



*International Civil Aviation Organization*

**EIGHTEENTH MEETING OF THE COMMUNICATIONS/NAVIGATION  
AND SURVEILLANCE SUB-GROUP (CNS SG/18) OF APANPIRG**

Asia and Pacific Regional Sub-Office, Beijing, China  
(21 – 25 July 2014)

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**Agenda Item 5:           Aeronautical Mobile Service (AMS)**

5.1) Discuss RCP/RSP Implementation Framework (APANPIRG Decision  
24/33)

**PBCS GUIDANCE MATERIAL**

(Presented by New Zealand)

**SUMMARY**

This paper presents guidance material on performance based communication and surveillance (PBCS) that is currently under development by the ICAO Operational Data link Panel. The current Doc 9869 Manual of RCP is being revised and renamed as the PBCS Manual with completion scheduled in October 2014. The material in this paper is extracted from Chapter 2 of an interim draft revision v1.3.x to Doc 9869. The OPLINKP drafting team considers that this material is mature and may be used by CNS SG/18 in their discussion of the RCP/RSP implementation framework in Asia/Pac.

**1.       INTRODUCTION**

1.1           Some progress has been made by individual states and regions in implementing a RCP/RSP framework. The development of post implementation monitoring by some states and the establishment of sub-regional CRA are all indicative of this process.

1.2           While initial steps have been taken a lot of work remains. The draft guidance material below is provided to assist CNS SG/18 in their discussions on a RCP/RSP implementation framework.

**2.       DISCUSSION**

**General**

2.1           The PBCS concept provides objective operational criteria to evaluate different and emerging communication and surveillance technologies that are intended for evolving operating ATM operations. Once these criteria have been set and accepted, a specific implementation of an ATM operation including its technical and human performance may have its viability assessed against these operational criteria.

2.2 The PBCS concept is aligned with the concept 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.

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



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

*Note.— 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 SSPs to oversee CSPs in administering accounts to authorized subscribers with 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.*

2.4 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 air operator; the PBN concept applies RNP/RNAV specifications, which allocate criteria only to the aircraft capability and the air operator; and

b) The PBCS concept includes post-implementation monitoring programmes, on a State and regional basis, with global exchange of information; 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).*

#### **Relationship of the PBCS concept to State safety oversight**

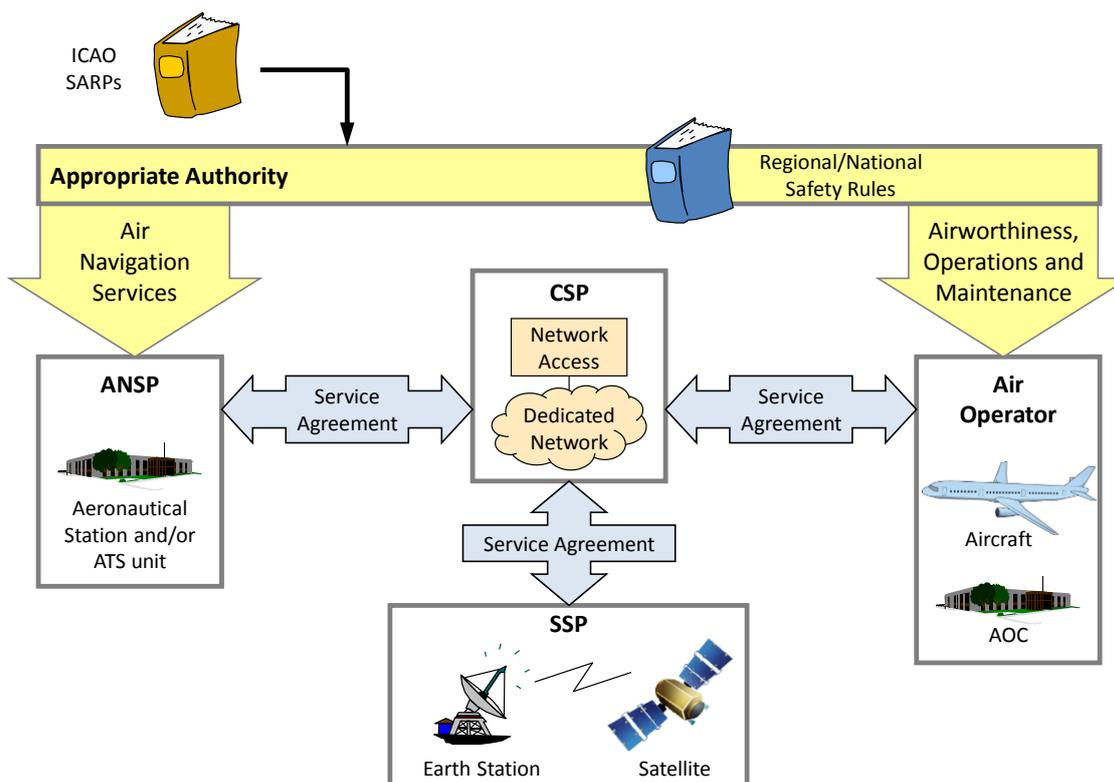
2.5 The States provide safety oversight of air navigation service providers and air operators in accordance with ICAO standards to ensure safe, regular and efficient conduct of operations, including those provided by contractors. The PBCS concept applies RCP and RSP specifications to support State safety oversight.

