Workshop on PBN Implementation in En-route Environment

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PBCS Implementation

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PBN Implementation in Enroute

ICAO Documents

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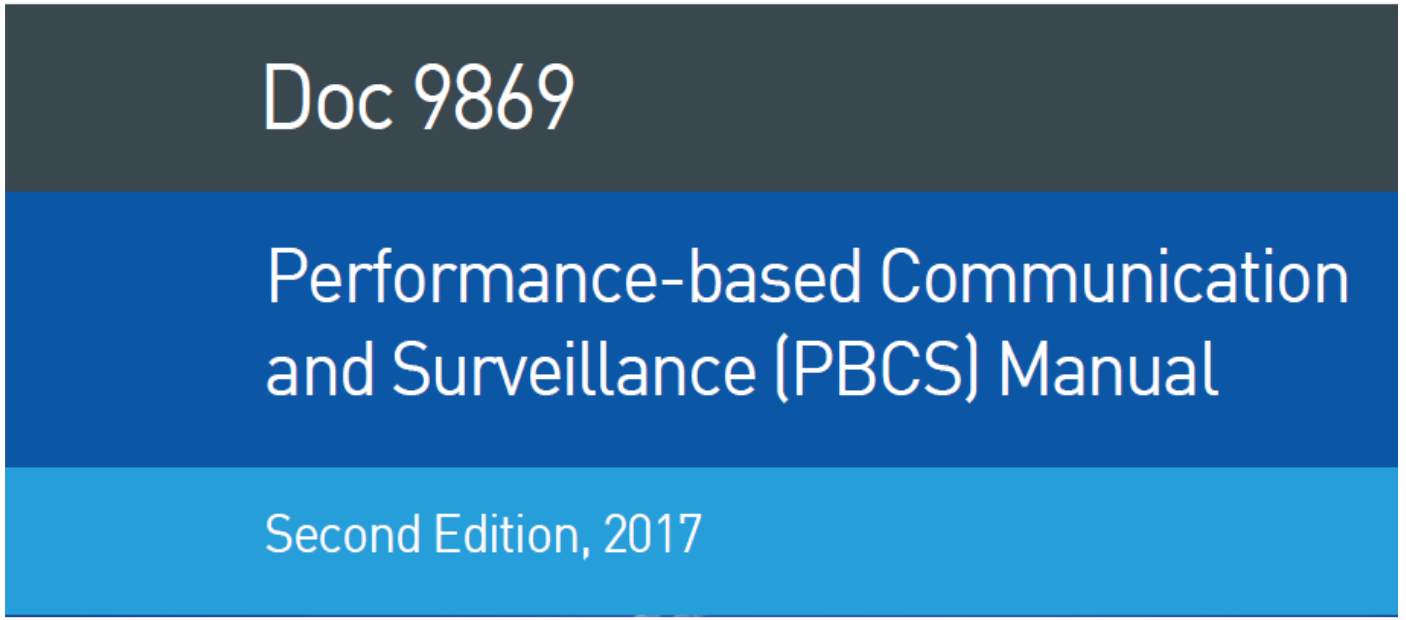

