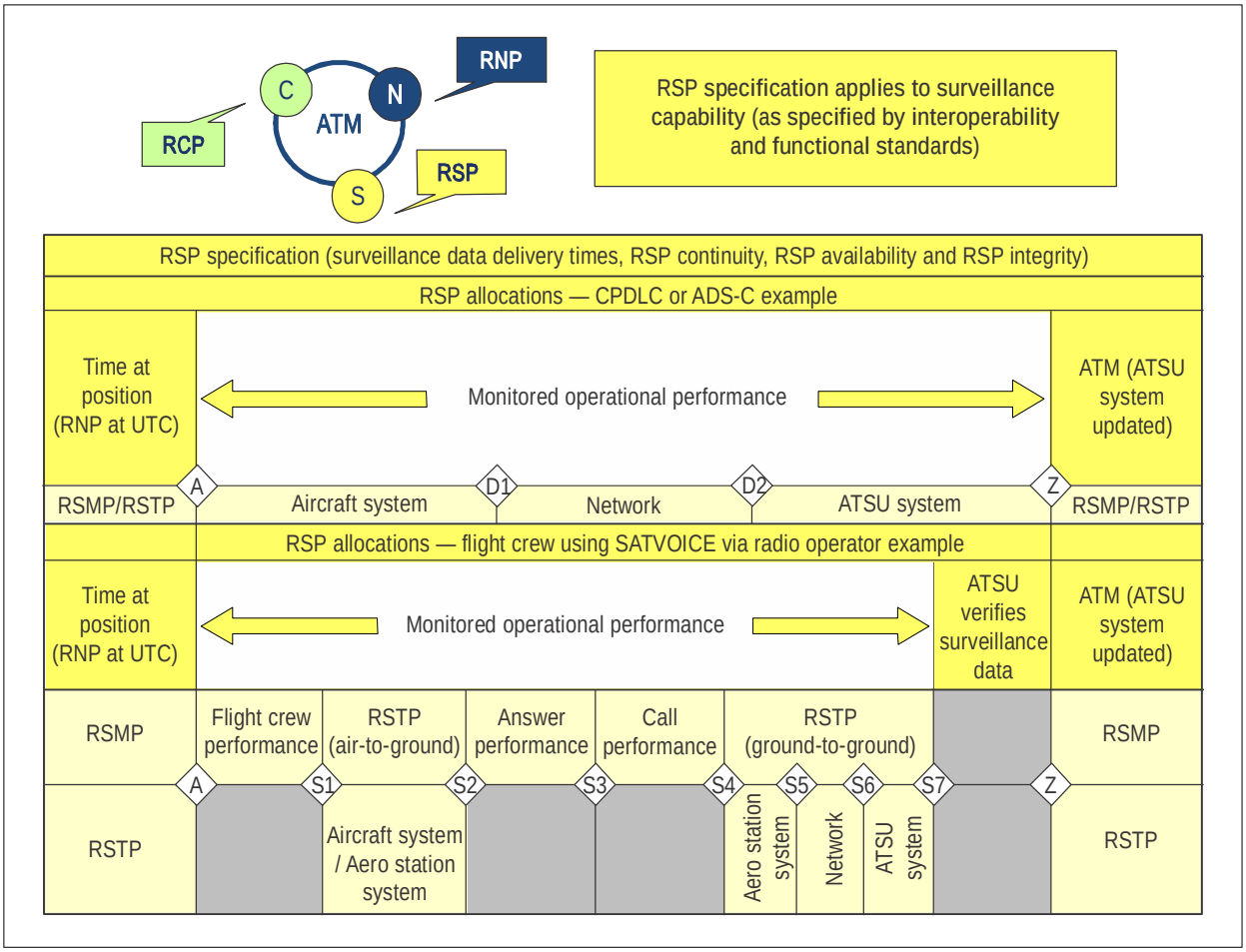



**Figure 2-5. RSP specification model**

2.4.1.6 As is illustrated in Figure 2-5, surveillance data delivery is allocated to the following components:

a) SATVOICE: flight crew (initiator) — position report preparation and call establishment; and

b) operational performance (monitored) — RSTP.

*Note.— In the case of ADS-C usage, surveillance data delivery is a system-based transaction, for which RSTP coincides with RSP.*

2.4.1.7 The RSP specification should include the necessary operational, functional, safety and performance criteria, for example:

a) the type of reports and intended use;

b) the interactive capability of voice communication;

c) the air-ground integration capability of data communication;

d) times that indicate non-compliant performance and procedures when such indications occur; and

e) positive assurance of the controller's receipt of a report.

2.4.1.8 The set of requirements for an RSP specification are based on the following parameters:

a) *RSP surveillance data transit time*. Maximum time for the reception of the surveillance data after which the controller should revert to an alternative procedure;

b) *RSP continuity.* The minimum proportion of surveillance data delivery to be completed within the specified RSP surveillance data delivery time, given that the service was available at the start of the delivery;

c) *RSP availability.* The required probability that surveillance data can be provided; and

d) *RSP integrity.* The required probability that surveillance data delivery is completed with no "undetected" errors.

*Note.— While RSP integrity is defined in terms of the quality of the surveillance capability, the criterion is specified as a probability of malfunction on a per flight hour basis (e.g. $10^{-5}$), consistent with an RNAV/RNP specification.*

2.4.1.9 Table 2-2 lists RSP specifications, also provided in Appendix C. Currently, the number of specifications is limited to two (RSP 180 and RSP 400) in airspace where procedural separation applies. Other RSP specifications may be added, pending the introduction of new ATM operations or the use of new surveillance technologies.

2.4.1.10 RSP 180 may be applied to maintain the performance for normal means of surveillance, which supports controller intervention capability in procedurally controlled airspace, where separation minimum applied is predicated on surveillance performance.

**Table 2-2. RSP specifications**

| *RSP specification* | *RSP delivery time (seconds)* | *RSP continuity (probability)* | *RSP availability (probability)* | *RSP integrity (acceptable rate/flight hour)* |
|---|---|---|---|---|
| RSP 180 | 180 | 0.999 | 0.999<br>0.9999 (efficiency)<br>(see Note 3) | FOM = navigation specification<br>Time at position accuracy = +/- 1 sec<br>Data integrity (malfunction) = $10^{-5}$ |
| RSP 400 | 400 | 0.999 | 0.999 | FOM = Navigation specification<br>Time at position accuracy = +/- 30 sec<br>Data integrity (malfunction) = $10^{-5}$ |

*Note 1.— The results of safety assessments and further information on RSP 180 and RSP 400 are contained in RTCA DO-306/EUROCAE ED-122. Additional RSP specifications will be validated by a safety assessment, data collection and/or other means prior to inclusion.*

*Note 2.— When a unit of measure other than the "per flight hour" is used to specify RSP specification values for integrity, the conversion process will need to be validated. For example, when data are analysed on a "per transaction" basis, or on a "per sector" basis, the average number of transactions per flight hour or the average number of flight hours per sector hour, respectively, will need to be validated for the specific implementation.*

*Note 3.— The values for availability are based on a safety assessment, taking into account assumptions about the environment, such as the mitigation of procedures for failed data communication and contingencies. For RSP 180, an additional, more stringent value has been assigned, based on the operational effect of frequent losses of the service on providing an efficient and orderly flow of air traffic. Two values are used to determine corrective action when the service availability degrades below the assigned value. The corrective action may vary depending on whether the criterion is for safety or for efficiency.*

2.4.1.10 RSP 180 may be applied to maintain the performance for normal means of surveillance, which supports controller intervention capability in procedurally controlled airspace, where separation minimum applied is predicated on surveillance performance.

2.4.1.11 RSP 400 may be applied to maintain the performance for emerging technology (e.g. satellite voice) used to provide normal means of surveillance supporting controller intervention capability in procedurally controlled airspace, where the separation minimum being applied is based on position reporting at compulsory reporting points. RSP 400 might also be applied to maintain the performance required for emerging technologies used to provide alternative means of surveillance, that may be required in combination with the normal means of surveillance, to which RSP 180 is applied.

*Note.— RSP specifications were derived from intervention capabilities used in collision risk modelling (Doc 9689), aircraft performance characteristics, conflict detection and resolution capability, PANS-ATM (Doc 4444), RTCA/EUROCAE Standards, and other factors.*

### 2.4.2 RSP data delivery time and allocations

2.4.2.1 The value for the RSP data delivery time is based on the time when the surveillance data delivery is considered overdue.

2.4.2.2 The assessment would take into consideration the time needed to safely execute the contingency procedure and can include an analysis of empirical data applicable to the RSP data delivery times for the ATM operation.

2.4.2.3 For separation assurance, the RSP data delivery can be determined by collision risk modelling. This method considers the RSP delivery times in the surveillance data delivery supporting separation assurance. Figure 2-1 illustrates the surveillance data delivery in the context of surveillance capabilities.

2.4.2.4 In practice, the RSP data delivery time is specified for a nominal continuity and for an operational continuity (OT). The time associated with the operational continuity (OT) is termed “overdue time”, as this is associated with the time the controller takes action upon receiving an alert provided by the expiration of the ground timer. These times, indicated below, are directly associated with the RSP continuity requirements for the controller’s surveillance capability:

a) the DT value is used in statistical analysis during post-implementation monitoring and is not monitored in real time. The DT value is known as the nominal delivery time (i.e. the time at which 95 per cent of the surveillance reports in a data sample are delivered). Other statistical values, such as mean and average time values, may be considered in local assessments. If the system does not meet the DT value, appropriate action should be taken to identify and rectify the source(s) of performance deterioration to improve performance to an acceptable level before providing the ATM operation predicated on RSP;

b) The OT value is monitored in real time for each surveillance report by the ATC system. When the surveillance report is not received within the OT value (i.e. the report is overdue), the ATC system provides an indication to the controller for appropriate action. The OT value is associated with a continuity requirement of 0.999 (99.9 per cent), which was determined by an operational safety assessment, in accordance with DO-264/ED-78A. In this case, the operational safety assessment concluded that under worst case conditions, a frequent occurrence of this indication to the controller (i.e. that a surveillance report is overdue) could result in a significant increase in controller workload. This is considered to be a “Class 4” hazard. The corresponding safety objective is that the occurrence of an overdue surveillance report is no greater than $10^{-3}$ (or 99.9 per cent of surveillance reports are received within the OT value); and

c) The time values at 95 per cent and at the operational continuity criterion (e.g. 99.9 per cent) apply to the RSP data delivery and RSTP. It should be noted that only the RSP time value at the operational RSP continuity criterion (which coincides with the RSTP) has an expiration timer (OT).

2.4.2.5 For example, Appendix C contains the RSP 180 specification, including the allocated RSP surveillance data delivery time values. Compliance with the times for the RSP data delivery is shown by analysis, contracts and/or service agreements for surveillance services and post-implementation monitoring of actual surveillance data deliveries (ASP). Allocated requirements associated with ASP aid in determining initial compliance and further assessment when ASP does not meet the requirements for RSP.

*Note.— Guidance on means of compliance and the RSP 180 specification are contained in Chapter 4 and Appendix C, respectively.*

### 2.4.3 RSP continuity and allocations

2.4.3.1 The value for the RSP continuity parameter is associated with the actual surveillance performance of the overdue value of RSP and is selected based on the results of an operational hazard and performance assessment.

2.4.3.2 The operational hazard assessment should include a severity-of-effects analysis of detected errors within the surveillance data deliveries. Detected errors include, but are not limited to:

a) detecting that the surveillance data delivery has exceeded the RSP data delivery time (OT);

b) detecting that the surveillance data delivery is corrupted, misdirected, directed out-of-sequence or lost, and cannot be corrected to data delivery within the RSP data delivery time; and

c) detecting loss of the surveillance service or aircraft capability to use the service while data deliveries are pending.

2.4.3.3 An acceptable operational RSP continuity value should be determined based on an analysis of the severity and the probability of surveillance data deliveries with detected errors. As stated in 2.4.2.4, the operational safety assessment for RSP 180, classified the effects of identified hazards on ATS services, such as controller workload as "minor", which equates to a probability of malfunction less frequent than $10^{-3}$, or a 0.999 success rate (99.9 per cent).

2.4.3.4 From a performance perspective, RSP continuity is associated with the required level of usability. This places a limit on the number of interrupted data deliveries after which it becomes annoying or less productive, from a usability point of view, to use ADS-C.

2.4.3.5 A nominal RSP continuity value (DT) is specified to assess the performance at 95 per cent. Other statistical values, such as mean and average time values, may be considered in local assessments.

2.4.3.6 The values for RSP continuity remain the same (95 per cent and 99.9 per cent) for all RSP allocations.

### 2.4.4 RSP availability and allocations

2.4.4.1 RSP availability (RSP A) is a system requirement, associated with the surveillance service, at the disposal of the aircraft system and controller. RSP A is the required probability that the surveillance system is in service, measured over a period of time.

2.4.4.2 RSP A is defined as the ratio between the time during which the system is actually available for service (actual service time) and the time the system is planned for service (actual service time + unplanned outage time), (i.e. RSP A = actual service time/actual service time + unplanned outage time).

2.4.4.3 In a given airspace, RSP A is specified in terms of the RSP availability for the surveillance service (RSP $A_{SERVICE}$), which comprises the RSP availability for the ATS unit (RSP $A_{ATSU}$) and the RSP availability for the CSP(RSP $A_{CSP}$), and the RSP availability for the aircraft system (RCP $A_{AIR}$). Therefore:

a) RSP $A_{SERVICE}$ = RSP $A_{ATSU}$ x RSP $A_{CSP}$; and

b) RSP A = RSP $A_{SERVICE}$ x RSP $A_{AIR}$.

2.4.4.4 In order for the surveillance service to be available, the ATS unit's system, any CSP's service and any aircraft system that the surveillance service depends on, must also be available.

2.4.4.5 The value for RSP A is selected based on the results of an operational hazard and performance assessment. The operational hazard assessment should include a severity-of-effects analysis of the detected loss of the surveillance service. Detected loss includes, but is not limited to loss of surveillance information for multiple aircraft and single aircraft.

2.4.4.6 A criterion should be determined for the probability of an inability to initiate surveillance data delivery based on the severity-of-effects analysis.

2.4.4.7 From a performance (efficiency) perspective, RSP availability is affected by aircraft operators, ANSP expectations and the confidence that the communications service is available.

*Note.— If a service outage is declared in the midst of surveillance data delivery, causing a continuity failure, this failure is only counted against availability and is excluded from the continuity measurement. This is because it is anticipated that most service outage durations will be more than the overdue time.*

2.4.4.8 The value for RSP A is based on the acceptable rate of detected inability to initiate the delivery of the surveillance data.

2.4.4.9 RSP availability for the aircraft ($A_{AIR}$) is the required probability that the aircraft system is serviceable for the relevant surveillance capability. It is the ratio between the time during which the aircraft system is actually in operation (actual time of operation) and the time the aircraft system is planned for being in operation (actual time of operation/actual time of operation + unplanned outage time).

2.4.4.9.1 The aircraft system providing the surveillance functionality comprises various components (including the radio that is accessing the different communication subnetworks). Since no system is perfect, the aircraft system has a failure rate, expressed on a per flight hour basis (e.g. 7 x $10^{-4}$/flight hour). The reciprocal of failure rate is actual time of operation and represents the average number of flight hours between two failures as shown in Figure 2-6.

2.4.4.9.2 The surveillance system failure duration (unplanned outage time) for the aircraft corresponds to the duration of a flight, which should be taken into account in the availability computation. From this, RSP $A_{AIR}$ can be derived (i.e. actual time of operation/actual time of operation + unplanned outage time).

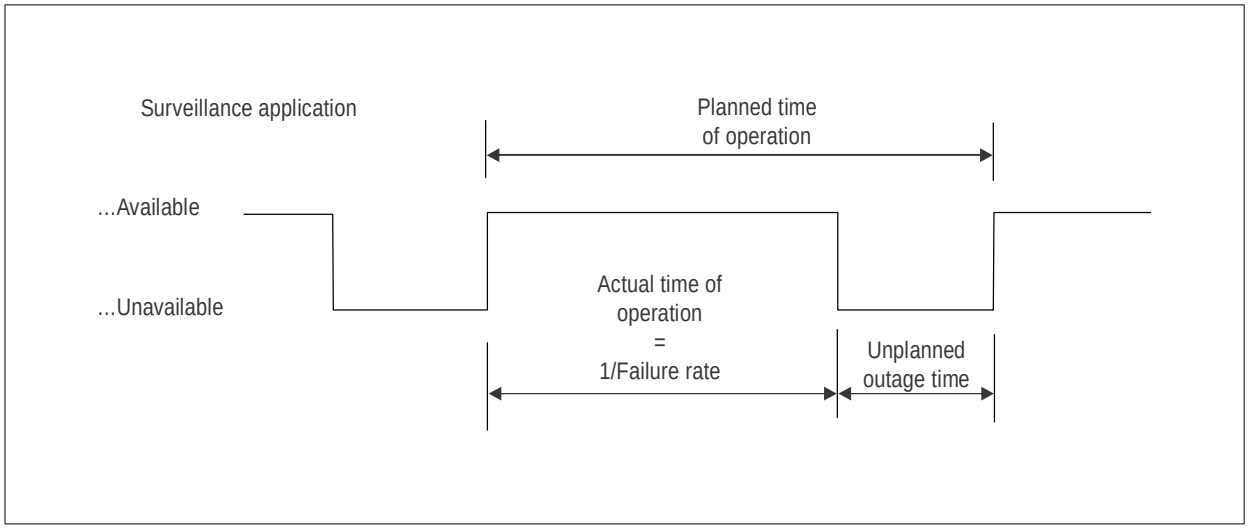



**Figure 2-6. RSO availability — aircraft (RSP $A_{AIR}$)**

2.4.4.9.3 When the surveillance service is dependent on an aircraft system, the RSP $A_{AIR}$ for that system typically determines the number of similar components (redundancy) required for installation on the aircraft. The number of similar components needed in any given architecture for the aircraft system will depend on the component availability.

2.4.4.10 RSP availability for the air traffic service ($A_{SERVICE}$) is the probability that the system is in service within a planned service area for planned hours of operation, and is measured over a period of time. It is the ratio between the time during which the ATS unit and CSP systems are actually in service (actual service time) and the time the ATS unit's and CSP systems are planned for being in service (actual service time + unplanned outage time).

2.4.4.10.1 $A_{SERVICE}$ is evaluated only over the ATS unit and CSP.

2.4.4.10.2 If the CSP or ATS unit is not available for surveillance service provision, the ATS unit will have to cease ATM operations predicated on that particular service and apply an alternative procedure.

2.4.4.10.3 A service outage counts against RSP $A_{SERVICE}$ regardless of whether any aircraft are located in the service area. The RSP $A_{SERVICE}$ requirements (RSP $A_{CSP}$ and RSP $A_{ATSU}$) are specified in terms of unplanned outage duration limit, maximum number of unplanned outages (exceeding the duration limit) per year, maximum accumulated unplanned outage time in minutes/year and unplanned outage notification delay.

2.4.4.11 Figure 2-4 provides an overview of relationships among the parameters specified for RSP service availability, which are identical to those used for RCP service availability.

2.4.4.12 As an example, Appendix C contains the RSP 180 specification, including the values for RSP availability and allocations. The RSP availability requirement of 99.99 per cent for efficiency is specifically a value for consideration in local assessments (i.e. within a specific centre). The RSP availability requirement of 99.9 per cent was determined based on an operational safety assessment (per DO-264/ED-78A) that classified the effect of loss of service as "minor", provided procedural mitigations are in place to transition to a different separation minimum (those not predicated on RSP 180 performance). The RSP availability requirements for safety should determine whether reduced separations requiring RSP 180 are applied.

2.4.4.12.1 For RSP 180, RSP availability is ensured initially in contract/service agreements with the CSP and approval of aircraft ADS-C equipment. Post-implementation monitoring evaluates service availability from unplanned outage events on a per centre basis if the outage exceeds 10 minutes and if it affects multiple aircraft. The service availability requirements are allocated exclusively to the CSP, and assume that failed ADS-C components within the ANSP would not significantly contribute to loss of ADS-C.

2.4.4.13 When the operational system does not meet the RSP availability requirements, the ANSP may consider local factors, such as whether the reduced separation minimum is being applied between pairs of suitably equipped aircraft or on tracks, to determine the appropriate mitigation and/or action. See also RTCA DO-306/EUROCAE ED-122 for examples of other factors.

*Note.— Guidance on means of compliance and RSP specifications are contained in Chapter 4 and Appendix C, respectively.*

### 2.4.5 RSP integrity and allocations

2.4.5.1 The value for the RSP integrity parameter is selected based on the results of an operational hazard assessment. This assessment should include a severity-of-effects analysis of communication transactions with undetected errors. Undetected errors include, but are not limited to:

a) corruption of the delivered surveillance data;

b) misdirection of delivered surveillance data;

c) delivery of ADS-C reports in an order that was not intended;

d) delivery of an ADS-C report after the RSP data delivery time; and

e) loss of service or interruption in surveillance data delivery.

*Note.— Undetected loss of service is associated with integrity because it is "undetected". In some operational scenarios, it is conceivable that a network could have failed with no indication provided to the users of the system.*

2.4.5.2 A criterion should be determined for the probability of surveillance data deliveries with undetected errors, based on the severity-of-effects analysis.

2.4.5.3 The RSP integrity parameter value is the acceptable probability of surveillance data deliveries with undetected errors.

2.4.5.4 Additionally, the RSP integrity requirements include criteria for the accuracy of navigation data and time at the position provided in the surveillance data. The information provided in the surveillance data includes the following:

a) the accuracy of the navigation position data in terms of a navigation figure of merit (FOM) or equivalent; and

b) the accuracy of the time the aircraft was actually at the position.

2.4.5.5 The RSP integrity requirements are specified in terms of the probability of malfunction (i.e. failure instead of quality of service) on a per flight hour basis. As an example, for RSP 180 and RSP 400, probability of malfunction shall be less frequent than $10^{-5}$ per flight hour. The RSP integrity requirements were determined based on an operational safety assessment (per DO-264/ED-78A) that classified the effects of undetected message corruption, misdelivery and other misleading anomalous system behaviours as "major". These requirements are allocated to system components in terms of safety and performance requirements.

2.4.5.6 RSP integrity is demonstrated by procedures, design assurance, design features and system architecture, characterized by interoperability standards (e.g. RTCA DO-258A/EUROCAE ED-100A for FANS 1/A) and safety and performance requirements (SPR) standards (e.g. RTCA DO-306/EUROCAE ED-122 for oceanic/remote airspace).

2.4.5.7 Some examples include:

a) RTCA DO-258A/EUROCAE ED-100A employs a cyclic redundancy check (CRC) algorithm implemented in the CPDLC and ADS-C application (RTCA DO-178C/EUROCAE ED-12C level C software) to eliminate the potential risk of undetected corruption of message content and message address caused by communication services as required by the SPR standard;

b) specification of a safety requirement, requiring the ATS unit to correlate flight plan information with the information provided in the logon request from the aircraft to ensure that the ADS-C contract establishment with the aircraft is legitimate; and

c) specification of a safety requirement, requiring the flight crew to ensure the aircraft is correctly identified and that instructions are properly executed.

2.4.5.8 There may be situations in operations where problems affecting system integrity are discovered post-implementation. These problems should be reported to the appropriate PBCS monitoring entity and/or authorities to determine the appropriate action to be taken. If such problems are systematic, additional actions may be recommended to remove the source of the problem. A systematic problem is identified when the accumulation of similar reports increase over time.

## 2.5 SELECTING THE RSP SPECIFICATIONS

2.5.1 Once all the safety and operational requirements are identified, the RSP specification meeting these requirements is selected from Table 2-2.

2.5.2 Separate analyses of different ATM operations may result in the need to apply a number of different RSP specifications.

*Note.— Guidance on prescribing an RSP specification in these situations is contained in Chapter 3.*

# Chapter 3

# APPLYING AN RCP/RSP SPECIFICATION

## 3.1 GENERAL

3.1.1 The standards and procedures for an air traffic management (ATM) operation that is predicated on communication and surveillance capabilities, such as the application of a reduced separation minimum, should refer to the appropriate required communication performance (RCP)/required surveillance performance (RSP) specification. The RCP/RSP specification provide the operational performance criteria and associated allocations to the subsystems for the communication and surveillance capabilities supporting the ATM operation.

*Note.— Refer to Appendix B for RCP specifications and Appendix C for RSP specifications.*

3.1.2 This chapter provides guidance for application of an RCP/RSP specification to communication and/or surveillance capabilities supporting an ATM operation in applicable airspace. An RCP/RSP specification provides a globally standardized means to prescribe in the Aeronautical Information Publication (AIP) (or equivalent publication) the initial and continued compliance criteria for communication and surveillance capabilities in the applicable airspace, supporting:

a) approval of air navigation services providers (ANSP) to provide new ATM operations that depend on RCP/RSP capabilities, including flight plan provisions and notifications of service;

b) operational approval, including the relevant aircraft system to participate in ATM operations that depend on RCP/RSP capabilities; and

c) performance-based communication and surveillance (PBCS) monitoring programmes.

3.1.3 Applying an RCP/RSP specification to ANSP approval, operational approval and PBCS monitoring programmes provide a globally standardized means to ensure the communication system, within a particular airspace, meets applicable performance requirements initially and in continued operations.

*Note.— Guidance for determining initial and continued compliance with an RCP/RSP specification is provided in Chapter 4.*

## 3.2 PRESCRIBING AN RCP/RSP SPECIFICATION

3.2.1 The State should prescribe the appropriate RCP/RSP specification for the communication and surveillance capability in the AIP (or equivalent publication) for the applicable airspace, concurrent with operational implementation of:

a) a new ATM operation predicated on communication and surveillance performance; or

b) any significant safety-related change to communication and surveillance capabilities.

*Note.— When an ATM operation is being trialled, the State may refer to the appropriate RCP/RSP specification to measure and assess actual system performance in preparation for operational implementation.*

3.2.2 If the appropriate RCP/RSP specification does not exist for the relevant ATM operation or safety-related change intended to be implemented, the State should coordinate with ICAO to develop and publish the appropriate RCP/RSP specification in this manual.

*Note.— Guidance for developing an RCP/RSP specification is provided in Chapter 2.*

3.2.3 When prescribing the RCP/RSP specification in the AIP (or equivalent publication), the State should specify the following:

a) applicable airspace or specific routes;

b) specific ATM operations (e.g. 5-minute longitudinal separation minimum);

c) associated designator defining the interoperability standards for communication and surveillance capabilities (e.g. FANS 1/A controller-pilot data link communications (CPDLC) and automatic dependent surveillance — contract (ADS-C), Iridium, Inmarsat or MTSAT SATVOICE); and

d) any limitations that may apply as a result of communication and/or surveillance infrastructure constraints or specific communication and/or surveillance functionality requirements.

*Note 1.— Refer to the* Global Operational Data Link (GOLD) Manual (Doc 10037) *for designators defining the interoperability standards for CPDLC and ADS-C. Refer to the* Satellite Voice Operations Manual (SVOM) (Doc 10038) *for designators defining interoperability standards for SATVOICE. For example, FANS 1/A is an interoperability designator for CPDLC and ADS-C; or Iridium, Inmarsat or MTSAT are interoperability designators for SATVOICE.*

*Note 2.— Limitations may apply to specific areas of operation. For example, due to lack of Inmarsat SATCOM coverage above 82°N or below 82°S, or specific communication subnetwork types, limitations may apply to avoid non-compliant performance on routes in VHF/SATCOM transition areas or extensive use of HFDL outside VHF coverage.*

3.2.4 Figure 3-1 provides an example of information included in the AIP (or equivalent publication) when prescribing an RCP/RSP specification.

3.2.5 The State should prescribe an RCP/RSP specification in the AIP (or equivalent publication) on the basis of a bilateral, multilateral or regional air navigation agreement, as appropriate, when:

a) the ATM operation affects neighbouring airspace, such as when applying a separation minimum predicated on communication and surveillance capability at the boundary; or

b) the communication and surveillance infrastructure is common within the region.

3.2.6 The air navigation agreement should contain:

a) flight plan provisions for aircraft operators to file PBCS capabilities;

b) means of compliance with the appropriate RCP/RSP specification, including requirements for air traffic services (ATS) provision, aircraft system and operational approval for PBCS operations;

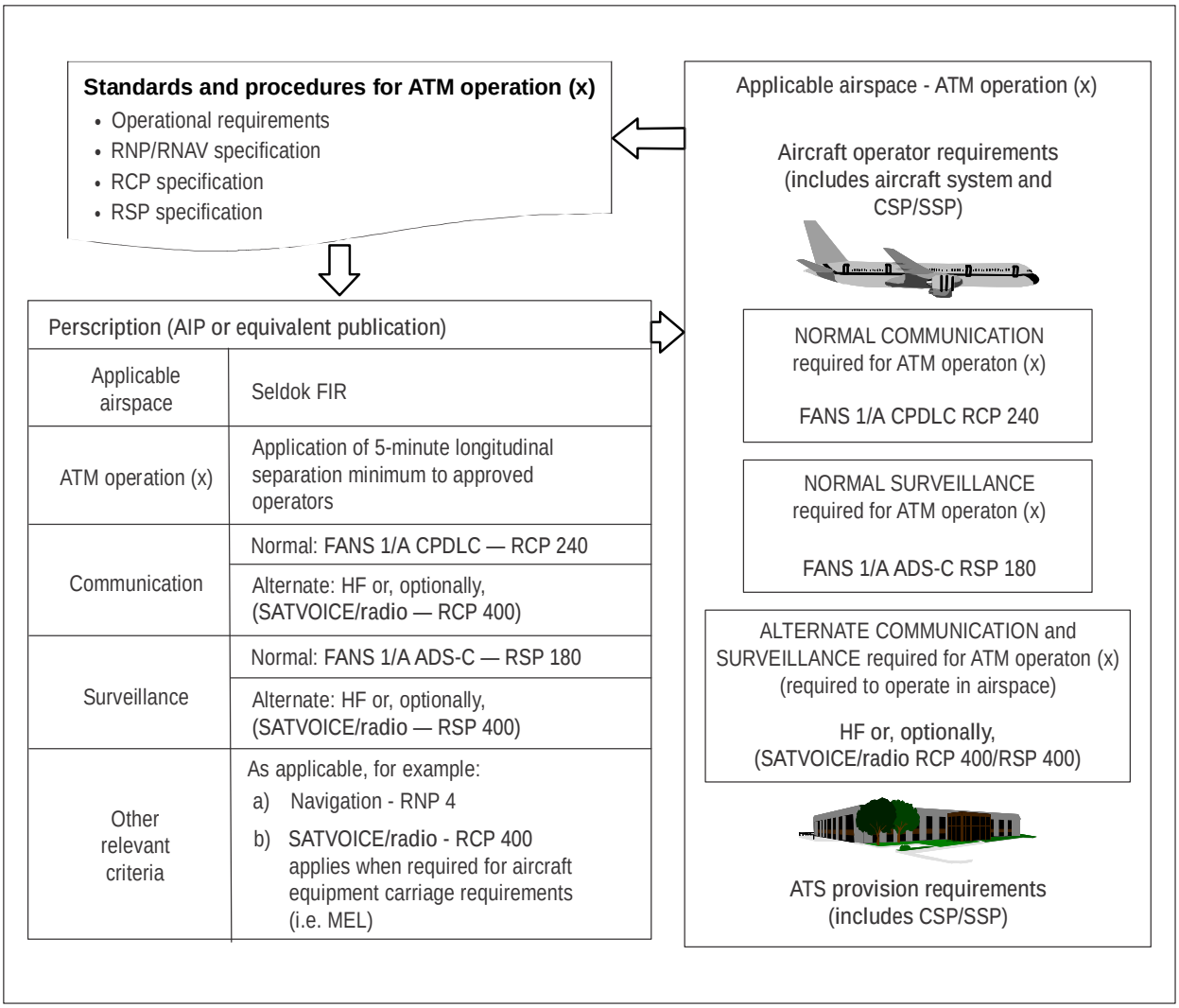



**Figure 3-1. Example of prescribing an RCP/RSP specification**

c) the application of the RCP/RSP specification to communication and surveillance capabilities for the ATM operation; and

d) PBCS monitoring programmes.

### 3.3 APPLYING AN RCP/RSP SPECIFICATION TO PBCS MONITORING PROGRAMMES

3.3.1 When the State does not prescribe an RCP/RSP specification, the ANSP should apply the appropriate RCP/RSP specification to identify the continuing compliance criteria for PBCS monitoring programmes when employing new technology for communication and surveillance capabilities.

3.3.2 The ANSP should also establish policies and procedures for taking appropriate action when the PBCS monitoring programme indicates that communication and surveillance capabilities do not meet the RCP/RSP specification.

## 3.4 ADAPTING THE PBCS MONITORING PROGRAMME (ABSENT RCP/RSP SPECIFICATION)

3.4.1 When monitoring the performance of existing communication and surveillance capabilities, the ANSP should adapt the PBCS monitoring programme guidelines outlined in Chapter 4, to ensure globally standardized measurements of ACP and ASP.

*Note.— Refer to Figure 2-2 for ACP measuring points (C and X), and Figure 2-5 for ASP measuring points (C and X). Refer to Figure 2-4 for the measuring parameters used to assess the actual service availability.*

3.4.2 If other measuring points or parameters are used, the ANSP should specify how the measuring points and parameters used will affect the actual measurements against the standardized measuring points and parameters.

*Note.— For example, the ANSP may adapt the PBCS monitoring programme to measure the ACP of ATC clearance transactions and ASP of position reports on high frequency (HF) voice via a radio operator. The aeronautical station may measure communication performance from the "time value" included with the ATC clearance message received from the ATS unit, to the "time value" included in the response message the aeronautical station sends back to the ATS unit. The ACP may be estimated taking into account a relatively small and statistically stable value for the time from when the aeronautical station sent the response message to when the ATS unit received the response message.*

# Chapter 4

# COMPLYING WITH AN RCP/RSP SPECIFICATION

## 4.1 GENERAL

4.1.1 The guidance in this chapter is intended for use by States, to set their policies and objectives for performance-based communication and surveillance (PBCS), to support the safety oversight of training organizations, aircraft operators and associated maintenance organizations, organizations responsible for the type design or manufacture of aircraft, and the air navigation services providers (ANSP). It is also intended for the appropriate organizations to show initial compliance for different system components and continued compliance at the operational level through PBCS monitoring programmes.

4.1.2 Initial compliance provides a level of confidence that the system component will perform in accordance with its allocation provided by the RCP/RSP specification and will not compromise the overall performance of the operational system. Since the initial compliance for a system component is not exhaustive, the PBCS monitoring programmes provide a higher level of confidence that the operational system will continue to meet the RCP/RSP specification.

*Note 1.— RCP specifications are contained in Appendix B. RSP specifications are contained in Appendix C.*

*Note 2.— Guidelines on PBCS monitoring programmes are contained in section 4.5, Appendix D for controller-pilot data link communications (CPDLC) and automatic dependent surveillance — contract (ADS-C), and Appendix E for SATVOICE.*

4.1.3 This guidance is applicable when a State prescribes an RCP/RSP specification for a communication and/or surveillance capability and performance required to support an ATM operation, such as the application of a reduced separation minimum.

4.1.4 This guidance is also applicable when monitoring performance of any communication and surveillance capabilities even when an RCP/RSP specification is not prescribed for communication and surveillance supporting an ATM operation. Following this guidance will facilitate a globally standardized means of monitoring the communication and surveillance capabilities.

4.1.5 It is assumed that the air traffic services (ATS) system, CSP system and aircraft system comply with appropriate interoperability standards prior to assessing compliance with an RCP/RSP specification.

*Note.— Refer to the* Global Operational Data Link (GOLD) Manual (Doc 10037) *for appropriate interoperability standards associated with CPDLC and ADS-C systems. Refer to the* Satellite Voice Operations Manual (SVOM) (Doc 10038) *for appropriate interoperability standards associated with SATVOICE systems.*

## 4.2 GUIDANCE FOR STATES

### 4.2.1 General policies and objectives

4.2.1.1 The State should provide policies and guidance material for appropriate organizations with regard to demonstrating that systems, procedures and supporting programmes, initially comply with the RCP/RSP allocations and that the operational system continues to comply with the prescribed RCP/RSP specification.

4.2.1.2 The State should ensure that the ANSP establishes local and regional PBCS monitoring programmes and means for appropriate entities, not necessarily under the jurisdiction of the State, to participate in the programmes in accordance with 4.3.1.8. Other entities may include the ATS units, aeronautical stations, CSPs, aircraft manufacturers and equipment suppliers and aircraft operators.

*Note 1.— PBCS monitoring programmes may support search and rescue (SAR) and accident/incident investigations. However, they are not intended to replace the ATS incident reporting Standards and guidelines, as specified in the* Procedures for Air Navigation Services — Air Traffic Management *(PANS-ATM, Doc 4444), Appendix 4;* Air Traffic Services Planning Manual *(Doc 9426), Part I, Section 2, Chapter 8; or applicable State regulations affecting the parties directly involved in a potential ATS incident.*

*Note 2.— PBCS monitoring programmes are not intended to replace the Standards to retain records of communications and surveillance data for accident/incident investigation purposes in accordance with Annex 11, 6.1.1.3, and Annex 10, Volume II, 3.5.*

### 4.2.2 State safety oversight of an ANSP

4.2.2.1 When an RCP/RSP specification is prescribed, the State should ensure that the ANSP establishes means to assess the actual performance of communication and surveillance services in a particular airspace prior to operational implementation of associated ATM operations. In addition to ensuring that the ANSP adheres to the guidelines of section 4.3.1, the ANSP should determine that the actual performance within the applicable airspace complies with the RCP/RSP specification.

4.2.2.2 The State should also ensure that the ANSP performs ATM operations predicated on RCP/RSP specifications in the applicable airspace only to aircraft operators that file the appropriate PBCS capability in the flight plan, in accordance with section 4.4.

4.2.2.3 To determine compliance in the applicable airspace, the State should obtain a sufficient sample from the applicable airspace of the actual communication performance (ACP) of relevant communication transactions and actual surveillance performance (ASP) of surveillance data delivery measured against RCP/RSP time values, and apply the following criteria:

a) time values associated with nominal continuity criterion (95 per cent):

   1) ACP should meet RCP transaction time (TT) value at the nominal continuity criterion; and

   2) ASP should meet RSP delivery time (DT) value at the nominal continuity criterion.

b) time values associated with operational continuity criterion (see Note 1):

   1) ACP should meet RCP expiration time (ET) value at the operational continuity criterion; and

   2) ASP should meet the RSP overdue time (OT) value at the operational continuity criterion; or

3) if ACP or ASP does not meet the operational continuity criteria, the State may determine that the performance is acceptable from an ANSP's local safety assessment, taking into account the significance of the impact on operations within the relevant ATS unit(s).

*Note 1.— While RCP 240, RCP 400, RSP 180 and RSP 400 specify operational continuity criteria of 99.9 per cent, early implementations of PBCS for CPDLC and ADS-C have indicated that an operational continuity of 99 per cent is acceptable. However, as ATM operations become more dependent on communication and surveillance performance, the operational continuity may need to be more stringent.*

*Note 2.— The time values for operational continuity provide values for when the ATS unit takes appropriate action when alerted by the ATS system that the relevant communication transaction was not completed or surveillance data was not delivered. The actual operational continuity determines how often the ATS unit is alerted when an operational response to an ATC instruction has not yet been received, or when a surveillance data report is considered overdue. The local safety assessment would determine the impact which the frequency of these alerts has on operations within the ATS unit.*

c) service availability:

1) actual availability measurements should meet the RCP/RSP availability criteria for safety; or

2) if actual availability measurements do not meet the RCP/RSP availability criteria for safety, the State may determine performance is acceptable only by taking into account the ANSP's assessment of the impact on operations within the relevant ATS unit(s).

*Note 3.— If the operational continuity or service availability criteria are not met, a local safety assessment to determine appropriate mitigation and/or action may take into account local factors. Local factors include, for example, whether a reduced separation minimum predicated on an RCP/RSP specification is being applied between pairs of suitably-equipped aircraft or within an organized track system, frequency of application of the ATM operation, route structure, traffic density, loading conditions of the communication and surveillance capability, alternative means of communication and surveillance capability available, and contingency procedures.*

4.2.2.4 The State should ensure that the ANSP establishes a means to notify the operator and the State of the Operator or the State of Registry when the actual performance of the operator's fleet, taking into account different aircraft types/systems, does not comply with an RCP/RSP specification (refer to 4.5.3.11).

4.2.2.5 The State should ensure that the ANSP establishes a means to assess the risk of any non-compliance with the RCP/RSP specification and take appropriate action to correct the related deficiency and provide notification, as appropriate.

4.2.2.6 If the non-compliance cannot be satisfactorily corrected, the ANSP may continue to provide communication and surveillance services, but cease any ATM operation predicated on the RCP/RSP specification in the relevant airspace or as appropriate (e.g. cease an ATM operation involving a particular aircraft operator or an aircraft type/system within an operator's fleet).

### 4.2.3 State safety oversight of an aircraft operator

4.2.3.1 Annex 6, Parts I, II and III requires States to ensure that an aircraft operator meets the requirements prescribed in the RCP and RSP specifications for PBCS operations. However, there are no provisions for applying a specific approval to PBCS operations at this time.