2.5.1 Annex 11 contains standards for safety management, including monitoring programmes, for the provision and operation of air traffic services.

2.5.2 Annex 10, Volume II, Chapter 2 contains standards for the “supervision” of the communication services by the appropriate State-designated authority.

2.5.3 Annex 6 contains standards for safety oversight of air operators, including airworthiness of aircraft systems and equipment in accordance with Annex 8.

2.5.4 When communication and surveillance services are negotiated, as depicted in Figure 2, the ATSP and air operator establish proper mechanisms, such as administrative and legal arrangements, to oversee the contracted CSP and SSP, as appropriate.



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

2.5.5 Annex 19 requires States to establish a State safety programme for the management of safety in the State, to achieve an acceptable level of safety performance in civil aviation. The relationship of the PBCS concept to each of the components of a State safety programme are highlighted as follows:

- a) **State safety policy and objectives** – The PBCS concept provides means to establish a safety policy with objectives to ensure responsible parties manage, commit, and account for achieving acceptable level of performance for communication and surveillance systems;
- b) **State safety risk management** – The PBCS concept provides a basis for initial and ongoing compliance determination, including hazard identification, risk assessment, and mitigation, through the application of RCP/RSP specifications to communication and surveillance systems;
- c) **State safety assurance** – The PBCS concept supports safety oversight by providing allocated functional, safety and performance requirements, which are contained in RCP/RSP specifications, and a means of compliance framework for approval of the different communication and surveillance system components, such as air operator/aircraft type combinations (including CSP/SSP), ATS provision (including CSP/SSP); ANSPs, air operators and others, as appropriate, identify substandard performance for appropriate action; and

d) **State safety promotion** – The PBCS concept is global in nature, to support State activities to effectively and efficiently promote the safety of communication and surveillance capabilities by applying RCP/RSP specifications, and exchanging information on a regional and global basis, such as through workshops and monitoring programmes.

### **The PBCS framework**

2.6 The PBCS concept provides a framework to apply RCP and RSP specifications to ensure the acceptable performance of communication and surveillance capabilities within a complete ATM system. The PBCS concept applies RCP and RSP specifications in any one or more of the following ways:

- a) Air traffic services (ATS) provision and prescription (in accordance with ICAO Annex 11, PANS, Doc 7030 and/or Aeronautical Information Publication (or equivalent publication)) of a RCP specification for a communication capability and/or a RSP specification for a surveillance capability, either of which is required for the ATS in a particular airspace;
- b) Operator authorization (under Air Operator Certificate, special authorization or equivalent, in accordance with ICAO Annex 6) of a communication and/or surveillance capability including aircraft equipment where RCP and/or RSP specifications have been prescribed for the communications and/or surveillance capabilities supporting the ATS provision; and
- c) State and regional monitoring programmes to assess actual communication and surveillance performance against RCP and RSP specifications and to determine corrective action, as applicable, for the appropriate entity.