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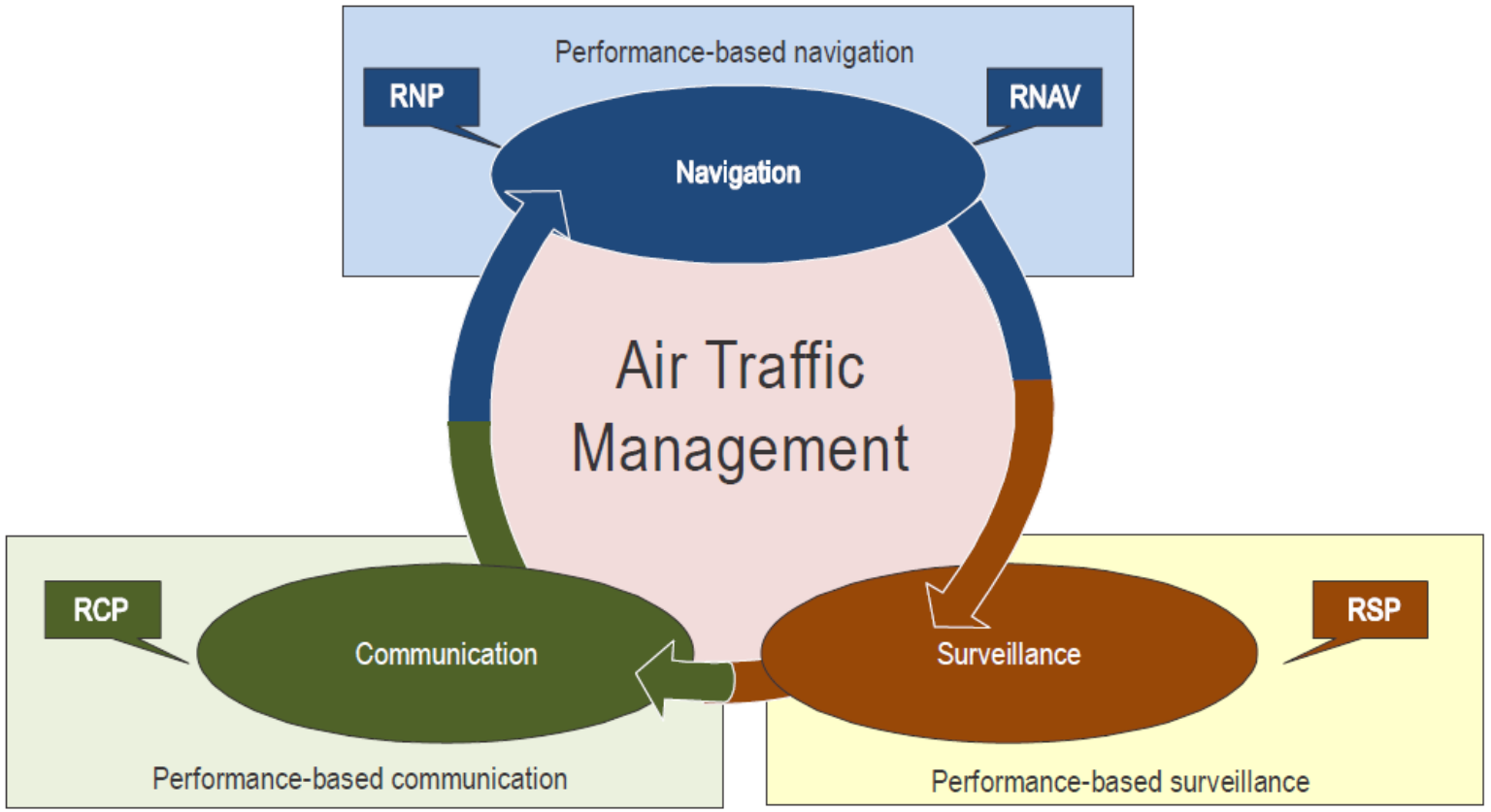
PBCS Concept



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ICAO requirements and guidance material

- **Annex 11 requires in paragraph 3.3.5.2 that where RCP/RSP specifications are applied, program shall be instituted for monitoring the performance of the infrastructure and the participating aircraft against the appropriate RCP and or RSP specifications, to ensure that operations in the applicable airspace continue to meet safety objectives.**
- **Annex 11 3.3.5.2 requires that the scope of monitoring program shall be adequate to evaluate communication and/or surveillance performance, as applicable.**
- **Guidance material relating to the RCP and RSP specifications and monitoring of communication and surveillance performance is in the PBCS Manual (Doc 9869).**

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PBCS Concept

- PBCS concept provides objective operational criteria to evaluate different and emerging communication and surveillance technologies, intended for evolving air traffic management (ATM) operations.
- The PBCS concept is aligned with that of performance-based navigation (PBN).
- 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.
- The PBCS concept is primarily intended for emerging technologies, and not traditional ones.

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PBCS Concept

Differences between the PBCS concept and PBN concept;

- **PBCS concept applies RCP and RSP specifications, which allocate criteria to ATS provision, including communication services, aircraft capability, and the aircraft operator.**
- **PBN concept applies RNP/RNAV specifications, which allocate criteria only to the aircraft capability and the aircraft operator.**
- **PBCS concept includes post-implementation monitoring programs, on a local and regional basis, with global exchange of information;**
- **PBN concept includes real time monitoring and alerting functionality in the aircraft capability.**