4.2.3.2 The State of the Operator is required to approve an aircraft operator for flight operations where an RCP/RSP specification for PBCS is prescribed. In approving these operations, the State of the Operator should review the operator's documentation to ensure that it includes:

a) normal and abnormal procedures including contingency procedures;

b) flight crew qualification and proficiency requirements, in accordance with appropriate RCP/RSP specification(s);

c) a training programme for relevant personnel consistent with the intended operations; and

d) appropriate maintenance procedures to ensure continued airworthiness, in accordance with the appropriate RCP/RSP specification(s).

4.2.3.3 For general aviation, the State of Registry is required to establish the criteria which an aircraft operator/owner is required to meet in order to conduct PBCS operations. These criteria include requirements, procedures, and programmes, as listed in 4.2.3.1, that the aircraft operator/owner needs to establish. A general aviation operator/owner is approved for these operations as long as the established criteria are followed.

4.2.3.4 The State of the Operator or the State of Registry should ensure that the aircraft operator establishes means to assess the actual performance of its fleet. In addition to ensuring that the aircraft operator adheres to the guidelines of section 4.3.4, the State of the Operator or the State of Registry should determine that the actual performance of specified aircraft types/systems in the aircraft operator's fleet complies with the RCP/RSP specification.

4.2.3.5 To determine compliance, the State of the Operator or the State of Registry should obtain a sufficient sample from different aircraft types/systems, in the aircraft operator's fleet of the ACP, of relevant communication transactions and ASP of surveillance data delivery measured against RCP/RSP time values, and apply the following criteria:

a) time values associated with nominal continuity criterion (95 per cent):

   1) ACP should meet the RCP transaction time (TT) value associated with the nominal continuity criterion; and

   2) ASP should meet the RSP delivery time (DT) value associated with the nominal continuity criterion.

b) time values associated with operational continuity criterion (see Note below):

   1) ACP should meet the RCP expiration time (ET) value associated with the operational continuity criterion; and

   2) ASP should meet the RSP overdue time (OT) value associated with the operational continuity criterion; or

   3) if ACP or ASP does not meet the operational continuity criteria, the State of the Operator or the State of Registry may determine that the performance is acceptable, based on a local safety assessment by the ANSPs in control of the airspace in which the aircraft operator operates (see 4.2.2.2).

*Note.— While RCP 240, RCP 400, RSP 180 and RSP 400 specify operational continuity criteria of 99.9 per cent, early implementations of PBCS for CPDLC and ADS-C have indicated that an operational continuity of 99 per cent is acceptable. However, as ATM operations become more dependent on communication and surveillance performance, the operational continuity may need to be more stringent.*

4.2.3.6 If the relevant PBCS monitoring programme provides notification that a particular aircraft operator does not comply with the RCP/RSP specification, the State of the Operator or the State of Registry should provide the aircraft operator with information on the non-compliance and corrective action with a predetermined timeframe based on the severity of the deficiency and magnitude of the solution.

*Note.— The relevant PBCS monitoring programme would provide such notification, in accordance with 4.5.3.11, after the non-compliance and recommended action has been confirmed with the aircraft operator that participated in the investigation.*

4.2.3.7 If the non-compliance cannot be corrected within the timeframe specified, the State of the Operator or the State of Registry may allow the aircraft operator to continue to use the communication and surveillance capabilities, but should restrict the aircraft operator from filing RCP/RSP capability and participating in ATM operations predicated on the RCP/RSP specification.

4.2.3.8 The State of the Operator or State of Registry should establish a means to verify that aircraft operators filing PBCS capabilities in the flight plan are authorized, as appropriate.

*Note.— Operational approval status is maintained by regional monitoring programmes for reduced vertical separation minimum (RVSM) and performance-based horizontal separation minima. Guidelines for these monitoring programmes can be found in the* Manual on Implementation of a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive *(Doc 9574), the* Manual of Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the Use of a 300 m (1 000 ft) Vertical Separation Minimum above FL 290 *(Doc 9937) and the* Manual on Monitoring the Application of Performance-based Horizontal Separation Minima *(Doc 10063).*

## 4.3 INITIAL COMPLIANCE DETERMINATION AND RELATED APPROVALS

### 4.3.1 Air navigation services provision

4.3.1.1 The ANSP should ensure that the following is in place for PBCS operations:

a) an ATS system, comprising communication services, procedures, personnel training and qualification, and service provision approval;

b) the establishment of local and regional PBCS monitoring programmes; and

c) notification of ATM operations-related aircraft operator requirements, including compliance with appropriate RCP and RSP specifications.

4.3.1.2 The ANSP should also ensure a validation process confirming that the system and its procedures meet capability and performance requirements, in order to support PBCS operations. This process should include:

a) a system safety assessment, including a functional hazard analysis, demonstrating that the service provision meets the safety objectives. This assessment should:

1) identify failure conditions;

2) assign levels of criticality;

3) determine probabilities for occurrence; and

4) identify mitigating measures;

b) a design evaluation, demonstrating that the ATS system complies with the RCP/RSP specification by providing the necessary functionality, performance, human-machine interface, including controls, displays and alerts;

c) configuration management, demonstrating that the operational system, including network and/or frequency management, priority selection criteria of subnetworks, and changes to the system, continues to meet the RCP/RSP specification;

d) integration testing and operational trials of sufficient duration, confirming interoperability, and that performance is acceptable for the ATM operation predicated on the RCP/RSP specification; and

e) confirmation that ATS operation manuals are compatible with those of adjacent providers, where applicable.

4.3.1.3 The ANSP should also establish procedures to ensure the notification and mitigation of identified failure conditions, including failure conditions within its aeronautical stations, ATS units, and CSPs, taking into account local factors and other mitigating circumstances, such as:

a) the ATS unit's capability to apply specific ATM operations, predicated on a prescribed RCP/RSP specification, only to eligible aircraft and operators;

*Note.— In cases where an aircraft operator does not meet a more stringent prescribed RCP/RSP specification (e.g. RCP 240/RSP 180) for its communication and surveillance capabilities to support a specific ATM operation, the ANSP may find it useful to continue to allow the aircraft operator to use those capabilities in the applicable airspace for other ATM operations not dependent on the more stringent RCP/RSP specification, and consistent with 4.2.3.4.*

b) the ATS unit's capability to take appropriate action when alerted that:

1) a relevant communication transaction was not completed by the expiration time value specified by the RCP specification;

2) the surveillance data was not delivered by the overdue delivery time value specified by the RSP specification; and

3) an ATS system has failed for a significant portion of the flights in the applicable airspace (i.e. unexpected service outage).

4.3.1.4 The ANSP should establish procedures to restore operations after a failure condition is rectified.

4.3.1.5 The ANSP should ensure that contracted services, such as with CSPs and aeronautical stations, are bound by contractual arrangements stipulating the RCP/RSP allocations, including any monitoring or recording requirements, and the guidelines of section 4.3.2.

4.3.1.6 The ANSP should also ensure that its air traffic controllers and aeronautical station operators receive appropriate training in accordance with ICAO Annex 1.

4.3.1.7 The ANSP should establish the following, subject to a bilateral, multilateral or regional air navigation agreement, if applicable:

a) a local PBCS monitoring programme, to ensure that the communication and surveillance capabilities in the airspace applicable to its ATS units continue to meet the RCP/RSP specification, and to coordinate monitored data, analysis and corrective action; and

b) in cooperation with the other ANSPs within the region, a regional PBCS monitoring programme to assess regional performance and exchange the results of PBCS monitoring programmes regionally and globally.

*Note.— Guidelines for PBCS monitoring programmes are provided in section 4.5.*

4.3.1.8 The ANSP should notify aircraft operators in the AIP (or equivalent publication) of PBCS operations and include, as a minimum:

a) requirements for aircraft systems, capabilities, and also participation in PBCS monitoring programmes, in accordance with section 4.3.3; and

b) flight plan filing requirements in accordance with section 4.4.

### 4.3.2 Communication services provision

4.3.2.1 The CSP should provide services that meet the RCP/RSP allocations provided in the specifications. These allocations are used to establish contractual arrangements, which support safety oversight and approval of both ANSP and the aircraft operator for provision and use of the services, respectively.

4.3.2.2 The CSP should ensure that the services it provides adhere to the contractual arrangements, which include:

a) RCP/RSP allocations, as contained in the appropriate RCP/RSP specification(s); and

b) notification to ATS units, aircraft operators and others, as appropriate, of any failure condition that may impact PBCS operations.

4.3.2.3 When a CSP holds a contract with an aircraft operator, but not with ATS units for airspace in which the aircraft operator operates, that CSP should also notify the appropriate the ATS units of any failure condition that may impact the aircraft operator's PBCS operations.

4.3.2.4 The CSP should record and retain all communication and surveillance data, thereafter providing this data to ANSP and regional PBCS monitoring programmes upon request, when authorized by appropriate parties, in accordance with the contractual arrangements with the ANSP or aircraft operator.

### 4.3.3 Aircraft system

*Note 1.— The aircraft system is approved by the State of Design and/or State of Manufacture, which typically issues design, production and airworthiness certificates to an aircraft manufacturer or equipment supplier, in accordance with national regulations. However, national regulations often allow an aircraft operator to obtain the necessary certificates for equipment approval. In such cases, the guidelines in this section (4.3.3) would apply to the aircraft operator.*

*Note 2.— The PBCS requirements for aircraft system design concern its functionality, interoperability and performance in accordance with national airworthiness standards. There are no additional PBCS requirements concerning the production and airworthiness certificates other than those provided by national regulations. Certificates issued for design, production and airworthiness approval of the aircraft system do not constitute operational approval to use the system.*

4.3.3.1 The aircraft manufacturer or supplier should demonstrate that the aircraft system meets the RCP/RSP allocations.

*Note.— For a FANS 1/A CPDLC and ADS-C aircraft system, RTCA DO-306/EUROCAE ED-122 is equivalent to RCP 240, RCP 400, RSP 180 and RSP 400 specifications. For an ATN B1 or FANS 1/A CPDLC aircraft system, RTCA DO-290/EUROCAE ED-120 provides performance criteria for the EUR Region.*

4.3.3.2 The aircraft manufacturer or equipment supplier should also demonstrate that the aircraft meets the RCP/RSP integrity criteria and associated safety requirements. RCP/RSP integrity is typically shown by analysis, design, system architecture, and evaluations of HMI, taking into account flight crew training and qualification programmes instituted by the aircraft operator.

4.3.3.3 The aircraft manufacturer or supplier should demonstrate that the aircraft system meets the RCP/RSP availability criteria. RCP/RSP availability is typically shown by the evaluation of equipment failure and the number of similar components (redundancy) installed on the aircraft.

*Note.— For voice communication, the number and types of radios required may be specified by operating rules and airspace requirements (i.e. the AIP or equivalent publication).*

4.3.3.4 The aircraft manufacturer or supplier should demonstrate that the aircraft system, when operating with a representative ATS system (i.e. simulation or real ground system), is capable of meeting the operational RCP/RSP time and continuity criteria.

*Note.— It would be impractical to exhaustively demonstrate compliance at the aircraft system level.*

4.3.3.5 The aircraft manufacturer or supplier should demonstrate that the aircraft system provides the flight crew with alerts in case of aircraft system or connectivity failures, causing the aircraft to be incapable of meeting the RCP/RSP specification.

*Note.— Examples of alerts include failure of a particular communication means, definitive connectivity loss, or failure of the communication and/or surveillance functions. There is no consolidated RCP/RSP capability directly displayed to the flight crew. Appropriate procedures and flight crew training associated with the alerts ensure continued compliance with PBCS operations.*

4.3.3.6 The aircraft manufacturer or equipment supplier should identify any specific items related to PBCS capability in the master minimum equipment list (MMEL).

4.3.3.7 The aircraft manufacturer or equipment supplier should identify the demonstrated PBCS capability of the aircraft, any associated operating limitations, information and procedures, in the flight manual.

### 4.3.4 Aircraft operator eligibility

4.3.4.1 The aircraft operator should meet the requirements established by the State of the Operator or State of Registry to be eligible for PBCS operations as described in 4.2.3. The aircraft operator should consider the guidance in this section (4.3.4) as it applies to flight crew training and qualification, the aircraft system, MEL, continued airworthiness, user modifiable software and CSP service agreements.

4.3.4.2 The aircraft operator should ensure that procedures are established and the flight crews and other personnel (e.g. aircraft maintenance, flight operations officer/flight dispatcher) are trained and qualified for PBCS operations. The flight crew procedures and training should include normal operations, as well as those associated with alerts provided by the aircraft system to indicate failures when the aircraft is no longer capable of meeting the RCP/RSP specification prescribed for the associated ATM operations.

4.3.4.3 The aircraft operator should ensure that contracted services, such as those with CSPs, are bound by contractual arrangements stipulating the RCP/RSP allocations, including any monitoring or recording requirements, and the guidelines of section 4.3.2.

4.3.4.4 The aircraft operator should ensure that contractual arrangements include a provision for the CSP to notify the appropriate ATS units for the route system of the aircraft operator in case failure conditions impact PBCS operations.

*Note.— This provision ensures appropriate ATS units are notified in cases when the ANSP does not have a contractual arrangement with a particular CSP, and services are provided through internetworking among CSPs/SSPs.*

4.3.4.5 The aircraft operator should ensure that the aircraft system has been approved for the intended use, in accordance with the appropriate RCP/RSP specification(s) and guidelines provided in section 4.3.3.

4.3.4.6 The aircraft operator should ensure that the aircraft system is properly maintained, including configuring user-modifiable software, such as those used to manage communication media and routing policies, to meet the appropriate RCP/RSP specification(s).

4.3.4.7 The aircraft operator should participate in local and regional PBCS monitoring programmes, which are applicable to the aircraft operator's route system, and should provide the following information to the appropriate PBCS monitoring entities specified in AIPs (or equivalent publications):

a) operator name;

b) operator contact details; and

c) other coordination information.

4.3.4.8 The aircraft operator should advise the appropriate PBCS monitoring entities of any changes to the information listed in 4.3.4.7.

4.3.4.9 The aircraft operator should establish procedures to report problems, identified either by the flight crew or other personnel, to the appropriate PBCS monitoring entities associated with the route of flight on which the problem occurred.

4.3.4.10 The aircraft operator should ensure procedures are established for the timely disclosure and delivery of operational data, including data from its CSPs/SSPs, to the appropriate PBCS monitoring entity when requested for the purposes of investigating a reported problem.

## 4.4 FLIGHT PLAN REQUIREMENTS

4.4.1 When filing RCP/RSP capabilities, the aircraft operator should ensure that the planned use of associated communication and surveillance capabilities for the flight will be in accordance with regulations, policies and procedures in control areas for the flight, as published by the applicable States in their AIPs (or equivalent publications).

*Note.— RCP/RSP capabilities are inserted only when the descriptors J2 through J7 for CPDLC, M1 through M3 for SATVOICE, and/or D1 for ADS-C, are also inserted. While RCP/RSP capability denotes performance,*

*the descriptors J2 through J7, M1 through M3 and D1 in item 10 (see Table 4-1) denote the interoperability for the aircraft equipment. Guidance on filing J2 through J7 and D1 descriptors is contained in Doc 10037. Guidance on filing M1 through M3 descriptors is contained in Doc 10038.*

4.4.2 The aircraft operator should ensure that the proper denotation of PBCS capabilities are included in the ICAO flight plan.

*Note 1.— Refer to ICAO Doc 4444, 4.4.1.4 and Appendix 2, for flight plan requirements.*

*Note 2.— The inclusion of PBCS capability in the filed flight plan indicates that the relevant aircraft equipment is approved and serviceable, and that the operator is eligible (e.g. flight crew training and qualification) to use the equipment for PBCS operations. If these conditions are not met, PBCS capability should not be included in the flight plan. Refer to 4.3.4 for guidance on operator eligibility for PBCS operations*.

4.4.3 In Item 10 of the flight plan, the aircraft operator should insert one or more descriptors, as appropriate, listed in Table 4-1, to identify an aircraft's RCP capability:

**Table 4-1. Descriptors for RCP capability in flight plan — Item 10**

| *Item 10a — Radio communication, navigation and approach aid equipment and capabilities* | *Descriptor* |
|---|---|
| CPDLC RCP 400 | P1 |
| CPDLC RCP 240 | P2 |
| SATVOICE RCP 400 | P3 |
| (reserved) | P4 |
| (reserved) | P5 |
| (reserved) | P6 |
| (reserved) | P7 |
| (reserved) | P8 |
| (reserved) | P9 |

4.4.4 In Item 18 of the flight plan, the aircraft operator should file the RSP capability by inserting the indicator SUR/ followed by the appropriate designator, with no spaces, for the RSP specification (e.g. RSP400 or RSP180).

*Note.— The ATS unit uses the flight plan information to determine when to apply particular ATM operations that are dependent on the capability and to configure the system (e.g. set timer threshold values) for efficient operation when required communication and/or surveillance performance varies.*

## 4.5 CONTINUED OPERATIONAL COMPLIANCE — PBCS MONITORING PROGRAMMES

*Note.— This section provides general guidelines for local and regional PBCS monitoring programmes. Guidelines for monitoring CPDLC and ADS-C are provided in Appendix D, and guidelines for monitoring SATVOICE are provided in Appendix E.*

### 4.5.1 Administering PBCS monitoring programmes

4.5.1.1 While the RCP/RSP specification provides subsystem allocations to support the initial compliance processes, ANSPs should establish local and regional PBCS monitoring programmes to monitor actual performance against the operational (end-to-end) criteria provided in the RCP/RSP specification, and take any necessary action to resolve unacceptable performance.

*Note — Guidance for a local (ANSP) PBCS monitoring programme is provided in section 4.5.2. Guidance for a regional PBCS monitoring programme is provided in section 4.5.3.*

4.5.1.2 The ANSPs should identify the entity and focal point(s) for administering the regional PBCS monitoring programme to manage a regional problem-reporting system and provide regional level analysis and reporting of ANSP-monitored performance.

4.5.1.3 The ANSPs should consider combining the PBCS monitoring programmes with other monitoring programmes, particularly those established on the basis of a bilateral, multilateral or regional air navigation agreement, such as for monitoring RVSM, performance-based horizontal separation minima, and safety of ATM operations.

*Note.— Guidance on monitoring programmes for RVSM is provided in Doc 9574 and Doc 9937. Guidance on monitoring programmes for horizontal separation minima is provided in Doc 10063.*

4.5.1.4 The ANSPs should establish the policies and procedures for administering the regional PBCS monitoring programmes, including:

a) formats and intervals of ANSP-monitored data provided to the regional PBCS monitoring programme;

b) the extent to which the PBCS monitoring programme will manage problem reports, maintain data, and support analysis of ANSP-monitored data; and

c) formats and intervals of reports provided by the PBCS monitoring programme to the ANSPs and other participants.

4.5.1.5 When administering the PBCS monitoring programmes, the ANSPs should take into consideration the following:

a) collect, monitor and analyse data, investigate problem reports, coordinate corrective actions. Additionally, for regional PBCS monitoring programmes, global exchange of their monitoring result should be considered.

b) report, track and resolve internal problems in accordance with local policies and procedures and to report problems to the regional PBCS monitoring programme;

c) collect other data and monitor other characteristics where beneficial, or to support other regional monitoring programmes (4.5.1.3 refers), such as the frequency of use for specific message types, proportion of flights using CPDLC, ADS-C and SATVOICE services, and the aircraft operators and proportion of flights that file RCP/RSP capabilities in the flight plan.

d) use similar monitoring and analysis methods; however, the sample of data monitored and used in the analysis will vary and the local PBCS monitoring programme may be more comprehensive than the regional PBCS monitoring programme;

*Note.— For example, the local PBCS monitoring programme may use a data sample that is filtered from the data collected from the ANSP's operational system, to include only certain communication transactions or surveillance data through a particular routing path, from a particular aircraft operator, aircraft type or individual aircraft. The regional PBCS monitoring programme may only provide an aggregate result from similar summary information provided by each of the ANSPs within the region.*

e) monitor actual performance against the operational and technical criteria for RCP transaction time, RSP surveillance data delivery time, RCP/RSP continuity and RCP/RSP availability. RCP/RSP integrity, which is shown during initial subsystem approval processes, is not monitored, although routine analysis of operational data and problem reports could reveal undetected errors and their effects as a consequence of a problem requiring corrective action;

f) measure the performance of a particular subsystem against its RCP/RSP allocations. These measurements can facilitate the identification and resolution of problems, on a case-by-case basis, when actual performance has degraded below the operational (end-to-end) criteria specified in the RCP/RSP specification; and

g) apply the guidelines indicated in 4.2.2.2, to determine a successful operation (i.e. compliance with an RCP/RSP specification) within the applicable airspace, and in 4.2.3.5 for a specific aircraft operator. Additionally, PBCS monitoring programmes should further investigate any performance degradation measured from a sample of data within a specified time interval (e.g. 0.5 per cent per month) when compared to the measured sample performance of similar data from previous time intervals.

### 4.5.2 Local PBCS monitoring programme

4.5.2.1 After an ATM operation predicated on the RCP/RSP specification becomes operational, the ANSP should ensure that the communication and surveillance systems continue to operate successfully as a whole, to ensure efficient and safe operations.

4.5.2.2 The ANSP should establish means to collect and maintain operational performance data in the standardized data formats defined in Appendix D for CPDLC and ADS-C and Appendix E for SATVOICE.

*Note.— While the ANSP develops the data collection mechanisms, monitoring tools, and internal reporting requirements that best suit their particular environment, the data formats provide a consistent means to aggregate performance monitoring data on a regional and global basis. This aggregation of performance data is in accordance with the guidelines provided in the* Manual on Global Performance of the Air Navigation System *(Doc 9883).*

4.5.2.3 To determine continued operational compliance, the ANSP should monitor communication and surveillance capabilities in the applicable airspace to detect and correct performance degradations due to potential instabilities or variations in overall system performance, or changes to any of the various subsystems.

4.5.2.4 The ANSP should also be the entity to perform local analysis, as it possesses the necessary operational expertise, local area knowledge and control, when identifying problems and taking corrective action.

4.5.2.5 The ANSP should determine the extent to which these capabilities are monitored (i.e. what to monitor and the interval for producing the monitoring results). As a minimum, the ANSP should monitor ACP for relevant communication transactions and ASP for surveillance data delivery collectively for the airspace concerned, as well as on the basis of other factors affecting the stability of communication or surveillance performance, such as:

a) various infrastructure and technological dependencies (e.g. subnetwork types, subnetwork routing policies, frequencies); and

b) different aircraft operators, different aircraft types/systems or individual aircraft.

4.5.2.6 The ANSP should perform an analysis of ACP and ASP at an interval suitable to verify system performance, and enable continuous performance improvement by detecting where specific infrastructure, aircraft operator fleet, aircraft type, or individual aircraft is not meeting the RCP/RSP specification.

*Note.— Typically, an ANSP will conduct its analysis on data taken at monthly intervals. However, the specific interval will depend on local factors, such as volume of data accumulated and confidence level in the stability of performance over time.*

4.5.2.7 The ANSP should also perform an analysis of service availability at an interval suitable to verify the acceptable number and duration of unplanned service outages affecting a significant portion of flights in the applicable airspace.

4.5.2.8 The ANSP should report to the regional PBCS monitoring programme any problems that may have a regional or global impact, or affect aircraft operators in its airspace, including any non-compliance with an RCP/RSP specification.

### 4.5.3 Regional PBCS monitoring programme

4.5.3.1 The regional PBCS monitoring programme should provide flexible services and centralized support to accommodate specific local, regional and global needs. Figure 4-1 provides an overview of the regional PBCS monitoring programme.

4.5.3.2 The regional PBCS monitoring programme should manage resources and any contracts, fund and recover costs, and secure access to services and information.

4.5.3.3 The regional PBCS monitoring programme should establish a process that authorizes users, such as ANSPs, aircraft operators, CSPs, aircraft manufacturers, equipment suppliers and other participants, to submit or access information. This process may include issuing a user ID and password associated with a unique security profile to users requesting an account. This would ensure that each user is authorized to submit or access information. For example, a user may:

a) submit problem reports and other ANSP-monitored information (e.g. summary reports or PBCS CSV data files, as necessary);

b) submit other data supporting the problem investigation and analysis;

c) access relational databases which provide information specific to an operator, aircraft type, ANSP, CSP or message type; and

d) access standardized reports, such as status reports for management, civil aviation authorities (CAAs) or regional groups on an as-needed basis.

4.5.3.4 The regional PBCS monitoring programme should validate submitted data before importing it into a secure centralized database and desensitize reports consistent with non-disclosure and security policies established for defining the security profile of authorized users.

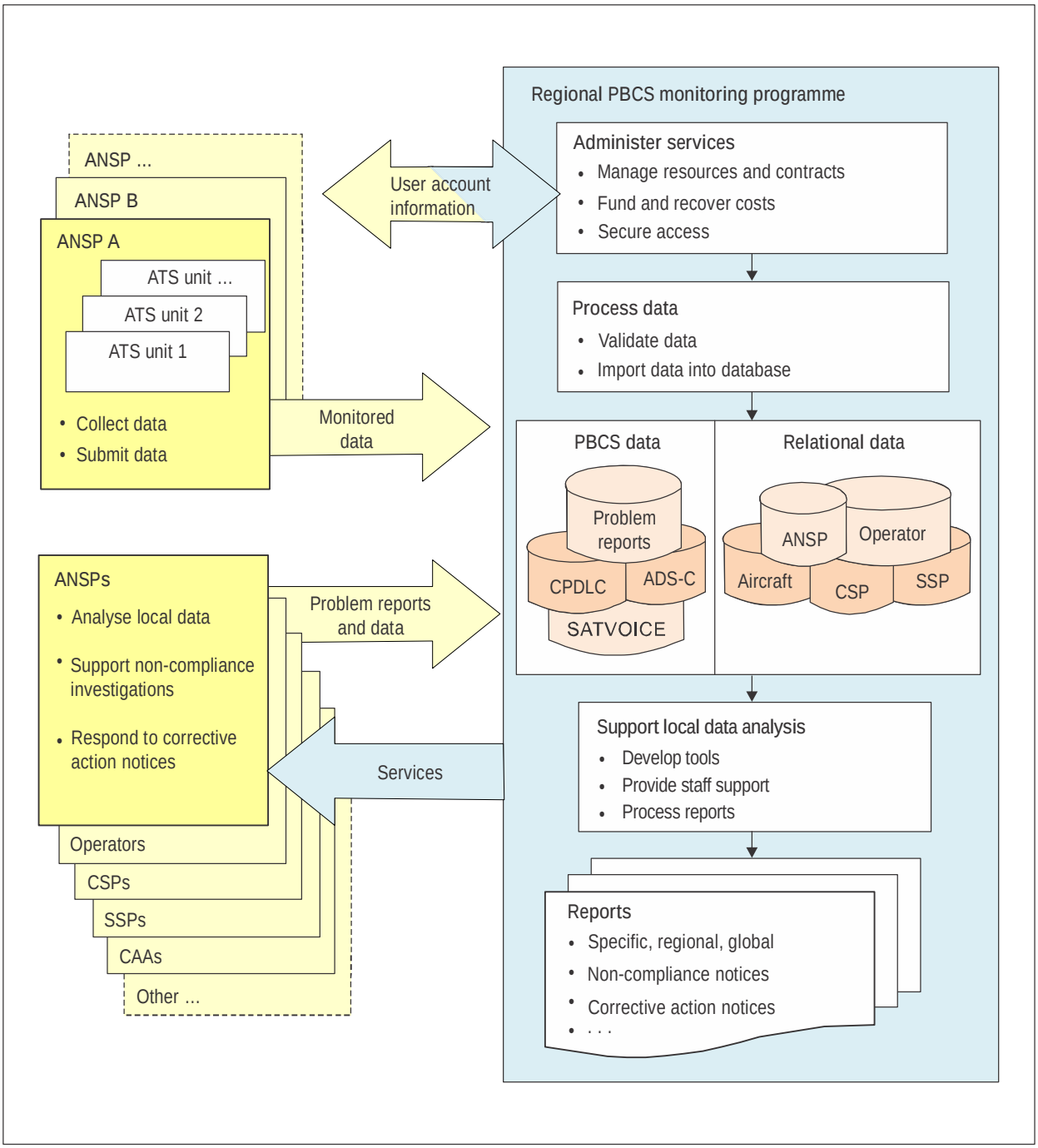



**Figure 4-1. Regional PBCS monitoring programme overview**

4.5.3.5 The regional PBCS monitoring programme should maintain relational data, such as related to the ANSP, CSP, aircraft type and aircraft operator.

4.5.3.6 The regional PBCS monitoring programme should provide a forum for users to develop and share tools, in order to facilitate the conduct of a specific analysis on selected data or to automatically query a database and send non-compliance and corrective action notices to appropriate parties.

4.5.3.7 The regional PBCS monitoring programme should provide staff support to assist ANSPs and other participants to investigate problems and conduct local and regional analyses.

4.5.3.8 The regional PBCS monitoring programme should manage problem reports, including:

a) provide a means to receive, track and manage problem reports (e.g. web-based service);

b) request data from relevant sources;

c) coordinate the problem investigation and assign appropriate entities to assist in the analysis;

d) provide a diagnosis of the problem and recommend resolutions; and

e) inform the originator of the problem report on status and closure of the problem.

4.5.3.9 The regional PBCS monitoring programme should support participating ANSPs in the analysis and reporting of operational data, including ACP, ASP and availability data, at the regional level. Support activities include:

a) coordinate, as requested by the participating ANSPs, the analysis of degraded performance and availability issues most common within the region or globally; and

b) produce regional PBCS monitoring reports in accordance with established procedures for receiving ANSP-monitored information and report formats provided by the participating ANSPs;

*Note.— When the regional PBCS monitoring programme is established, the participating ANSPs determine the extent to which the regional PBCS monitoring programme receives monitoring information and supports any regional analysis of monitored information.*

4.5.3.10 The regional PBCS monitoring programme should coordinate, as necessary, with other regional monitoring programmes, such as those established for monitoring RVSM, performance-based horizontal separation minima, and safety of ATM operations. (See relevant guidance material in the *Manual on Implementation of a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive* (Doc 9574), the *Manual of Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the Use of a 300 m (1 000 ft) Vertical Separation Minimum above FL 290* (Doc 9937) and the *Manual on Monitoring the Application of Performance-based Horizontal Separation Minima* (Doc 10063).)

4.5.3.11 The regional PBCS monitoring programme should notify appropriate parties when the operational system does not meet the RCP/RSP specification, including:

a) the relevant ANSP, when the non-compliance concerns a subsystem of the infrastructure, including the CSP, under its control; and

b) the relevant operator and the State of the Operator or the State of Registry when the non-compliance concerns the operator, or any aircraft type or individual aircraft within its fleet.

*Note.— Typically, means to notify the State of the Operator or the State of Registry will be conducted via the regional PBCS monitoring programme to which the relevant State is assigned. If the relevant State is not assigned to a regional PBCS monitoring programme, then the regional PBCS monitoring programme that originated the non-compliance action would contact the State directly.*

4.5.3.12 The regional PBCS monitoring programme should coordinate the global exchange of monitoring information in accordance with the guidelines provided in section 4.5.4.

### 4.5.4 Global exchange of monitoring information

4.5.4.1 The RCP and RSP specifications provide global criteria for communication and surveillance capabilities supporting ATM operations. In many cases, the RCP and RSP specifications are applicable to commercially owned and operated global systems providing services for aviation, maritime, land-mobile and military purposes. For example, application of a 30 NM longitudinal separation minimum depends on acceptable levels of performance from satellite systems and global networks.

4.5.4.2 These systems and global networks supporting ATM operations are complex and require oversight of system components to ensure that the operational system performs in accordance with RCP and RSP specifications. In addition, when one region experiences a problem and resolves it, exchanging this information globally will be more efficient than if another region has to conduct its own investigation to determine the cause and resolution of a similar problem.

4.5.4.3 Local and regional PBCS monitoring conducted in accordance with the guidelines set forth in this manual will allow for the sharing of analytical tools and ensure consistent results for comparative analysis.

4.5.4.4 The regional PBCS monitoring programme in one region should exchange the following information with the regional PBCS monitoring programme in other regions:

a) lessons learned from PBCS implementation and operations;

b) analytical tools that can be shared for conducting analysis of ACP and ASP;

c) a list of aircraft operators currently filing RCP/RSP designators in their flight plan; and

d) a list of known problems, including those with particular networks, components of a network, aircraft types/systems, or aircraft operators, and associated resolutions.

*Note.— Any of the information maintained by a regional PBCS monitoring programme, as described in section 4.5.3, may be of interest to other regional or local PBCS monitoring programmes. A local PBCS monitoring programme acting on its own within a region may also exchange information with other local and regional PBCS monitoring programmes.*

# Appendix A

# PBCS IMPLEMENTATION PLAN — CHECKLIST

The checklist in Table A-1 should be used as a guide for planning the implementation of any performance-based communication and surveillance (PBCS) operation. The checklist is organized as follows:

Group A tasks — State/region preparation;

Group B tasks — air navigation services provider (ANSP) general project development and management;

Group C tasks — ANSP implementation activities – air traffic services (ATS) provision;

Group D tasks — Aircraft operator, aircraft type/system (airworthiness) eligibility; and

Group E tasks — All stakeholders – post-implementation monitoring.

**Table A-1. Checklist for PBCS implementation plan**

| *Task ID* | *Task descriptor* | *Task detail* | *Reference(s)* |
|---|---|---|---|
| *Group A tasks — State/region preparation* | | | |
| A-1 | Aeronautical Information Publication (AIP) — prescription of a required communication performance (RCP)/RSP specification(s) | Prescribe the appropriate RCP/RSP specification(s) in the AIP (or equivalent publication). If applicable, common AIP language may be based on a bilateral, multilateral or regional air navigation agreement. | Chapter 3 |
| A-2 | ANSP — PBCS policies, objectives supporting safety oversight | Identify means to apply RCP/RSP specification(s) and criteria for initial and continued compliance, including:<br>a) ATS provision requirements, and requirements for ATS unit's system and communication services provider (CSP) service agreements, if applicable;<br>b) flight plan requirements; and<br>c) monitoring, alerting and reporting requirements. | Chapter 4<br>Section 4.2.1<br>Section 4.2.2 |
| A-3 | Operator and aircraft | Identify means to determine aircraft operator eligibility | Chapter 4 |

| *Task ID* | *Task descriptor* | *Task detail* | *Reference(s)* |
|---|---|---|---|
| | system — PBCS policies, objectives supporting safety oversight | requirements for PBCS operations, including requirements for operations, maintenance, aircraft system and CSP service agreements, if applicable:<br><br>a) establish State airworthiness requirements;<br><br>b) establish policy/procedures and criteria for operational approval;<br><br>c) prepare State inspectors to perform tasks for operational approval;<br><br>d) develop a plan to issue operational approval to national operators. Train pilots and, if applicable, dispatchers on PBCS operations; and<br><br>e) develop and distribute operations manuals, pilot bulletins or other appropriate documents containing PBCS policy and/or procedures.<br><br>*Note.— The State of the Operator identifies means for commercial air transport operations. The State of Registry identifies means for general aviation operations. The State of Design identifies means for design approval of the aircraft system.* | Section 4.2.1<br>Section 4.2.3 |
| A-4 | *Regional Supplementary Procedures* (Doc 7030) for PBCS operations, if applicable. | On behalf of a region, a State may develop a proposed amendment to the *Regional Supplementary Procedures* (Doc 7030), if applicable. | Chapter 3<br>Chapter 4 |
| *Group B tasks — ANSP general project development and management* | | | |
| B-1 | PBCS implementation plan | Establish a PBCS implementation team and prepare a plan outlining the tasks. Include interdependencies between tasks, completion date of task, lead point of contact and any coordination required. | State/region-specific – this appendix serves as a guide |
| B-2 | Target dates for PBCS and relevant ATM operations | Identify key target dates for PBCS implementation, while supporting specified ATM operation(s) and the tasks identified in the plan. | State/region specific |
| B-3 | RCP and RSP specifications | Identify and confirm applicable RCP and RSP specifications to be used for the operational implementation of communication and surveillance capabilities supporting specified ATM operation(s). Existing RCP and RSP specifications may be appropriate for a new ATM operation predicated on RCP and RSP specifications (e.g. application of performance-based | Chapter 3<br>Appendix B<br>Appendix C |

| *Task ID* | *Task descriptor* | *Task detail* | *Reference(s)* |
|---|---|---|---|
| | | separation minimum), or when implementing an emerging technology to provide a communication or surveillance capability (e.g. SATVOICE) supporting an existing ATM operation. If a new RCP or RSP specification is needed, establish a task to coordinate with ICAO on the development of appropriate RCP/RSP specification(s) and update this manual. | |
| B-4 | PBCS awareness | Establish means to raise awareness on PBCS implementation in a particular region or airspace through workshops and distribution of information. Establish a planning team to work with ICAO and subject matter experts to develop relevant material. | Doc 9869<br>Doc 10037<br>Doc 10038 |
| *Group C tasks — ANSP implementation activities — ATS provision* | | | |
| C-1 | Operational concepts and procedures for PBCS operations | Develop operational concepts for the implementation of any ATM operation predicated on an RCP/RSP specification. Consider the following:<br><br>a) applicable ATM operation(s);<br><br>b) relevant interoperability requirements for communication and surveillance capabilities;<br><br>c) provisions for PBCS operations and appropriate RCP and RSP specifications;<br><br>d) operating procedures for PBCS operations;<br><br>e) operator/flight/flight crew and/or ATS unit/controller contingency procedures when system degrades below that required by RCP and RSP specifications; and<br><br>f) procedures for resuming specified ATM operation(s) after the system is restored to an acceptable level of performance. | Doc 9869<br>Doc 10037<br>Doc 10038 |
| C-2 | ATC automation changes to use flight plan RCP/RSP indicators | Implement changes, recognizing and using flight plan RCP/RSP indicators, in order to apply ATM operation(s) predicated on the RCP and RSP specifications only, to eligible operators/aircraft, and/or adapt other system parameters, if applicable (e.g. set timer threshold values), based on different performance levels).<br><br>This task should be completed prior to operational implementation of ATM operation(s) predicated on RCP and RSP specifications. | Chapter 4<br>Section 4.4 |
| C-3 | ATC automation changes for PBCS | Apply post-implementation monitoring capability in ATC automation. | Chapter 4<br>Section 4.5 |

| *Task ID* | *Task descriptor* | *Task detail* | *Reference(s)* |
|---|---|---|---|
| | monitoring | This task should be completed in order to obtain sufficient sampling confirming that ACP and ASP comply with RCP and RSP specifications prior to the implementation of specified ATM operation(s). | Appendix D<br>Appendix E |
| C-4 | Confirm initial ANSP compliance with RCP and RSP specifications | Prior to operational implementation, confirm that controller-pilot data link communications (CPDLC) and automatic dependent surveillance — contract (ADS-C) comply with RCP and RSP specifications:<br><br>a) measure actual performance against RCP and RSP specifications for compliance to support approval of ATS provision, including CSP service agreement, if applicable;<br><br>b) identify any aspect of service performance that is not compliant with the RCP and RSP specifications; and<br><br>c) take appropriate action to mitigate. | Chapter 4<br>Section 4.2.2<br>Section 4.3.1<br>Section 4.3.2<br>Appendix D<br>Appendix E |
| *Group D tasks — Aircraft operator, aircraft type/system (airworthiness) eligibility* | | | |
| D-1 | Aircraft operator readiness | Satisfy operator eligibility requirements for PBCS operations established by the State of the Operator or the State of Registry in Task A-3. This includes requirements for flight crew training and qualification, operations, maintenance, aircraft systems and CSP service agreements. | Chapter 4<br>Section 4.2.3<br>Section 4.3.2<br>Section 4.3.3<br>Section 4.3.4 |
| D-2 | Confirm initial operator and/or aircraft type/system compliance with RCP and RSP specifications | Prior to operational approval, confirm that CPDLC and ADS-C aircraft equipment and operator capabilities comply with RCP and RSP specifications:<br><br>a) measure actual performance against RCP and RSP specifications for compliance to support the initial approval of the operator, including aircraft system approval and CSP service agreement, if applicable;<br><br>b) identify any aspect of aircraft type/system and/or capability performance that is not compliant with the RCP and RSP specifications; and<br><br>c) take appropriate action to mitigate. | Chapter 4<br>Section 4.2.3<br>Section 4.3.2<br>Section 4.3.3<br>Section 4.3.4<br>Appendix D<br>Appendix E |

| *Group E tasks — All stakeholders — post-implementation monitoring* | | | |
|---|---|---|---|
| E-1 | PBCS monitoring — post-implementation | Ongoing post-implementation data collection, monitoring, problem reporting and tracking, analysis and corrective action.<br><br>When performance falls below specified levels, or problems are reported, operational judgment may be a consideration in determining appropriate actions. | Chapter 4<br>Section 4.5<br>Appendix D<br>Appendix E<br>Doc 9937<br>Doc 10063 |

# Appendix B

# RCP SPECIFICATIONS

## 1. GENERAL

1.1 Required communication performance (RCP) specifications are derived mainly from a safety assessment. However, in cases where it has been determined to be beneficial, the RCP specifications may include criteria to support the operational efficiency and orderly flow of air traffic. In these cases, the RCP specifications indicate the distinction between safety and efficiency.

1.2 In general, RCP specifications provide a means of compliance. Additional guidance related to service provision, aircraft approval and operational approval is in Chapter 4. Guidance and requirements on post-implementation monitoring is in Appendix D for controller-pilot data link communications (CPDLC) and automatic dependent surveillance — broadcast (ADS-B) and Appendix E for satellite voice communications (SATVOICE).