*Note.— Consistent with ICAO Doc 4444, 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) where applicable, authorization from the appropriate authority.*

2.7 There is a need to ensure consistent definition and use of communication and surveillance capabilities to apply the PBCS concept on a global basis to achieve the benefits that are advantageous to States, ATS providers and users.

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

### **RCP and RSP specifications supporting ATM operations**

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

2.10 When assessing the criteria for any single element, C, N or S, supporting a particular ATM operation, trade-offs in required performance for some or all of the other elements can be made taking into account practical and technological constraints, provided the target level of safety can be maintained.

2.11 The Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689), outlines considerations for assessing the risk of collision when determining separation minima within an acceptable target level of safety. The risk of collision is a function of navigation performance, route configuration, traffic density, surveillance, communication and air traffic control service. Determination of separation minima allows for trade-offs among these considerations to ensure that the target level of safety is achieved.

2.12 Doc 9689 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 ( $\tau$ ). Table 1 shows the relationship of the parameters of tau ( $\tau$ ) with RCP/RSP specifications, considering three different scenarios: normal communication and surveillance, non-normal communication (i.e. initial communication was not completed by a specified time) and non-normal surveillance (i.e., initial surveillance data was not delivered by a specified time).

*Note.— Table 1 was derived from RTCA DO-306/EUROCAE ED-154, paragraph 5.2.3.2, Table 5-5.*

**Table 1. Relationship of tau ( $\tau$ ) with RCP/RSP specifications**

<b>Communication and controller intervention buffer, <math>\tau</math>, parameter (Doc 9689, Appendix 5)</b>	<b>Normal communication and surveillance</b>	<b>Non-normal communication</b>	<b>Non-normal surveillance</b>
The time for the system to delivery the surveillance data to the ATS unit. (This time is not included in $\tau$ )	Consideration for RSP specification	Consideration for RSP 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 RSP or RCP specification	Not applicable. (Overdue position report)
The time taken to communicate the instructions to the pilot (via normal means of communication)	Consideration for RCP specification	Consideration for RCP specification	Consideration for RSP specification
The time taken to communicate the instructions to the pilot (via alternative means of communication)	Not applicable	Consideration for RCP specification.	Consideration for RSP specification
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	Consideration for RCP specification (Communication time is concurrent with manoeuvring the aircraft)	Consideration for RCP specification (Communication time is concurrent with manoeuvring the aircraft)	Not applicable

2.13 A RCP or 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 communication transaction time, RSP surveillance data delivery time, RCP/RSP continuity, RCP/RSP availability and RCP/RSP integrity. A RCP/RSP specification includes functional, safety and performance requirements that are associated with each of the operational parameters.

2.14 In addition, a RCP and RSP specification includes allocated criteria to system components based on technological dependencies. These allocations are used to:

- a) assess viability of different technologies to meeting operational requirements;
- b) approve the provision of air traffic services supported by communication systems;
- c) determine when to initiate contingency procedures;
- d) design, implement and qualify communication services;
- e) design, implement, qualify and approve aircraft type designs;
- f) approve air operators for PBCS operations; and
- g) operationally monitor, detect and resolve non-compliant performance.

2.15 A RCP and RSP specification is globally harmonized and applied for the same 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 a RCP/RSP specification to components of the system that are global in nature, such as aeronautical mobile satellite services and ground-ground networks.

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

- a) developing a RCP/RSP specification for one or more the communication and surveillance capabilities supporting one or more ATM operations on a global basis; then
- b) applying a RCP/RSP specification related to one or more communication and surveillance system(s) supporting one or more ATM operations within that airspace; and
- c) complying with a prescribed RCP/RSP specification through initial approvals of the different system components and on-going State and regional monitoring programmes, which include operational assessments of the actual performance of communication and surveillance systems and corrective action.