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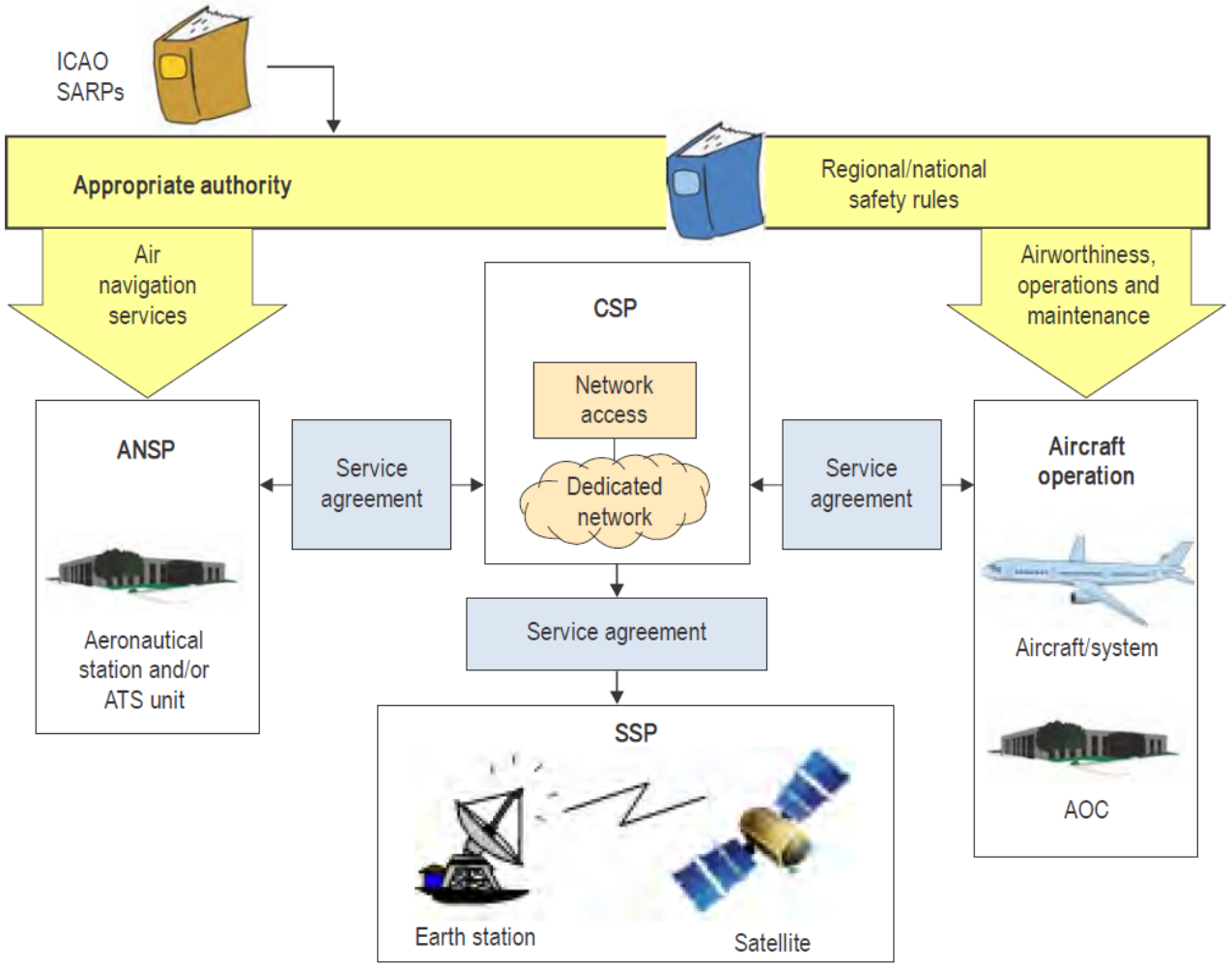
Example of contracted communication and surveillance services

Initial compliance

- ANSP
- Operator, aircraft and system
- ANSP and Operator oversee CSP/SSP via service agreements

Post-implementation monitoring

- Component and sub-component analysis
- Change management
- Continuous improvement – corrective action