1.3 RCP specifications include allocations for CPDLC and SATVOICE via a radio operator. The /D designator is used to indicate the RCP allocations associated with CPDLC. The /$V_{RO}$ designator is used in this specification to indicate the RCP allocations associated with controller intervention via a radio operator, while the /$V_{ATC}$ designator is reserved for RCP allocations associated with controller intervention via direct controller-pilot communications (DCPC) . See Figure 2-2 for RCP allocations for CPDLC and SATVOICE via a radio operator.

1.4 RCP allocations are provided for SATVOICE when the intended use is to provide an intervention and/or surveillance capability in support of air traffic services that is subject to a specified RCP. The RCP allocations for SATVOICE communications are based on the operational performance criteria, for intervention capability. As it is difficult to compare the actual performance of different technologies, the RCP 400 operational performance criteria provides a common basis for assessing SATVOICE, CPDLC or any new technology that may emerge.

## 2. RCP 240 SPECIFICATION

| *RCP specification* | |
|---|---|
| *RCP specification* | *RCP 240* |
| *Airspace specific considerations* | |
| *Interoperability* | Specify interoperability criteria (e.g. FANS 1/A) |
| *ATM operation* | Specify ATM operation(s) (e.g. applicable separation standard) |
| *Application* | Specify controller-pilot ATC communication intervention capability (e.g. CPDLC application per Doc 4444, and RTCA DO-306/EUROCAE ED-122, Annex A) |

<table>
<tr><td colspan="4">RCP parameter values</td></tr>
<tr><td>Transaction time<br>(seconds)</td><td>Continuity<br>(C)</td><td>Availability<br>(A)</td><td>Integrity<br>(I)</td></tr>
<tr><td>ET = 240</td><td>C(ET) = 0.999</td><td rowspan="2">0.999<br><br>0.9999 (efficiency)</td><td rowspan="2">Malfunction = $10^{-5}$ per flight hour</td></tr>
<tr><td>TT = 210</td><td>C(TT) = 0.95</td></tr>
<tr><td colspan="4">RCP monitoring and alerting criteria</td></tr>
<tr><td>Reference</td><td colspan="3">Criteria</td></tr>
<tr><td>MA-1</td><td colspan="3">The system shall be capable of detecting failures and configuration changes causing the communication service to no longer meet the RCP specification for the intended function.</td></tr>
<tr><td>MA-2</td><td colspan="3">When the communication service can no longer meet the RCP specification for the intended function, the flight crew and/or the controller shall take appropriate action.</td></tr>
<tr><td colspan="4">Notes</td></tr>
<tr><td colspan="4">Note 1.— Rationale for the criteria provided in this specification can be found in Annex 11, Doc 4444, Doc 9689, and RTCA DO-306/EUROCAE ED-122.<br><br>Note 2.— The values for transaction times are to be applied to transactions representative of communication capability for the controller to intervene with a specific operator, aircraft type, and aircraft identification.<br><br>Note 3.— If changes are made to the system capacity limits, as specified by the airspace requirements, and the changes cause the system to perform below the RCP specification, this would be considered a change in system configuration.<br><br>Note 4.— RTCA DO-306/EUROCAE ED-122 specifies an availability value based on a safety assessment of the operational effects pertaining to the loss of the service. The availability value herein is more stringent, based on an additional need to maintain orderly and efficient operations.</td></tr>
</table>

## 2.1 RCP 240/D allocations

### 2.1.1 *General*

2.1.1.1 The RCP 240/D allocations are applicable to the controller intervention capability via CPDLC. Figure B-1 provides the RCP 240/D allocations associated with transaction time and continuity. The time taken for the controller to issue the instruction and receive the response is shown by analysis. Actual communication performance (ACP) is monitored from C to X. The remaining allocations support initial compliance and problem investigation when ACP does not meet the specified criteria.

2.1.1.2 The RCP 240/D allocations are shared by the air navigation services provider (ANSP), the communication services provider (CSP), the aircraft system and the aircraft operator. The descriptions and assignments for these allocations, as shown in Figure B-1, are provided in Table B-1.

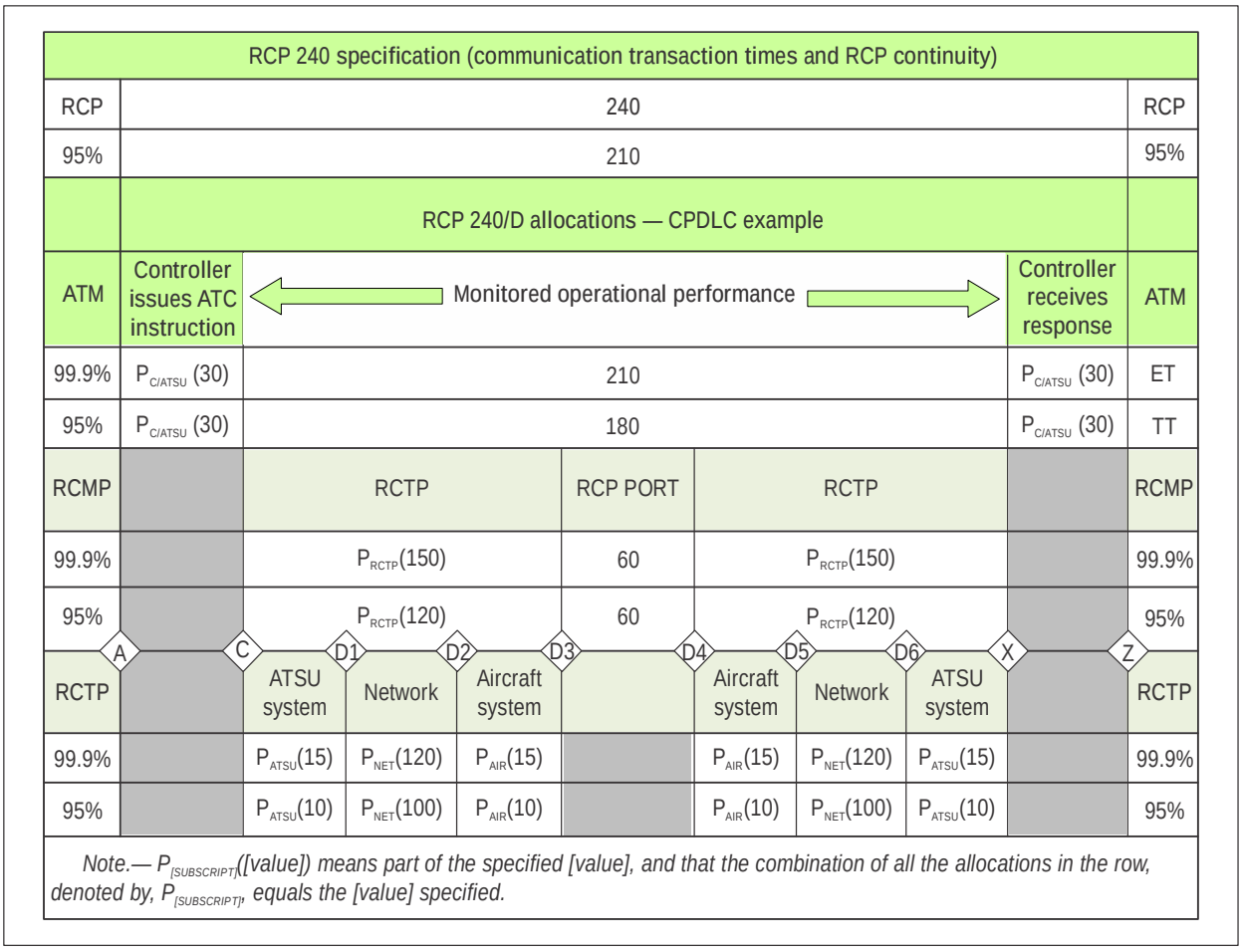



**Figure B-1. RCP 240/D allocations — communication transaction times and continuity**

**Table B-1. RCP 240/D allocation descriptions and assignments**

| *RCP 240/D allocations* | *Description* | *ANSP* | *CSP* | *Aircraft* | *Operator* |
|---|---|---|---|---|---|
| Controller (RCP initiator performance) | Maximum time allocated to the controller for the issuance of an ATC instruction and receipt of response. | X | | | |
| RCMP | Maximum time against which ACP is assessed. | X | X | X | X |
| RCP PORT | Maximum time allocated to the flight crew for the recognition and response to an ATC instruction. | | | X | X |

| *RCP 240/D allocations* | *Description* | *ANSP* | *CSP* | *Aircraft* | *Operator* |
|---|---|---|---|---|---|
| RCTP | Maximum technical time allocated to relevant parts of the ATS unit's system, aeronautical station's system, the network systems and the aircraft system, for which there is no human contribution to the communication transaction performance. | X | X | X | X |
| ATSU system ($RCTP_{ATSU}$) | Maximum portion of RCTP allocated to the ATS unit's system. | X | | | |
| Network ($RCTP_{CSP}$) | Maximum portion of RCTP allocated to the network, including CSP and SSP. | X | X | | X |
| Aircraft system ($RCTP_{AIR}$) | Maximum portion of RCTP allocated to the aircraft system. | | | X | |

2.1.2 *Air navigation services provider (ANSP)*

| *RCP transaction time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | | *Component: ANSP* |
| Transaction time parameter | ET (sec)<br>C = 99.9% | TT (sec)<br>C = 95% | Means of compliance |
| Transaction time value<br>(A to Z) | 240 | 210 | Analysis, monitored. |
| *RCP time allocations* | | | |
| Initiator (controller/ATSU system)<br>(A to C) + (X to Z) | 30 | 30 | Analysis, simulations, safety and human factors assessments. |
| RCMP<br>(C to X) | 210 | 180 | Monitored. |
| *RCMP time allocations* | | | |
| RCTP<br>(C to D3) + (D4 to X) | 150 | 120 | Monitored. |
| *RCTP time allocations* | | | |
| $RCTP_{ATSU}$<br>(C to D1) + (D6 to X) | 15 | 10 | Pre-implementation demonstration. |
| $RCTP_{CSP}$<br>(D1 to D2) + (D5 to 6) | 120 | 100 | CSP contract/service agreement. See also , 2.1.3 of this appendix. |

| *RCP availability criteria* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | | *Component: ANSP* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability service ($A_{SERVICE}$) | 0.9999 | 0.999 | Contract/service agreement terms.<br><br>*Note 1.— For guidelines to aid in the development of the contract/service agreement with the CSP, see 2.1.3 of this appendix, RCP 240/D allocations to CSP for RCP availability criteria.*<br><br>*Note 2.— The availability criteria are allocated entirely to $A_{CSP}$ and assume that the ATS unit's system is always available.* |

| *RCP integrity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | | *Component: ANSP* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* | |
| Integrity (I) | Malfunction = $10^{-5}$ per flight hour | Analysis, safety requirements, development assurance level commensurate with integrity level, (compliance shown prior to operational implementation). See also RCP-related safety requirement SR-26 for the ANSP, CSP contract/service agreement. See also RCP integrity criteria for CSP, 2.1.3, of this appendix. | |

| *RCP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | *Component: ANSP* |
| *Ref:* | *Criteria* | *Means of compliance* |
| MA-1a | The ground system shall be capable of detecting ground system failures and configuration changes causing the communication service to no longer meet the requirements for the intended function.<br><br>*Note.— If changes are made to the system capacity limits, as specified by the airspace requirements, and the changes cause the system to perform below the RCP specification, this would be considered a change in system configuration.* | System design, implementation. CSP contract/service agreement. See also 2.1.3 of this appendix, RCP availability criteria. |

| *RCP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | *Component: ANSP* |
| *Ref:* | *Criteria* | *Means of compliance* |
| MA-1b | When the communication service no longer meets the requirements for the intended function, the ground system shall provide indication to the controller. | System design, implementation. CSP contract/service agreement. See also 2.1.3 of this appendix, RCP availability criteria. |
| MA-2 | When the controller receives an indication that the communication service no longer meets the requirements for the intended function (e.g. reduced longitudinal separation), the controller shall take action to resolve the situation (e.g. apply an alternative form of separation). | System design, procedures, implementation. |

| *RCP-related safety requirements* | | |
|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | *Component: ANSP* |
| *Ref:* | *Related RCP parameter* | Safety requirement |
| SR-1a (ANSP) | A | The ATS unit shall display the indication provided by the aircraft system when a data link service request initiated by the ground system or the controller is rejected at the application layer. |
| SR-1b (ANSP) | A | The ATS unit shall provide the aircraft system with an indication when it rejects a data link service request initiated by the flight crew at the application layer. |
| SR-2 (ANSP) | A, C | The ATS unit shall advise the controller of a detected data link service loss. |
| SR-3 (ANSP) | A | Data link service shall be established in sufficient time to be available for operational use. |
| SR-4 (ANSP) | A, C | The ATS unit shall be notified of data link service planned outages sufficiently ahead of time. |
| SR-5 (ANSP) | A, C | The ATS unit shall advise the controller when a message cannot be successfully transmitted. |
| SR-6 (ANSP) | C, I | The ATS unit end system shall provide the unambiguous and unique identification of the origin and destination with each message it transmits. |
| SR-7 (ANSP) | C, I | The ATS unit shall indicate in each response to which messages it refers. |
| SR-8 (ANSP) | I | The ATS unit shall send the route clearance information as per the route clearance from the ATS unit via data link. |

| *RCP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | | *Application: CPDLC* | *Component: ANSP* |
| *Ref:* | *Related RCP parameter* | Safety requirement | |
| SR-9 (ANSP) | C, I | The ATS unit end system shall timestamp (to within one second UTC) each message when it is released for onward transmission. | |
| SR-11 (ANSP) | C, I | Any processing performed by the ATS unit (data entry/encoding/transmitting/ decoding/displaying) shall not affect the intent of the message. | |
| SR-12 (ANSP) | C, I | The ATS unit end system shall reject messages not addressed to itself. | |
| SR-13 (ANSP) | C, I | The ATS unit shall transmit messages to the designated aircraft system. | |
| SR-14 (ANSP) | A, C, I | The ATS unit system shall indicate to the controller when a required response for a message sent by the ATS unit is not received within the required time ($ET_{RCMP}$). | |
| SR-15 (ANSP) | C, I | When the ATS unit receives a message whose timestamp exceeds $ET_{RCMP}$, the ATS unit shall provide appropriate indication. | |
| SR-16 (ANSP) | C, I | The ATS unit shall prevent the release of clearance without controller action. | |
| SR-17 (ANSP) | C, I | The ATS unit shall prohibit the controller from the operational processing of corrupted messages. | |
| SR-18 (ANSP) | C, I | The ATS unit shall be able to determine the message initiator. | |
| SR-19 (ANSP) | C, I | The ATS unit shall prohibit the controller from the operational processing of messages not addressed to the ATS unit. | |
| SR-20 (ANSP) | C, I | The ATS unit shall only establish and maintain data link services when the aircraft identifiers in data link initiation correlates with the ATS unit's corresponding aircraft identifiers in the current flight plan. | |
| SR-21 (ANSP) | C, I | The aircraft identifiers used for data link initiation correlation by the ATS unit shall be unique and unambiguous (e.g. the aircraft identification and either the registration marking or the aircraft address). | |
| SR-23 (ANSP) | C, I | An ATS unit system shall not permit data link services when there are non-compatible version numbers. | |
| SR-24 (ANSP) | C, I | The ATS unit shall respond to messages in their entirety. | |
| SR-25 (ANSP) | I | The ATS unit end system shall be capable of detecting errors resulting in misdelivery introduced by the communication service. | |

| *RCP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | | *Application: CPDLC* | *Component: ANSP* |
| *Ref:* | *Related RCP parameter* | Safety requirement | |
| SR-26 (ANSP) | I | The ATS unit end system shall be capable of detecting errors resulting in corruption introduced by the communication service. | |

2.1.3 *Communication services provider (CSP)*

*Note.— The RCP allocations for the CSP are intended to aid the ANSP and the aircraft operator in the development of contracts and service agreements.*

| *RCP transaction time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | | *Component: CSP* |
| *Transaction time parameter* | *ET (sec) C = 99.9%* | *TT (sec) C = 95%* | *Means of compliance* |
| *RCTP time allocations* | | | |
| $RCTP_{CSP}$ (D1 to D2) + (D5 to D6) | 120 | 100 | Contract/service agreement terms. Pre-implementation demonstration. |

| *RCP availability criteria* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | | *Component: CSP* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — CSP ($A_{CSP}$) | 0.9999 | 0.999 | Contract/service agreement terms. |
| Unplanned outage duration limit (minutes). | 10 | 10 | Contract/service agreement terms. |
| Maximum number of unplanned outages. | 4 | 48 | Contract/service agreement terms. |
| Maximum accumulated unplanned outages time (minutes/year). | 52 | 520 | Contract/service agreement terms. |
| Unplanned outage notification delay (minutes). | 5 | 5 | Contract/service agreement terms. |

| *RCP availability criteria* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | | *Component: CSP* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| *Note.— RTCA DO-306/EUROCAE ED-122 specifies a requirement to indicate loss of the service. Unplanned outage notification delay is an additional time value associated with the requirement to indicate such loss to the ANSP, per RCP-related safety requirement SR-4 for the ANSP.* | | | |

| *RCP integrity criteria* | | |
|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | *Component: CSP* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* |
| Integrity (I) | Not specified | Contract/service agreement terms. As per RCP-related safety requirements SR-26 for the ANSP and SR-26 for the aircraft system, the end system is required to include provisions, consistent with the overall RCP integrity criteria, to mitigate the effects of errors introduced by the network. These provisions require the network to pass protected information (or data) to the end system without manipulating the protected information (or data) it passes.<br><br>*Note.— In formulating contract terms with the CSP, the ANSP and/or operator may specify an integrity value, and other related criteria, as appropriate, for networks and subnetworks, ensuring acceptable data integrity, consistent with the assumptions used to define the end system provisions (e.g. CRC or Fletcher's checksum).* |

2.1.4 *Aircraft system*

| *RCP transaction time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | | *Component: Aircraft system* |
| *Transaction time parameter* | *ET (sec)*<br>*C = 99.9%* | *TT (sec)*<br>*C = 95%* | *Means of compliance* |
| *RCMP time allocations* | | | |
| Responder (PORT)<br>(D3 to D4) | 60 | 60 | Human-machine interface capability, pre-implementation demonstration. |
| *RCTP time allocations* | | | |

| *RCP transaction time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | | *Component: Aircraft system* |
| *Transaction time parameter* | *ET (sec)*<br>*C = 99.9%* | *TT (sec)*<br>*C = 95%* | *Means of compliance* |
| $RCTP_{AIR}$<br>(D2 to D3) + (D4 to D5) | 15 | 10 | Pre-implementation demonstration. |

| *RCP availability criteria* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | | *Component: Aircraft system* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — aircraft ($A_{AIR}$) | N/A | 0.999 | Analysis, architecture, design, pre-implementation demonstration. |

| *RCP integrity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | | *Component: Aircraft system* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* | |
| Integrity (I) | Malfunction = $10^{-5}$ per flight hour | Analysis, safety requirements, development assurance level (e.g. Level C software) commensurate with integrity level, pre-implementation demonstration. See also RCP-related safety requirement SR-26 for the aircraft system. | |

| *RCP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | *Component: Aircraft system* |
| *Ref:* | *Criteria* | *Means of compliance* |
| MA-1a | The aircraft system shall be capable of detecting aircraft system failures or loss of air/ground communication, causing the aircraft communication capability to no longer meet the requirements for the intended function. | System design, implementation. |
| MA-1b | When the aircraft communication capability no longer meets the requirements for the intended function, the aircraft system shall provide indication to the flight crew. | System design, implementation. |

| *RCP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | | *Application: CPDLC* | *Component: Aircraft system* |
| *Ref:* | *Related RCP parameter* | *Safety requirement* | |
| SR-1a (Air) | A | The aircraft system shall indicate to the ATS unit when it rejects a data link service request initiated by the ground system or the controller at the application layer. | |
| SR-1b (Air) | A | The aircraft system shall display the indication provided by the ATS unit, when a data link service request initiated by the flight crew is rejected at the application layer. | |
| SR-2 (Air) | A, C | The aircraft system shall indicate a detected loss of data link service to the flight crew. | |
| SR-5 (Air) | A, C | The aircraft system shall indicate to the flight crew when a message cannot be successfully transmitted. | |
| SR-6 (Air) | C, I | The aircraft end system shall provide unambiguous and unique identification of the origin and destination with each message it transmits. | |
| SR-7 (Air) | C, I | The aircraft system shall indicate in each response to which messages it refers. | |
| SR-8 (Air) | I | The aircraft system shall execute the route clearance as per the route clearance received from the ATS unit via data link. | |
| SR-9 (Air) | C, I | The aircraft end system shall timestamp to within one second UTC each message when it is released for onward transmission. | |
| SR-10 (Air) | C, I | The aircraft end system shall include the time of position, to within one second of the UTC time, the aircraft was actually at the position, in each ADS-C report. | |
| SR-11 (Air) | C, I | Any processing performed by aircraft system (data entry/encoding/ transmitting/decoding/displaying) shall not affect the intent of the message. | |
| SR-12 (Air) | C, I | The aircraft end system shall reject messages not addressed to itself. | |
| SR-13 (Air) | C, I | The aircraft system shall transmit messages to the designated ATS unit. | |
| SR-15 (Air) | C, I | When the aircraft system receives a message whose timestamp exceeds $ET_{RCMP}$, the aircraft system shall provide appropriate indication. | |
| SR-16 (Air) | C, I | The aircraft end system shall prevent the release of responses to clearances without flight crew action. | |
| SR-17 (Air) | C, I | The aircraft system shall prohibit operational processing of corrupted messages by flight crew. | |

| *RCP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | | *Application: CPDLC* | *Component: Aircraft system* |
| *Ref:* | *Related RCP parameter* | *Safety requirement* | |
| SR-18 (Air) | C, I | The aircraft system shall be able to determine the message initiator. | |
| SR-19 (Air) | C, I | The aircraft system shall prohibit the flight crew to operationally process messages not addressed to the aircraft. | |
| SR-21 (Air) | C, I | The aircraft identifiers sent by the aircraft system and used for data link initiation correlation shall be unique and unambiguous (e.g. the aircraft identification and either the registration marking or the aircraft address). | |
| SR-24 (Air) | C, I | The aircraft system shall respond to messages in their entirety or allow the flight crew to do so. | |
| SR-25 (Air) | I | The aircraft end system shall be capable of detecting errors resulting in misdelivery introduced by the communication service. | |
| SR-26 (Air) | I | The aircraft end system shall be capable of detecting errors that would result in corruption introduced by the communication service. | |
| SR-27 (Air) | C, I | The aircraft and/or flight crew shall ensure the correct transfer into or out of the aircraft's FMS of route data received/sent via data link, to be used to define the active flight plan. | |

2.1.5 *Aircraft operator*

| *RCP transaction time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | | *Component: Aircraft operator* |
| *Transaction time parameter* | *ET (sec) C = 99.9%* | *TT (sec) C = 95%* | *Means of compliance* |
| *RCMP time allocations* | | | |
| Responder (PORT) (D3 to D4) | 60 | 60 | Procedures, flight crew training and qualification in accordance with safety requirements. |
| *RCTP time allocations* | | | |
| $RCTP_{AIR}$ (D2 to D3) + (D4 to D5) | 15 | 10 | Aircraft type design approval, maintenance, properly configured user-modifiable software (e.g. owner requirements table). |

| *RCP transaction time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | | *Component: Aircraft operator* |
| *Transaction time parameter* | *ET (sec)*<br>*C = 99.9%* | *TT (sec)*<br>*C = 95%* | *Means of compliance* |
| $RCTP_{CSP}$<br>(D1 to D2) + (D5 to D6) | 120 | 100 | CSP contract/service agreement. See also 2.1.3 of this appendix. Pre-implementation demonstration. |

| *RCP availability criteria* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | | *Component: Aircraft operator* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — aircraft ($A_{AIR}$) | N/A | 0.999 | Aircraft type design approval, maintenance, properly configured user-modifiable software (e.g. owner requirements table or airline policy file). |
| Availability — CSP ($A_{CSP}$) | 0.9999 | 0.999 | Contract/service agreement terms.<br><br>*Note.— For guidelines to aid in the development of the contract/service agreement with the CSP, see 2.1.3 of this appendix, RCP 240/D allocations to CSP for RCP availability criteria.* |

| *RCP integrity criteria* | | |
|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | *Component: Aircraft operator* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* |
| Integrity (I) | Malfunction = $10^{-5}$ per flight hour | Aircraft type design approval, established procedures, training, and qualification to meet safety requirements. CSP contract/service agreement. See also RCP integrity criteria for CSP, 2.1.3 of this appendix. |

| *RCP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RCP 240/D* | *Application: CPDLC* | *Component: Aircraft operator* |
| *Ref:* | *Criteria* | *Means of compliance* |
| MA-2 | When the flight crew determines that the aircraft communication capability no longer meets the requirements for the intended function, the flight crew shall advise the ATS unit concerned. | Procedures, flight crew training and qualification. |

| *RCP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RCP 240/D* | | *Application: CPDLC* | *Component: Aircraft operator* |
| *Ref:* | *Related RCP parameter* | *Safety requirement* | |
| SR-22 (Operator) | C, I | The flight crew shall perform the initiation data link procedure with any change of the flight identifier. | |
| SR-24 (Operator) | C, I | The flight crew shall respond to a message in its entirety, when not responded to by the aircraft system. | |
| SR-27 (Operator) | C, I | The aircraft and/or flight crew shall ensure the correct transfer into or out of the aircraft's FMS of route data received/sent via data link, to be used to define the active flight plan. | |

## 3. RCP 400 SPECIFICATION

| *RCP specification* | | | |
|---|---|---|---|
| *RCP specification* | *RCP 400* | | |
| *Airspace specific considerations* | | | |
| *Interoperability* | Specify interoperability criteria (e.g. FANS 1/A, SATVOICE Iridium, Inmarsat, and/or MTSAT communications). | | |
| *ATM operation* | Specify ATM operation(s) (e.g. applicable separation standard), if necessary. | | |
| *Application* | Specify controller-pilot ATC communication intervention capability (e.g. CPDLC, SATVOICE communications). | | |
| *RCP parameter values* | | | |
| *Transaction time (sec)* | Continuity (C) | Availability (A) | Integrity (I) |
| ET = 400 | C(ET) = 0.999 | 0.999 | Malfunction = $10^{-5}$ per flight |

| | | | |
|---|---|---|---|
| TT = 350 | C(TT) = 0.95 | | hour |
| *RCP monitoring and alerting criteria* | | | |
| *Ref:* | *Criteria* | | |
| CMA-1 | The system shall be capable of detecting failures and configuration changes causing the communication service to no longer meet the RCP specification for the intended function. | | |
| CMA-2 | When the communication service can no longer meet the RCP specification for the intended function, the flight crew and/or the controller shall take appropriate action. | | |
| *Notes* | | | |
| *Note 1.— Rationale for the criteria provided in this specification can be found in Annex 11, Doc 4444, Doc 9689, and RTCA DO-306/EUROCAE ED-122.*<br><br>*Note 2.— The values for transaction times are to be applied to transactions that are representative of communications capability, for the controller to intervene with a specific operator, aircraft type, and aircraft identification.*<br><br>*Note 3.— If changes are made to the system capacity limits, as specified by the airspace requirements, and the changes cause the system to perform below the RCP specification, this would be considered a change in system configuration.* | | | |

### 3.1 RCP 400/D allocations

3.1.1 *General*

3.1.1.1 The RCP 400/D allocations are applicable to the controller intervention capability via CPDLC. Figure B-2 provides the RCP 400/D allocations associated with transaction time and continuity. The time taken for the controller to issue the instruction and receive the response is shown by analysis. Actual communication performance (ACP) is monitored from C to X. The remaining allocations support initial compliance and problem investigation when ACP does not meet the specified criteria.

3.1.1.2 The RCP 400/D allocations are shared by the ANSP, the CSP, the aircraft system and the aircraft operator. The descriptions and assignments for these allocations, as shown in Figure B-2, are identical to the descriptions and assignments for the RCP 240/D allocations provided in Table B-1.

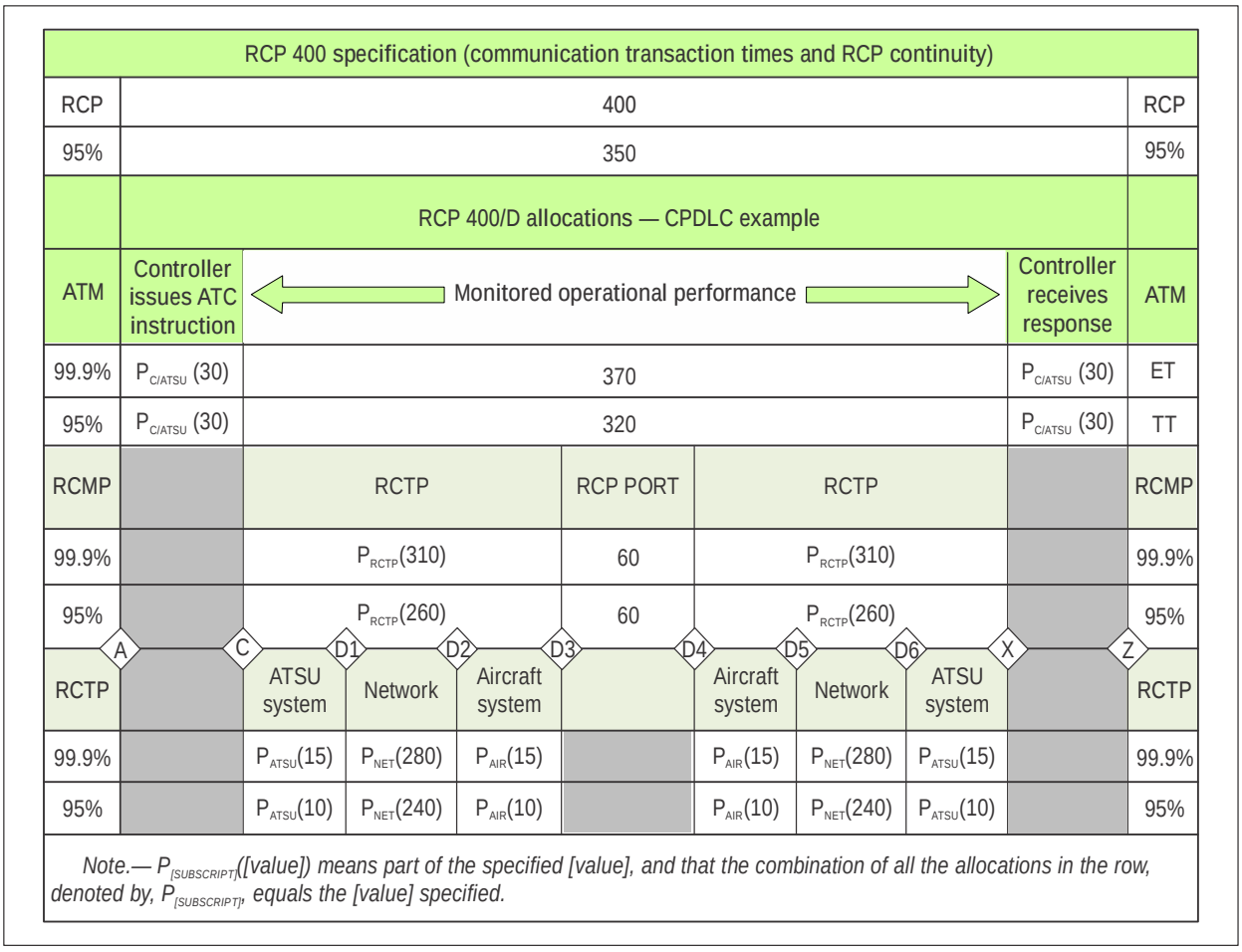



**Figure B-2. RCP 400/D allocations — communication transaction times and continuity**

3.1.2 *Air navigation services provider (ANSP)*

| *RCP transaction time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | | *Component: ANSP* |
| *Transaction time parameter* | *ET (sec)*<br>*C = 99.9%* | *TT (sec)*<br>*C = 95%* | *Means of compliance* |
| Transaction time value<br>(A to Z) | 400 | 350 | Analysis, monitored. |
| *RCP time allocations* | | | |
| Initiator (controller/ATSU system)<br>(A to C) + (X to Z) | 30 | 30 | Analysis, simulations, safety and human factors assessments. |

| *RCP transaction time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | | *Component: ANSP* |
| *Transaction time parameter* | *ET (sec)*<br>*C = 99.9%* | *TT (sec)*<br>*C = 95%* | *Means of compliance* |
| RCMP<br>(C to X) | 370 | 320 | Monitored. |
| *RCMP time allocations* | | | |
| RCTP<br>(C to D3) + (D4 to X) | 310 | 260 | Monitored. |
| *RCTP time allocations* | | | |
| $RCTP_{ATSU}$<br>(C to D1) + (D6 to X) | 15 | 10 | Pre-implementation demonstration. |
| $RCTP_{CSP}$<br>(D1 to D2) + (D5 to D6) | 280 | 240 | CSP contract/service agreement.<br>See also 3.1.3 of this appendix. |

| *RCP availability criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | | *Component: ANSP* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — service ($A_{SERVICE}$) | N/A | 0.999 | Contract/service agreement terms.<br><br>*Note 1.— For guidelines to aid in the development of the contract/service agreement with the CSP, see 3.1.3 of this appendix, RCP 400/D allocations to CSP for RCP availability criteria.*<br><br>*Note 2. — The availability criteria are allocated entirely to $A_{CSP}$ and assume that the ATS unit's system is always available.* |

| *RCP integrity criteria* | | |
|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | *Component: ANSP* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* |
| Integrity (I) | *Note.— RCP integrity criteria related to RCP 400/D are identical to those for RCP 240/D. See 2.1.2 of this appendix.* | |

| *RCP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | *Component: ANSP* |
| *Ref:* | *Criteria* | *Means of compliance* |
| All | *Note.— RCP monitoring and alerting criteria related to RCP 400/D are identical to those for RCP 240/D. See 2.1.2 of this appendix.* | |

| *RCP-related safety requirements* | | |
|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | *Component: ANSP* |
| *Ref:* | *Related RCP parameter* | *Safety requirement* |
| All | A, C, I | *Note.— Safety requirements related to RCP 400/D are identical to those for RCP 240/D. See 2.1.2 of this appendix.* |

3.1.3 *Communication services provider (CSP)*

*Note.— The RCP allocations for the CSP are intended to aid the ANSP and the aircraft operator in the development of contracts and service agreements.*

| *RCP transaction time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | | *Component: CSP* |
| *Transaction time parameter* | *ET (sec)*<br>*C = 99.9%* | *TT (sec)*<br>*C = 95%* | *Means of compliance* |
| *RCTP time allocations* | | | |
| $RCTP_{CSP}$<br>(D1 to D2) + (D5 to D6) | 280 | 240 | Contract/service agreement terms. |

| *RCP availability criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | | *Component: CSP* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — CSP ($A_{CSP}$) | N/A | 0.999 | Contract/service agreement terms. |
| Unplanned outage duration limit (minutes). | N/A | 20 | Contract/service agreement terms. |
| Maximum number of unplanned outages. | N/A | 24 | Contract/service agreement terms. |
| Maximum accumulated unplanned outages time (minutes/year). | N/A | 520 | Contract/service agreement terms. |
| Unplanned outage notification delay (minutes). | N/A | 10 | Contract/service agreement terms. |

| *RCP integrity criteria* | | |
|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | *Component: CSP* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* |
| Integrity (I) | *Note.— RCP integrity criteria related to RCP 400/D are identical to those for RCP 240/D. See 2.1.3 of this appendix.* | |

3.1.4 *Aircraft system*

| *RCP transaction time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | | *Component: Aircraft system* |
| *Transaction time parameter* | *ET (sec)*<br>*C = 99.9%* | *TT (sec)*<br>*C = 95%* | *Means of compliance* |
| *RCMP time allocations* | | | |
| Responder (PORT)<br>(D3 to D4) | 60 | 60 | Human-machine interface capability, pre-implementation demonstration. |
| *RCTP time allocations* | | | |
| $RCTP_{AIR}$<br>(D2 to D3) + (D4 to D5) | 15 | 10 | Pre-implementation demonstration. |

| *RCP availability criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | | *Component: Aircraft system* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — aircraft ($A_{AIR}$) | N/A | 0.999 | Analysis, architecture, design, pre-implementation demonstration. |

| *RCP integrity criteria* | | |
|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | *Component: Aircraft system* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* |
| Integrity (I) | *Note.— RCP integrity criteria related to RCP 400/D are identical to those for RCP 240/D. See 2.1.4 of this appendix.* | |

| *RCP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | *Component: Aircraft system* |
| *Ref:* | *Criteria* | *Means of compliance* |
| All | *Note.— RCP monitoring and alerting criteria related to RCP allocations 400/D are identical to those for RCP 240/D. See 2.1.4 of this appendix.* | |

| *RCP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RCP 400/D* | | *Application: CPDLC* | *Component: Aircraft system* |
| *Ref:* | *Related RCP parameter* | *Safety requirement* | |
| All | A, C, I | *Note.— Safety requirements related to RCP 400/D are identical to those for RCP 240/D. See 2.1.4 of this appendix.* | |

3.1.5 *Aircraft operator*

| *RCP transaction time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | | *Component: Aircraft operator* |
| *Transaction time parameter* | *ET (sec)*<br>*C = 99.9%* | *TT (sec)*<br>*C = 95%* | *Means of compliance* |
| *RCMP time allocations* | | | |
| Responder (PORT)<br>(D3 to D4) | 60 | 60 | Procedural capability, flight crew training and qualification in accordance with safety requirements. |
| *RCTP time allocations* | | | |
| $RCTP_{AIR}$<br>(D2 to D3) + (D4 to D5) | 15 | 10 | Aircraft type design approval, maintenance, properly configured user-modifiable software (e.g. owner requirements table). |
| $RCTP_{CSP}$<br>(D1 to D2) + (D5 to D6) | 280 | 240 | CSP contract/service agreement. See also 3.1.3 of this appendix. |

| *RCP availability criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | | *Component: Aircraft operator* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — aircraft ($A_{AIR}$) | N/A | 0.999 | Aircraft type design approval, maintenance, properly configured user-modifiable software (e.g. owner requirements table). |
| Availability — CSP ($A_{CSP}$) | N/A | 0.999 | Contract/service agreement terms.<br><br>*Note.— For guidelines to aid in the development of the contract/service agreement with the CSP, see 3.1.3 of this appendix, RCP 400/D allocations to CSP for RCP availability criteria.* |

| *RCP integrity criteria* | | |
|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | *Component: Aircraft operator* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* |
| Integrity (I) | *Note.— RCP integrity criteria related to RCP 400/D are identical to those for RCP 240/D. See 2.1.5 of this appendix.* | |

| *RCP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RCP 400/D* | *Application: CPDLC* | *Component: Aircraft operator* |
| *Ref:* | *Criteria* | *Means of compliance* |
| All | *Note.— RCP monitoring and alerting criteria related to RCP 400/D are identical to those for RCP 240/D. See 2.1.5 of this appendix.* | |

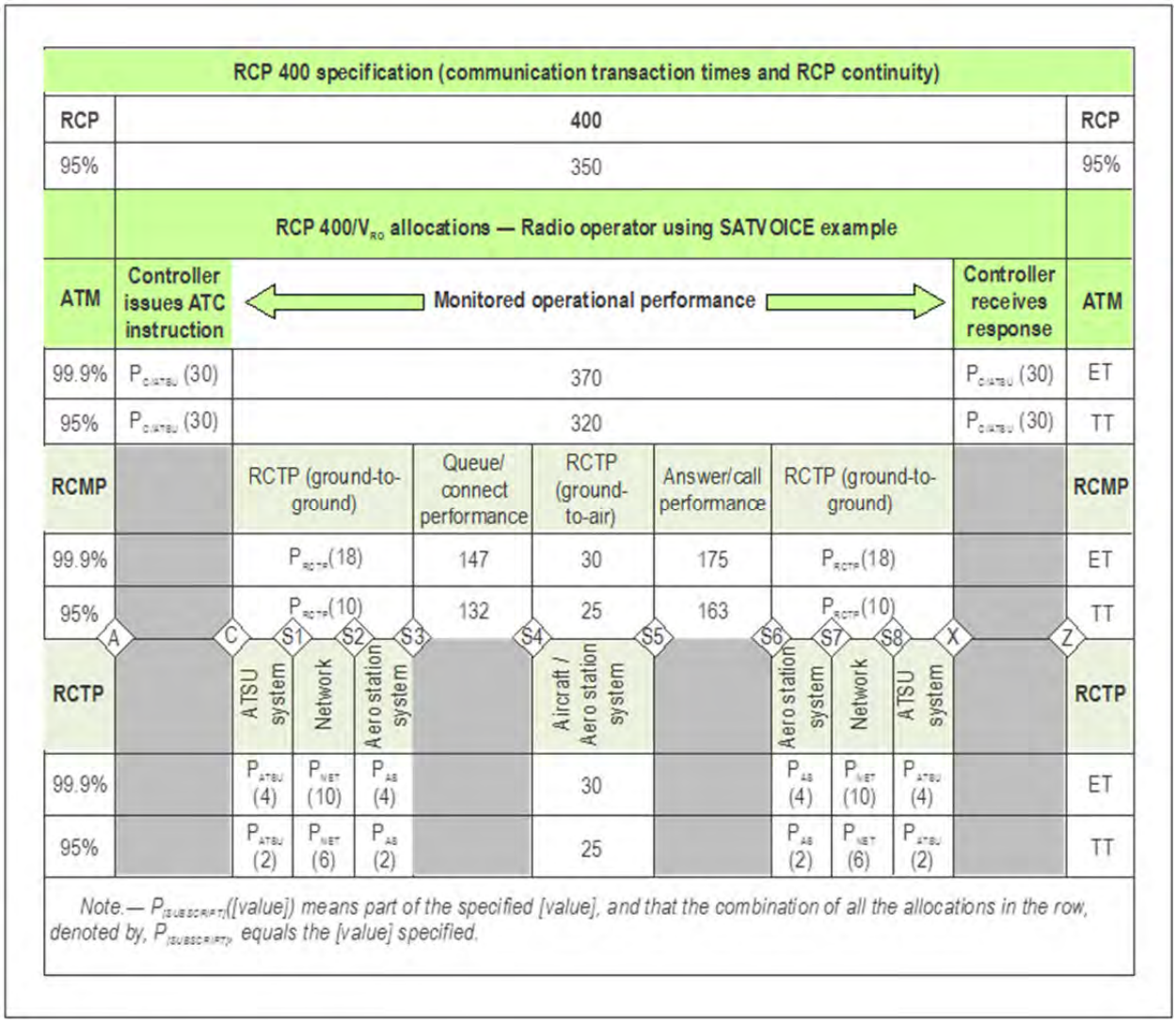
| *RCP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RCP 400/D* | | *Application: CPDLC* | *Component: Aircraft operator* |
| *Ref:* | *Related RCP Parameter* | *Safety requirement* | |
| All | C, I | *Note.— Safety requirements related to RCP 400/D are identical to those for RCP 240/D. See 2.1.5 of this appendix.* | |

## 3.2 RCP 400/$V_{RO}$ allocations

### 3.2.1 *General*

3.2.1.1 The RCP 400/$V_{RO}$ allocations are applicable to the controller intervention capability via a radio operator using SATVOICE. Figure B-3 provides these allocations associated with transaction time and continuity. The time taken for the controller to issue the instruction and receive the response is shown by analysis. Actual communication performance (ACP) is monitored from C to X. The remaining allocations support initial compliance and problem investigation when ACP does not meet the specified criteria.