#### **Applying a RCP/RSP specification**

2.17 States can apply RCP/RSP specifications through prescription in applicable airspace for particular ATM operations, safety oversight of air traffic services, operational authorizations, aircraft system design approval and post-implementation monitoring.

2.18 Several factors affect a States' decision as to when it prescribes a RCP and/or RSP specification. These factors are based on the ATM functions that an air traffic services (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 includes showing that the criteria defined by the RCP and RSP specifications have been met.

2.19 When the ATM operations within that airspace are predicated on communication and/or surveillance performance, the State prescribes RCP/RSP specifications for an airspace, either locally or on the basis of regional air navigation agreements.

2.20 To perform certain ATM operations, States can require a mixture of voice and data communication and surveillance capabilities applicable to the prescribed RCP and RSP specifications. Data communication and surveillance capabilities allow for the integration of functional capabilities to exchange information between air traffic management facilities and aircraft. Data communication and surveillance capabilities can provide for functional integration (e.g. loading CPDLC messages on the flight deck and ATS conformance monitoring using ADS-C periodic reports) with the aircraft's flight management system or an ATS unit's flight data processing system.

2.21 Potential airspace to which RCP/RSP specifications can be applied to communication and surveillance capabilities includes:

- a) a defined airspace, such as in the 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, such as between Sydney, Australia, and Auckland, New Zealand;
- c) random track operations, such as between Hawaii and Japan; or
- d) a volume of airspace, such as a block altitude on a specified route.

2.22 When a State prescribes a RCP/RSP specification, the RCP/RSP specification indicates the requirements for initial qualification and approval of the procedures, aircraft equipment and airspace infrastructure, requirements for operational authorization, flight plan filing requirements and post-implementation monitoring programmes.

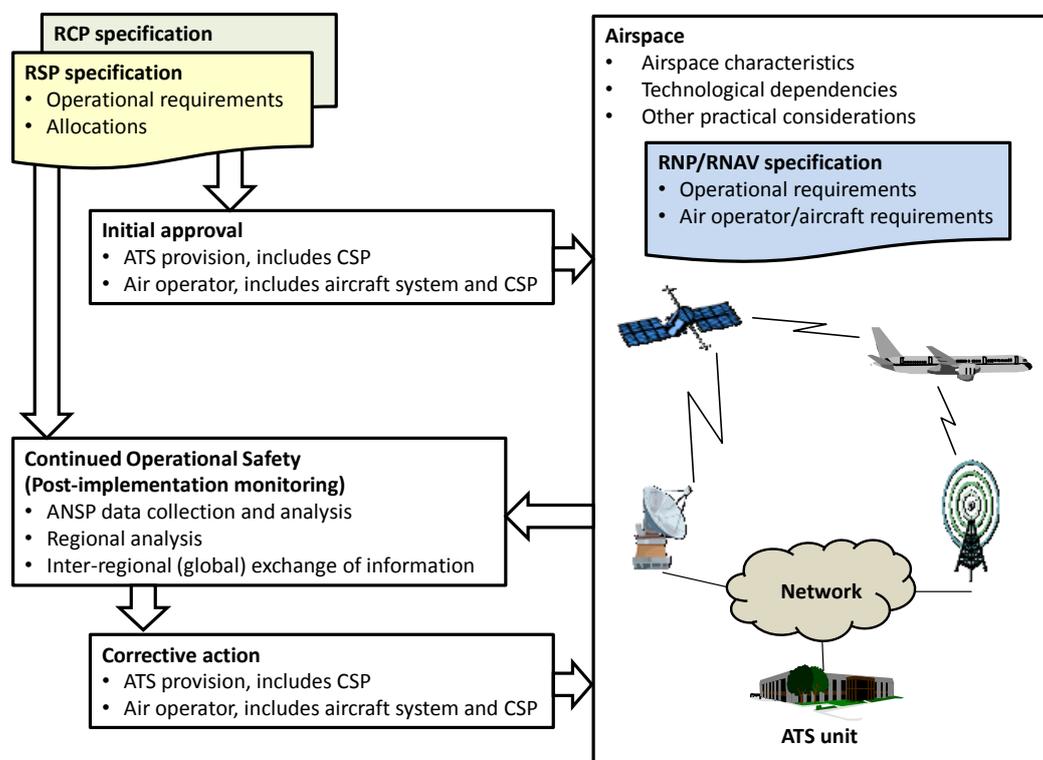
2.23 Ideally, the State prescribes a single RCP and/or single RSP specification to an airspace. However, the State can prescribe multiple RCP/RSP specifications within a given airspace. An example would be for the State to prescribe one RCP specification, applicable to the normal means of communication appropriate for the controller's ability to intervene in a conflict situation given the separation minima and prescribe another RCP specification to a new communication technology that supports an alternative means of communication when the normal means of communication fails.