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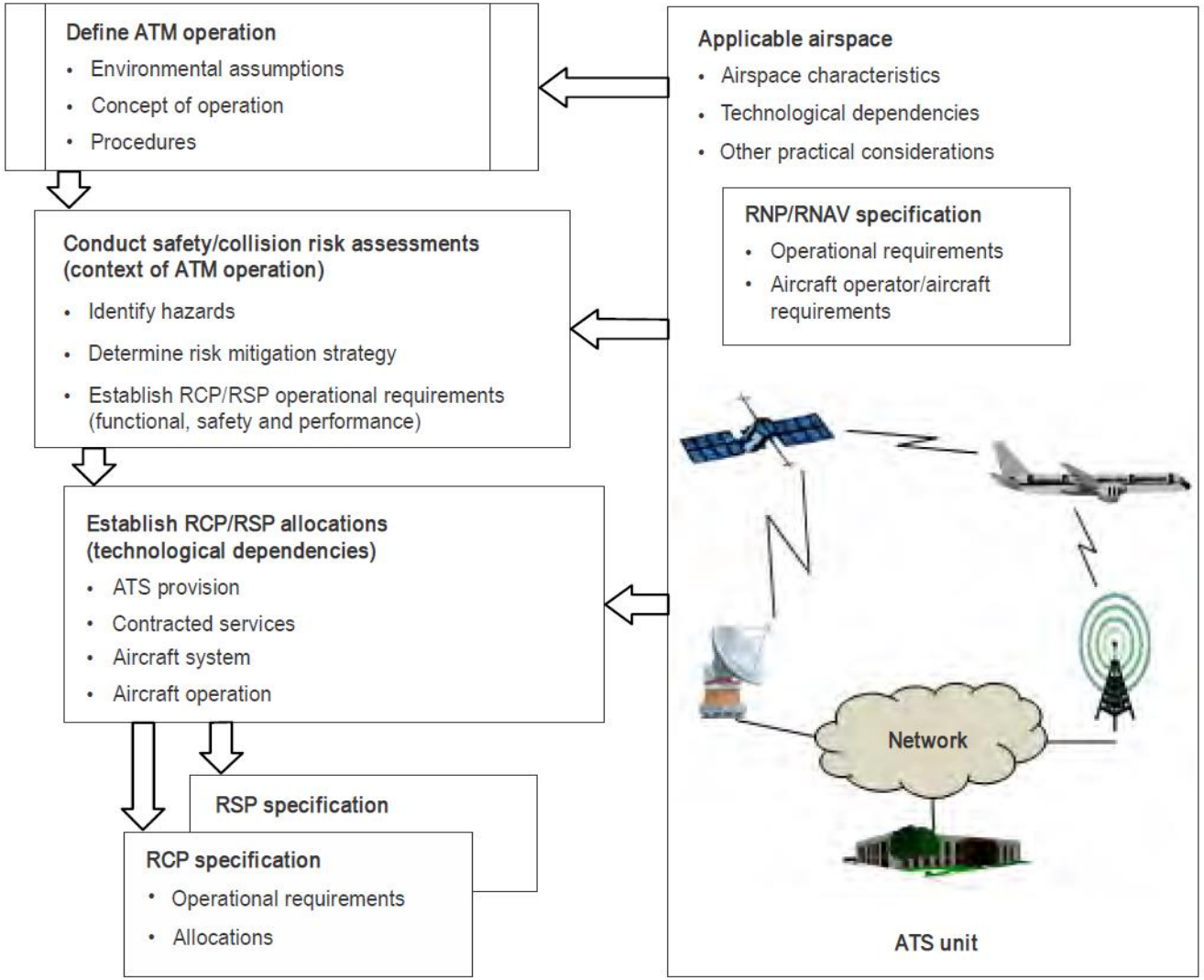
Overview RCP/RSP specification development



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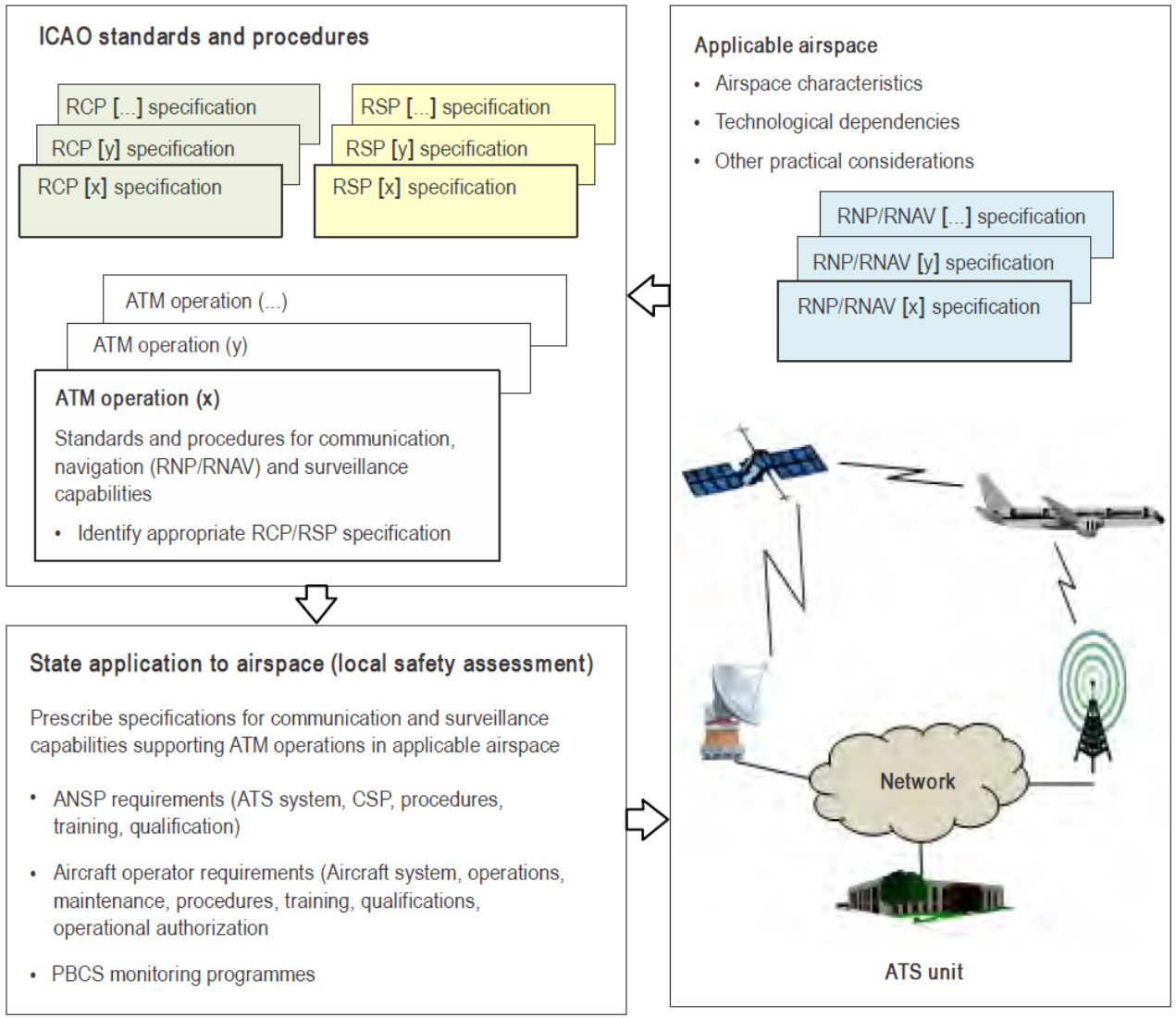
Overview of RCP/RSP specification application