3.2.1.2 RCP 400/$V_{RO}$ allocations are shared by the ANSP, the CSP, the aircraft system and the aircraft operator. The descriptions and assignments for these allocations, as shown in Figure B-3, are provided in Table B-2.



| RCP 400 specification (communication transaction times and RCP continuity) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **RCP** | **400** | | | | | | | | | | | | | **RCP** |
| 95% | 350 | | | | | | | | | | | | | 95% |
| | **RCP 400/$V_{RO}$ allocations — Radio operator using SATVOICE example** | | | | | | | | | | | | | |
| **ATM** | **Controller issues ATC instruction** | ⟵ | **Monitored operational performance** | | | | | | | | | ⟶ | **Controller receives response** | **ATM** |
| 99.9% | $P_{C\text{-}ATSU}$ (30) | 370 | | | | | | | | | | | $P_{C\text{-}ATSU}$ (30) | ET |
| 95% | $P_{C\text{-}ATSU}$ (30) | 320 | | | | | | | | | | | $P_{C\text{-}ATSU}$ (30) | TT |
| **RCMP** | | RCTP (ground-to-ground) | | | Queue/ connect performance | RCTP (ground-to-air) | | Answer/call performance | RCTP (ground-to-ground) | | | | | **RCMP** |
| 99.9% | | $P_{RCTP}$(18) | | | 147 | 30 | | 175 | $P_{RCTP}$(18) | | | | | ET |
| 95% | | $P_{RCTP}$(10) | | | 132 | 25 | | 163 | $P_{RCTP}$(10) | | | | | TT |
| | A | C | S1 | S2 | S3 | S4 | | S5 | S6 | S7 | S8 | X | Z | |
| **RCTP** | | ATSU system | Network | Aero station system | | Aircraft / Aero station system | | | Aero station system | Network | ATSU system | | | **RCTP** |
| 99.9% | | $P_{ATSU}$ (4) | $P_{NET}$ (10) | $P_{AS}$ (4) | | 30 | | | $P_{AS}$ (4) | $P_{NET}$ (10) | $P_{ATSU}$ (4) | | | ET |
| 95% | | $P_{ATSU}$ (2) | $P_{NET}$ (6) | $P_{AS}$ (2) | | 25 | | | $P_{AS}$ (2) | $P_{NET}$ (6) | $P_{ATSU}$ (2) | | | TT |

*Note.— $P_{(SUBSCRIPT)}$([value]) means part of the specified [value], and that the combination of all the allocations in the row, denoted by, $P_{(SUBSCRIPT)}$, equals the [value] specified.*

**Figure B-3. RCP 400/$V_{RO}$ allocations — communication transaction times and continuity**

**Table B-2. RCP 400/$V_{RO}$ allocation descriptions and assignments**

| *RCP 400/$V_{RO}$ allocations* | *Description* | *ANSP* | *CSP* | *Aircraft* | *Operator* |
|---|---|---|---|---|---|
| Controller (initiator performance) | The maximum time allocated to the controller for the issuance of an ATC instruction and receipt of response. | X | | | |
| RCMP | The maximum time against which ACP is assessed. | X | X | X | X |
| Queue/connect performance | The maximum time allocated to the radio operator/aeronautical station system to organize and place the call either via a manual or automated dialling sequence. | X | X | | |
| Answer/call performance (ground-to-air) | The maximum time allocated to when the flight crew receives an indication of an incoming call to when the parties on the call have completed the communication.<br><br>*Note.— The call is complete when the radio operator sends the flight crew response to the ATS unit.* | X | X | X | X |
| RCTP | The maximum technical time allocated to relevant parts of the ATS unit's system, aeronautical station's system, the network systems and the aircraft system, for which there is no human contribution to the communication transaction performance. | X | X | X | X |
| RCTP (ground-to-air) ($RCTP_{G/A}$) | The maximum portion of RCTP allocated to the ground system, network system and aircraft system to set up a ground-to-air call, as determined from when the last digit of the dialling sequence is finished to when the aircraft indicates an incoming call to the flight crew. | | X | X | |
| RCTP (ground-to-ground) | The maximum portion of RCTP allocated to the ground-to-ground network. | X | X | | |
| ATSU system ($RCTP_{ATSU}$) | The maximum portion of RCTP allocated to the ATS unit's system. | X | | | |
| Network ($RCTP_{CSP}$) | The maximum portion of RCTP allocated to the CSP. | X | X | | X |
| Aero station system ($RCTP_{AS}$) | The maximum portion of RCTP allocated to the aeronautical station's system for ground-ground communications with an ATS unit.<br><br>*Note.— $RCTP_{AS}$ includes two concurrent processes:*<br><br>*a) the aircraft and aeronautical station technically disconnect the call, which is assumed. Operationally, the call is disconnected when the flight crew and radio operator complete the call; and*<br><br>*b) the aeronautical station sends the response to the ATS unit via the ground-ground network; the performance is denoted by $RCTP_{AS}$.* | X | X | | |

3.2.1.3 Measurements for assessing ACP/continuity include disconnected or dropped calls, e.g. aircraft manoeuvres or switching satellites, or busy conditions. They would also include loss of service while on the call if the service outage is less than the maximum unplanned outage duration limit. If the outage is greater than the maximum unplanned outage duration limit, these calls would be excluded from ACP/continuity measurements, because they would be considered as part of SATVOICE service availability.

3.2.1.4 SATVOICE service availability includes failures prohibiting the call to be initiated or congestion (much like a terrestrial mobile phone network). Measurements for assessing SATVOICE service availability would not include any calls associated with the measurements for ACP/continuity.

3.2.1.5 SATVOICE integrity includes an assessment, such as a diagnostic rhyme test (DRT), of the intelligibility of the voice transaction and the extent to which the parties could potentially misunderstand the communication.

3.2.1.6 Table B-3 provides safety requirements related to RCP parameters for the RCP 400/$V_{RO}$ specification. The allocations for these requirements to ANSP, CSP, aircraft SATVOICE system and the aircraft operator are provided in the relevant sections of the specification.

**Table B-3. Safety requirements related to RCP 400/$V_{RO}$ parameters**

| *Reference* | *Related RCP parameter* | *RCP safety requirements* |
|---|---|---|
| SR-1 | A, C | The controller shall be capable of contacting the aircraft. |
| SR-2 | A, C | The flight crew shall be capable of contacting the radio operator and/or controller. |
| SR-3 | I | The ANSP and aircraft operator shall ensure adequate means to mitigate against voice communication errors leading to incorrect execution of clearances. |
| SR-4 | A, C, I | The SATVOICE system shall be capable of detecting loss of service, equipment failures and/or logon failures and provide indication to the controller/radio operator or flight crew of system status. |
| SR-5 | C, ET | The ATS unit system shall provide an indication to the controller when the transaction time, for the response-of-clearance issued via radio operator, exceeds the specified time ($ET_{RCMP}$). |
| SR-6 | All | The ANSP and aircraft operator shall ensure means are in place to monitor for compliance to RCP specification and provide alert(s) for appropriate action. |

3.2.2 *Air navigation services provider (ANSP)*

*Note 1.— The ANSP includes the specification criteria allocated to the aeronautical station.*

*Note 2.— Automation may employ autodial capability, databases and other features to meet performance specifications.*

| *RCP transaction time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | *Component: ANSP* |
| *Transaction time parameter* | *ET (sec) C = 99.9%* | *TT (sec) C = 95%* | *Means of compliance* |
| Transaction time value (A to Z) | 400 | 350 | Analysis, monitored. |
| *RCP time allocations* | | | |
| Initiator (controller/ATSU system) (A to C) + (N to Z) | 30 | 20 | Analysis, simulations, safety and human factors assessments. |
| RCMP (C to X) | 370 | 330 | Monitored. |
| *RCMP time allocations* | | | |
| Queue/connect performance (S3 to S4) | 147 | 132 | Initially, by analysis, simulations, safety human factors assessments. |
| Answer/call performance (S5 to S6) | 175 | 163 | Initially, by analysis, simulations, safety and human factors assessments. |
| *RCTP time allocations* | | | |
| $RCTP_{ATSU}$ (C to S1) + (S8 to X) | 4 | 2 | Pre-implementation demonstration. |
| RCTP (ground-to-ground) (C to S3) + (S6 to X) | 18 | 10 | Estimated; CSP contract/service agreement. See 3.2.3 of this appendix. |
| $RCTP_{G/A}$ (S4 to S5) | 30 | 25 | Estimated; CSP contract/service agreement. See 3.2.3 of this appendix.. |

| *RCP availability criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | *Component: ANSP* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability – service ($A_{SERVICE}$) | N/A | 0.999 | Contract/service agreement terms.<br><br>*Note 1.— For guidelines to aid in the development of the contract/service agreement with the CSP, see 3.2.3 of this appendix, RCP 400/$V_{RO}$ allocations to CSP for RCP availability criteria.*<br><br>*Note 2.— The availability criteria are allocated entirely to $A_{CSP}$ and assume that the ATS unit's system is always available.* |

| *RCP integrity criteria* | | |
|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | *Component: ANSP* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* |
| Integrity (I) | Malfunction = $10^{-5}$ per flight hour | Analysis, safety requirements, development assurance level commensurate with integrity level, (compliance shown prior to operational implementation). See related safety requirements SR-3 and SR-4 for the ANSP, CSP contract/service agreement, RCP integrity criteria for CSP, and 3.2.3 of this appendix. |

| *RCP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | *Component: ANSP* |
| *Ref:* | *Criteria* | *Means of compliance* |
| CMA-1<br>CMA-2 | *Note.— RCP monitoring and alerting criteria are specified by safety requirements allocated to the ANSP for SR-6.* | Review. |

| *RCP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component: ANSP* |
| *Ref:* | *Related RCP parameter* | *Safety requirement* | |
| SR-1 | A, C | a) The ANSP shall use the aircraft address to contact the aircraft;<br><br>b) the ANSP shall use 2/HGH/Q12 priority to contact the aircraft; and<br><br>c) the ANSP shall ensure that access number(s) support the commercial SATVOICE services (e.g. Inmarsat, MTSAT, Iridium) it provides in its airspace. | |
| SR-2 | A, C | a) The ANSP shall provide public switched phone telephone network (PSTN) phone numbers to SSP for short code assignments; and<br><br>b) the ANSP shall publish its SATVOICE number(s) (e.g. short code(s)) for its ATS units and aeronautical stations in aeronautical publications/charts. | |
| SR-3 | I | a) The ANSP shall establish procedures that use RTF conventions and provide training for the controller;<br><br>b) the ANSP shall ensure the SATVOICE system at its aeronautical stations and ATS units provide a DRT score of at least 85 when measured in accordance with ANSI/ASA S3.2-2009 in a jet transport aircraft noise environment; and<br><br>c) the ANSP shall ensure that its CSP maintains acceptable voice call quality for contracted SATVOICE services. | |
| SR-4 | A, C, I | a) The ANSP shall indicate to the radio operator/controller of detected SATVOICE equipment failure; and<br><br>b) the ANSP shall notify operators of service outages, degradation and restoration by NOTAM (or equivalent publication). | |
| SR-5 | C, ET | a) The ATS unit system shall indicate to the controller when a required response for a message sent by the ATS unit is not received within the required time ($ET_{RCMP}$). | |

| *RCP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component: ANSP* |
| *Ref:* | *Related RCP parameter* | *Safety requirement* | |
| SR-6 | All | a) The ANSP shall be capable of detecting failures and configuration changes that would cause the communication service to no longer meet the RCP specification for the intended uses; and<br><br>b) the ANSP shall ensure that when the communication service can no longer meet the RCP specification for the intended uses, the controller shall take appropriate action.<br><br>*Note.— Compliance with the RCP specification is determined by initial approvals of system components, compliance with safety requirements, means for the flight crew and controller to report problems, and for ANSPs to conduct post-implementation monitoring, analysis and corrective actions.* | |

3.2.3 *Communication services provider (CSP)*

| *RCP transaction time and continuity criteria* | | | | |
|---|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | | *Component: CSP* |
| *Transaction time parameter* | *ET (sec) C = 99.9%* | *IT (sec) C = 99%* | *TT (sec) C = 95%* | *Means of compliance* |
| RCTP time allocations | 44 | [Not defined] | 33 | Contract/service agreement terms. |
| $RCTP_{CSP}$<br>(S1 to S2) + (S7 to S8) | 10 | [Not defined] | 6 | Contract/service agreement terms. |
| $RCTP_{AS}$<br>(S2 to S3) + (S6 to S7) | 4 | [Not defined] | 2 | Contract/service agreement terms. |
| $RCTP_{G/A}$<br>(S4 to S5) | [Not defined] | 30 | 25 | Contract/service agreement terms.<br><br>*Note.— Criteria are shared between aircraft system, ground system and air-ground network.* |

| *RCP availability criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | *Component: CSP* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — CSP ($A_{CSP}$) | N/A | 0.999 | Contract/service agreement terms. |
| Unplanned outage duration limit (minutes) | N/A | 20 | Contract/service agreement terms. |
| Maximum number of unplanned outages | N/A | 24 | Contract/service agreement terms. |
| Maximum accumulated unplanned outages time (minutes/year) | N/A | 520 | Contract/service agreement terms. |
| Unplanned outage notification delay (minutes) | N/A | 10 | Contract/service agreement terms. |
| Grade of service | N/A | 1% | Contract/service agreement terms.<br><br>*Note.— This value is the same as that defined in Annex 10, Volume III.* |

| *RCP integrity criteria* | | |
|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | *Component: CSP* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* |
| Integrity (I) | [not defined] | Pre-implementation demonstration and contract/service agreement terms.<br><br>*Note.— RCP integrity criteria are specified by safety requirements allocated to the CSP for SR-3 and SR-4.* |

| *RCP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component: CSP* |
| *Ref:* | *Related RCP parameter* | *Safety requirement* | |
| SR-1 | A, C | The CSP shall ensure that the aircraft SATVOICE number is the aircraft address represented in octal code. | |

| *RCP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component: CSP* |
| *Ref:* | *Related RCP parameter* | *Safety requirement* | |
| SR-2 | A, C | a) The CSP shall assign a unique short code for each PSTN phone number; and<br><br>b) the CSP shall provide a means to distribute a SATVOICE number (e.g. short code, direct dial) directory to operators, ANSP and other stakeholders that subscribe to receive the directory. | |
| SR-3 | I | The CSP shall ensure the SATVOICE network provides a DRT score of at least 85 when measured in accordance with ANSI/ASA S3.2-2009 in a jet transport aircraft noise environment. | |
| SR-4 | A, C, I | a) The SSP shall notify its CSPs of outages, degradation and restoration; and<br><br>b) the CSP shall notify its subscribers (e.g. ANSPs, operators) of outages, degradation and restoration. | |
| SR-5 | C, ET | [Not applicable] | |
| SR-6 | All | The CSP shall provide notification to its ANSP and aircraft operator subscribers of any service impairment causing the SATVOICE service to no longer comply with the RCP specification. | |

3.2.4 *Aircraft system*

| *RCP transaction time and continuity criteria* | | | | |
|---|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | | *Component: Aircraft system* |
| *Transaction time parameter* | *ET (sec) C = 99.9%* | *IT (sec) C = 99%* | *TT (sec) C = 95%* | *Means of compliance* |
| *RCMP time allocations* | | | | |
| Answer/call performance (S5 to S7) | 175 | [Not defined] | 163 | Human-machine interface capability, pre-implementation demonstration. |
| *RCTP time allocations* | | | | |
| $RCTP_{G/A}$ (S4 to S5) | [Not defined] | 30 | 25 | Pre-implementation demonstration.<br><br>*Note.— Criteria are shared between aircraft system, ground system and air-ground network.* |

| *RCP availability criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | *Component: Aircraft system* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — aircraft ($A_{AIR}$) | N/A | 0.999 | Analysis, architecture, design, pre-implementation demonstration. |

| *RCP integrity criteria* | | |
|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | *Component: Aircraft system* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* |
| Integrity (I) | Malfunction = $10^{-3}$ per flight hour | Design approval of aircraft system. Analysis, safety requirements, development assurance level (e.g. Level D software), commensurate with integrity level, pre-implementation demonstration.<br><br>*Note.— RCP integrity criteria are specified by safety requirements allocated to the aircraft system for SR-3 and SR-4.* |

| *RCP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | *Component: Aircraft system* |
| *Ref:* | *Criteria* | *Means of compliance* |
| CMA-1<br>CMA-2 | *Note.— RCP monitoring and alerting criteria are specified by safety requirements allocated to the aircraft system for SR-6.* | Review. |

| *RCP-related safety requirements* | | |
|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | *Component: Aircraft system* |
| *Ref:* | *Related RCP parameter* | *Safety requirement* |
| SR-1 | A, C | The aircraft SATVOICE system shall be properly maintained to receive calls with 2/HGH/Q12 priority level and using the aircraft address represented in octal code. |

| *RCP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component: Aircraft system* |
| *Ref:* | *Related RCP parameter* | *Safety requirement* | |
| SR-2 | A, C | The aircraft SATVOICE system shall be operable prior to entering airspace where SATVOICE is used to meet LRCS requirements. | |
| SR-3 | I | The aircraft SATVOICE system shall provide a DRT score of at least 85 when measured in accordance with ANSI/ASA S3.2-2009 in a jet transport aircraft noise environment. | |
| SR-4 | A, C, I | The aircraft SATVOICE system shall detect logon failure and equipment failure and provide the appropriate indication to the flight crew. | |
| SR-5 | C, ET | [Not applicable] | |
| SR-6 | All | a) The aircraft SATVOICE system shall provide indication(s) for the flight crew to determine when the aircraft SATVOICE system or logon failures would cause the system to no longer comply with the RCP specification. | |

3.2.5 *Aircraft operator*

| *RCP transaction time and continuity criteria* | | | | |
|---|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | | *Component: Aircraft operator* |
| *Transaction time parameter* | *ET (sec) C = 99.9%* | *IT (sec) C = 99%* | *TT (sec) C = 95%* | *Means of compliance* |
| *RCMP time allocations* | | | | |
| Answer/call performance (S5 to S6) | 175 | [Not defined] | 163 | Procedural capability, flight crew training and qualifications in accordance with safety requirements. |
| *RCTP time allocations* | | | | |
| $RCTP_{G/A}$ (S4 to S5) | [Not defined] | 30 | 25 | CSP contract/service agreement, aircraft type design approval and maintenance. |

| *RCP availability criteria* | | | |
|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | *Component: Aircraft operator* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — aircraft ($A_{AIR}$) | N/A | 0.999 | Aircraft type design approval, maintenance and properly configured user-modifiable software (e.g. Owner Requirements Table (ORT). |
| Availability — CSP ($A_{CSP}$) | N/A | 0.999 | Contract/service agreement terms.<br><br>*Note.— For guidelines to aid in the development of the contract/service agreement with the CSP,RCP 400/D allocations to CSP for RCP availability criteria, see 3.2.3 of this appendix.* |

| *RCP integrity criteria* | | |
|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | *Component: Aircraft operator* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* |
| Integrity (I) | Malfunction = $10^{-5}$ per flight hour | Review of procedures, training programmes, and qualification to meet safety requirements. Design approval of aircraft SATVOICE system. CSP contract/service agreement.<br><br>*Note.— RCP integrity criteria are specified by safety requirements allocated to the aircraft operator for SR-3 and SR-4. See also RSP integrity criteria for the aircraft system, 3.2.4 of this appendix, and the CSP, 3.2.3 of this appendix.* |

| *RCP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | *Application: SATVOICE/RO* | *Component: Aircraft operator* |
| *Ref:* | *Criteria* | *Means of compliance* |
| CMA-1<br>CMA-2 | *Note.— RCP monitoring and alerting criteria are specified by safety requirements allocated to the aircraft system for SR-6.* | Review. |

| *RCP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RCP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component: Aircraft operator* |
| *Ref:* | *Related RCP parameter* | *Safety requirement* | |
| SR-1 | A, C | a) The aircraft operator shall file appropriate SATVOICE capability, the aircraft address and aircraft registration in the flight plan; and<br><br>b) the operator shall ensure that the phone number for the aircraft is activated by the CSP prior to return to service. | |
| SR-2 | A, C | a) The aircraft operator shall ensure that the flight crew has means to contact the appropriate ATS unit or aeronautical station for route of flight, where SATVOICE services are available; and<br><br>b) the aircraft operator shall ensure the flight crew uses 2/HGH/Q12 priority. | |
| SR-3 | I | a) The aircraft operator shall establish procedures that use RTF conventions and provide training for the flight crew; and<br><br>b) the aircraft operator shall ensure that its CSP maintains acceptable voice call quality for contracted SATVOICE services. | |
| SR-4 | A, C, I | The aircraft operator shall notify the flight crew of service outages, degradation, or restoration. | |
| SR-5 | C, ET | [Not applicable] | |
| SR-6 | All | The aircraft operator shall ensure that when the aircraft SATVOICE system fails such that it can no longer meet the RCP specification for the intended uses, the flight crew shall take appropriate action. | |

### 3.3 RCP 400/$V_{ATC}$ ALLOCATIONS

(reserved)

# Appendix C

# RSP SPECIFICATIONS

## 1. GENERAL

1.1 Required surveillance performance (RSP) specifications are mainly derived from a safety assessment. However, in cases where it has been determined to be beneficial, the RSP specifications may include criteria to support operational efficiency and orderly flow of air traffic. In these cases, the RSP specifications indicate the distinction between safety and efficiency.

1.2 In general, RSP specifications provide a means of compliance. Additional guidance related to service provision, aircraft approval and operational approval can be found in Chapter 4. Guidance and requirements on post-implementation monitoring can be found at Appendix D for controller-pilot data link communications (CPDLC) and automatic dependent surveillance — contract (ADS-C) and Appendix E for satellite voice communications (SATVOICE).

1.3 RSP specifications include allocations for CPDLC and SATVOICE via a radio operator. The /D designator is used to indicate the RSP allocations associated with ADS-C. The /$V_{RO}$ designator is used to indicate the RSP allocations associated with voice position reporting via a radio operator, while the /$V_{ATC}$ designator is reserved for those associated with position reporting direct to the controller.

1.4 RCP allocations are supplied for SATVOICE, when the intended use is to provide an intervention and/or surveillance capability in support of air traffic services (ATS), subject to a specified RSP. The RSP allocations for SATVOICE communications are based on the operational performance criteria for surveillance capability. As it is difficult to compare the actual performance of different technologies, the RSP 400 operational performance specification provides a common basis for assessing SATVOICE, ADS-C or any new technology that may emerge.

## 2. RSP 180 SPECIFICATION

| *RSP specification* | |
|---|---|
| *RSP specification* | *RSP 180* |
| *Airspace specific considerations* | |
| Interoperability | Specify interoperability criteria (e.g. FANS 1/A). |
| ATM operation | Specify ATM operation(s) (e.g. applicable separation standard). |
| Application | Specify the required surveillance capability. For ADS-C, specify the types of contracts required to support the ATM operation (e.g. ADS-C periodic interval, waypoint change event, lateral deviation event). |
| *RSP parameter values* | |

<table>
<tr><td colspan="5">RSP specification</td></tr>
<tr><td colspan="2">RSP specification</td><td colspan="3">RSP 180</td></tr>
<tr><td>Transit time (sec)</td><td>Continuity I</td><td>Availability (A)</td><td colspan="2">Integrity (I)</td></tr>
<tr><td>OT = 180</td><td>C(OT) = 0.999</td><td rowspan="3">0.999<br>0.9999<br>(efficiency)<br>see Note 3.</td><td>Navigation FOM</td><td>See Note 4.</td></tr>
<tr><td>DT = 90</td><td>C(DT) = 0.95</td><td>Time at position accuracy</td><td>+/- 1 sec (UTC)</td></tr>
<tr><td colspan="2"></td><td>Data integrity</td><td>Malfunction = $10^{-5}$ per flight hour</td></tr>
<tr><td colspan="5">RSP monitoring and alerting criteria</td></tr>
<tr><td>Ref:</td><td colspan="4">Criteria</td></tr>
<tr><td>MA-1</td><td colspan="4">The system shall be capable of detecting failures and configuration changes causing ADS-C to no longer meet the surveillance parameter values for the intended function.</td></tr>
<tr><td>MA-2</td><td colspan="4">When ADS-C can no longer meet the surveillance parameter values for the intended function, the flight crew and/or controller shall take appropriate action.</td></tr>
<tr><td colspan="5">Notes</td></tr>
<tr><td colspan="5">Note 1.— Rationale for the criteria provided in this specification can be found in Annex 11 — Air Traffic Services, Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM (Doc 4444)), , the Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689), and RTCA DO-306/EUROCAE ED-122.<br><br>Note 2.— If changes are made to the system capacity limits, as specified by the airspace requirements, and the changes cause the system to perform below the surveillance parameter values, this would be considered a change in system configuration.<br><br>Note 3.— RTCA DO-306/EUROCAE ED-122 specifies an availability value based on a safety assessment of the operational effects of the loss of the service. The availability value herein is more stringent, based on an additional need to maintain orderly and efficient operations.<br><br>Note 4.— The navigation figure of merit (FOM) is specified based on the navigation criteria associated with this specification. For example, if RNP 4 is prescribed, then for ADS-C surveillance service, the FOM level would need to be 4 or higher. In all cases, when the navigation capability no longer meets the criteria specified for the operation, the flight crew is responsible for reporting the non-compliance to ATC in accordance with ICAO procedures.</td></tr>
</table>

## 2.1 RSP 180/D allocations

2.1.1 *General*

2.1.1.1 The RSP 180/D allocations are applicable to the delivery of surveillance data via ADS-C. Figure C-1 provides these allocations, which are associated with surveillance data delivery time and continuity. Actual surveillance performance (ASP) is monitored from A to Z. The remaining allocations support initial compliance and problem investigation when ASP does not meet the specified criteria.

2.1.1.2 The RSP 180/D allocations are shared by the air navigation services provider (ANSP), the communication services provider (CSP), the aircraft system and the aircraft operator. The descriptions and assignments for these allocations, as shown in Figure C-1, are provided in Table C-1.

**Table C-1. RSP 180/D allocation descriptions and assignments**

| *RSP 180/D allocations* | *Description* | ANSP | CSP | Aircraft | Operator |
|---|---|---|---|---|---|
| RSMP | The maximum time against which ASP is assessed. | X | X | X | X |
| RSTP | The maximum technical time allocated to relevant parts of the ATS unit's system, aeronautical station's system, the network systems and the aircraft system, for which there is no human contribution to the surveillance data delivery performance. | | | | |
| ATSU system ($RSTP_{ATSU}$) | The maximum portion of RSTP allocated to the ATS unit's system. | X | | | |
| Network ($RSTP_{CSP}$) | The maximum portion of RSTP allocated to the CSP. | X | X | | X |
| Aircraft system ($RSTP_{AIR}$) | The maximum portion of RSTP allocated to the aircraft system. | | | X | |

2.1.2 *Air navigation services provider (ANSP)*

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | | *Component: ANSP* |
| *Data delivery time parameter* | *OT (sec) C = 99.9%* | *DT (sec) C = 95%* | *Means of compliance* |
| RSMP time allocation | 180 | 90 | Monitored. |
| RSTP time allocations | | | |

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | | *Component: ANSP* |
| *Data delivery time parameter* | *OT (sec)*<br>*C = 99.9%* | *DT (sec)*<br>*C = 95%* | *Means of compliance* |
| $RSTP_{ATSU}$<br>(D2 to Z) | 5 | 3 | Pre-implementation demonstration. |
| $RSTP_{CSP}$<br>(D1 to D2) | 170 | 84 | CSP contract/service agreement. See also 2.1.3 of this appendix. |

| *RSP availability criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | | *Component: ANSP* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — service ($A_{SERVICE}$) | 0.9999 | 0.999 | Contract/service agreement terms.<br><br>*Note 1.— For guidelines to aid in the development of the contract/service agreement with the CSP, see 2.1.3 of this appendix, RSP 180/D allocations to CSP for surveillance availability criteria.*<br><br>*Note 2.— The availability criteria are allocated entirely to $A_{CSP}$ and assume that the ATS unit's system is always available.* |

| *RSP integrity criteria* | | |
|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | *Component: ANSP* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* |
| Integrity (I) | Malfunction = $10^{-5}$ per flight hour | Analysis, safety requirements, development assurance level commensurate with integrity level, (compliance shown prior to operational implementation). See also related safety requirement SR-26 for the ANSP, CSP contract/service agreement. See also surveillance integrity criteria for CSP, 2.1.3 of this appendix. |

| *RSP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | *Component: ANSP* |
| *Ref:* | *Criteria* | *Means of compliance* |
| MA-1a | The ground system shall be capable of detecting ground system failures and configuration changes causing ADS-C to no longer meet the requirements for the intended function.<br><br>*Note.— If changes are made to the system capacity limits, as specified by the airspace requirements, and the changes cause the system to perform below the RSP specification, this would be considered a change in system configuration.* | System design, implementation. CSP contract/service agreement. See also 2.1.3 of this appendix, surveillance availability criteria. |
| MA-1b | When ADS-C no longer meets the requirements for the intended function, the ground system shall provide indication to the controller. | System design, implementation. CSP contract/service agreement. See also 2.1.3 of this appendix, surveillance availability criteria. |
| MA-2 | When the controller receives an indication that ADS-C no longer meets the requirements for the intended function (e.g. reduced longitudinal separation), the controller shall take action to resolve the situation, (e.g. apply an alternative form of separation). | System design, procedures, implementation. |

| *RSP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | | *Application: ADS-C* | *Component: ANSP* |
| *Ref:* | *Related surveillance parameter* | *Safety requirement* | |
| All | A, C, I | *Note.— Safety requirements related to RSP 180/D are identical to those for RCP 240/D, unless otherwise modified in this table. See Appendix B, 2.1.2.* | |

2.1.3 *Communication services provider (CSP)*

*Note.— The RSP allocations for the CSP are intended to aid the ANSP and the aircraft operator in the development of contracts and service agreements.*

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | | *Component: CSP* |
| *Data delivery time parameter* | *OT (sec)*<br>*C = 99.9%* | *DT (sec)*<br>*C = 95%* | *Means of compliance* |

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | | *Component: CSP* |
| *Data delivery time parameter* | *OT (sec)*<br>*C = 99.9%* | *DT (sec)*<br>*C = 95%* | *Means of compliance* |
| *RSTP time allocations* | | | |
| $RSTP_{CSP}$<br>(D1 to D2) | 170 | 84 | Contract/service agreement terms.<br>Pre-implementation demonstration. |

| *RSP availability criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | | *Component: CSP* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability – CSP ($A_{CSP}$) | 0.9999 | 0.999 | Contract/service agreement terms. |
| Unplanned outage duration limit (minutes) | 10 | 10 | Contract/service agreement terms. |
| Maximum number of unplanned outages | 4 | 48 | Contract/service agreement terms. |
| Maximum accumulated unplanned outages time (minutes/year) | 52 | 520 | Contract/service agreement terms. |
| Unplanned outage notification delay (minutes) | 5 | 5 | Contract/service agreement terms. |
| *Note.— The RSP availability criteria for RSP 180/D are the same as those provided for RCP 240/D. See Appendix B, 2.1.3.* | | | |

| *RSP integrity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | | *Application: ADS-C* | *Component: CSP* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* | |

| *RSP integrity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | | *Application: ADS-C* | *Component: CSP* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* | |
| Integrity (I) | Not specified | Contract/service agreement terms. As per surveillance-related safety requirements SR-26 for the ANSP and SR-26 for the aircraft system, the end system is required to include provisions, consistent with the overall data integrity criteria, to mitigate the effects of errors introduced by the network. These provisions require the network to pass protected information (or data) to the end system without manipulating the protected information (or data) it passes.<br><br>*Note.— In formulating contract terms with the CSP, the ANSP and/or operator may specify an integrity value and other related criteria, as appropriate, for the network, including subnetworks, that will ensure acceptable data integrity, consistent with the assumptions used to define the end system provisions (e.g. CRC or Fletcher's checksum).* | |

2.1.4 *Aircraft system*

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | | *Component: Aircraft system* |
| *Data delivery time parameter* | *OT (sec)*<br>*C = 99.9%* | *DT (sec)*<br>*C = 95%* | *Means of compliance* |
| *RSTP time allocations* | | | |
| $RSTP_{AIR}$<br>(A to D1) | 5 | 3 | Pre-implementation demonstration. |

| *RSP availability criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | | *Component: Aircraft system* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — aircraft ($A_{AIR}$) | N/A | 0.999 | Analysis, architecture, design, pre-implementation demonstration. |
| *Note.— The surveillance availability criteria for RSP 180/D are identical to those for RCP 240/D. See Appendix B, 2.1.4.* | | | |

| *RSP integrity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | | *Application: ADS-C* | *Component: Aircraft system* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* | |
| Integrity (I) | Malfunction = $10^{-5}$ per flight hour | Analysis, safety requirements, development assurance level (e.g. Level C software) commensurate with integrity level, pre-implementation demonstration. See also related safety requirement SR-26 for the aircraft system. | |

| *RSP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | *Component: Aircraft system* |
| *Ref:* | *Criteria* | *Means of compliance* |
| MA-1a | The aircraft system shall be capable of detecting aircraft system failures or loss of air/ground communication, causing the aircraft surveillance capability to no longer meet the requirements for the intended function. | System design, implementation. |
| MA-1b | When the aircraft surveillance capability no longer meets the requirements for the intended function, the aircraft system shall provide indication to the flight crew. | System design, implementation. |

| *RSP-related safety requirements* | | |
|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | *Component: Aircraft system* |
| *Ref:* | *Related surveillance parameter* | *Safety requirement* |
| All | A, C, I | *Note.— Safety requirements related to RSP 180/D are identical to those for RCP 240/D, unless otherwise modified in this table. See Appendix B, 2.1.4.* |

2.1.5 *Aircraft operator*

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | | *Component: Aircraft operator* |
| *Data delivery time parameter* | *OT (sec) C = 99.9%* | *DT (sec) C = 95%* | *Means of compliance* |
| *RSTP time allocations* | | | |

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | | *Component: Aircraft operator* |
| *Data delivery time parameter* | *OT (sec)*<br>*C = 99.9%* | *DT (sec)*<br>*C = 95%* | *Means of compliance* |
| $RSTP_{AIR}$<br>(A to D1) | 5 | 3 | Aircraft type design approval, maintenance, properly configured user-modifiable software (e.g. owner requirements table). |
| $RSTP_{CSP}$<br>(D1 to D2) | 170 | 84 | CSP contract/service agreement. See also 2.1.3 of this appendix. Pre-implementation demonstration. |

| *RSP availability criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | | *Component: Aircraft operator* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — aircraft ($A_{AIR}$) | N/A | 0.999 | Aircraft type design approval, maintenance, properly configured user-modifiable software (e.g. owner requirements table or airline policy file). |
| Availability — CSP ($A_{CSP}$) | 0.9999 | 0.999 | Contract/service agreement terms.<br><br>*Note.— For guidelines to aid in the development of the contract/service agreement with the CSP, see 2.1.3 of this appendix, RSP 180/D allocations to CSP for surveillance availability criteria.* |

| *RSP integrity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 180/D* | | *Application: ADS-C* | *Component: Aircraft operator* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* | |
| Integrity (I) | Malfunction = $10^{-5}$ | Aircraft type design approval, establish procedures, training, and qualification to meet safety requirements. CSP contract/service agreement. See also surveillance integrity criteria for CSP, see 2.1.3 of this appendix. | |

| *RSP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | *Component: Aircraft operator* |
| *Ref:* | *Criteria* | *Means of compliance* |
| MA-2 | When the flight crew determines that the aircraft surveillance capability no longer meets the requirements for the intended function, the flight crew shall advise the ATS unit concerned. | Procedures, flight crew training and qualification. |

| *RSP-related safety requirements* | | |
|---|---|---|
| *Specification: RSP 180/D* | *Application: ADS-C* | *Component: Aircraft operator* |
| *Ref:* | *Related surveillance parameter* | *Safety requirement* |
| All | C, I | *Note.— Safety requirements related to RSP 180/D are identical to those for RCP 240/D. See Appendix B, 2.1.5.* |

## 3. RSP 400 SPECIFICATION

| *RSP specification* | | | | |
|---|---|---|---|---|
| *RSP specification* | *RSP 400* | | | |
| *Airspace specific considerations* | | | | |
| Interoperability | Specify interoperability criteria (e.g. FANS 1/A or SATVOICE Iridium, Inmarsat, and/or MTSAT communications). | | | |
| ATM operation | Specify ATM operation(s) (e.g. use or required for applicable separation standard). | | | |
| Application | Specify the required surveillance capability. For position reporting, specify the ATM operation (e.g. ADS-C periodic interval, waypoint change event, lateral deviation event or SATVOICE via a radio operator). | | | |
| *Surveillance parameter values* | | | | |
| *Data delivery time (sec)* | *Continuity I* | *Availability (A)* | *Integrity (I)* | |
| OT = 400 | C(OT) = 0.999 | 0.999 | *Navigation FOM* | See Note 3. |
| DT = 300 | C(DT) = 0.95 | | *Time at position accuracy* | +/- 30 sec (UTC) |

| | | | | |
|---|---|---|---|---|
| | | | *Data integrity* | Malfunction = $10^{-5}$ per flight hour |

| *Surveillance monitoring and alerting criteria* | |
|---|---|
| *Ref:* | *Criteria* |
| SMA-1 | The system shall be capable of detecting failures and configuration changes causing the ADS-C or SATVOICE service to no longer meet the RSP parameter values for the intended function. |
| SMA-2 | When the ADS-C or SATVOICE service can no longer meet the RSP parameter values for the intended function, the flight crew and/or controller shall take appropriate action. |

*Notes*

*Note 1.— Rationale for the criteria provided in this specification can be found in Annex 11, Doc 4444, Doc 9689, and RTCA DO-306/EUROCAE ED-122.*

*Note 2.— If changes are made to the system capacity limits, as specified by the airspace requirements, and the changes cause the system to perform below the surveillance parameter values, this would be considered a change in system configuration.*

*Note 3.— The navigation figure of merit (FOM) is specified based on the associated navigation criteria . For example, if RNP 10 is prescribed, then for ADS-C surveillance service, the FOM level would need to be 3 or higher. In all cases, when the navigation capability no longer meets the criteria specified for the operation, the flight crew is responsible for reporting the non-compliance to ATC in accordance with ICAO procedures.*

## 3.1 RSP 400/D allocations

### 3.1.1 *General*

3.1.1.1 RSP 400/D allocations are applicable to the delivery of surveillance data via ADS-C. Figure C-2 provides these allocations associated with surveillance data delivery time and continuity. Actual surveillance performance (ASP) is monitored from A to Z. The remaining allocations support initial compliance and problem investigation when ASP does not meet the specified criteria.

3.1.1.2 RSP 400/D allocations are shared by the ANSP, the CSP, the aircraft system and the aircraft operator. The descriptions and assignments for these allocations, as shown in Figure C-2, are the same as the descriptions and assignments for the RSP 180/D allocations provided in Table C-1.