2.24 The State can prescribe different RCP/RSP specifications for different airspace depending on the ATM operations. For example, a RCP specification applicable in terminal area airspace can be different from the RCP specification for en-route or oceanic airspace.

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

**Complying with a RCP/RSP specification**

2.26 When the State prescribes an RCP/RSP specification for communication or surveillance capability, the ANSP and the air operator shows that the provision of air traffic service and use of the service comply with the specifications to achieve and maintain the required communication and surveillance performance. Figure 3 provides an overview of complying with a RCP/RSP specification.



**Figure 3. Overview of complying with RCP/RSP specifications**

2.27 Compliance with a RCP/RSP specification can be achieved in many different ways, and the State can provide guidance on acceptable means through which the ATS provider and the air operator show how RCP/RSP is achieved. Typically, an ATS provider or an air operator will show compliance to RCP/RSP specifications to obtain initial approval from the State. After the initial approval, the ANSP conducts post-implementation monitoring to ensure that the operational system continues to meet the RCP/RSP specifications.

2.28 The initial approval of the communication and surveillance services, the aircraft system and operational use occur at different times; the processes for these approvals are different and the parties involved are different. Compliance with RCP/RSP specifications is determined as part of these approval processes. Generally:

- a) The ANSP obtains approval by the appropriate ATS authority as delegated by the State in accordance with National regulations and ICAO standards to provide air traffic services. The ANSP show that the necessary procedures training, and related contracted services comply with the RCP/RSP specifications; and

b) The operator obtains an Air Operator Certificate or a “special” operational authorization from the State of the Operator or State of Registry to use the air traffic services. Operators show that the necessary procedures and training, aircraft system and related contracted services comply with the RCP/RSP specifications. For the aircraft system, the operator usually presents a certificate of approval obtained by the aircraft or equipment manufacturer from the State of Registry or through bilateral or multilateral airworthiness agreements.

2.29 The ANSP establishes a State monitoring program to collect and analyze operational data to ensure the infrastructure and the air operators within its airspace continue to meet the appropriate RCP/RSP specifications following initial approval. In addition, ANSPs establish a regional monitoring program to analyze performance at the regional level. Air operators, CSPs, satellite service providers and other stakeholders participate in the ANSP monitoring programs in accordance with operational authorizations/approvals or service agreements.

2.30 The scope of State and regional monitoring programs includes analyses on an operator basis taking into account individual aircraft, aircraft types and various infrastructure and technological dependencies (e.g. sub-network types, sub-network routing policies, frequencies), all of which are factors in evaluating the stability of communication or surveillance performance.

2.31 When a monitoring program detects a non-compliance it is reported to the appropriate authority for corrective action.

### **3. ACTION BY THE MEETING**

3.1 The meeting is invited to:

- a) note the information contained in this paper; and
- b) discuss any relevant matters as appropriate.

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