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Overview of RCP/RSP specification compliance

Initial compliance

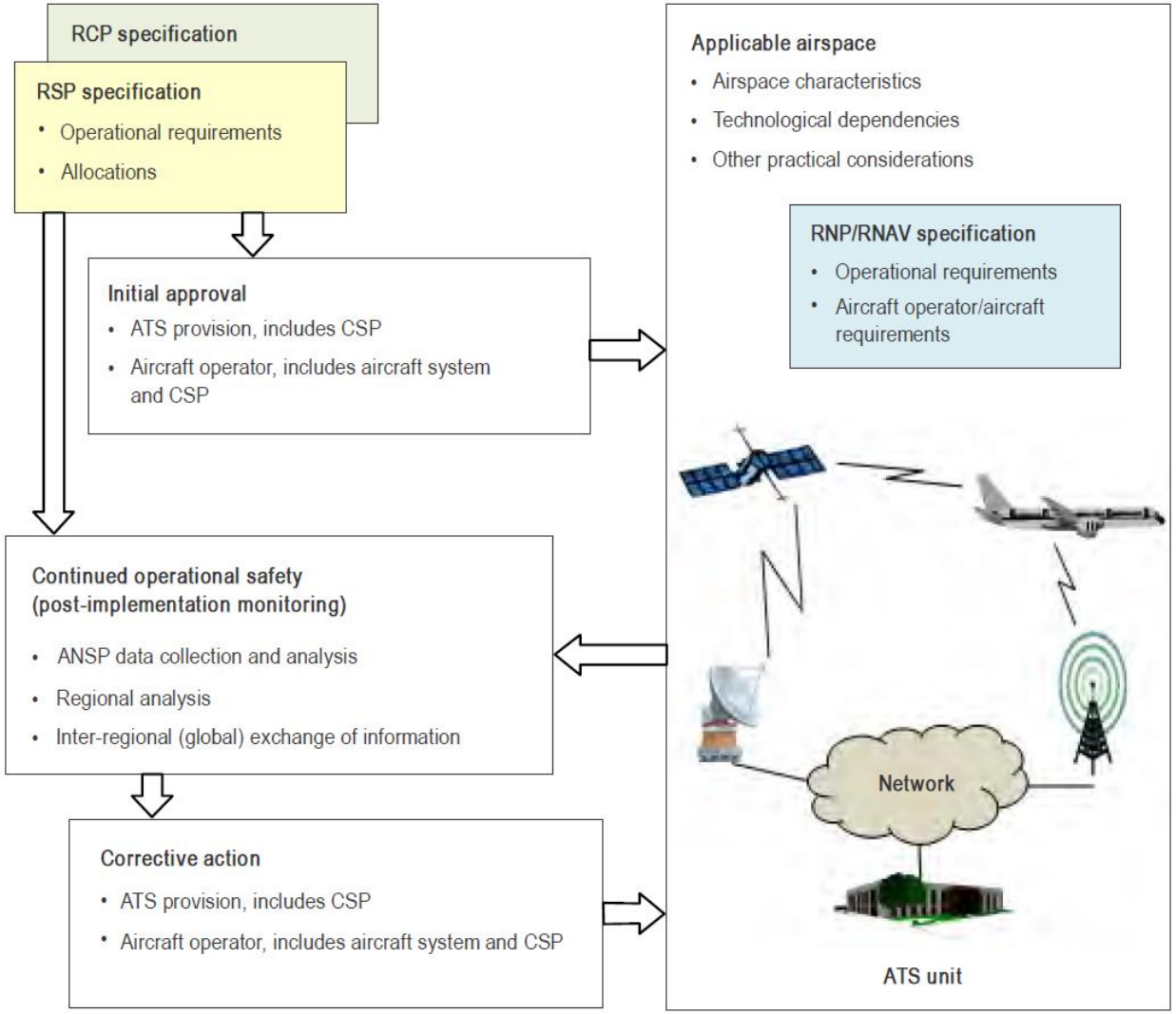
- ANSP (CSP, SSP)
- Aircraft type/system
- Operator (aircraft, CSP, SSP)