3.1.2 *Air navigation services provider (ANSP)*

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/D* | *Application: ADS-C* | | *Component: ANSP* |
| *Data delivery time parameter* | *OT (sec)*<br>*C = 99.9%* | *DT (sec)*<br>*C = 95%* | *Means of compliance* |
| *RSMP time allocation* | 400 | 300 | Monitored. |
| *RSMP/RSTP time allocations* | | | |
| RSTPATSU<br>(D2 to Z) | 30 | 15 | Pre-implementation demonstration. |
| RSTPCSP<br>(D1 to D2) | 340 | 270 | CSP contract/service agreement.<br>See also 3.1.3 of this appendix. |

| *RSP availability criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/D* | *Application: ADS-C* | | *Component: ANSP* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — service ($A_{SERVICE}$) | N/A | 0.999 | Contract/service agreement terms.<br><br>*Note 1.— For guidelines to aid in the development of the contract/service agreement with the CSP, see 3.1.3 of this appendix, RSP 180/D allocations to CSP for surveillance availability criteria.*<br><br>*Note 2. — The availability criteria are allocated entirely to $A_{CSP}$ and assume that the ATS unit's system is always available*. |

*Note.— The RSP integrity criteria, monitoring and alerting criteria, and related safety requirements for RSP 400/D are the same as the criteria provided for RSP 180/D. See 2.1.2 of this appendix.*

3.1.3 *Communication services provider (CSP)*

*Note.— The RSP allocations for the CSP are intended to aid the ANSP and the aircraft operator in the development of contracts and service agreements.*

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/D* | *Application: ADS-C* | | *Component: CSP* |
| *Data delivery time parameter* | *OT (sec)*<br>*C = 99.9%* | *DT (sec)*<br>*C = 95%* | *Means of compliance* |
| *RSTP time allocations* | | | |
| $RSTP_{CSP}$<br>(D1 to D2) | 340 | 270 | Contract/service agreement terms.<br>Pre-implementation demonstration. |

| *RSP availability criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/D* | *Application: ADS-C* | | *Component: CSP* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — CSP ($A_{CSP}$) | N/A | 0.999 | Contract/service agreement terms. |
| Unplanned outage duration limit (minutes). | N/A | 20 | Contract/service agreement terms. |
| Maximum number of unplanned outages. | N/A | 24 | Contract/service agreement terms. |
| Maximum accumulated unplanned outages time (minutes/year). | N/A | 520 | Contract/service agreement terms. |
| Unplanned outage notification delay (minutes). | N/A | 10 | Contract/service agreement terms. |
| *Note.— The RSP availability criteria for RSP 400/D are identical to those for RCP 400/D. See Appendix B, 3.1.3.* | | | |

| *RSP integrity criteria* | | |
|---|---|---|
| *Specification: RSP 400/D* | *Application: ADS-C* | *Component: CSP* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* |
| Integrity (I) | *Note.— RSP integrity criteria related to RSP 400/D are identical to those for RSP 180/D. See2.1.4 of this appendix.* | |

3.1.4 *Aircraft system*

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/D* | *Application: ADS-C* | | *Component: Aircraft system* |
| *Data delivery time parameter* | *OT (sec)*<br>*C = 99.9%* | *DT (sec)*<br>*C = 95%* | *Means of compliance* |
| *RSTP time allocations* | | | |
| $RSTP_{AIR}$<br>(A to D1) | 30 | 15 | Pre-implementation demonstration. |

*Note.— The RSP availability, integrity and monitoring and alerting criteria, and related safety requirements for RSP 400/D are identical to the criteria and related safety requirements provided for RSP 180/D. See 2.1.4 of this appendix.*

3.1.5 *Aircraft operator*

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/D* | *Application: ADS-C* | | *Component: Aircraft operator* |
| *Data delivery time parameter* | *OT (sec)*<br>*C = 99.9%* | *DT (sec)*<br>*C = 95%* | *Means of compliance* |
| *RSTP time allocations* | | | |
| $RSTP_{AIR}$<br>(A to D1) | 30 | 15 | Aircraft type design approval, maintenance, properly configured user-modifiable software (e.g. owner requirements table). |
| $RSTP_{CSP}$<br>(D1 to D2) | 340 | 270 | CSP contract/service agreement. See also 3.1.3 of this appendix.<br>Pre-implementation demonstration. |

*Note.— The RSP availability, integrity and monitoring and alerting criteria, and related safety requirements for RSP 400/D are identical to the criteria and related safety requirements provided for RSP 180/D. See 2.1.5 of this appendix.*

## 3.2 RSP 400/$V_{RO}$ allocations

3.2.1 *General*

3.2.1.1 RSP 400/$V_{RO}$ allocations are applicable to the delivery of surveillance data via a radio operator using SATVOICE. Figure C-3 provides these allocations associated with surveillance data delivery time and continuity. The time taken for the surveillance data upon receipt is shown by analysis. Actual surveillance performance (ASP) is

monitored from A to S7. The remaining allocations support initial compliance and problem investigation when ASP does not meet the specified criteria.

3.2.1.2 The RSP 400/$V_{RO}$ allocations are shared by the ANSP, the CSP, the aircraft system and the aircraft operator. The descriptions and assignments for these allocations, as shown in Figure C-3, are provided in Table C-2.

**Table C-2. RSP 400/$V_{RO}$ allocation descriptions and assignments**

| *RSP 400/$V_{RO}$ Allocations* | *Description* | ANSP | CSP | Aircraft | Operator |
|---|---|---|---|---|---|
| RSMP | The maximum time against which ASP is assessed. | X | X | X | X |
| Flight crew (initiator performance) | The maximum time allocated to the flight crew for the preparation of a position report, from the time the aircraft was over its compulsory reporting point to when the call is initiated. | | | X | X |
| Answer performance | The maximum time allocated to when the ground user receives an indication of an incoming call to when the ground user accepts the call. | X | X | | |
| Call performance (air-to-ground) | The maximum time allocated to when the ground user accepts an incoming call to when the parties on the call have completed the communication.<br><br>*Note.— The call is complete when the radio operator sends the surveillance data to the ATS unit.* | X | X | X | X |
| RSTP | The maximum technical time allocated to relevant parts of the ATS unit's system, aeronautical station's system, network systems and aircraft system, for which there is no human contribution to the surveillance data delivery performance. | X | X | X | X |
| RSTP (air-to-ground) ($RSTP_{A/G}$) | The maximum portion of RSTP time allocated to the ground system, network and aircraft system to set up an air-to-ground call as determined from when the last digit of the dialling sequence is finished to when the ground system indicates an incoming call to the receiving party. | | X | X | |
| RSTP (ground-to-ground) | The maximum portion of RSTP allocated to the ATS unit's system, ground-to-ground network, and aeronautical station's system for ground-ground communications. | X | X | | |
| ATSU system ($RSTP_{ATSU}$) | The maximum portion of RSTP time allocated to the ATS unit's system. | X | | | |
| Network ($RSTP_{CSP}$) | The maximum portion of RSTP time allocated to the CSP. | X | X | | X |

| *RSP 400/$V_{RO}$ Allocations* | *Description* | ANSP | CSP | Aircraft | Operator |
|---|---|---|---|---|---|
| Aero station system ($RSTP_{AS}$) | Maximum portion of RSTP allocated to the aeronautical station's system for ground-to-ground communications with an ATS unit.<br><br>*Note.— $RSTP_{AS}$ includes two concurrent processes:*<br><br>a) the aircraft and aeronautical station technically disconnect the call; which is assumed. Operationally, the call is disconnected when the flight crew and radio operator complete the call; and<br><br>b) the aeronautical station sends the surveillance data to the ATS unit via the ground-ground network; the performance is denoted by $RCTP_{AS}$. | X | X | | |

3.2.1.3 Measurements for assessing ACP/continuity include disconnected or dropped calls, e.g. aircraft manoeuvres or switching satellites, or busy conditions. They would also include loss of service while on the call if the service outage is less than the maximum unplanned outage duration limit. If the outage is greater than the maximum unplanned outage duration limit, these calls would be excluded from ACP/continuity measurements, because they would be considered as part of SATVOICE service availability.

3.2.1.4 SATVOICE service availability includes failures prohibiting the call to be initiated or congestion (much like a terrestrial mobile phone network). Measurements for assessing SATVOICE service availability would not include any calls associated with the measurements for ACP/continuity.

3.2.1.5 SATVOICE integrity includes an assessment, such as a diagnostic rhyme test (DRT), of the intelligibility of the voice transaction and the extent to which the parties could potentially misunderstand the communication.

| *Ref:* | *RSP safety requirements* |
|---|---|
| All | Safety requirements for RSP 400/$V_{RO}$ are identical to those for RCP 400/$V_{RO}$ (See Appendix B, 3.2.1.6). |

3.2.2 *Air navigation services provider (ANSP)*

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | *Component: ANSP* |
| *Data delivery time parameter* | *OT (sec)*<br>*C = 99.9%* | *DT (sec)*<br>*C = 95%* | *Means of compliance* |
| Recipient performance (verify data) (S7 to Z) | 15 | 10 | Initially, by analysis, simulations, safety human factors assessments. |
| RSMP time allocation | 385 | 290 | Monitored. |

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | *Component: ANSP* |
| *Data delivery time parameter* | *OT (sec) C = 99.9%* | *DT (sec) C = 95%* | *Means of compliance* |
| Answer performance (H to I) | 46 | 25 | Initially, by analysis, simulations, safety human factors assessments. |
| Call performance (I to J) | 120 | 85 | Initially, by analysis, simulations, safety human factors assessments. |
| *RSTP time allocations* | | | |
| $RSTP_{ATSU}$ (S6 to S7) | 2 | 1 | Pre-implementation demonstration. |
| $RSTP_{A/G}$ (S1 to S2) | 15 | 10 | Estimated, CSP contract/service agreement. See 3.2.3 of this appendix. |
| RSTP (ground-to-ground) (S4 to S7) | 9 | 5 | Estimated, CSP contract/service agreement. See 3.2.3 of this appendix. |

| *RSP availability criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | *Component: ANSP* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — service ($A_{SERVICE}$) | N/A | 0.999 | Contract/service agreement terms.<br><br>*Note 1.— For guidelines to aid in the development of the contract/service agreement with the CSP, see 3.2.3 of this appendix, RSP 400/$V_{RO}$ allocations to CSP for RSP availability criteria.*<br><br>*Note 2.— The availability criteria are allocated entirely to $A_{CSP}$ and assume that the ATS unit's system is always available.* |

| *RSP integrity criteria* | | |
|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | *Application: SATVOICE/RO* | *Component: ANSP* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* |
| Integrity (I) | Malfunction = $10^{-5}$ per flight hour | Analysis, safety requirements, development assurance level commensurate with integrity level, (compliance shown prior to operational implementation). See related safety requirements SR-3 and SR-4 for the ANSP, CSP contract/service agreement, and RSP integrity criteria for CSP, 3.2.3 of this appendix. |

| *RSP monitoring and alerting criteria* | | |
|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | *Application: SATVOICE/RO* | *Component: ANSP* |
| *Ref:* | *Criteria* | *Means of compliance* |
| SMA-1<br>SMA-2 | *Note.— RSP monitoring and alerting criteria are specified by safety requirements allocated to the ANSP for SR-6.* | Review. |

| *RSP-related safety requirements* | | |
|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | *Application: SATVOICE/RO* | *Component: ANSP* |
| *Ref:* | *Related RSP parameter* | *Safety requirement* |
| All | A, C, I, ET | *Note.— Safety requirements related to RSP 400/$V_{RO}$ are identical to those for RCP 400/$V_{RO}$. See Appendix B, 3.2.2.* |

3.2.3 *Communication services provider (CSP)*

| *RSP data delivery time and continuity criteria* | | | | |
|---|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | | *Component: CSP* |
| *Data delivery time parameter* | *OT (sec)*<br>*C = 99.9%* | *IT (sec)*<br>*C = 99%* | *DT (sec)*<br>*C = 95%* | *Means of compliance* |
| *RSTP time allocations* | | | | |

| *RSP data delivery time and continuity criteria* | | | | |
|---|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | | *Component: CSP* |
| *Data delivery time parameter* | *OT (sec) C = 99.9%* | *IT (sec) C = 99%* | *DT (sec) C = 95%* | *Means of compliance* |
| $RSTP_{A/G}$ (S1 to S2) | [Not defined] | 15 | 10 | Pre-implementation demonstration. |
| $RSTP_{AS}$ (S4 to S5) | 2 | [not defined] | 1 | Pre-implementation demonstration. |
| $RSTP_{CSP}$ (S5 to S6) | 5 | [not defined] | 3 | Contract/service agreement terms. Pre-implementation demonstration. |

| *RSP availability criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | *Component: CSP* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — CSP ($A_{CSP}$) | N/A | 0.999 | Contract/service agreement terms. |
| Unplanned outage duration limit (minutes). | N/A | 20 | Contract/service agreement terms. |
| Maximum number of unplanned outages. | N/A | 24 | Contract/service agreement terms. |
| Maximum accumulated unplanned outages time (minutes/year). | N/A | 520 | Contract/service agreement terms. |
| Unplanned outage notification delay (minutes). | N/A | 10 | Contract/service agreement terms. |
| Grade of service | N/A | 1% | Contract/service agreement terms.<br><br>*Note.— This value is identical to the definition in Annex 10, Volume III.* |
| *Note.— The RSP 400/$V_{RO}$ availability are identical to those for RCP 400/$V_{RO}$. See Appendix B, 3.2.3.* | | | |

| *RSP integrity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component: CSP* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* | |
| Integrity (I) | [Not defined] | Pre-implementation demonstration and contract/service agreement terms.<br><br>*Note.— RSP integrity criteria are specified by safety requirements allocated to the CSP for SR-3 and SR-4.* | |

| *RSP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component: CSP* |
| *Ref:* | *Related RSP parameter* | *Safety requirement* | |
| All | A, C, I | *Note.— Safety requirements related to RSP 400/$V_{RO}$ are identical to those for RCP 400/$V_{RO}$. See Appendix B, 3.2.3.* | |

3.2.4 *Aircraft system*

| *RSP data delivery time and continuity criteria* | | | | |
|---|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | | *Component: Aircraft system* |
| *Data delivery time parameter* | *OT (sec) C = 99.9%* | *IT (sec) C = 99%* | *DT (sec) C = 95%* | *Means of compliance* |
| *RSMP time allocations* | | | | |
| Call performance (S3 to S4) | 120 | [Not defined] | 85 | Human-machine interface capability, pre-implementation demonstration. |
| *RSTP time allocations* | | | | |
| $RSTP_{A/G}$ (S1 to S2) | [Not defined] | 15 | 10 | Pre-implementation demonstration. |

| *RSP availability criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | *Component: Aircraft system* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — aircraft ($A_{AIR}$) | N/A | 0.999 | Analysis, architecture, design, pre-implementation demonstration. |
| *Note.— The RSP availability criteria for RSP 400/$V_{RO}$ are identical to those for RCP 400/$V_{RO}$. See Appendix B, 3.2.4.* | | | |

| *RSP integrity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component: Aircraft system* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* | |
| Integrity (I) | Malfunction = $10^{-3}$ per flight hour | Design approval of aircraft system. Analysis, safety requirements, development assurance level (e.g. Level D software), commensurate with integrity level, pre-implementation demonstration.<br><br>*Note.— RCP integrity criteria are specified by safety requirements allocated to the aircraft system for SR-3 and SR-4.* | |

| *RSP monitoring and alerting criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component: Aircraft system* |
| *Ref:* | *Criteria* | | *Means of compliance* |
| SMA-1<br>SMA-2 | *Note.— RSP monitoring and alerting criteria are specified by safety requirements allocated to the ANSP for SR-6.* | | Review. |

| *RSP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component: Aircraft system* |
| *Ref:* | *Related RSP parameter* | *Safety requirement* | |
| All | A, C, I | *Note.— Safety requirements related to RSP 400/$V_{RO}$ are identical to those for RCP 400/$V_{RO}$. See Appendix B, B.3.2.4.* | |

3.2.5 *Aircraft operator*

| *RSP data delivery time and continuity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | *Component: Aircraft operator* |
| *Data delivery time parameter* | *OT (sec) C = 99.9%* | *DT (sec) C = 95%* | *Means of compliance* |
| Initiator performance (A to G) | 195 | 165 | Procedural capability, flight crew training and qualifications in accordance with safety requirements. |
| Call performance (I to J) | 120 | 85 | Contract/service agreement terms, pre-implementation demonstration. |
| $RSTP_{A/G}$ (G to H) | 15 | 10 | Pre-implementation demonstration. |

| *RSP availability criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | *Application: SATVOICE/RO* | | *Component: Aircraft operator* |
| *Availability parameter* | *Efficiency* | *Safety* | *Means of compliance* |
| Availability — aircraft ($A_{AIR}$) | N/A | 0.999 | Aircraft type design approval, maintenance and properly configured user-modifiable software (e.g. Owner Requirement Table (ORT). |
| Availability — CSP ($A_{CSP}$) | N/A | 0.999 | Contract/service agreement terms.<br><br>*Note.— For guidelines to aid in the development of the contract/service agreement with the CSP, see 3.2.3 of this appendix, RSP 400/$V_{RO}$ allocations to CSP for RSP availability criteria.* |

| *RSP integrity criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component Aircraft operator* |
| *Integrity parameter* | *Integrity value* | *Means of compliance* | |
| Integrity (I) | Malfunction = $10^{-5}$ per flight hour | Review of procedures, training programmes, and qualifications to meet safety requirements. Design approval of aircraft SATVOICE system. CSP contract/service agreement.<br><br>*Note.— RSP integrity criteria are specified by safety requirements allocated to the aircraft operator for SR-3 and SR-4. See also RSP integrity criteria for the aircraft system, 3.2.4 of this appendix, and the CSP, 3.2.3 of this appendix.* | |

| *RSP monitoring and alerting criteria* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component: Aircraft operator* |
| *Ref:* | *Criteria* | | *Means of compliance* |
| SMA-1<br>SMA-2 | *Note.— RSP monitoring and alerting criteria are specified by safety requirements allocated to the ANSP for SR-6.* | | Review. |

| *RSP-related safety requirements* | | | |
|---|---|---|---|
| *Specification: RSP 400/$V_{RO}$* | | *Application: SATVOICE/RO* | *Component: Aircraft operator* |
| *Ref:* | *Related RSP Parameter* | *Safety requirement* | |
| All | A, C, I | *Note.— Safety requirements related to RSP 400/$V_{RO}$ are identical to those for RCP 400/$V_{RO}$. See Appendix B, 3.2.5.* | |

### 3.3 RSP 400/$V_{ATC}$ allocations

(reserved)

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# Appendix D

# Post-implementation monitoring and corrective action (CPDLC and ADS-C)

## 1. GENERAL

1.1 This appendix provides guidance additional to that provided in Chapter 4, for local and regional performance-based communication and surveillance (PBCS) monitoring programmes. It contains the post-implementation guidance material relevant to controller-pilot data link communications (CPDLC) and automatic dependent surveillance — contract (ADS-C) for which the required communication performance (RCP)/required surveillance performance (RSP) specifications provided in Appendices B and C are applicable, including:

a) air navigation services provider (ANSP) data collection — this section defines a common data reporting format, providing guidance on how to obtain the necessary data points;

b) ANSP monitoring and analysis — this section contains guidance on data analysis, including recommended filtering for completeness of monitoring;

c) regional performance monitoring and analysis — this section provides guidance on monitoring at a regional level; and

d) problem reporting and resolution — this section provides guidance on the process for problem identification and resolution.

## 2. ANSP DATA COLLECTION

### 2.1 ANSP data collection for CPDLC transaction time/continuity

2.1.1 *General*

2.1.1.1 This section provides guidance on data collection and performance measurement for the CPDLC application. CPDLC analysis is based on the measurement of actual communication performance (ACP) against required communication monitored performance (RCMP), actual communications technical performance (ACTP) against required communication technical performance (RCTP), and pilot operational response time (PORT) against RCP PORT.

2.1.1.2 While each ANSP may store the data using a database, for the purpose of sharing CPDLC transaction data (e.g. with the regional monitoring entity for regional analysis), the data should be sent as a comma delimited text file. The format for each record will contain, at a minimum, the 20 data points specified below in Table D-1.

2.1.1.3 In addition to monitoring data communications performance as described below, it is suggested that the ANSP conduct a regular analysis of message use statistics for the current CPDLC message set for the development of future CPDLC applications.

2.1.1.4 The CPDLC data set is comprised of controller-initiated transactions. Specifically, the subset of CPDLC uplinks that receive a single DM 0 WILCO response is used. The transactions in which an uplink receives DM 1 UNABLE, DM 2 STANDBY, DM 3 ROGER, DM 4 AFFIRM, DM 5 NEGATIVE responses are not considered. A DM 0 WILCO response following a DM 2 STANDBY is also not measured.

2.1.2 *Recording data points for each CPDLC transaction*

2.1.2.1 The data points shown in Table D-1 are recommended as the minimum set to be extracted by the ANSP from CPDLC system recordings, to provide sufficient information for RCP analysis and problem investigation. Additional data points that may be extracted for more detailed analysis are listed in Table D-1 below.

2.1.2.2 Most of the data points may be extracted from either the ACARS, ATN B1 header, CPDLC application message, or calculated based on the other data points. However, the aircraft type and operator must be matched to each record from a separate database, using the aircraft registration as the common point.

2.1.2.3 The methods for calculating the ACTP, ACP and PORT are described in 2.1.3 of this appendix.

**Table D-1. CPDLC data collection points**

| *Ref* | *Label* | *Description and/or remarks* |
|---|---|---|
| 1 | ANSP | Four-letter ICAO designator of the facility (e.g. NZZO). |
| 2 | Aircraft registration (FANS 1/A) | Aircraft registration in *Procedures for Air Navigation Services — Air Traffic Management (*PANS-ATM, Doc 4444) format (no hyphens, extraneous characters, etc.) (e.g. N104UA).<br><br>*Note.— Extracted from ACARS header or application message.* |
| 2 | Aircraft address (ATNB1) | 24-bit address in Doc 4444 format (alphanumerical character, in six hexadecimals).<br><br>*Note.— Extracted from CM application message*. |
| 3 | Aircraft type designator | ICAO aircraft type designator (e.g. B744).<br><br>*Note.— Extracted from the ANSP's database using aircraft registration as key. Aircraft type designators are contained in Doc 8643.* |
| 4 | Operator designator | ICAO designator for the aircraft operating agency (e.g. UAL).<br><br>*Note.— Extracted from the ANSP's database using aircraft registration as key.* |
| 5 | Date | In YYYYMMDD format (e.g. 20081114).<br><br>*Note.— Extracted from the ANSP's system data recording timestamp.* |
| 6 | MAS RGS | RGS designator from which the MAS downlink was received.<br><br>*Note.— This is a 3- or 4-letter designator extracted from the second field of the ACARS header DT line (e.g. DT DDL **POR1** 121212 M01A).* |

| *Ref* | *Label* | *Description and/or remarks* |
|---|---|---|
| 7 | OPS RGS | RGS designator from which the operational response was received.<br><br>*Note.— This is a 3 or 4 letter designator extracted from second field of the ACARS header DT line (e.g. DT DDL **AKL1** 121212 M01A).* |
| 8 | Uplink time | Timestamp on the uplink CPDLC message sent by the ANSP in HH:MM:SS format (e.g. 03:43:25).<br><br>*Note.— Extracted from the ANSP system data recording timestamp.* |
| 9 | MAS/LACK receipt time | ANSP timestamp on receipt of the MAS/LACK in HH:MM:SS format (e.g. 03:43:35).<br><br>*Note.— Extracted from the ANSP system data recording timestamp.* |
| 10 | MAS/LACK round trip time | In seconds (#9-#8) (e.g. 10). |
| 11 | Aircraft FMS timestamp | In the operational response messages in HH:MM:SS (e.g. 03:44:15).<br><br>*Note.— For FANS 1/A, extracted from the ATCmessageHeader timestamp in the decoded operational response message. See RTCA DO-258AEUROCAE ED-100A section 4.6.3.3.* |
| 12 | ANSP timestamp on the receipt of the operational response | In HH:MM:SS format (e.g. 03:44:45).<br><br>*Note.— Extracted from the ANSP system data recording timestamp.* |
| 13 | Operational message round-trip time | From sending uplink (#8) to receipt of operational response (#12) in seconds (e.g. 80). |
| 14 | Downlink response transit time | In seconds (#12-#11) (e.g. 30). |
| 15 | Uplink message elements | All uplink message element identifiers preceded by U encapsulated between quotation marks with a space between each element (e.g. “U118 U80”).<br><br>*Note.— Extracted from the decoded operational uplink that initiated the transaction.* |
| 16 | Downlink message elements | All downlink message elements encapsulated between quotation marks with a space between each element, if required (e.g. “D0”).<br><br>*Note.— Extracted from the decoded operational downlink.* |
| 17 | ACTP | Actual communication technical performance in seconds (e.g. 35).<br><br>*Note.— Truncated to whole seconds.* |
| 18 | ACP | Actual communications performance in seconds measured as the difference between the time uplink is sent (#8) and the time the operational response is received (#12) (e.g. 80). |

| *Ref* | *Label* | *Description and/or remarks* |
|---|---|---|
| 19 | PORT | Pilot operational response time = ACP (#18) – ACTP (#17) (e.g. 45).<br><br>*Note.— Implementers should allow for negative values where the operational response is received before the MAS as per above. When graphing, PORT negative values should be counted as 0.* |

2.1.2.4 In comma delimited text file format, these data points would appear as follows:

NZZO,N104UA,B744,UAL,20081114,POR1,AKL1,03:43:25,03:43:35,10,03:44:15,03:44:45,80,30,"U118 U80","D0",35,80,45

2.1.3 *Calculating ACP, ACTP and PORT*

2.1.3.1 The ACP is calculated by measuring the difference between the time when the uplink message originates from the ANSP and the time when the corresponding response downlink is received by the ANSP.

2.1.3.2 The ACTP is obtained by calculating the difference between the downlink's aircraft timestamp and the received time, and adding it to half the round trip time, determined by the difference between the uplink time when the message is sent from the ANSP and the receipt of the MAS response for the uplink at the ANSP ((uplink transmission time — MAS receipt)/2 + downlink time).

2.1.3.3 The PORT is estimated by measuring the difference between ACP and ACTP. Figure D-1 illustrates how these measurements are calculated.

2.1.3.4 The values for ACTP and PORT are approximations. The assumption that the uplink transit times are half of the MAS/LACK response round trip time is flawed in a small percentage of cases, because it is possible for the MAS to be received at the ANSP after the operational response is received; or for the timestamp on the operational response to be earlier than the MAS receipt time. This happens if:

a) the CSP does not hear the network ACK from the aircraft (which is sent on uplink receipt) and resends the uplink later;

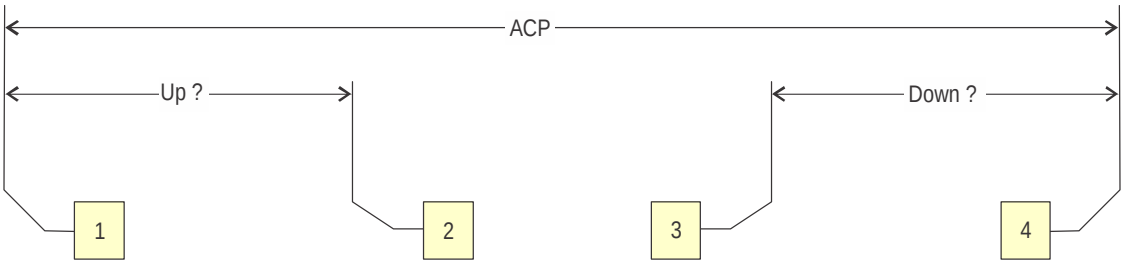
b) the CSP receives the network ACK from the aircraft (which is sent on uplink receipt) and resends the uplink later; and

c) the CSP receives the network ACK to this second uplink and sends the MAS to the ANSP.

2.1.3.5 In the meantime, the aircraft has already responded with the operational response. The ANSP will see this issue reflected in their data with crew response times with negative or extremely small values.

2.1.3.6 Therefore, **all transactions with zero or negative crew response times should be filtered from data prior to analysis**. The time sequence diagram below in Figure D-2 illustrates the issue. Additional errors may arise if there are delays between the ANSP and the CSP on the uplink path. These delays will result in excessive calculated PORT and skewed ACP.

2.1.3.7 The ANSP may find the following additional data points useful for further CPDLC performance analysis, reported problem investigation and other analysis support, such as from monitoring the application of performance-based horizontal separation minima:




| | | |
|---|---|---|
| 1 | Uplink sent | Date/time ATSU sent CPDLC clearance to the aircraft |
| 2 | MAS received | Date/time ATSU receives the MAS for the CPDLC clearance |
| 3 | WILCO sent | Date/time aircraft sends WILCO response for the CPDLC clearance |
| 4 | WILCO received | Date/time ATSU receives WILCO response for the CPDLC clearance |

The measurements (in seconds) are calculated as follows:

ACP = (WILCO received) – (Uplink sent) → **RCMP**

$$\text{ACTP} \cong \left( \left( \frac{\text{Up ?}}{2} \right) + (\text{Down ?}) \right) \rightarrow \textbf{RCTP}$$

PORT ≅ ACP – ACTP → **RCP PORT**

**Figure D-1. CPDLC transaction calculations**

a) the aircraft call sign extracted from either the flight plan (e.g. ANZ123) or the logon request message for the flight (e.g. NZ123) or the FI line in the ACARS header (e.g. NZ0123);

b) direction of flight calculated by the flight data processor and displayed as a three figure group representing degrees true (e.g. 275);

c) the estimated position in latitude and longitude of the aircraft when a CPDLC downlink is sent and calculated by the flight data processor. For consistency, the following formats are recommended: for latitude use “+” for North and “-” for South followed by a decimal number of degrees (e.g. -33.456732). For longitude use “+” for East and “-” for West followed by a decimal number of degrees (e.g. +173.276554);

d) the communication type (COMTYP) identifying the media used for delivering CPDLC uplink and downlink messages. This is determined based on the MAS RGS field (#6) and OPS RGS field (#7). Table D-2 lists the nine possible entries for COMTYP: SAT, VHF, HF, SV, SH, VS, VH, HS, HV; and

e) the regional monitoring entity should consider promulgating a list of RGS designators applicable to their respective region.

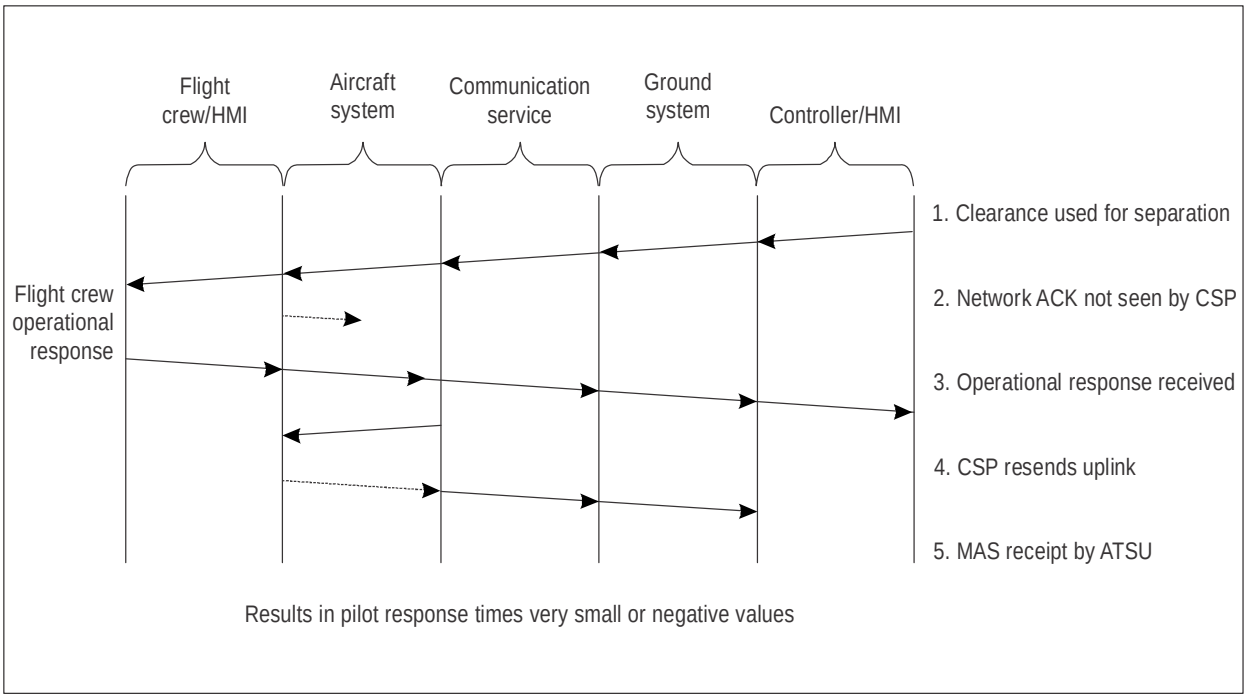



**Figure D-2. Issue with estimating uplink transit time as half MAS round trip**

**Table D-2. Determination of COMTYP indicators**

| *MAS RGS communication type* | *OPS RGS communication type* | *COMTYP* |
|---|---|---|
| SAT (e.g. MAS RGS = POR1) | SAT (e.g. OPS RGS = POR1) | SAT |
| VHF (e.g. MAS RGS = ADK) | VHF (e.g. OPS RGS = ADK) | VHF |
| HF (e.g. MAS RGS = H02) | HF (e.g. OPS RGS = H02) | HF |
| SAT (e.g. MAS RGS = POR1) | VHF (e.g. OPS RGS = ADK) | SV |
| SAT (e.g. MAS RGS = POR1) | HF (e.g. OPS RGS = H02) | SH |
| VHF (e.g. MAS RGS = ADK) | SAT (e.g. OPS RGS = POR1) | VS |
| VHF (e.g. MAS RGS = ADK) | HF (e.g. OPS RGS = H02) | VH |
| HF (e.g. MAS RGS = H02) | VHF (e.g. OPS RGS = ADK) | HV |
| HF (e.g. MAS RGS = H02) | SAT (e.g. OPS RGS = POR1) | HS |

### 2.2 ANSP data collection for ADS-C report delivery time/continuity

2.2.1 *General*

2.2.1.1 This section provides guidance on data collection and performance measurement for the ADS-C application. The ADS-C analysis is based on the measurement of actual surveillance performance (ASP), against the required surveillance performance (RSP). The ASP is the measurement of the difference between the time extracted from the decoded ADS-C basic group timestamp (i.e. time at position) and the time the ADS-C report is received at the ANSP.

2.2.1.2 While each ANSP may store the data using a database, for the purpose of sharing ADS-C transaction data (e.g. with the regional monitoring entity for regional analysis), the data should be sent as a comma delimited text file. The format for each record will contain, at a minimum, the 12 data points specified below in Table D-3.

2.2.2 *Recording data points for each ADS-C report*

2.2.2.1 The data points shown in Table D-3 are recommended as the minimum set to be extracted by the ANSP from ADS-C system recordings, to provide sufficient information for ASP analysis and problem investigation. Additional data points that may be extracted for more detailed analysis are listed in Table D-3 below. Most of the data points can be extracted from either the ACARS header or the ADS-C application message. However, the aircraft type and operator will need to be matched to each record from a separate database using the aircraft registration as the common point.

**Table D-3. ADS-C data collection points**

| *Ref:* | *Label* | *Description and/or remarks* |
|---|---|---|
| 1 | ANSP | Four-letter ICAO designator for the facility (e.g. NZZO). |
| 2 | Aircraft registration | Aircraft registration in Doc 4444 format (no hyphens, extraneous characters, etc.) (e.g. N104UA).<br><br>*Note.— Extracted from ACARS header or application message.* |
| 3 | Aircraft type designator | ICAO aircraft type designator (e.g. B744).<br><br>*Note.— Extracted from the ANSP's database using aircraft registration as key. Aircraft type designators are contained in Doc 8643.* |
| 4 | Operator Designator | ICAO designator for the aircraft operating agency (e.g. UAL).<br><br>*Note.— Extracted from the ANSP's database using aircraft registration as key.* |
| 5 | Date | In YYYYMMDD format (e.g. 20081114).<br><br>*Note.— Extracted from the ANSP's system data recording timestamp.* |
| 6 | RGS | RGS designator from which the ADS-C downlink was received.<br><br>*Note.— This is a 3- or 4-letter designator extracted from the second field of the ACARS header DT line (e.g. DT DDL **POR1** 121212 M01A).* |

| *Ref:* | *Label* | *Description and/or remarks* |
|---|---|---|
| 7 | Report type | The type of ADS-C report extracted from the ADS-C basic group report tag where tag value 7=PER, 9=EMG, 10=LDE, 18=VRE, 19=LRDE, 20=WCE. As some aircraft concatenate more than one report in the same downlink extract, the ADS-C report tag from each ADS-C basic group and identify them in the REP_TYPE column by using the first letter of the report type as an identifier (e.g. for a concatenated report containing two ADS-C basic groups for a periodic report and a waypoint event report the field will contain PW). Where a downlink does not contain an ADS-C basic group, the REP_TYPE field will be left blank. |
| 8 | Latitude | The current latitude decoded from the ADS-C basic group. The format is "+" for North and "-" for South followed by a decimal number of degrees (e.g. -33.456732). |
| 9 | Longitude | The current longitude decoded from the ADS-C basic group. The format is "+" for East and "-" for West followed by a decimal number of degrees (e.g. +173.276554). |
| 10 | Aircraft time | The time the aircraft was at the position (latitude and longitude) in the ADS-C report to within the accuracy specified by the RSP specification in HH:MM:SS format (e.g. 03:44:15).<br><br>*Note.— Decoded from the ADS-C basic group timestamp extracted as seconds since the most recent hour. See RTCA DO-258A/EUROCAE ED-100A, section 4.5.1.4.* |
| 11 | Received time | The ANSP timestamp on the receipt of the ADS-C message in HH:MM:SS format (e.g. 03:44:45).<br><br>*Note.— Extracted from the ANSP's system data recording timestamp.* |
| 12 | Transit time | The transit time of the ADS-C downlink in seconds calculated as the difference between #10 aircraft time and #11 received time (e.g. 30). |

2.2.2.1 In a comma delimited text file format, these data would appear as follows:

NZZO,N104UA,B744,UAL,20081114,POR1,PER,-33.456732,+173.276554,03:44:15,03:44:45,30

2.2.2.2 The ANSP may find the following additional data useful for performance analysis, reported problem investigation and other analysis support, such as from monitoring the application of performance-based horizontal separation minima:

a) the aircraft call sign extracted from either the flight plan (e.g. ANZ123), the AFN logon for the flight (e.g. NZ123) or the FI line in the ACARS header (e.g. NZ0123);

b) direction of flight calculated by the ANSP flight data processor and displayed as a three figure group representing degrees true (e.g. 275);

c) the current altitude (e.g. 35 000) decoded from the ADS-C basic group. The altitude combined with the latitude, longitude, and time, provide the aircraft position at the time the report was generated. Aircraft movement data is needed in airspace safety assessments and/or airspace safety monitoring analyses. Inclusion of altitude in the data sample would allow it to be used for both ADS-C performance monitoring and airspace safety monitoring analyses;

d) ADS-C predicted position latitude and longitude and time when available.

(*Note.— Time decoded from the ADS-C predicted group where the timestamp is extracted as seconds since the most recent hour (see RTCA DO-258A section 4.5.1.4*).

For consistency, the following formats are recommended: for latitude use "+" for North or "-" for South followed by a decimal number of degrees (e.g. -33.456732); for longitude use "+" for East or "-" for West followed by a decimal number of degrees (e.g. +173.276554); and

e) the communications type (COMTYP) identifying the media used for delivering the ADS-C report. This is determined based on the RGS field (#6). Satellite (SAT), very high frequency (VHF), high frequency (HF). (Refer to Table D-2.)

2.2.3 *Calculating ADS-C report delivery time*

2.2.3.1 The ADS-C report delivery time is calculated by measuring the difference between the times when the ADS-C report indicated the aircraft was at the reported position, to when the ATS unit received the report.

### 2.3 ANSP data collection for CPDLC and ADS-C availability

2.3.1 The ANSP should collect data on CSP-notified system outages, as well as detected outages not observed or notified by the CSP, as these data are used to calculate the actual availability of CPDLC and ADS-C.

2.3.2 For each outage, the following information should be collected:

a) time of CSP outage notification: in YYYYMMDDHHMM format or "Not Notified" if no CSP notification was received;

b) CSP name: name of CSP supplying outage notification, if applicable;

c) type of outage: report media affected SATCOM, VHF, HF, ALL;

d) outage start time: in YYYYMMDDHHMM format;

e) outage end time: in YYYYMMDDHHMM format; and

f) duration of outage: in minutes.

2.3.3 As per Appendix B, only outages lasting longer than 10 minutes are reported.

2.3.4 Data sets should also be examined in order to identify cases where outages are not detected or notified by the CSP. For example, when delays are observed from multiple aircraft and messages are received by the ANSP at similar times, this may indicate a system outage. An example of an outage not notified by any CSP is illustrated in Table D-4, with large ADS-C downlink delays observed from 3 aircraft during the period from 11h20m and 12h13m.

**Table D-4. ADS-C outages not notified**

| *Aircraft registration* | *Aircraft time* | *ANSP system time* | *Downlink time (seconds)* |
|---|---|---|---|
| ZKSUI | 11:55:38 | 12:12:52 | 1034 |
| ZKSUI | 11:44:42 | 12:12:19 | 1657 |
| ZKSUI | 11:23:21 | 12:08:32 | 2711 |
| ZKSUJ | 11:41:54 | 12:12:01 | 1807 |
| ZKSUJ | 11:26:18 | 12:09:42 | 2604 |
| ZKSUJ | 11:20:34 | 12:07:39 | 2825 |
| ZKOKG | 11:53:52 | 12:12:51 | 1139 |

## 3. ANSP PERFORMANCE MONITORING AND ANALYSIS

### 3.1 Monitoring time/continuity of CPDLC transactions and ADS-C report deliveries

3.1.1 *General*

3.1.1.1 The collected CPDLC and ADS-C data are used to monitor the time/continuity of CPDLC transactions and ADS-C report delivery. In addition to monitoring the aggregate system performance, important subsets of the data, including all observed media types, message type(s), operators, aircraft types and airframes should also be monitored and examined.

3.1.2.2 The first step of such an analysis requires organizing the collected data. The following sections therefore provide suggested filtering, which should allow for an effective measurement of RCP and RSP time/continuity parameters.

3.1.2 *Filtering CPDLC data*

3.1.2.1 CPDLC data sent to a regional monitoring entity should, at a minimum, include all transactions containing a WILCO response. The regional monitoring entity then will filter transactions as agreed by their regional forum.

3.1.2.2 For the purposes of monitoring at the local level, it is recommended that the CPDLC transactions initiated by the following message types should be filtered from the CPDLC data set when measuring RCP:

a) non-intervention route messages (UM 79, UM 80, UM 81, UM 82, UM 83, UM 84, UM 91, and UM 92);

b) contact instructions (UM 117 – UM 123); and

c) RESUME NORMAL SPEED (UM 116).

3.1.2.3 The data may only be assessed within a subset of CPDLC transactions, due to the critical communications requirement provided by intervention messages, when applying reduced separation standards. Incorporating other

message types such as free text queries, information requests not requiring a DM 0 WILCO response, messages with DM 1 UNABLE responses, or DM 2 STANDBY responses followed by DM 0 WILCO, or other CPDLC uplink messages specified above, will skew the observed data as a result of the longer response times from the flight deck.

3.1.2.3.1 The removal of all contact instructions (UM 117 – UM 123) will drastically reduce the monthly data set for smaller ANSPs and will make it difficult to assess ACTP for individual fleets or aircraft, on a monthly basis. For this reason, certain ANSPs may retain these (UM 117 – UM 123) transactions when assessing ACTP. The ANSP should therefore decide on a data set providing the best performance assessment capability.

3.1.3 *Filtering ADS-C data*

3.1.3.1 If an ADS-C report is sent and the acknowledgement (ACK) from the ground earth station (GES) is not received within a defined period of time, the aircraft system will resend the report. In such cases, the ATS unit may receive the same ADS-C report two or three times. This typically occurs when the aircraft system is transitioning between VHF and SATCOM media types, but there are other conditions resulting in the receipt of multiple reports by an ATS unit. Experience indicates that approximately 1.5 per cent of total ADS-C reports received are duplicates.

3.1.3.2 Duplicate ADS-C reports should be removed from the data set prior to analysis. In the case of duplicates, only the ADS-C report with the earliest receipt time should be retained in the data set. Table D-5 illustrates an example of multiple ADS-C reports received at different times, for the same position, from the same aircraft.

**Table D-5. Example of multiple ADS-C reports for same position from same aircraft**

| *LAT_LON* | *Aircraft time* | *ANSP system time* | *Downlink time (seconds)* |
|---|---|---|---|
| 350225S1694139E | 22:29:45 | 22:31:04 | 79 |
| 350225S1694139E | 22:29:45 | 22:34:56 | 311 |
| 350225S1694139E | 22:29:45 | 22:40:05 | 620 |

3.1.3.3 In addition, all ADS-C report delivery times that are zero or less should be filtered out. These times represent cases where the ADS-C basic group timestamp was extracted as seconds, since the most recent hour was incorrectly decoded into the HH:MM:SS format by the ATS unit's system.

3.1.4 *Filtering CPDLC and ADS-C data during service outage periods*

3.1.4.1 In addition to being used for the measurement of availability, the outage data should be employed for filtering ADS-C and CPDLC data sets. All ADS-C reports and CPDLC transactions occurring during outage periods reported by the CSP should be removed from the data set prior to analysis. All ADS-C reports and CPDLC transactions occurring during an unreported outage detected by the ANSP should also be removed.

3.1.5 *Cumulative distributions of CPDLC and ADS-C data*

3.1.5.1 Filtering data will limit the sample size used in the cumulative distributions of CPDLC and ADS-C data. When providing these cumulative distributions, a sufficient sample size should be determined, taking into account a number of factors, such as:

a) type of data that will be considered in the sample (e.g. CPDLC transactions that are representative of an intervention to manoeuvre the aircraft in the event of a conflict, or ADS-C reports);

b) cost, time and difficulty in collecting the data (e.g. for an entire airspace, an aircraft operator's fleet, an aircraft type/system, or a new media type);

c) existing knowledge about the underlying technologies and implementation (e.g. data have already been collected and analysed from a similar implementation using similar technologies);

d) variability of the data collected (e.g. how predictable is it that the performance will fall within a specified range?);

e) the specific criterion against which the data sample will be measured (e.g. if the criterion is specified at 95 per cent, then, statistically, the data sample would need to be at least 1 000 data points); and

f) level of confidence desired in the estimated result (e.g. operational judgment will play a role).

3.1.5.3 Once a sufficient sample of filtered data is collected, the next step is the calculation of a cumulative distribution for each of the performance parameters to be measured: ACP, ACTP, PORT, for the CPDLC applications and ASP for the ADS-C application. In order to enable the direct mapping of the performance data to the specifications, the cumulative distribution is plotted with a resolution and range appropriate for the RCP/RSP specification. For example, the cumulative distribution of ACP data plotted at 1-second intervals with a range of 300 seconds, would be appropriate for the RCP 240 specification.

3.1.5.3 Regarding assessment of the performance by media type, only those CPDLC transactions where both the RGS for the MAS and the RGS of the operational response from the same media type should be measured. Any mixed media transaction, such as where the MAS is received via a VHF RGS and the operational response is via a SATCOM RGS, would be excluded from a SATCOM analysis. These transactions would be measured under a VHF/SAT mixed media category and would also be included in the aggregate measurement. Since there is only one message involved in an ADS-C downlink report, this issue does not impact the ASP analysis.

3.1.5.4 It is recommended that the ANSP begins with a graphical analysis of the data, as this method is useful for clearly depicting performance and facilitating the identification of performance problems. The cumulative performance should be shown in comparison to the relevant parameter values for the transaction times and corresponding continuity requirements. For example, when measuring the cumulative ACP for an RCP 240 operation, the following parameter values should be included to determine whether the operation is meeting the RCP 240 safety and efficiency requirements: 240 seconds at 99.9 per cent and 210 seconds at 95.0 per cent.

3.1.5.5 Figure D-3 provides a typical graph, constructed using a spreadsheet application, illustrating ACTP over SATCOM in the NZZO flight information region (FIR) between 2009 and 2013. The performance is measured against the RCP 240 specifications defined for ACTP: 95 per cent within 120 seconds and 99.9 per cent within 150 seconds.

3.1.5.6 Similar graphs are used to assess ACP, PORT and ASP.

3.1.5.7 Figure D-4 illustrates an alternative graphical method of analysis, in which the value of the cumulative distribution of the ACP corresponding to the time value specified for the 99.9 per cent continuity requirement, 210 seconds, is charted for ALL RGS performance from 2009 to 2014.

3.1.5.8 It is also helpful to view and report the results in tabular format, especially when there is an impractical amount of series associated with a particular subset to be clearly displayed on a chart (e.g. the operator subsets). Table D-6 illustrates a tabular performance report for ASP, ACP, ACTP, and PORT by operator.

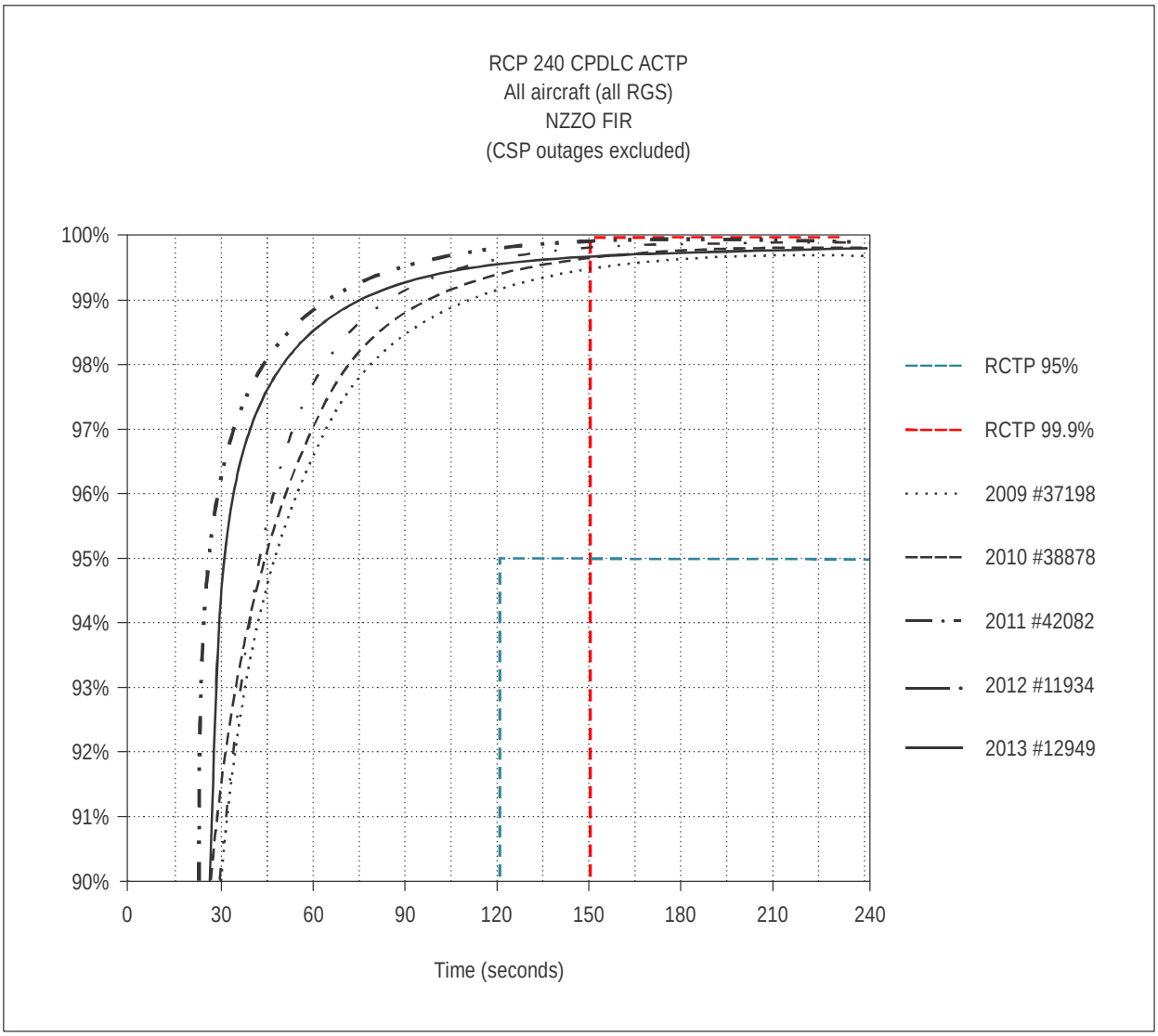



**Figure D-3. CPDLC ACTP performance — graphical by year**

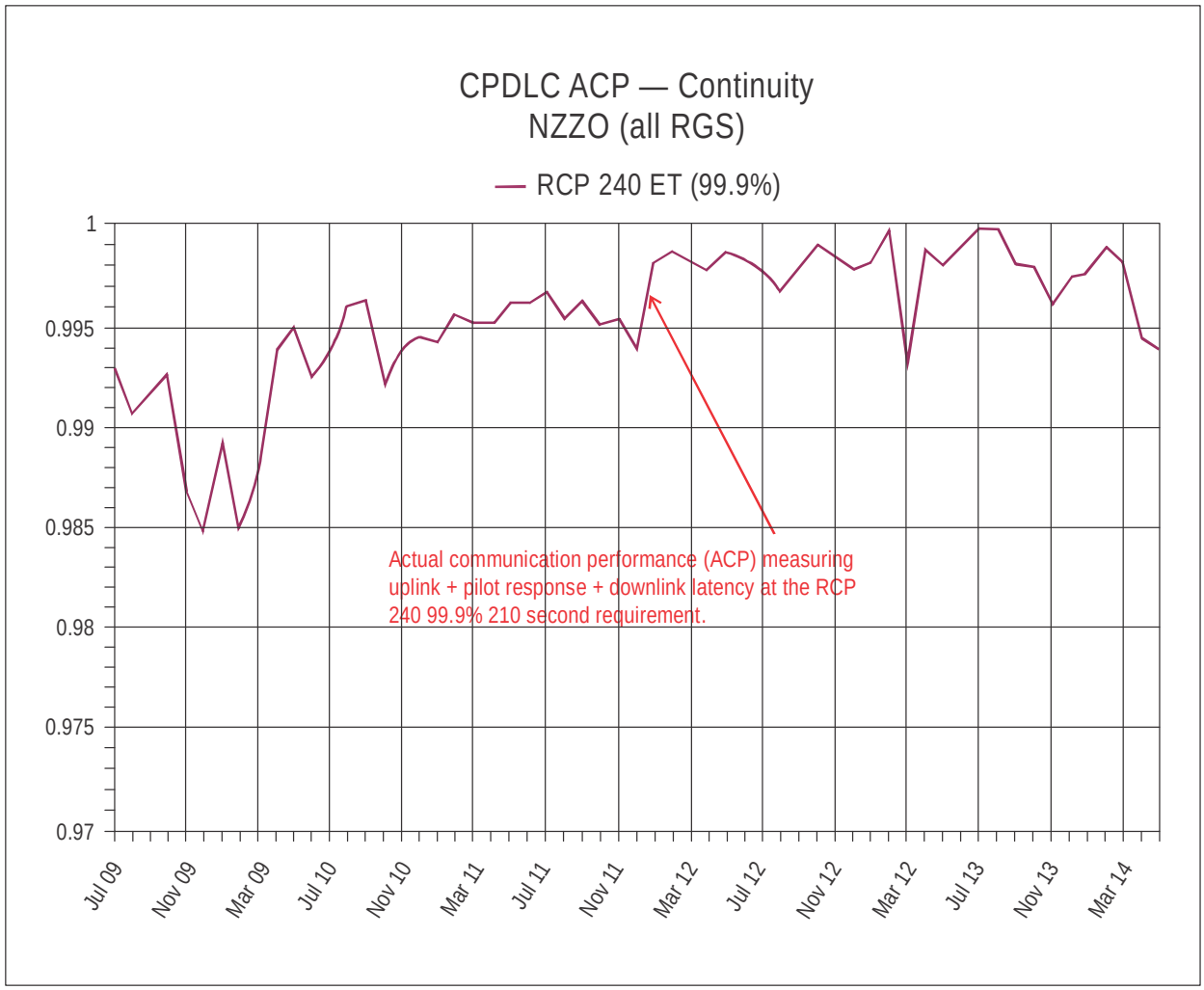



**Figure D-4. CPDLC ACTP performance — graphical by month**

**Table D-6. ASP, ACTP, ACP and PORT by operator – tabular format**

| *Operator* | *ADS-C* | | | | *CPDLC* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Code* | *Count of ADS-C* | *% of total ADS-C* | *ASP 95%* | *ASP 99.9%* | *Count of CPDLC* | *% of total CPDLC* | *ACTP 95%* | *ACTP 99.9%* | *ACP 95%* | *ACP 99.9%* | *PORT 95%* |
| R | 141 591 | 12.3% | 98.2% | 99.4% | 2 712 | 7.0% | 99.3% | 99.4% | 98.5% | 98.8% | 95.9% |
| AA | 113 648 | 9.9% | 99.2% | 99.8% | 5 309 | 13.7% | 99.9% | 99.9% | 99.5% | 99.6% | 97.9% |
| L | 85 874 | 7.5% | 98.0% | 99.3% | 2 490 | 6.4% | 99.4% | 99.6% | 98.6% | 98.8% | 95.0% |
| BB | 62 638 | 5.5% | 99.2% | 99.5% | 3 096 | 8.0% | 99.5% | 99.6% | 99.3% | 99.7% | 97.4% |
| II | 58 775 | 5.1% | 99.5% | 99.8% | 1 875 | 4.8% | 100.0% | 100.0% | 99.2% | 99.5% | 96.6% |
| A | 54 411 | 4.7% | 96.0% | 98.5% | 1 133 | 2.9% | 98.3% | 98.9% | 97.6% | 98.2% | 95.3% |
| FF | 51 564 | 4.5% | 97.5% | 99.4% | 2 711 | 7.0% | 99.6% | 99.7% | 99.2% | 99.5% | 97.2% |
| GG | 42 737 | 3.7% | 99.2% | 99.7% | 1 185 | 3.1% | 99.7% | 99.8% | 99.2% | 99.4% | 95.5% |
| HH | 42 369 | 3.7% | 99.4% | 99.7% | 1 393 | 3.6% | 99.7% | 99.9% | 99.2% | 99.5% | 93.2% |
| DD | 40 236 | 3.5% | 96.5% | 99.1% | 2 051 | 5.3% | 99.6% | 100.0% | 98.6% | 99.1% | 94.0% |
| SS | 31 387 | 2.7% | 98.2% | 99.6% | 524 | 1.3% | 99.1% | 99.6% | 98.3% | 99.1% | 92.6% |
| BH | 30 213 | 2.6% | 94.3% | 97.4% | 939 | 2.4% | 98.1% | 98.8% | 96.5% | 97.8% | 92.3% |
| EE | 28 790 | 2.5% | 99.2% | 99.6% | 1 856 | 4.8% | 99.7% | 99.7% | 99.0% | 99.4% | 94.9% |
| CC | 24 260 | 2.1% | 98.5% | 99.2% | 856 | 2.2% | 99.7% | 99.8% | 99.3% | 99.5% | 96.9% |
| TT | 23 432 | 2.0% | 99.7% | 99.9% | 777 | 2.0% | 99.7% | 99.7% | 99.4% | 99.6% | 96.7% |
| JJ | 23 352 | 2.0% | 98.9% | 99.8% | 338 | 0.9% | 99.7% | 99.7% | 98.2% | 98.5% | 94.1% |
| KKKK | 21 066 | 1.8% | 99.7% | 99.8% | 1 657 | 4.3% | 100.0% | 100.0% | 100.0% | 100.0% | 98.1% |
| MM | 20 228 | 1.8% | 99.5% | 99.8% | 553 | 1.4% | 99.8% | 99.8% | 98.9% | 99.1% | 95.8% |
| AQ | 18 239 | 1.6% | 96.8% | 98.5% | 733 | 1.9% | 98.8% | 99.5% | 98.1% | 99.2% | 93.7% |
| PP | 15 648 | 1.4% | 99.1% | 99.9% | 429 | 1.1% | 100.0% | 100.0% | 100.0% | 100.0% | 96.7% |
| MMMM | 15 027 | 1.3% | 96.2% | 98.2% | 336 | 0.9% | 99.1% | 99.1% | 95.8% | 97.6% | 86.6% |
| ZZ | 14 595 | 1.3% | 99.2% | 99.7% | 599 | 1.5% | 99.8% | 99.8% | 99.3% | 99.8% | 98.2% |
| Meets criteria → | | | | Under criteria but above 99.0% → | | | | | Under criteria → | | |

3.1.5.9 Figure D-5 illustrates a comparative analysis of the ACTP over SATCOM, for different fleets operating in the NZZO FIR during 2012. Significant variations in observed performance, especially for the same aircraft type should be flagged for further analysis. It may also be useful to compare the performance of underperforming fleets with that observed for the same fleet in other CTAs.

3.1.5.10 Figure D-6 illustrates the performance before and after an issue was identified with the B772 fleet of operator DDD in 2009. The regional CRA determined the fleet's poor performance to be related to an aircraft issue that affected all B777 aircraft, which was eventually resolved by a software upgrade. It should be noted that software upgrades for aircraft may take some time to be implemented by all airlines.

3.1.6 *Identifying poor performers*

3.1.6.1 There are many potential causes of degraded performance. Considerable analysis may be required to identify the reasons behind poor performing fleets, therefore it is not possible to provide guidance in all situations. Certain analysis techniques that were found to be useful are provided in the following paragraphs.

3.1.6.2 On a number of occasions poor performance has been attributed to a specific aircraft in a fleet. Usually these poor-performing aircraft can be identified by the visual inspection of monthly data ordered in terms of transit time, or, more accurately, by graphing the monthly data for a fleet by aircraft registration.

3.1.6.3 Techniques such as graphing the positions of all delayed messages on a geographical display have identified areas for further investigation.

3.1.6.4 There are low speed (600 bps and 1 200 bps) and high speed (10 500 bps) data rates defined for the P, R, and T SATCOM channels. Some aircraft are capable of low speed SATCOM only. Other aircraft are capable of both high speed and low speed. However, not all aircraft capable of high speed operation have enabled the use of high speed SATCOM: instead, they operate in low speed only. It is recommended that an operator using low speed SATCOM channels change to high speed channels where possible. Low or high speed channel use is selectable by an individual operator in the aircraft operational requirements table (ORT).

3.1.6.5 Significant performance benefits accrue with the use of the high speed channels as illustrated in Figure D-7.

3.1.6.6 The ANSP can assess ACARS channel speed use by evaluating the monthly downlink times for ADS-C reports via SATCOM. For high speed channel users, the ANSP will consistently see a small percentage of reports in the 6- to 8-second time bands. Low speed channel users usually have few reports less than 10 seconds.

3.1.6.7 The ANSP should identify low speed channel operators, in order to enable the collaboration of stakeholders and achieve the high speed channels upgrade.

## 3.2 Monitoring availability of CPDLC and ADS-C

Using the data collected on outages reported by the CSP and unreported outages identified by the ANSP (as described in 2.3), a graphical analysis can be used to track availability, as illustrated in Figures D-8 and D-9.

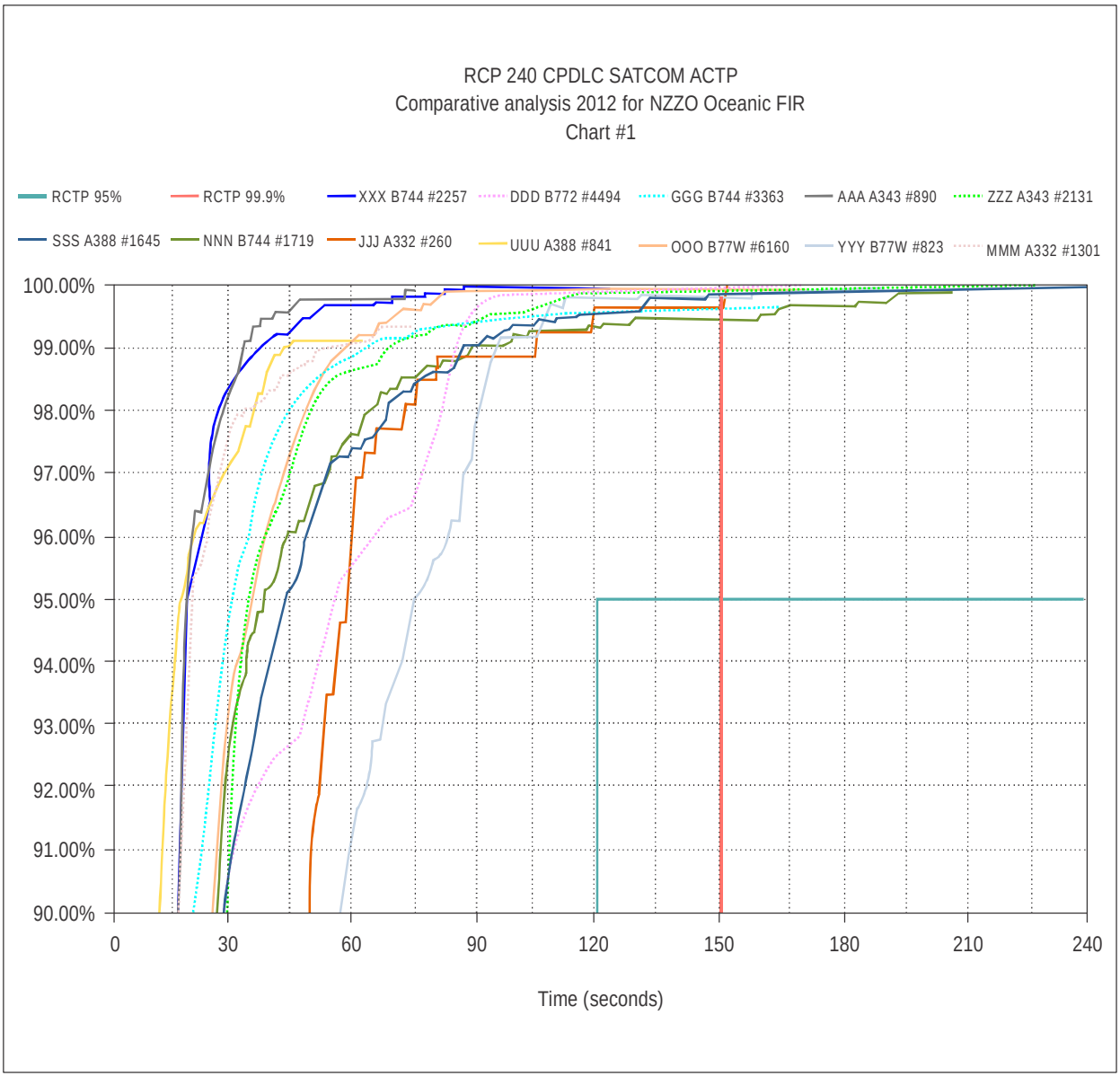



**Figure D-5. CPDLC ACTP comparative operator/aircraft type performance**

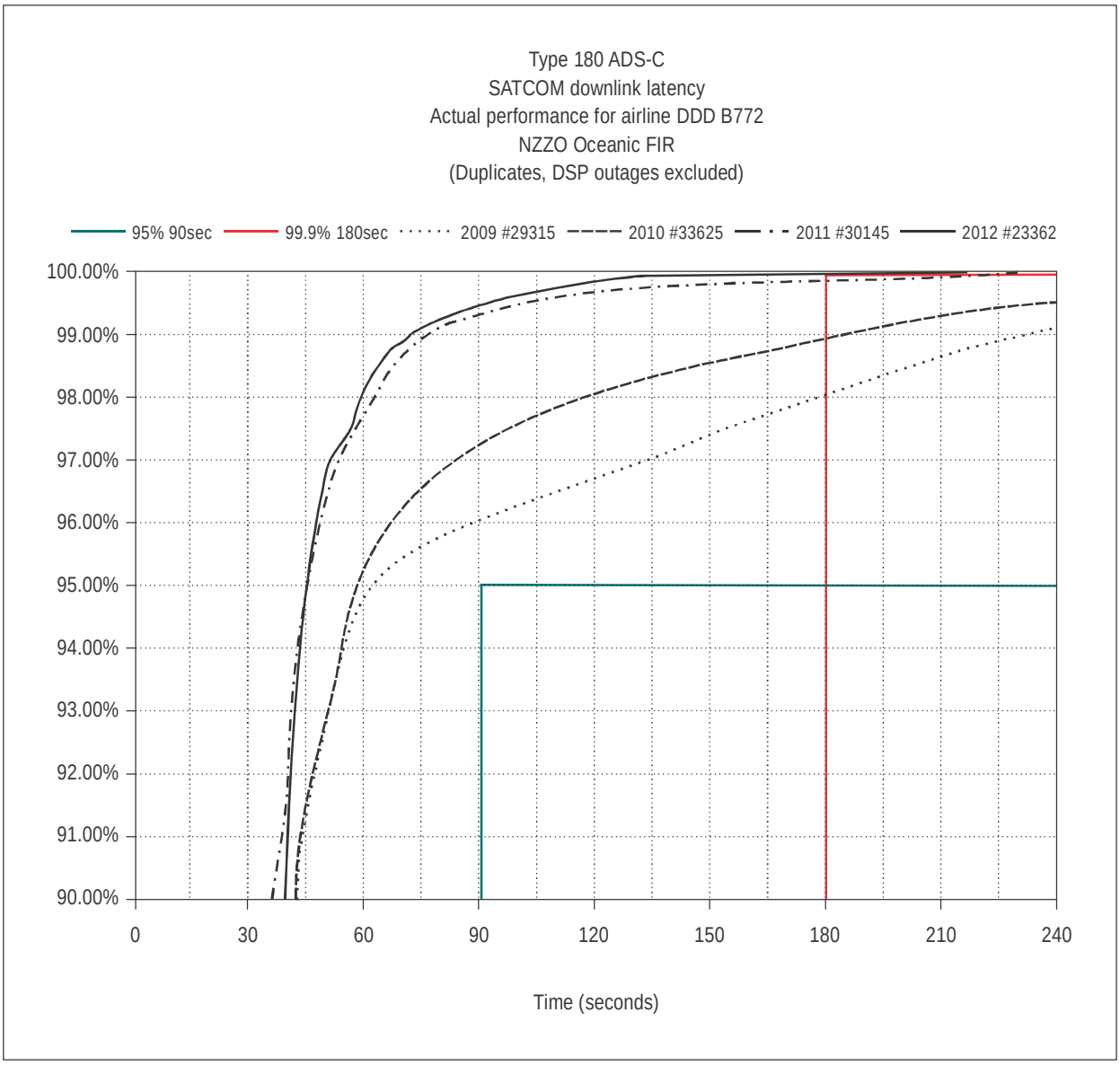



**Figure D-6. SATCOM ADS-C Operator DDD B777 2009-2012**

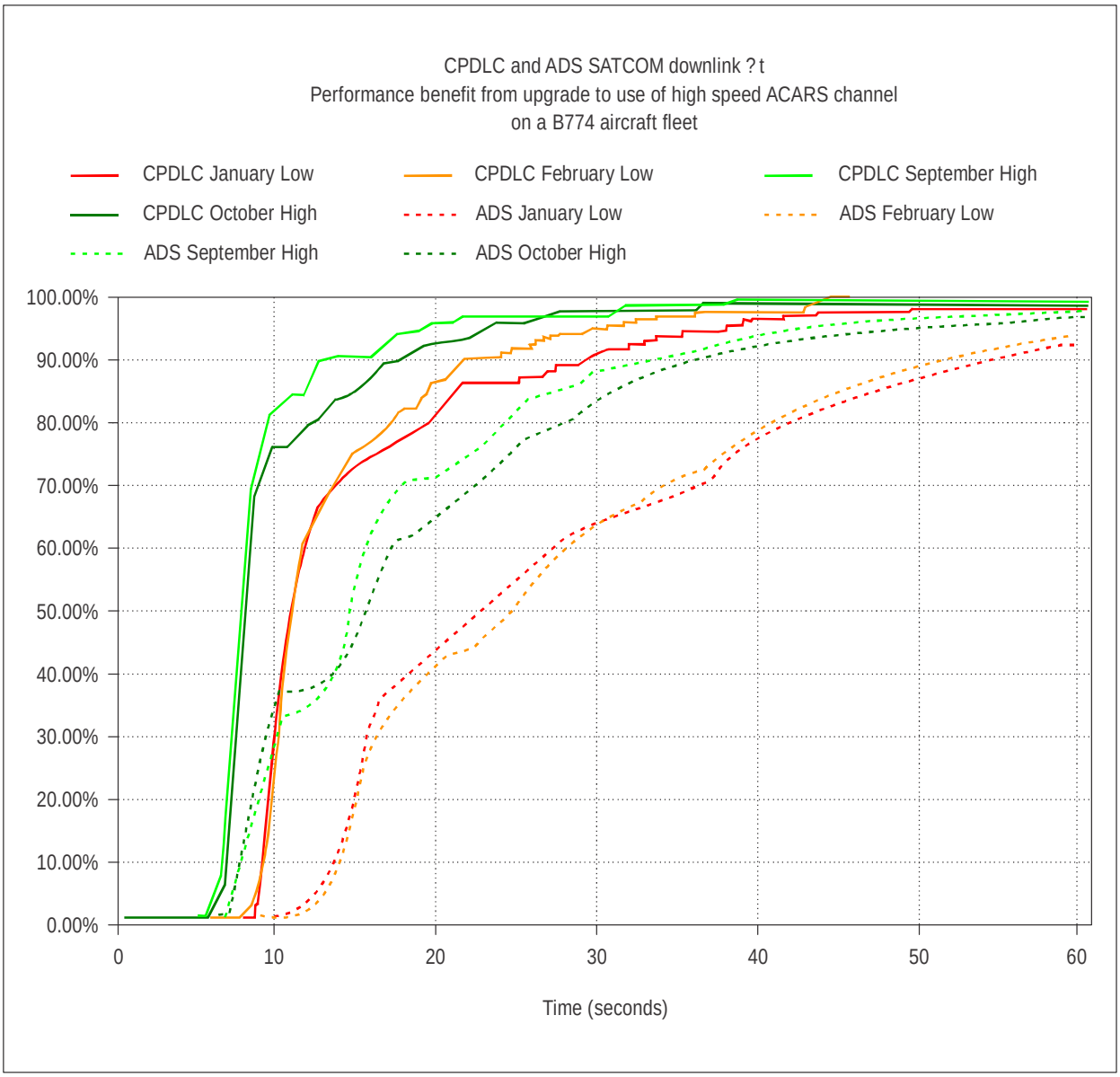



**Figure D-7. Effect of ACARS channel speed on ADS-C surveillance data transit time**


**Figure D-8. Example system availability graph**

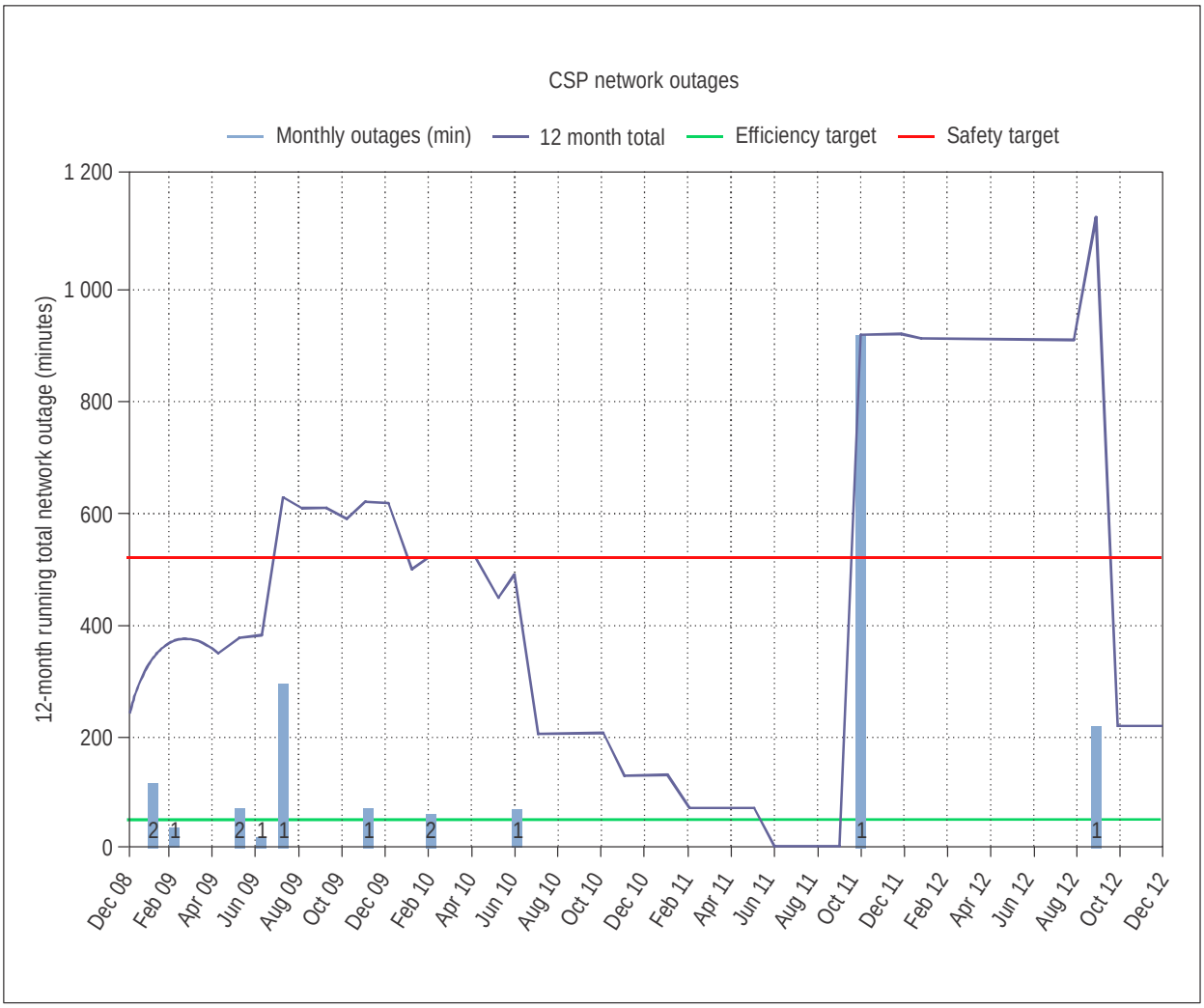



**Figure D-9. Example network outage graph**

| *PBCS Monitoring Report – RCP Cum %* | | | |
|---|---|---|---|
| *ANSP/CTA →* | *ANSP1/CTA1* | *Period →* | *Jan – Jun 2014* |
| *Specification →* | *RCP 240* | *Application →* | *CPDLC* |
| *Number of CPDLC transactions in sample →* | | | *12,354* |
| *Time increment (seconds)* | *RCMP = 180 @ 95% 210 @ 99.9%* | *RCTP = 120 @ 95% 150 @ 99.9%* | *RCP PORT = 60 @ 95%* |
| | *Cum % ACP* | *Cum % ACTP* | *Cum % PORT* |
| 1 | 0.0000 | 0.0000 | 0.0000 |
| 2 | 0.0000 | 0.0001 | 0.0000 |
| … | | | |
| 59 | 0.9213 | 0.9877 | 0.9779 |
| 60 | 0.9256 | 0.9881 | 0.9789 |
| … | | | |
| 119 | 0.9843 | 0.9950 | 0.9950 |
| 120 | 0.9845 | 0.9951 | 0.9950 |
| … | | | |
| 149 | 0.9896 | 0.9962 | 0.9964 |
| 150 | 0.9897 | 0.9963 | 0.9964 |
| … | | | |
| 179 | 0.9921 | 0.9967 | 0.9972 |
| 180 | 0.9921 | 0.9967 | 0.9972 |
| … | | | |
| 209 | 0.9947 | 0.9988 | 0.9978 |
| 210 | 0.9947 | 0.9989 | 0.9978 |
| … | | | |
| 239 | 0.9968 | 0.9989 | 0.9983 |
| 240 | 0.9968 | 0.9989 | 0.9983 |

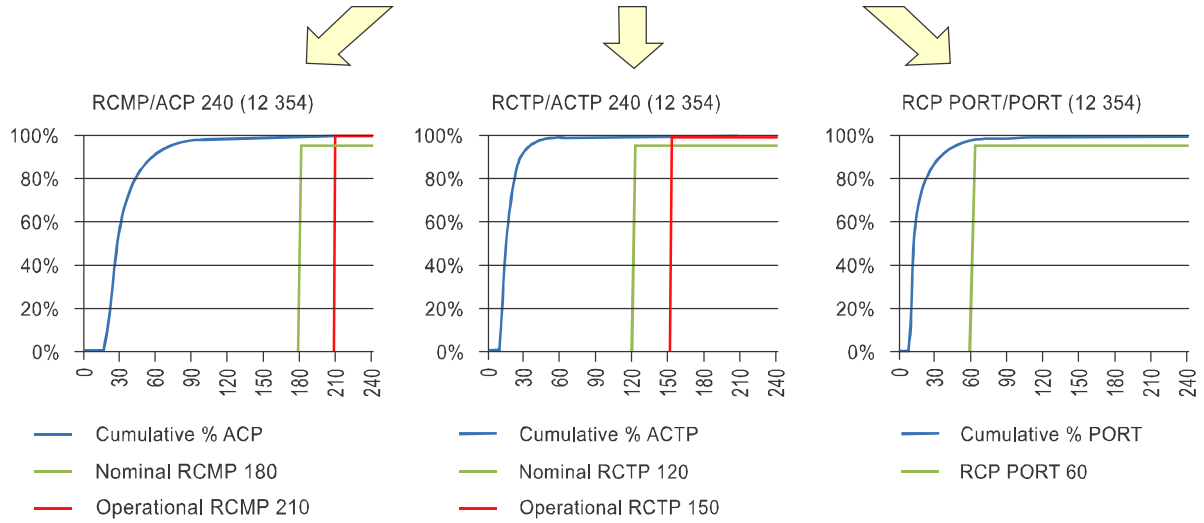



**Figure D-10. Example of an ANSP report enabling graphical analysis**

### 3.3 ANSP monitoring reports for regional and global use

3.3.1 Each ANSP within a region should compile monitoring reports at the interval agreed by the regional forum. A tabular format can be used to report on the observed system performance, in terms of the availability and time/continuity parameters specified in the applicable RCP and RSP specifications. Examples of local PBCS monitoring reports are provided as follows:

a) Table D-7 — service availability;

b) Table D-8 — RCP; and

c) Table D-9 — RSP.