Post-implementation monitoring

- ANSP data collection and analysis
- Regional analysis
- Inter-regional exchange of information

Performance improvement

- ANSP (CSP, SSP)
- Operator (aircraft, CSP, SSP)



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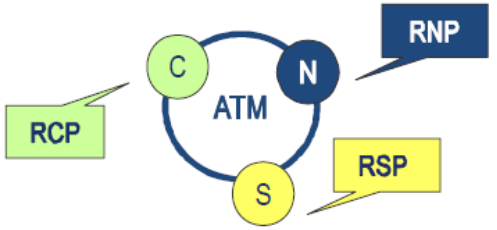
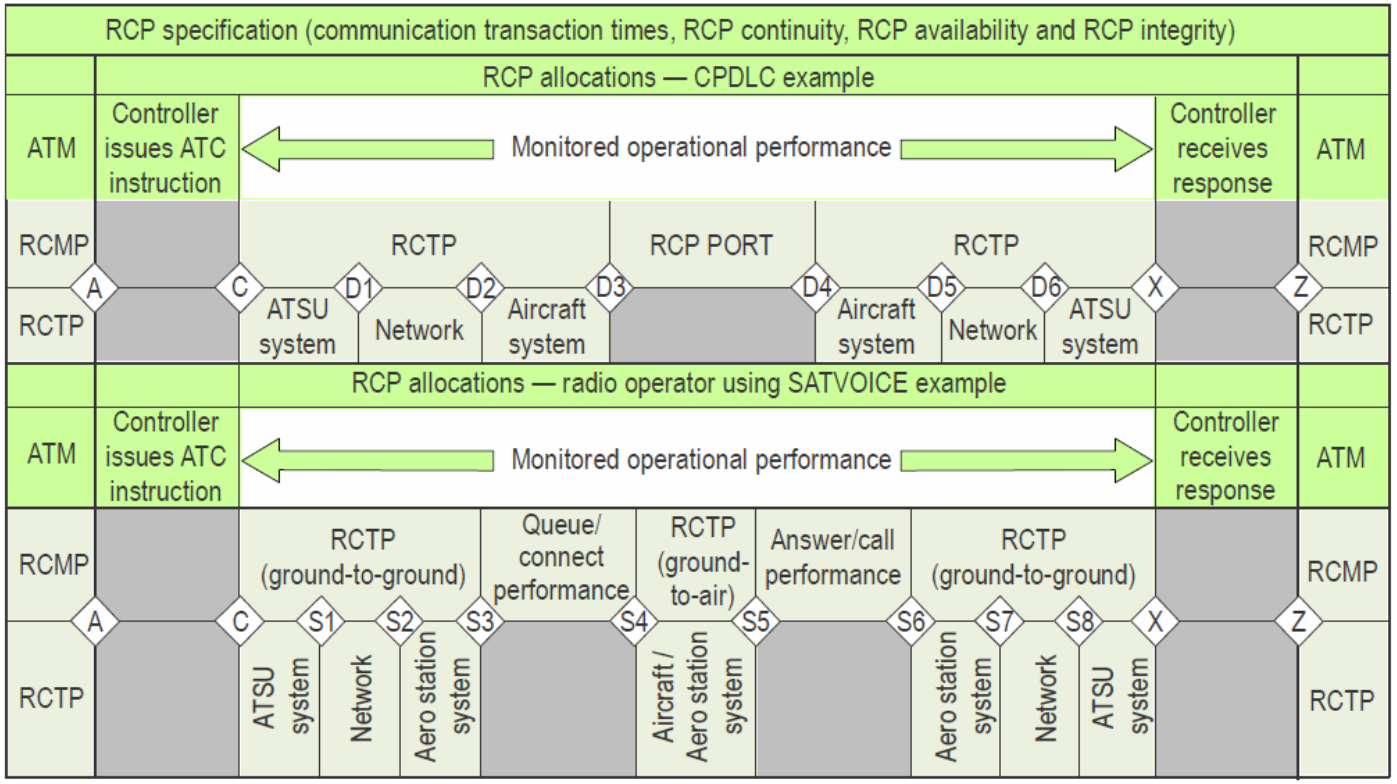
RCP specification model

- **Required communication monitored performance – RCMP**
- **Required communication technical performance - RCTP**
- **Pilot operational response time - PORT**



RCP specification applies to communication capability as specified by interoperability and functional standards



RCP specification

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. RCP integrity is defined in terms of the quality of the communications capability.

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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 0.9999 (efficiency) *(see Note 3)*	10^{-5}
RCP 400	400	0.999	0.999	10^{-5}

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RCP specifications

- 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.
- 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.

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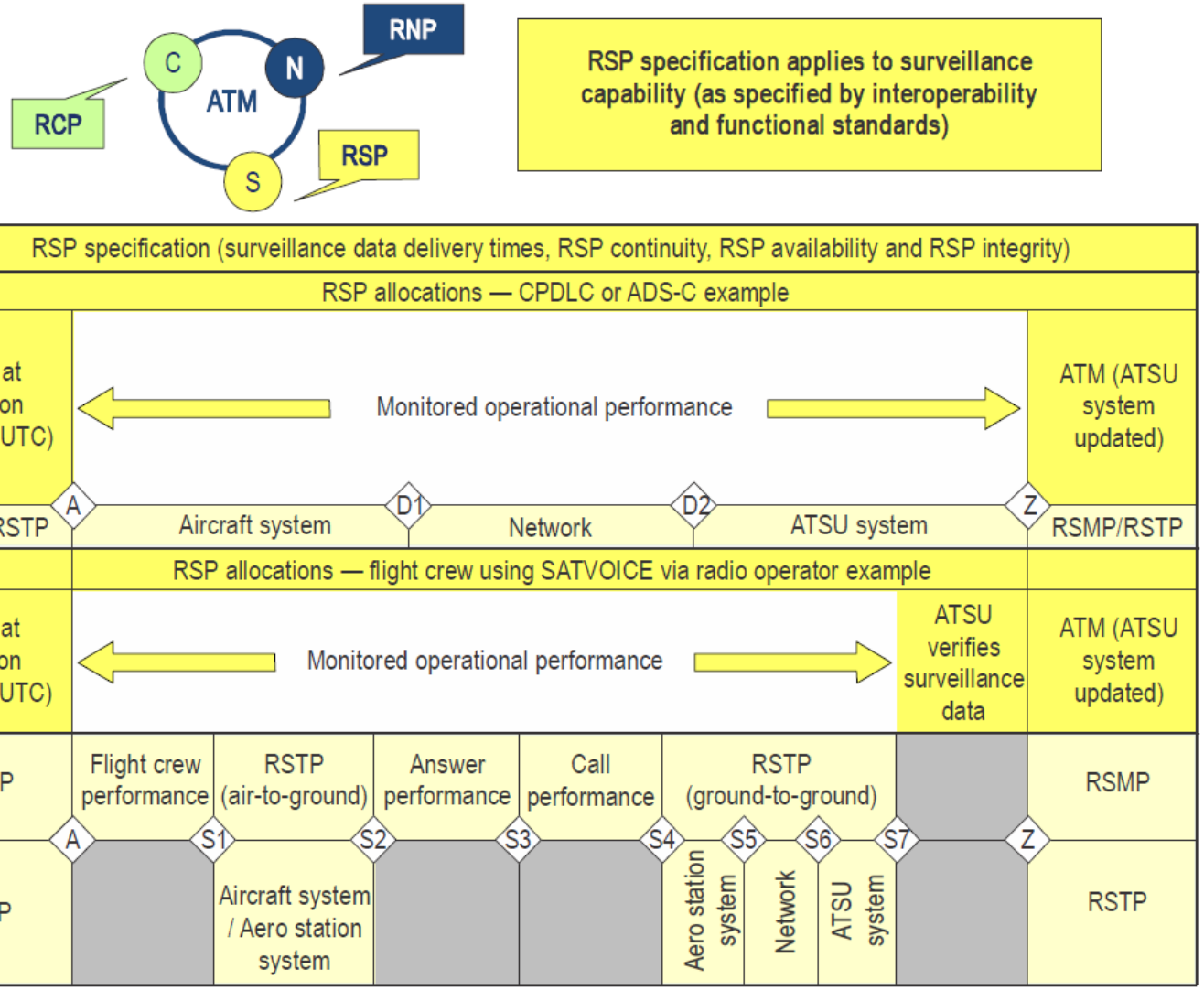
RSP specifications

- **Required surveillance monitored performance – RSMP**
- **Required surveillance technical performance - RSTP**



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RSP specification

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. RSP integrity is defined in terms of the quality of the surveillance capability

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RSP specification

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 0.9999 (efficiency) (see Note 3)	FOM = navigation specification Time at position accuracy = +/- 1 sec Data integrity (malfunction) = 10^{-5}
RSP 400	400	0.999	0.999	FOM = Navigation specification Time at position accuracy = +/- 30 sec Data integrity (malfunction) = 10^{-5}

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RSP specification

- 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.
- 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.