3.3.2 Table D-10 provides an example of a PBCS monitoring report for an operator with different aircraft types/systems in its fleet.

**Table D-7. Example service availability local PBCS monitoring report**

| *PBCS monitoring report – service availability* | | | | |
|---|---|---|---|---|
| *ANSP/CTA →* | ANSP1/CTA1 | *Period →* | 1 January to 30 June 2014 (6 months) | |
| *Specification →* | RCP 240/RSP 180 | *Application →* | CPDLC/ADS-C | |
| *CSP notification* | *CSP name* | *Outage type* | *Start time* | *Duration (minutes)* |
| 200907150005 | CSP1 | SATCOM | 200907150001 | 19 |
| Not notified | N/A | SATCOM | 200907212233 | 22 |
| 200907281515 | CSP2 | VHF | 200907281510 | 15 |
| . . . | | | | |

**Table D-8. Example RCP local PBCS monitoring report**

| *PBCS monitoring report – RCP* | | | | | | | |
|---|---|---|---|---|---|---|---|
| **ANSP/CTA →** | ANSP1/CTA1 | | **Period →** | | 1 January to 30 June 2014 (6 months) | | |
| **Specification →** | RCP 240 | | **Application →** | | CPDLC | | |
| **Colour key** | | **Transaction counts (WILCO received)** | **95% RCP 240 benchmark** | | **99.9% RCP 240 benchmark** | | |
| Meets criteria → | | | **ACP** | **ACTP** | **ACP** | **ACTP** | **PORT** |
| Under criteria but above 99.0% → | | | **<=180 sec** | **<=120 sec** | **<=210 sec** | **<=150 sec** | **<=60 sec** |

| Under criteria → | | | End-to-end | Network | End-to-end | Network | Pilot response |
|---|---|---|---|---|---|---|---|
| **Media type (100 messages or more)** | | | | | | | |
| SATCOM | | 35 123 | 98.90% | 99.53% | 99.28% | 99.67% | |
| VHF | | 3 422 | 99.15% | 99.80% | 99.27% | 99.85% | |
| HF | | 13 | | | | | |
| SATCOM+HF | | - | | | | | |
| SAT+VHF | | - | | | | | |
| VHF+SAT | | - | | | | | |
| HF+VHF | | - | | | | | |
| . . . | | | | | | | |
| All | | 38 837 | 98.86% | 99.52% | 99.23% | 99.67% | |
| **Remote ground station (RGS) / ground earth station (GES) (100 messages or more)** | | | | | | | |
| GES1 | VHF | 14 476 | 99.03% | 99.68% | 99.32% | 99.76% | |
| GES2 | VHF | 5 893 | 99.42% | 99.69% | 99.69% | 99.76% | |
| GES3 | VHF | 4 494 | 98.49% | 99.29% | 98.82% | 99.49% | |
| GES4 | VHF | 4 328 | 99.26% | 99.70% | 99.54% | 99.77% | |
| GES5 | VHF | 1 455 | 95.60% | 97.73% | 97.32% | 98.63% | |
| . . . | | | | | | | |
| **Uplink message type (UM) (100 messages or more)** | | | | | | | |
| U20 U129 | | 13 516 | 99.29% | 99.64% | 99.59% | 99.74% | 97.57% |
| U26 U129 | | 12 894 | 99.12% | 99.54% | 99.37% | 99.64% | 96.49% |
| U106 | | 2 301 | 99.48% | 99.70% | 99.70% | 99.74% | 98.44% |
| U74 | | 1 001 | 97.60% | 99.30% | 98.50% | 99.60% | 92.01% |
| . . . | | | | | | | |
| **Aircraft type (100 messages or more)** | | | | | | | |
| ACT1 | | 5 960 | 99.41% | 99.80% | 99.58% | 99.87% | 96.49% |

| *PBCS monitoring report – RCP* | | | | | | | |
|---|---|---|---|---|---|---|---|
| **ANSP/CTA →** | ANSP1/CTA1 | | **Period →** | | 1 January to 30 June 2014 (6 months) | | |
| **Specification →** | RCP 240 | | **Application →** | | CPDLC | | |
| **Colour key** | | **Transaction counts (WILCO received)** | **95% RCP 240 benchmark** | | **99.9% RCP 240 benchmark** | | |
| Meets criteria → | | | **ACP** | **ACTP** | **ACP** | **ACTP** | **PORT** |
| Under criteria but above 99.0% → | | | **<=180 sec** | **<=120 sec** | **<=210 sec** | **<=150 sec** | **<=60 sec** |
| Under criteria → | | | **End-to-end** | **Network** | **End-to-end** | **Network** | **Pilot response** |
| ACT2 | | 5 357 | 99.12% | 99.72% | 99.48% | 99.79% | 95.13% |
| ACT3 | | 4 590 | 99.39% | 99.65% | 99.63% | 99.69% | 97.82% |
| ACT4 | | 4 422 | 97.33% | 98.91% | 98.10% | 99.30% | 92.74% |
| ACT5 | | 4 390 | 98.54% | 99.45% | 98.95% | 99.70% | 93.69% |
| . . . | | | | | | | |
| **Operator (100 messages or more)** | | | | | | | |
| OP1 | | 5 309 | 99.47% | 99.85% | 99.62% | 99.91% | 97.87% |
| OP2 | | 3 096 | 99.29% | 99.52% | 99.71% | 99.61% | 97.35% |
| OP3 | | 2 712 | 98.45% | 99.34% | 98.78% | 99.41% | 95.87% |
| OP4 | | 2 711 | 99.15% | 99.63% | 99.45% | 99.67% | 97.23% |
| OP5 | | 2 051 | 98.63% | 99.61% | 99.12% | 99.95% | 93.95% |
| . . . | | | | | | | |

**Table D-9. Example RSP local PBCS monitoring report**

| *PBCS monitoring report — RSP* | | | | |
|---|---|---|---|---|
| **ANSP/CTA →** | ANSP1/CTA1 | **Period →** | 1 January to 30 June 2014 (6 months) | |
| **Specification →** | RSP 180 | **Application →** | ADS-C | |
| **Colour key** | | **Report counts** | **95% RSP 180 benchmark** | **99.9% RSP 180 benchmark** |
| Meets criteria → | | | **ASP** | **ASP** |
| Under criteria but above 99.0% → | | | **<=90 sec** | **<=180 sec** |
| Under criteria → | | | **End-to-end** | **End-to-end** |
| **Media type (100 messages or more)** | | | | |
| SATCOM | | 893 064 | 97.98% | 99.27% |
| VHF | | 251 619 | 98.98% | 99.54% |
| HF | | 4 013 | 92.30% | 94.49% |
| . . . | | | | |
| All | | 1 148 696 | 98.09% | 99.28% |
| **Remote ground station (RGS) / ground earth station (GES) (100 messages or more)** | | | | |
| GES1 | VHF | 355 121 | 98.57% | 99.51% |
| GES2 | VHF | 167 491 | 97.54% | 99.31% |
| GES3 | VHF | 106 908 | 99.05% | 99.62% |
| GES4 | VHF | 101 662 | 98.64% | 99.38% |
| GES5 | VHF | 38 006 | 91.96% | 96.33% |
| . . . | | | | |
| **Operator (100 messages or more)** | | | | |
| OP1 | | 141 591 | 98.17% | 99.35% |
| OP2 | | 113 648 | 99.17% | 99.78% |

| | | | | |
|---|---|---|---|---|
| OP3 | | 85 874 | 98.01% | 99.31% |
| OP4 | | 62 638 | 99.23% | 99.46% |
| OP5 | | 30 213 | 94.31% | 97.44% |
| . . . | | | | |

**Table D-10. Example aircraft operator PBCS monitoring report**

| *Aircraft operator PBCS monitoring report – by fleet* | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Operator →** | ZYX | | **Period →** | | 1 January to 30 June 2014 (6 months) | | |
| **ANSP →** | ANSP1 | | **CTA →** | | CTA1 | | |
| **RCP** | | | | | | | |
| **Specification →** | RCP 240 | | **Application →** | | CPDLC | | |
| **Colour key** | | **Transaction counts (WILCO received)** | **95% RCP 240 benchmark** | | **99.9% RCP 240 benchmark** | | **RCP PORT** |
| Meets criteria → | | | **ACP** | **ACTP** | **ACP** | **ACTP** | **PORT** |
| Under criteria but above 99.0% → | | | **<=180 sec** | **<=120 sec** | **<=210 sec** | **<=150 sec** | **<=60 sec** |
| Under criteria → | | | **End-to-end** | **Network** | **End-to-end** | **Network** | **Pilot response** |
| **Aircraft type (ACT)/equipment type (EQ)** | | | | | | | |
| ACT1 | EQ1 | 777 | 99.4% | 99.7% | 99.6% | 99.7% | 96.7% |
| ACT1 | EQ2 | 172 | 99.4% | 99.4% | 100% | 100% | 97.7% |
| ACT2 | EQ1 | 336 | 95.8% | 99.1% | 97.6% | 99.1% | 86.6% |
| ACT2 | EQ2 | 317 | 99.4% | 99.7% | 99.7% | 100% | 95.9% |
| ACT3 | EQ1 | 142 | 99.3% | 100% | 100.0% | 100% | 97.9% |
| *Aggregate* | | *1 744* | *98.7%* | *99.6%* | *99.3%* | *99.7%* | *94.8%* |

| RSP | | | | |
|---|---|---|---|---|
| **Specification →** | RSP 180 | | **Application →** | ADS-C |
| | **Report counts** | | **95% RSP 180 benchmark** | **99.9% RSP 180 benchmark** |
| | | | **ASP % <=90 sec** | **ASP % <=180 sec** |
| **Aircraft type (ACT)/equipment type (EQ)** | | | | |
| ACT1 | EQ1 | 23 432 | 99.7% | 99.9% |
| ACT1 | EQ2 | 8 709 | 97.6% | 99.3% |
| ACT2 | EQ1 | 15 027 | 96.2% | 98.2% |
| ACT2 | EQ2 | 14 534 | 98.1% | 99.4% |
| ACT3 | EQ1 | 7 408 | 98.5% | 99.7% |
| *Aggregate* | | *69 110* | *98.2%* | *99.3%* |

3.3.3 When compiling data for analysis at the regional level, data from individual ANSPs may be shared as .csv file formats, as described in 2.1.2.4 for CPDLC data and 2.2.2.1 for ADS-C data. In this case, the regional PBCS monitoring programme would aggregate the data and perform the analysis as described in 3.1 and 3.2.

3.3.4 The regional PBCS monitoring programme may elect to receive data containing the cumulative distributions calculated by the ANSP. In this case, the regional PBCS monitoring programme would specify the time period of interest, the subset(s) of interest, the required filtering and the required format to ensure consistency between the data sets.

3.3.5 Figure D-10 illustrates a suggested format for data sharing with the regional PBCS monitoring programme and includes part of an ANSP report on actual performance for ACTP, ACP, and PORT, against the RCP 240 specification. The total number of transactions and the cumulative percentage at 1-second increments are shown. This format would enable the regional aggregation of agreed performance information, as well as assist in the aggregation at the global level. A similar format can be used for ASP against the RSP 180 specification.

D.3.3.6 Consistent data provided by each ANSP within a region can be aggregated to create a regional PBCS monitoring report in graphical or tabular form. An example RCP/RSP regional PBCS monitoring report is provided in Table D-11.

**Table D-11. Example RCP/RSP regional PBCS monitoring report**

| *Regional PBCS monitoring report* | | | | | | |
|---|---|---|---|---|---|---|
| **Region →** | LAT Region | | **Period →** | 1 January to 30 June 2014 (6 months) | | |
| **RCP** | | | | | | |
| **Specification →** | RCP 240 | | **Application →** | CPDLC | | |
| **Colour key** | | **Transaction counts (WILCO received)** | **95% RCP 240 benchmark** | | **99.9% RCP 240 benchmark** | |
| Meets criteria → | | | **ACP** | **ACTP** | **ACP** | **ACTP** |
| Under criteria but above 99.0% → | | | **<=180 sec** | **<=120 sec** | **<=210 sec** | **<=150 sec** |
| Under criteria → | | | **End-to-end** | **Network** | **End-to-end** | **Network** |
| **ANSP/control area (CTA)** | | | | | | |
| LAT Region | | 201 723 | 98.6% | 99.0% | 99.4% | 99.6% |
| ANSP1/CTA1 | | 27 608 | 98.5% | 98.9% | 99.3% | 99.6% |
| ANSP2/CTA2 | | 22 736 | 98.9% | 99.3% | 99.5% | 99.6% |
| . . . | | | | | | |
| | | | | | | |
| **RSP** | | | | | | |
| **Specification →** | RSP 180 | | **Application →** | ADS-C | | |
| **Colour key** (Same as for RCP) | | **Report counts** | **95% RSP 180 benchmark** | | **99.9% RSP 180 benchmark** | |
| | | | **ASP % <=90 sec** | | **ASP % <=180 sec** | |
| **Control area** | | | | | | |
| LAT Region | | 5 043 218 | 98.4% | | 99.4% | |
| ANSP1/CTA1 | | 484 610 | 97.7% | | 98.9% | |
| ANSP2/CTA2 | | 628 998 | 98.6% | | 99.3% | |

| *Regional PBCS monitoring report* | | | |
|---|---|---|---|
| **Region →** | LAT Region | **Period →** | 1 January to 30 June 2014 (6 months) |
| . . . | | | |

### 3.4 Case study

3.4.1 In early 2009, a slight performance degradation was detected for both CPDLC and ADS-C, through an analysis of the December 2008 performance data from NZZO, as measured against the RCP 240/RSP 180 specifications. Further performance deterioration was observed mid-February 2009 when the January 2009 data was assessed.

3.4.2 During this period further local analysis was initiated. By March 2009, a CRA problem report had been raised and a full investigation was under way by the CRA and the CSPs. Further deterioration in performance was noted in the following months through to October 2009.

3.4.3 ADS-C performance for the fleet, as measured against the RSP 180 performance standard, is illustrated in Figure D-11. CPDLC performance, as measured against the RCP 240 specification, is illustrated in Figure D-12.

3.4.4 A safety assessment in early 2009 concluded that reduced separation standards dependent on RCP and RSP specifications would be withdrawn, although CPDLC and ADS-C would continue to be used.

3.4.5 The origin of the problem was identified in mid-2009 as a system-level GES issue. This was caused by the implementation of new cabin services on the aircraft that were gradually installed on the fleet from late 2008 until mid-2009, and explained the continued performance degradation through this period.

3.4.6 A software fix was released in early 2010 with observed performance levels for the fleet immediately and meeting the RSP 180/RCP 240 standard.

3.4.7 Reduced separation standards were restored to the fleet in April 2009 after monitoring had demonstrated that performance standard compliance had been achieved.

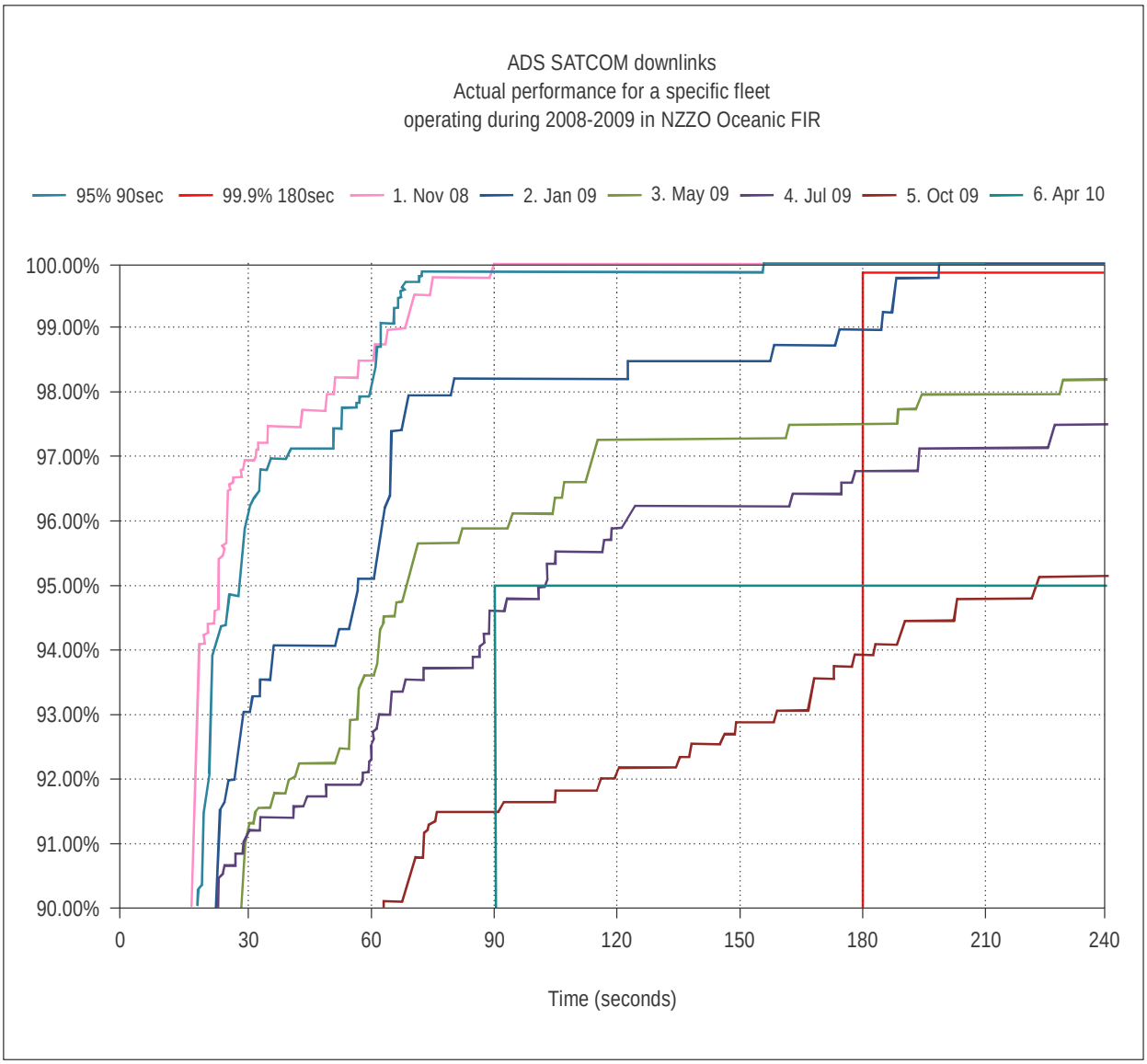



**Figure D-11. Example of ADS-C ASP deterioration**

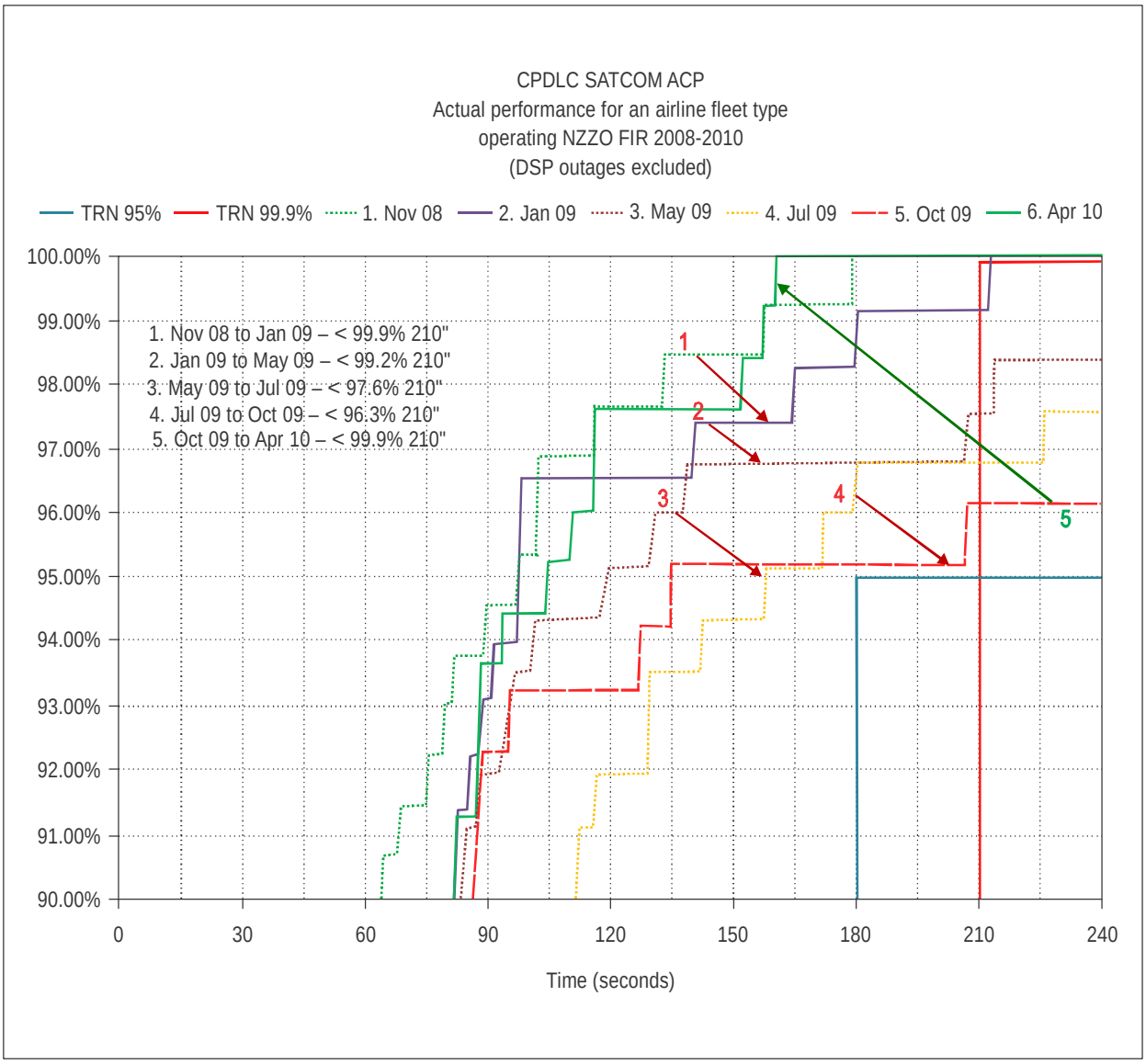



**Figure D-12. Example of CPDLC ACP deterioration**

## 4. REGIONAL PERFORMANCE MONITORING AND ANALYSIS

### 4.1 General

4.1.1 This section provides guidance on periodic reporting by ANSPs of observed system performance in its respective airspace, enabling regional performance metrics to be developed for availability, CPDLC transaction time and ADS-C surveillance data transit time requirements, as specified in Appendix B and Appendix C.

4.1.2 These regional performance metrics should be made available to all interested stakeholders. As such, the use of regional websites to enhance the distribution of these metrics should be considered. An example may be viewed at http://www.ispacg-cra.com/.

4.1.3 It is recommended that regions implement monthly performance reporting in order to obtain system performance metrics. These reports will provide data on observed availability, CPDLC transaction time and ADS-C surveillance data transit time, as described herein.

### 4.2 Reporting on CPDLC actual communications performance

4.2.1 The ANSP should report observed ACP and ACTP for RCP 240 and RCP 400, for different media paths using all transactions involving a WILCO response, as described in section 3. The media paths to report are from all aircraft:

a) via all remote ground station (RGS) types;

b) where both uplink and downlink are via SATCOM RGS;

c) where both uplink and downlink are via VHF RGS;

d) where both uplink and downlink are via HF RGS; and

e) where either uplink and downlink are via HF or SATCOM RGS.

4.2.2 A tabular reporting format may be used to capture the observed performance at the 95 per cent and 99.9 per cent RCP 240/400 times.

4.2.3 As PORT is independent of a media path, this is only reported for all RGS types. An example form is shown in Table D-10.

### 4.3 Reporting on RSP data transit times

The ANSP should report observed RSP data transit times for RSP 180, RSP 400 and DO290/ED120-based performance specifications for different media paths, as described in section 3. The media paths to report are from all aircraft:

a) via all remote ground station (RGS) types;

b) where both uplink and downlink are via SATCOM RGS;

c) where both uplink and downlink are via VHF RGS;

d) where both uplink and downlink are via HF RGS; and

e) where either uplink and downlink are via HF or SATCOM RGS.

## 5 REGIONAL PROBLEM REPORTING AND RESOLUTION

### 5.1 General

5.1.1 The working principles in this guidance material result from the combined experience from CPDLC and ADS-C implementation, worldwide. Many regions established regional monitoring programmes to manage the problem reporting and resolution process.

5.1.2 While problem reporting programmes exist at the local level, the guidance in this section considers only problem reporting and resolution at the regional level.

5.1.3 All stakeholders should be actively involved in the problem reporting and resolution process. It is essential that all aircraft operators in a region have the opportunity to become involved in the process and CRAs should be pro-active in getting all aircraft operators and other stakeholders to register and participate in the process.

5.1.4 The problem identification and resolution process, as it applies to an individual problem, consists of the following phases: a data collection; problem analysis and coordination with affected parties to secure a resolution; and recommendation of interim procedures to mitigate the problem, in some instances. This is shown in the Figure D-13.

### 5.2 Problem report form

5.2.1.1 The problem identification task begins with the receipt of a problem report from a stakeholder, usually an operator, an ANSP or CSP, but may include an aircraft or avionics manufacturer. Standard reporting forms should be developed and regions should investigate the use of a website to receive and store problem reports.

5.2.1.2 An example of an online problem reporting form is shown in Figure D-14. The fields used in the form are as follows:

a) Originator’s reference number: originators problem report reference (e.g. ANZ_2009-23);

b) Title: a short title which conveys the main issue of the reported problem (e.g. CPDLC transfer failure);

c) Date UTC: date in YYYYMMDD format (e.g. 20090705);

d) Time UTC: time in HHMM format (e.g. 2345);

e) Aircraft registration: ICAO flight plan aircraft registration (e.g. ZKADR);

f) Aircraft identification: ICAO flight plan call sign if applicable (e.g. NZA456);

g) Flight sector: if applicable, the departure and destination airfield of the flight (e.g. NZAA-RJBB);

h) Organization: name of the originator’s organization (e.g. Airways NZ);

i) Active centre: controlling centre at time of occurrence, if applicable (e.g. NZZO);

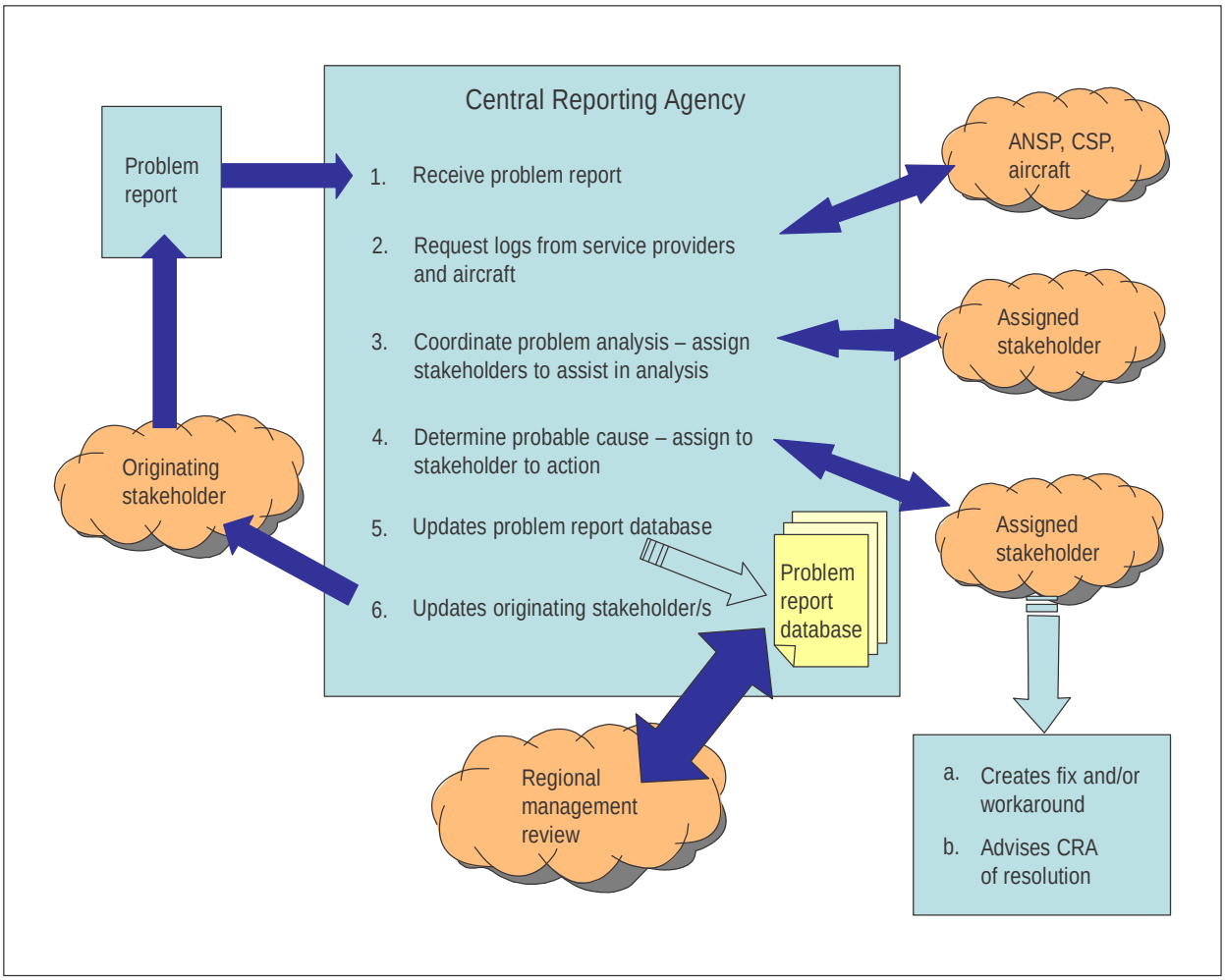



**Figure D-13. Problem reporting and resolution process**


**Figure D-14. Example online problem reporting form**

j) Next centre: next controlling centre at time of occurrence, if applicable (e.g. NFFF);

k) Position: position of occurrence (e.g. 3022S16345E);

l) Problem description: detailed description of problem;

m) Attach file: area of web page where originator and assigned stakeholders can attach data files or other detailed information, such as geographic overlays; and

n) Additional data: area set aside for feedback from stakeholders assigned by the regional/local monitoring entity. This will include the results of the investigation and the agreed action plan.

### 5.3 Problem assessment

5.3.1 *Data collection*

5.3.1.1 The data collection phase consists of obtaining message logs from the appropriate parties (which will depend on the ANSP and CSPs used and operator service contracts). Today, this usually means obtaining logs for the appropriate period of time from the CSPs involved. Usually, a log for a few hours before and after the event that was reported will suffice, but once the analysis has begun, it is sometimes necessary to request additional data, perhaps for several days prior to the event if the problem appears to be ongoing.

5.3.1.2 Additionally, some aircraft-specific recordings may be available to assist in the data analysis task. These are not always initially requested, as doing so would be an unacceptable imposition on the operators. However, such a request may occur when the nature of the problem is clarified enough to indicate the line of investigation to be pursued. These additional records include:

a) aircraft maintenance system logs;

b) built-in test equipment data dumps for some aircraft systems;

c) SATCOM activity logs; and

d) logs/printouts from the flight crew and recordings/logs from the ANSPs involved in the problem. It is important that the entity collecting data for the analysis task requests all this data in a timely manner, as much of it is subject to limited retention.

5.3.2 *Data analysis*

5.3.2.1 Once the data has been collected, the analysis can begin. The decoding of every ATS message type involved would be necessary, therefore a tool capable of such decoding is essential for the region. These messages include:

a) AFN (ARINC 622), ADS-C and CPDLC (RTCA DO-258/EUROCAE ED-100) in a region operating FANS-1/A;

b) Context management, ADS-C and CPDLC applications (ICAO Doc 9705 and RTCA DO-280B/ED-110B) in a region using ATN B1; and

c) ARINC 623 messages used in the region.

5.3.2.2 The analysis of the decoded messages requires a thorough understanding of the complete message traffic, including:

a) media management messages;

b) relationship of ground-ground and air-ground traffic; and

c) message envelope schemes used by the particular CPDLC and ADS-C technology (e.g. ACARS or ATN).

5.3.2.3 The analyst must also understand how the aircraft systems operate and interact to provide CPDLC and ADS-C, as many of the reported problems are aircraft system problems.

5.3.2.4 This information will enable the analyst to determine a probable cause by working back from the area where the problem was noticed, to where it began. In some cases, this may entail a manual decoding of message parts based on the appropriate standard to identify particular encoding errors. It may also require lab testing using the airborne equipment (and sometimes the ground networks) to reliably assign the problem to a particular cause.

5.3.2.5 Once the problem is identified, coordination with the affected parties begins. The stakeholder who is responsible for fixing the problem should be contacted and a corrective action plan should be agreed upon. The stakeholder who initiated the problem report shall be provided with regular updates on the progress and resolution of the problem.

5.3.2.6 This information (problem description, results of analysis and plan for corrective action) is then entered into a database covering CPDLC and ADS-C problems, both in a complete form to allow continued analysis and monitoring of the corrective action and also in a de-identified form for the information of other stakeholders. These de-identified summaries are reported at the appropriate regional management forum and made available to other PBCS monitoring entities on request.

### 5.4 Mitigating procedures — problem resolution

The regional monitoring entity's responsibility does not end with the problem's identification and resolution. As part of the activity, and because a considerable period of time may elapse while software updates are applied to all aircraft in a fleet, procedural methods to mitigate the problem may need to be developed while the solution is being coordinated. The regional monitoring entity should identify the need for such procedures and develop recommendations for implementation by the ANSPs, CSPs and operators involved.

## 6. SUPPLEMENTAL GUIDANCE FOR THE EUR REGION

### 6.1 General

6.1.1 This section provides supplemental information to support post-implementation monitoring and analysis in the European Region (EUR).

6.1.2 EC Regulation 29/2009 (the DLS IR) stipulates:

> "The quality of service of air-ground data link communications should be regularly monitored by ATS Providers".

6.1.3 It also states:

> "ATS providers shall monitor the quality of service of communication services and verify their conformance with the level of performance required".

6.1.4 RTCA DO 290/EUROCAE ED 120 — Continental SPR standard, comprises the performance requirements for:

a) data link initiation capability (DLIC) logon and contact; and

b) CPDLC — ATS communication management (ACM) and ATS clearance (ACL) delivery.

*Note.— The intention is to define a new RCP specification for ACM and ACL-controller initiated messages based on DO 290/ED 120.*

6.1.5 In addition to CPDLC data collection, monitoring and analysis described in 2.1, 2.3 and 3 of this appendix, the ANSP should collect data and conduct analysis for the following:

a) DLIC contact transactions; and

b) all CPDLC ground-initiated and air-initiated transactions.

*Note.— The ANSP measures all implemented controller–initiated messages, including all received responses.*

6.1.6 The ANSP should analyse air-initiated transactions separately from ground-initiated transactions.

6.1.7 The ANSP should analyse FANS 1/A DLIC and CPDLC transactions separately from ATN B1 DLIC and CPDLC transactions.

6.1.8 Instead of the method provided in 2.1.3.2, the ANSP should calculate ACTP by taking the difference between the MAS/LACK reception time and the CPDLC uplink message transmission time. The uplink messages are associated with their corresponding MAS/LACKs through the use of the CPDLC message reference number (see Figure D-15).

### 6.2 CPDLC flight crew-initiated transactions

6.2.1 The ANSP should measure the transit and response times to a subset of CPDLC flight crew-initiated downlink messages that receive a single UNABLE or clearance response.

6.2.2 The ACP is calculated by measuring the difference between the time in the header of the LACK message acknowledging the response and the time in the CPDLC header of the downlink message request. Figure D-16 illustrates the measurements.

*Note.— The time provided in the header of the LACK message, sent from the aircraft, can be considered as giving a fairly accurate indication of when the associated uplink response is processed and available to the flight crew.*

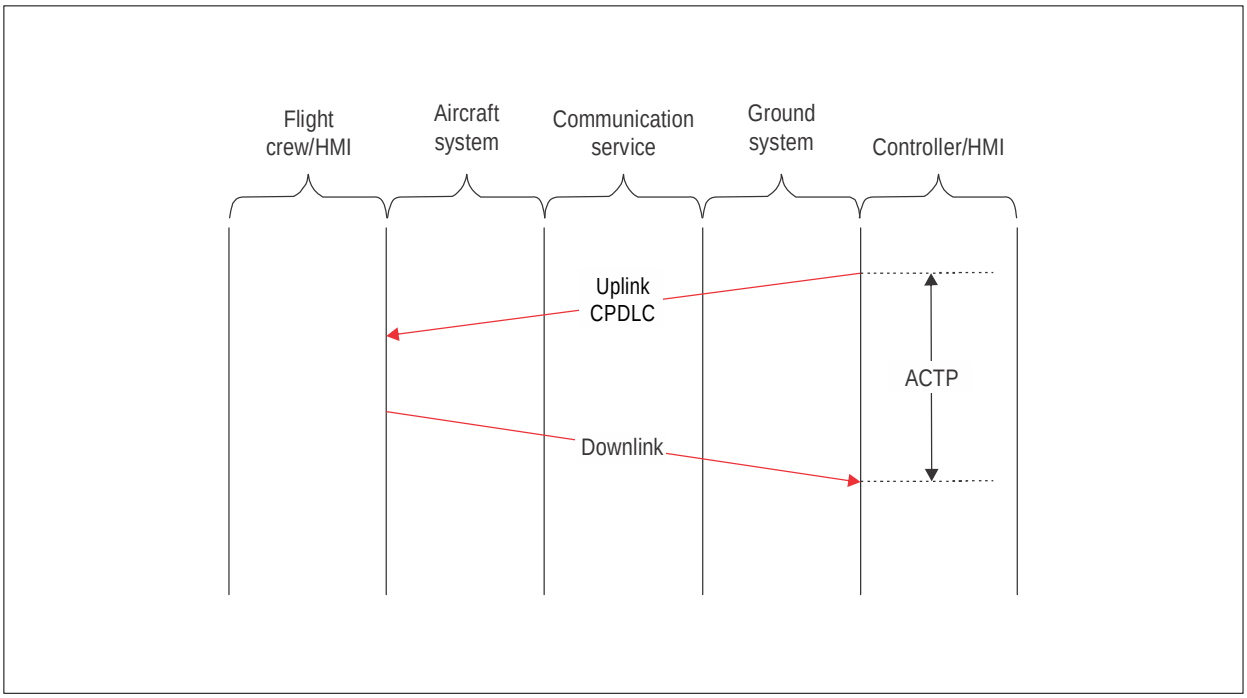



**Figure D-15. EUR Region — ACTP measurement**

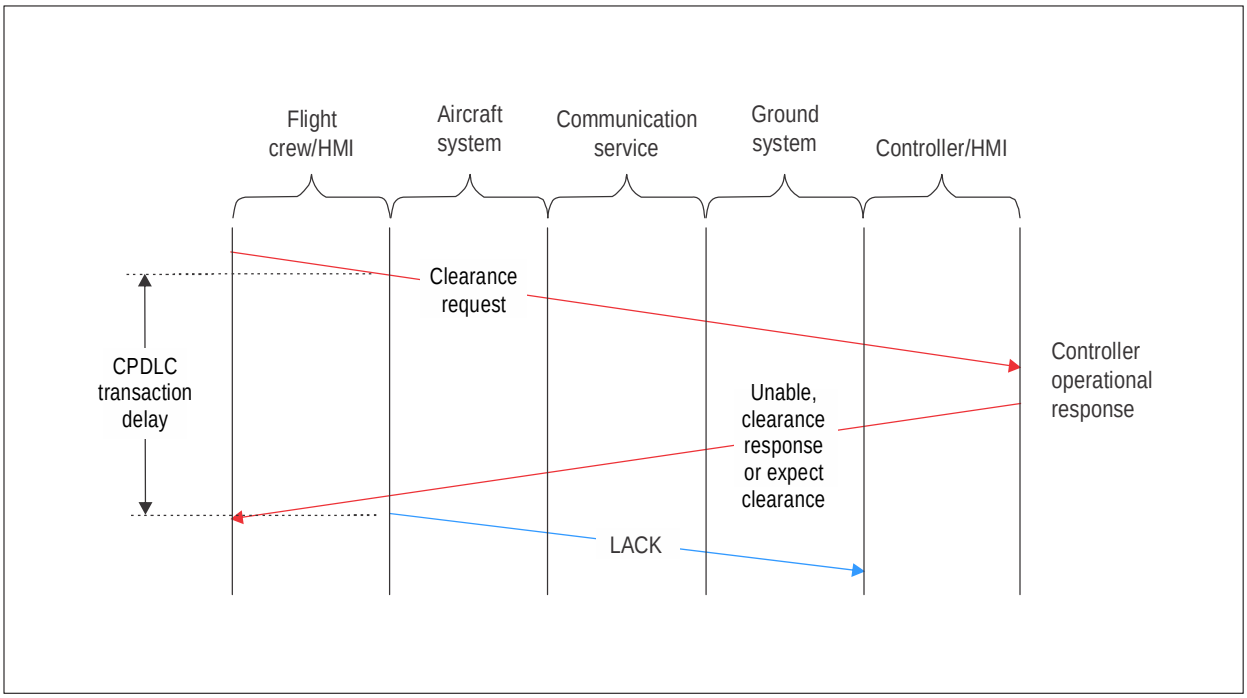



**Figure D-16. Flight crew-initiated ACP time**

### 6.3 DLIC contact transactions

6.3.1 The ANSP should measure the DLIC contact transaction time.

6.3.2 The ACP is calculated by the difference between the contact response reception time and the contact request transmission time, as is illustrated in Figure D-17.

*Note.— It is not possible to accurately measure DLIC logon transactions. Moreover, a logon is normally initiated well in advance of establishing a CPDLC connection with the first ATS unit.*

### 6.4 Data collection and reporting

6.4.1 For ATN B1 and FANS 1/A service provision in the EUR Region, the following additional data should be provided:

a) *DLIC initiation logon counts*. The number of unsuccessful logon attempts, the number of successful logon attempts followed by the establishment of a CPDLC connection, and the number of successful logon attempts that are not followed by the establishment of a CPDLC connection;

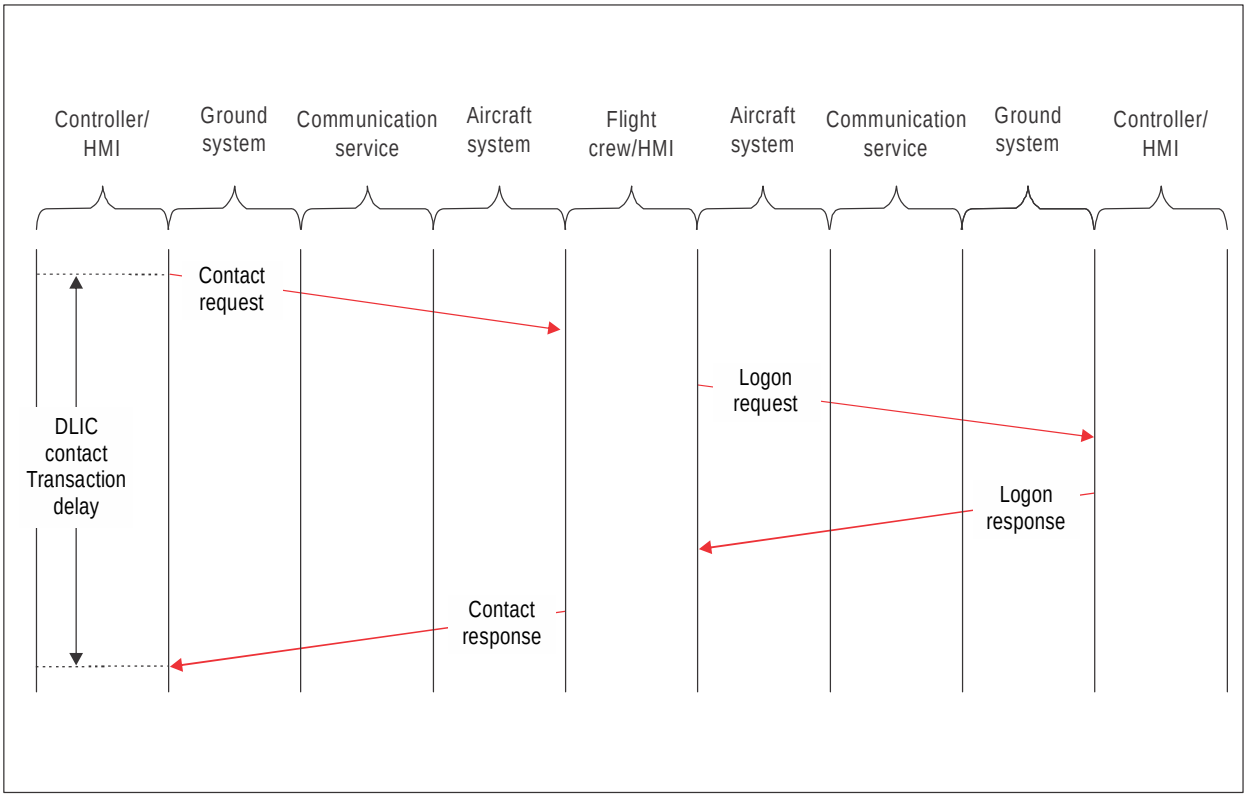



**Figure D-17. DLIC contact transaction**

b) *Continuity for DLIC contact and CPDLC ground-initiated and air-initiated transactions*. As the performance requirements are different for ground-initiated transactions and air-initiated transactions, the actual probability for Continuity is calculated separately for ground-initiated and air-initiated transactions;

c) *Availability (use)*. The number of provider aborts experienced by the ANSP and manually reported availability problems affecting a single aircraft;

*Note.— Measuring the actual probability of A(USE) according to the formal definition is problematic. An acceptable indication would be to count the number of provider aborts (the air-ground connectivity is lost after 6 minutes).*

d) *Availability of service ($A_{SERVICE}$).* Defined as Actual Hours of CPDLC Operations / Planned Hours of CPDLC Operations, where:

1) Actual Hours of CPDLC Operations = Planned Hours of CPDLC Operations - accumulated declared unplanned service outages;

2) Planned Hours of CPDLC Operations = 24 x 7 operations over a certain period – planned service outages;

3) Accumulated declared unplanned service outages. The sum of all partial failures (affecting multiple aircraft) or total failure (affecting all aircraft) over a certain period; and

4) Unplanned service outages affecting more than one aircraft are due to problems originated from, for example, FDP, CSP, VDL GS and router.

e) Deployment indicators using:

1) Fleet equipage. The percentage of the aircraft fleet equipped to use CPDLC; and

2) Fleet usage. The percentage of the aircraft fleet equipped to use CPDLC that are actually using CPDLC operationally.

f) System health indicators, using:

1) User aborts. The number of user aborts;

2) Error messages. The number of different types of error message;

3) Message usage. The number of different ACL and ACM messages sent;

4) Transport level (TP4) retries (ATN B1). The number of uplink retries per ground end-system identifying which aircraft were involved, along with the ratio of the number of uplink TP4 retransmissions to the number of successfully transmitted data TPDUs per ground end-system. Monitoring the rate of TP4 retries for each system on the ground and identifying which aircraft are involved will allow the identification of the problems occurring within the network/ground system or with a particular aircraft;

*Note.— A TP4 retry could occur as the result of:*

*a) temporary delays;*

*b) unavailability of a component of the network;*

*c) a dysfunctional VDL handoff; or*

*d) a problem in an end- system (ATS unit or aircraft system).*

5) Failed transport connection attempts (ATN B1). The number of failed transport connection attempts measured per ground end-system identifying which aircraft were involved. Monitoring the number of failed attempts to establish a transport level connection will give an indication of problems with the slightly longer term availability of one of the end-systems or the underlying network; and

6) TP4 round-trip delay (ATN B1). The time taken from the transmission of a data TPDU to its acknowledgement.

g) Inconsistency in flight plan and logon association. The number of inconsistencies found in the flight plan — logon association criteria (i.e. aircraft registration/aircraft address, CPDLC equipment and capability in Item 10 a)).

The ANSP may find that the following additional data may be useful for performance analysis:

h) Air-ground VDLM2 data. CSP sends VDLM2 data to the CRO, which may be supplemented with VDLM2 data from ANSPs for VDLM2 frequency capacity planning and problem investigation.

6.4.2 The ANSP should record the observed ACP and ACTP for CPDLC flight crew-initiated log files for different media paths using all transactions requiring a response. In addition, it should record the observed ACP and ACTP for DLIC contact/CPDLC log files and ATN B1 transport level log files, deployment and system health log files in the standardized XML format. All ANSPs send the log files to the central reporting organization (CRO) for importing into the Pan-European Repository of Information Supporting the Management of EATM (PRISME). PRISME is an integrated ATM data warehouse for creation of various performance monitoring reports (e.g. EUR network, an ANSP, an aircraft operator, particular avionics configuration).

6.4.3 The EUR network performance monitoring reports are published on the CRO website. Reports at all other levels (per ANSP, per aircraft operator and per avionics configuration) are restricted to the European Organisation for the Safety of Air Navigation (EUROCONTROL) and the relevant stakeholder.

### 6.5 Problem reporting

6.5.1 JIRA (http://www.eurocontrol.int/link2000/wiki/index.php/) provides a secured web-based problem reporting and tracking application, which is managed by the LINK2000+/Central Reporting Office of EUROCONTROL.

6.5.2 ANSPs, aircraft operators and other participants should report problems to the regional PBCS monitoring programme, regardless of whether they may be resolved locally or regionally, in order to promote knowledge-sharing among the participants as well as on a global level.

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# Appendix E

# Post-implementation monitoring and corrective action (SATVOICE)

## 1. GENERAL

1.1 This appendix provides guidance additional to that provided in Chapter 4, for local and regional PBCS monitoring programmes. It contains guidance material relevant to monitoring satellite voice communications (SATVOICE) services for which the required communication performance (RCP)/required surveillance performance (RSP) specifications provided in Appendix B and Appendix C are applicable, including:

a) air navigation services provider (ANSP) data collection and analysis — this section defines a common data reporting format, providing guidance on how to obtain the required data points;

b) ANSP monitoring and analysis — this section contains guidance on data analysis, including recommended filtering for completeness of monitoring;

c) regional performance monitoring and analysis — this section provides guidance on monitoring at a regional level; and

d) problem reporting and resolution — this section provides guidance on the process for problem identification and resolution.

## 2. ANSP DATA COLLECTION

### 2.1 ANSP data collection for SATVOICE transaction time/continuity

2.1.1 *General*

2.1.1.1 This section provides guidance on data collection and performance measurement for the communication application. SATVOICE communication performance analysis is based on the calculation of actual communication performance (ACP) used to monitor RCP time allocations for communication transaction (RCMP). The analysis uses the measurement of transit and response times related to clearances sent via SATVOICE — containing “ATCC” — that receive a single read back response, since the critical communications requirement is based on intervention messages.

2.1.2 *Recording the data points for each clearance transaction*

2.1.2.1 The data points shown in Table E-1 are recommended as the minimum set to be extracted by the ANSP from system recordings, to provide sufficient information for RCP analysis and problem investigation. An ANSP may extract additional data points for their own analysis requirements, some possibilities of which are listed below in Table E-1.

2.1.2.2 Most of the data points can be extracted from either the ACARS header or the ACARS application message. However, the aircraft type and operator will need to be matched to each record from a separate database using the aircraft registration as the common point.

2.1.2.3 The methods for calculating the ACP are described in 2.1.3 of this appendix.

**Table E-1. Clearance transaction collection points**

| *Ref* | *Label* | *Description and/or remarks* |
|---|---|---|
| 1 | ANSP facility | Four-letter ICAO designator of the ATS unit (e.g. NZZO). |
| 2 | Aircraft call sign | *Note.— Extracted from ACARS header or application message (e.g. UAL12).* |
| 3 | Operator designator | ICAO designator for the aircraft operating agency (e.g. UAL).<br><br>*Note.— Extracted from aircraft call sign.* |
| 4 | Aircraft type designator | ICAO aircraft type designator (e.g. B744).<br><br>*Note.— Extracted from the ANSP's database using aircraft registration as key. This may not be possible if the registration number is not available. Aircraft type designators are contained in Doc 8643.* |
| 5 | Date | In YYYYMMDD format (e.g. 20081114).<br><br>*Note.— Extracted from the ANSP's system data recording timestamp.* |
| 6 | Clearance media | Designator of the media type through which the clearance was sent (e.g. SAT Iridium, Inmarsat or MTSAT, or HF).<br><br>*Note.— This is extracted from the ACARS header or application message.* |
| 7 | Clearance send time | Timestamp on the clearance message sent by the ANSP in HH:MM:SS format (e.g. 13:43:25).<br><br>*Note.— Extracted from the ANSP's system data recording timestamp.* |
| 8 | ANSP timestamp on the receipt of the read back response | In HH:MM:SS (e.g. 13:44:45).<br><br>*Note.— Extracted from the ANSP's system data recording timestamp.* |
| 9 | ACP | Actual communications performance in seconds measured as the difference between the time the clearance is sent (#7) and the time the operational read back response is received (#8) (e.g. 80). |

2.1.2.4 In comma delimited text file format, these data points would appear as follows:

NZZO,UAL12,UAL,B744,20081114,SAT,13:43:25,13:44:45,80

2.1.3 *Calculating ACP*

2.1.3.1 ACP is calculated by taking the difference between the time that the clearance message is originated at the ANSP and the time that the corresponding response read back is received at the ANSP.

2.1.3.2 The ANSP may find that the following additional data may be useful for performance analysis:

a) the aircraft registration format in the *Procedures for Air Navigation Services — Air Traffic* Management (PANS-ATM, Doc 4444) (e.g. with no hyphens, extraneous characters, such as N104UA); and

b) the aircraft address format in Doc 4444 represented in hexadecimal code (e.g. C0173E).

## 2.2 ANSP data collection for SATVOICE position report delivery time/continuity

2.2.1 *General*

2.2.1.1 This section provides guidance on data collection and performance measurement for the surveillance application. The analysis of actual surveillance performance (ASP) is based on the measurement of the difference between the time-over-position extracted from the decoded ACARS message and the time the message is received at the ANSP. Because the accuracy of the time-over-position within the ACARS position report message is to the minute (e.g. 15:11), while the accuracy of the timestamp of receipt at the ANSP is to the second (e.g. 15:11:11), the accuracy of the surveillance performance's measurement will be limited to the minute.

2.2.1.2 The methods for calculating the ASP are described in 2.2.3.

2.2.2 *Recording the data points for each position report*

2.2.2.1 The data points listed in Table E-2 are recommended as the minimum set to be extracted by the ANSP from system recordings, to provide sufficient information for ASP analysis and problem investigation. An ANSP may extract additional data points for their own analysis requirements, possibilities of which are listed below in Table E-2. Most of the data points can be extracted from the ACARS header or message. However, the aircraft type and operator will need to be matched to each record from a separate database using the aircraft registration as the common point.

**Table E-2. Position report collection points**

| *Ref:* | *Label* | *Description and/or remarks* |
|---|---|---|
| 1 | ANSP facility | Four-letter ICAO designator for the ATS unit of the reporting ANSP (e.g. NZZO). |
| 2 | Aircraft call sign | *Note.— Extracted from ACARS header or application message (e.g. UAL12).* |
| 3 | Operator designator | ICAO designator for the aircraft operating agency (e.g. UAL).<br><br>*Note.— Extracted from aircraft call sign.* |
| 4 | Aircraft type designator | ICAO aircraft type designator (e.g. B744).<br><br>*Note.— Extracted from the ANSP's database using aircraft registration as key. May not be possible if registration number is not available. Aircraft type designators are contained in Doc 8643.* |
| 5 | Date | In YYYYMMDD format (e.g. 20081114).<br><br>*Note.— Extracted from the ANSP's system data recording timestamp.* |
| 6 | Position report media | Designator of the media type through which the position report was sent (e.g. SAT Iridium, Inmarsat or MTSAT, or HF).<br><br>*Note.— This is extracted from the ACARS header or application message.* |
| 7 | Report type | The type of position report extracted from the ACARS header (e.g. POS or AEP). |
| 8 | Latitude | The reported latitude decoded from the ACARS position report message. The format is "+" for North or "-" for South followed by a decimal number of degrees (e.g.–33.456732). |
| 9 | Longitude | The reported longitude decoded from the ACARS position report message. The format is "+" for East or "-" for West followed by a decimal number of degrees (e.g. +173.276554). |
| 10 | Position time | The time contained within the ACARS position report message sent from the aircraft in HH:MM format (e.g. 03:44). |
| 11 | ANSP receipt time | The ANSP timestamp on the receipt of the ACARS position report message in HH:MM:SS (e.g. 03:44:45).<br><br>*Note.— Extracted from the ANSP's system data recording timestamp.* |
| 12 | ASP | The transit time of the position report calculated as the difference between the position time (#10) and the ANSP receipt time (#11). |

2.2.2.2 In a comma delimited text file format, these data would appear as follows:

NZZO,UAL12,UAL,B744,20081114,SAT,POS,-33.456732,+173.276554,03:44,03:44:45,45

2.2.2.3 The ANSP may find that the following additional data may be useful for performance analysis:

a) the aircraft registration format in Doc 4444 (e.g. no hyphens, extraneous characters, such as N104UA); and

b) the aircraft address format in Doc 4444 represented in hexadecimal code (e.g. C0173E).

2.2.3 *Calculating position report delivery time*

2.2.3.1 The position report delivery time is calculated by measuring the difference between the times when the position report indicated the aircraft was at the reported position to when the ATS unit received the report.

### 2.3 ANSP data collection for SATVOICE service availability

2.3.1 The ANSP should collect data on CSP notified system outages as well as detected outages not observed or notified by the CSP, as these data are used to calculate the actual availability of the SATVOICE service provision.

2.3.2 For each outage the following information should be collected:

a) time of CSP outage notification: in YYYYMMDDHHMM format or “Not Notified” if no CSP notification received;

b) CSP name: name of CSP providing outage notification, if applicable;

c) outage start time: in YYYYMMDDHHMM format;

d) outage end time: in YYYYMMDDHHMM format; and

e) duration of outage: in minutes.

2.3.3 Only outages greater than the unplanned outage duration limit are reported.

## 3. ANSP PERFORMANCE MONITORING AND ANALYSIS

### 3.1 Monitoring time/continuity of SATVOICE communications

3.1.1 *General*

3.1.1.1 The collected SATVOICE data are used to monitor the time/continuity of clearance transactions and position report delivery. In addition to monitoring the aggregate system performance, important subsets of the data, including all observed media types, message type(s), operators, aircraft types and airframes should also be monitored and examined.

3.1.1.2 The first step of such an analysis requires organizing the collected data. The following sections provide suggested filtering which should allow for an effective measurement of RCP and RSP time/continuity parameters.

### 3.1.2 *Filtering SATVOICE data*

3.1.2.1 The performance specifications are intended to provide criteria for “operational” performance, so as to not necessarily filter out failed attempts. However, in some cases filtering may be appropriate. It is also important that consistent data filtering is employed to ensure that all ANSPs are measured against the same baseline.

3.1.2.2 Raw data obtained from ANSP recordings will include delayed transactions, which are influenced by conditions affecting availability, such as system outages and congestion. These transactions should not be used when assessing clearance transaction time or position report delivery time, as they will be considered when assessing the service availability. This data should be filtered from the raw data before any performance assessment is made.

3.1.2.3 When SATVOICE is used after failed attempts on HF, the observed performance may indicate excessive delays in the SATVOICE performance. The analysis should include these data to reflect actual operational performance from the controller perspective and then determine whether procedures could potentially mitigate the effects of these delays (e.g. the radio operator may consider using the SATVOICE directly when it can be determined to provide a more reliable communication than HF).

3.1.2.4 Monitoring controller intervention (i.e. clearances) via radio operator using SATVOICE involves an assessment of the cumulative distribution of ACP. The purpose of the cumulative distribution is to depict the measured performance of only data representative of an intervention capability against the RCP 400 requirements at the 95 per cent and 99.9 per cent levels.

3.1.2.5 Monitoring position report delivery via radio operator using SATVOICE involves an assessment of the cumulative distribution of ASP. The purpose of the cumulative distribution is to depict measured performance of only surveillance data against the RSP 400 requirements at the 95 per cent and 99.9 per cent levels.

### 3.1.3 *Cumulative distributions of SATVOICE data*

3.1.3.1 Filtering data will limit the size of the sample used in the cumulative distributions of SATVOICE data. As such, a sufficient sample size should be determined by taking into account a number of factors, including:

a) the type of data to be considered in the sample (e.g. SATVOICE transactions representative of an intervention to manoeuvre the aircraft in the event of a conflict, or using SATVOICE to make position reports);

b) cost, time and difficulty in collecting the data (e.g. for an entire airspace, an aircraft operator’s fleet, an aircraft type/system, or a new media type);

c) existing knowledge about the underlying technologies and implementation (e.g. data have already been collected and analysed from a similar implementation using similar technologies);

d) variability of the data collected (e.g. how predictable is it that the performance will fall within a specified range?);

e) the specific criterion against which the data sample will be measured (e.g. if the criterion is specified at 95 per cent, then, statistically, the data sample would need to be at least 1 000 data points); and

f) level of confidence desired in the estimated result (e.g. operational judgment will play a role).

3.1.3.2 Once a sufficient sample of filtered data has been collected, the next step is to calculate a cumulative distribution for each of the performance parameters to be measured: ACP for intervention capability and ASP for position reports.

3.1.3.3 Monitoring may be completed at several levels for both communication and surveillance performances. The following structure is recommended:

a) monitoring performance by communication media — an analysis of:

1) voice data from all aircraft;

2) voice data from all aircraft via SAT (Iridium, Inmarsat and MTSAT);

3) voice data from all aircraft via HF, as appropriate;

b) monitoring performance by airline fleet — an analysis of:

1) observed performance of each type of aircraft operated by an operator for:

i) all voice data;

ii) voice data via SAT (Iridium, Inmarsat and MTSAT);

iii) voice data via HF, as appropriate; and

2) comparative analysis of the observed performance for an aircraft type used by different operators.

3.1.3.4 It is recommended that the ANSP begins with a graphical analysis of the collected performance data. Depicting the analysis results in graphical form has proven to be a useful technique for evaluating various aspects of performance and identifying problems.

3.1.3.5 Figure E-1 provides a typical graph, constructed using a spreadsheet application, illustrating the ACP of clearance transactions via a radio operator using SATVOICE. The observed performance of the 7 404 SATVOICE voice transactions in October 2011 is shown against the RCP 400 performance measures.

3.1.3.6 Figure E-2 illustrates an ACP chart showing the SATVOICE performance over a twelve-month period. The tight spread of the data shows relatively stable performance in this example.

3.1.3.7 Figure E-3 illustrates a typical graph, constructed using a spreadsheet application, demonstrating ASP of position report delivery times via a radio operator using SATVOICE. The observed performance of the 10 217 voice position reports is shown against the RSP 400 performance criteria. The cumulative distribution is plotted using 1-minute increments.

### 3.1.4 *Identifying poor performers*

3.1.4.1 There are many potential causes of degraded performance. Considerable analysis may be required to identify the reasons behind poor performing fleets, therefore it is not possible to provide guidance in all situations. Certain analysis techniques that were found to be useful are provided in the following paragraphs.

3.1.4.2 On a number of occasions poor performance has been attributed to a specific aircraft in a fleet. Usually these poor-performing aircraft can be identified by the visual inspection of monthly data ordered in terms of transit time, or more accurately by graphing the monthly data for a fleet by aircraft registration.

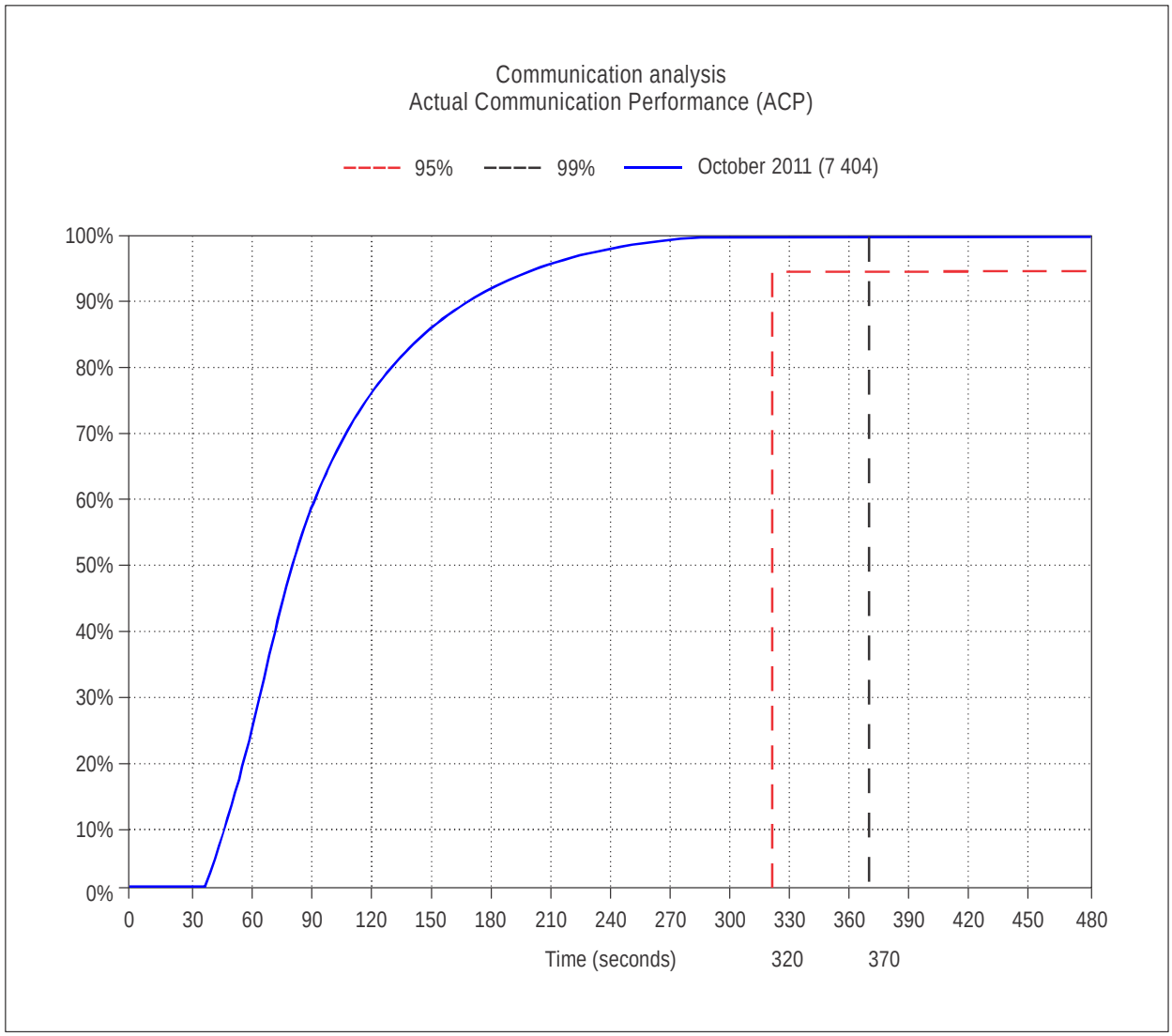


**Figure E-1. SATVOICE communication performance — ACP**

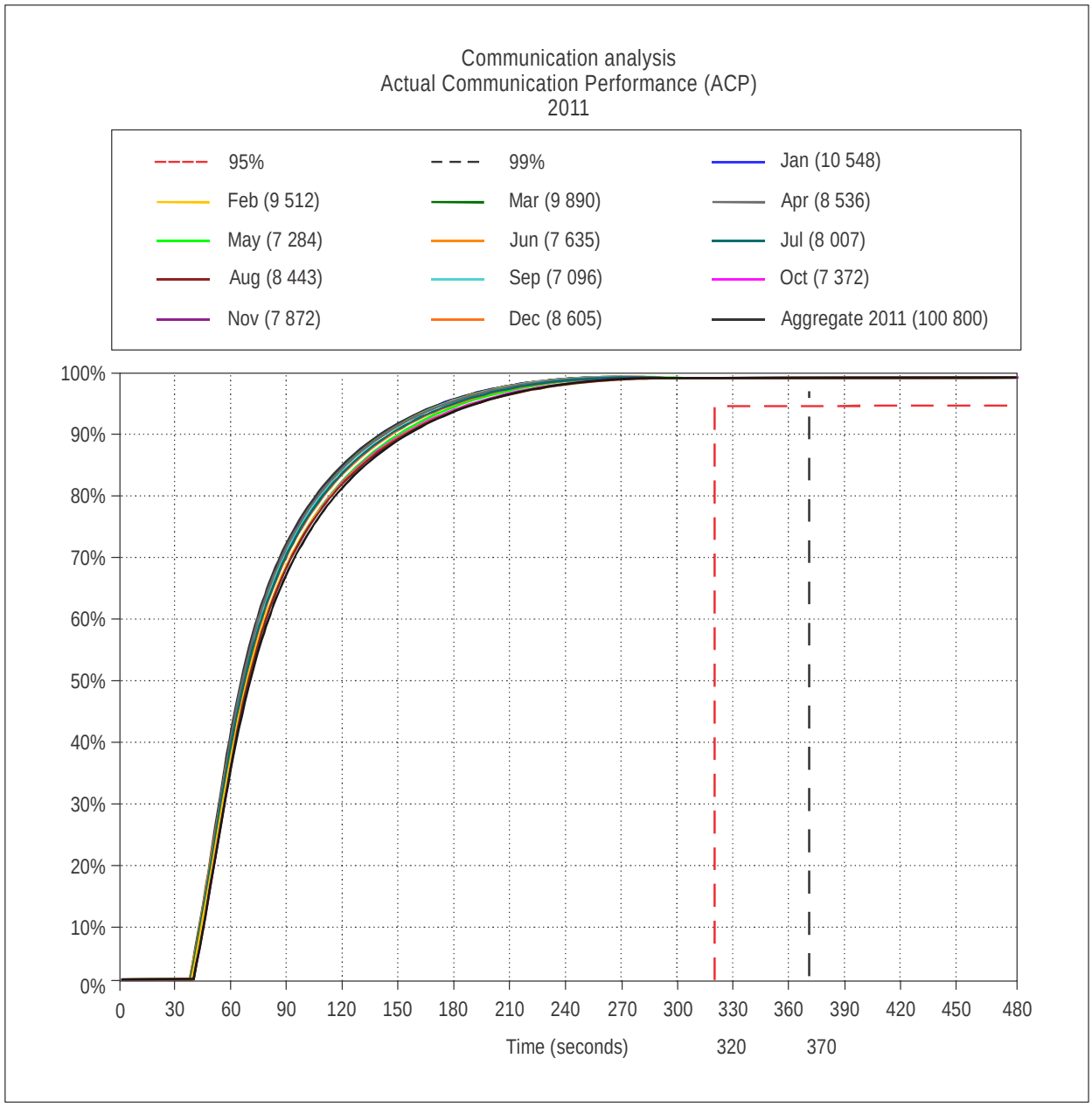


**Figure E-2. SATVOICE communication performance — ACP — 12 months**

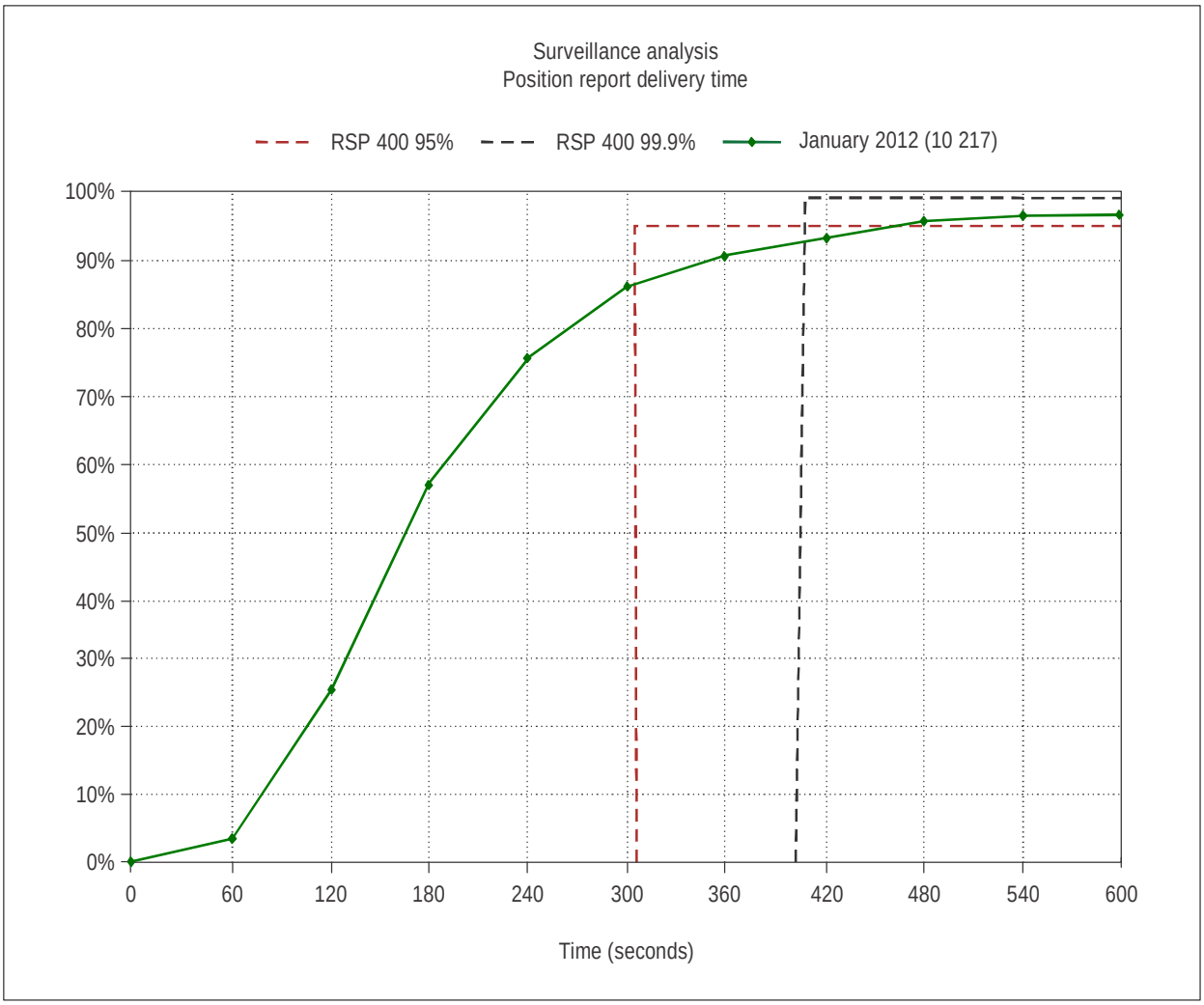


**Figure E-3. Position report delivery time**

3.1.4.3 Techniques such as graphing the positions of all delayed messages on a geographical display have identified areas for further investigation.

### 3.2 Monitoring availability of SATVOICE service

Using the data collected on outages reported by the CSP, as well as unreported outages identified by the ANSP, as described in 2.3, graphical analysis can be used to track availability. Graphical analysis methods are similar to those used for CPDLC and ADS-C provided in Appendix D.

## 4. REGIONAL PERFORMANCE MONITORING AND ANALYSIS

### 4.1 General

4.1.1 This section provides guidance on periodic reporting by each ANSP of observed system performance in its respective airspace enabling regional performance metrics to be developed for the availability, transaction time for interventions via SATVOICE, and position report delivery time requirements specified in Appendices B and C.

4.1.2 These regional performance metrics should be made available to all interested stakeholders. As such, the use of regional websites to enhance the distribution of these metrics for SATVOICE should be considered. For example, a website used for CPDLC and ADS-C monitoring programmes may be viewed at http://www.fans-cra.com.

### 4.2 Periodic reporting

4.2.1 It is recommended that regions implement monthly performance reporting to obtain system performance metrics. These reports will provide data on observed availability, transaction time for interventions via SATVOICE and position report delivery time.

a) The ANSP should report on CSP notified system outages and on detected outages that have not been notified. For each outage, the following information should be reported:

   1) time of CSP outage notification as described in 3.2: in YYYYMMDDHHMM format or “Not Notified” if no CSP notification received;

   2) CSP name: name of CSP and SSP providing outage notification, if applicable;

   3) type of outage: report media affected SATCOM, VHF, HF, ALL;

   4) outage start time: in YYYYMMDDHHMM format;

   5) outage end time: in YYYYMMDDHHMM format; and

   6) duration of outage: in minutes;

b) The ANSP should report observed ACP for controller intervention via the radio operator using SATVOICE as described in 3.1.

c) The ANSP should report observed position report delivery time as described in 3.1.

4.2.2 A tabular reporting format may be used to capture the observed performance at the 95 per cent and 99.9 per cent RSP 180 and RSP 400 times.

4.2.3 In addition to the tabular performance reporting, regions should consider presenting performance data using graphical means, as depicted in Figures E-1 and E-2. Performance graphs illustrating regional communications and surveillance performances for SATVOICE may be readily obtained by aggregating spreadsheet data from individual ANSPs. The relevant data may be included in an ANSP monthly report to enable the regional aggregation of agreed performance information for its presentation in graphical form. Regions could present all or some of the data reported in tabular and graphical forms, if desired. This method of reporting would also assist global aggregation.

## 5. PROBLEM REPORTING AND RESOLUTION

### 5.1 General

5.1.1 Typically, aircraft operators and ANSPs that experience SATVOICE problems should contact the CSP providing the SATVOICE service, to conduct an investigation. However, a region may have a regional monitoring programme to manage problem reporting and resolution processes for components supporting air traffic management, which is also capable of assisting in the resolution of SATVOICE problems.

5.1.2 The problem identification and resolution process, as it applies to an individual problem, consists of the following phases: data collection; problem analysis and coordination with affected parties to secure a resolution; and recommendation of interim procedures to mitigate the problem in some instances.

### 5.2 Problem report form

The problem identification task begins with the receipt of a report from a stakeholder, usually an operator or an ANSP. Standard reporting forms should be developed and regions should investigate the use of a website to receive and store problem reports. The fields used in the form are as follows:

a) Originator’s Reference Number: originator’s problem report reference (e.g. ANZ_2009-23);

b) Title: a short title conveying the main issue of the reported problem (e.g. SATVOICE connection);

c) Date UTC: date in YYYYMMDD format (e.g. 20090705);

d) Time UTC: time in HHMM format (e.g. 2345);

e) Aircraft Registration: ICAO flight plan aircraft registration (e.g. ZKADR);

f) Aircraft Identification: ICAO flight plan call sign, if applicable (e.g. NZA456);

g) Flight Sector: if applicable the departure and destination airfield of the flight (e.g. NZAA-RJBB);

h) Organization: name of the originators organization (e.g. Airways NZ);

i) Active Centre: controlling centre at time of occurrence, if applicable (e.g. NZZO);

j) Next Centre: next controlling centre at time of occurrence, if applicable (e.g. NFFF);

k) Position: position of occurrence (e.g. 3022S16345E);

l) Problem Description: detailed description of problem;

m) Attach File: originator and assigned stakeholders may attach data files or other detailed information, such as geographic overlays; and

n) Additional Data: area set aside for feedback from stakeholders assigned by the regional/local monitoring entity. This will include the results of the investigation and the agreed upon action plan.

*Note.— PBCS monitoring entities may develop websites to manage the problem reporting process.*

### 5.3 Problem assessment

5.3.1 *Data collection*

5.3.1.1 The data collection phase consists of obtaining operational data logs from the appropriate parties (which will depend on the ANSPs and CSPs/SSPs used and operator service contracts). This usually means obtaining operational data logs for the appropriate period of time from the ANSPs, CSPs and SSPs involved. Usually, a log for a few hours before and after the reported event will suffice, but once the analysis has begun, it is sometimes necessary to request additional data (perhaps for several days prior to the event if the problem appears to be ongoing).

5.3.1.2 Additionally, some aircraft-specific recordings may be available to assist in the data analysis task. These are not always initially requested, as doing so would be an unacceptable imposition on the operators. However, such a request may occur when the nature of the problem is clarified enough to indicate the line of investigation to be pursued. These additional records include:

a) aircraft maintenance system logs;

b) built-in test equipment data dumps for some aircraft systems;

c) SATCOM activity logs; and

d) logs and printouts from the flight crew and recordings/logs from the ANSP(s) involved in the problem. It is important that the entity collecting data for the analysis task requests all this data in a timely manner, as much of it is subject to limited retention.

5.3.2 *Data analysis*

5.3.2.1 Once the data has been collected, the analysis can begin. It may be necessary to use support tools to analyse operational data. The analysis requires a thorough understanding of the SATVOICE system and the situation in which it was used.

5.3.2.2 The analyst must also have a good understanding of how the aircraft systems operate and interact to provide the ATM operations, as many of the reported problems are aircraft system problems.

5.3.2.3 This information will enable the analyst to determine a probable cause by working back from the area where the problem was noticed to where it began. In some cases, it may require lab testing using the airborne equipment (and sometimes the ground networks) to reliably determine the cause of the problem.

5.3.2.4 Once the problem is identified, coordination with the affected parties begins. The stakeholder who is responsible for fixing the problem should be contacted and a corrective action plan should be agreed upon. The stakeholder who initiated the problem report shall be provided with regular updates on the progress and resolution of the problem.

5.3.2.5 This information (problem description, results of analysis and plan for corrective action) is then entered into a database covering SATVOICE problems, both in a complete form to allow continued analysis and monitoring of the corrective action and also in a de-identified form for the information of other stakeholders. These de-identified summaries are reported at the appropriate regional management forum and made available to other PBCS monitoring entities on request.

### 5.4 Mitigating procedures — problem resolution

Because a considerable period may elapse while software updates are applied to all aircraft in a fleet, a regional monitoring entity in coordination with the relevant ANSPs may need to develop procedural methods to mitigate the problem until the solution is implemented. A regional monitoring entity may serve to identify the need for such procedures and develop recommendations for implementation by the ANSPs, CSPs, SSPs and operators involved.

**— END —**

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