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Example of prescribing an RCP/RSP specification

Standards and procedures for ATM operation (x)

- Operational requirements
- RNP/RNAV specification
- RCP specification
- RSP specification

Perscription (AIP or equivalent publication)	
Applicable airspace	Seldok FIR
ATM operation (x)	Application of 5-minute longitudinal separation minimum to approved operators
Communication	Normal: **FANS 1/A CPDLC — RCP 240**
	Alternate: HF or, optionally, **(SATVOICE/radio — RCP 400)**
Surveillance	Normal: **FANS 1/A ADS-C — RSP 180**
	Alternate: HF or, optionally, **(SATVOICE/radio — RSP 400)**
Other relevant criteria	As applicable, for example: a) Navigation - RNP 4 b) **SATVOICE/radio - RCP 400** applies when required for aircraft equipment carriage requirements (i.e. MEL)

Applicable airspace - ATM operation (x)

Aircraft operator requirements (includes aircraft system and CSP/SSP)

NORMAL COMMUNICATION required for ATM operaton (x)

FANS 1/A CPDLC RCP 240

NORMAL SURVEILLANCE required for ATM operaton (x)

FANS 1/A ADS-C RSP 180

ALTERNATE COMMUNICATION and SURVEILLANCE required for ATM operaton (x) (required to operate in airspace)

HF or, optionally, (SATVOICE/radio RCP 400/RSP 400)

ATS provision requirements (includes CSP/SSP)

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Descriptors for RCP capability in flight plan — Item 10

RSP capability in flight plan

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).

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

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

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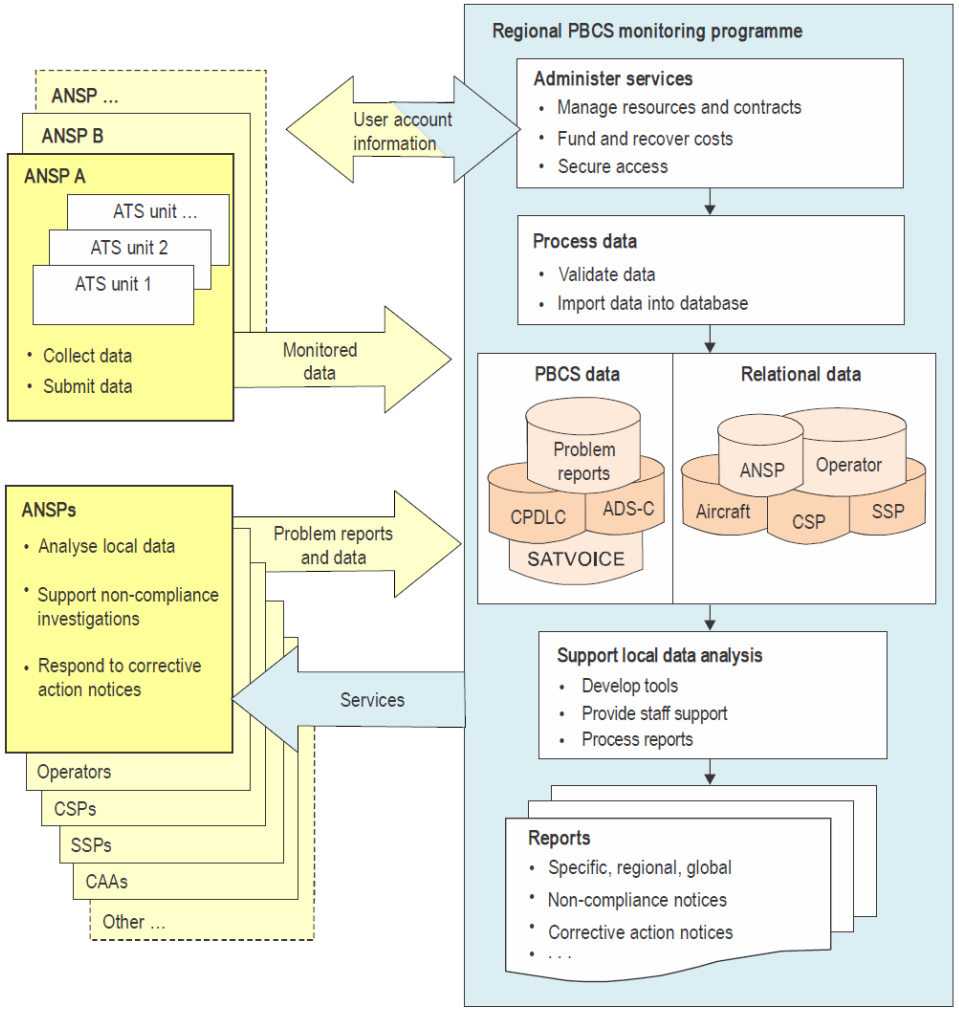
Regional PBCS monitoring program overview



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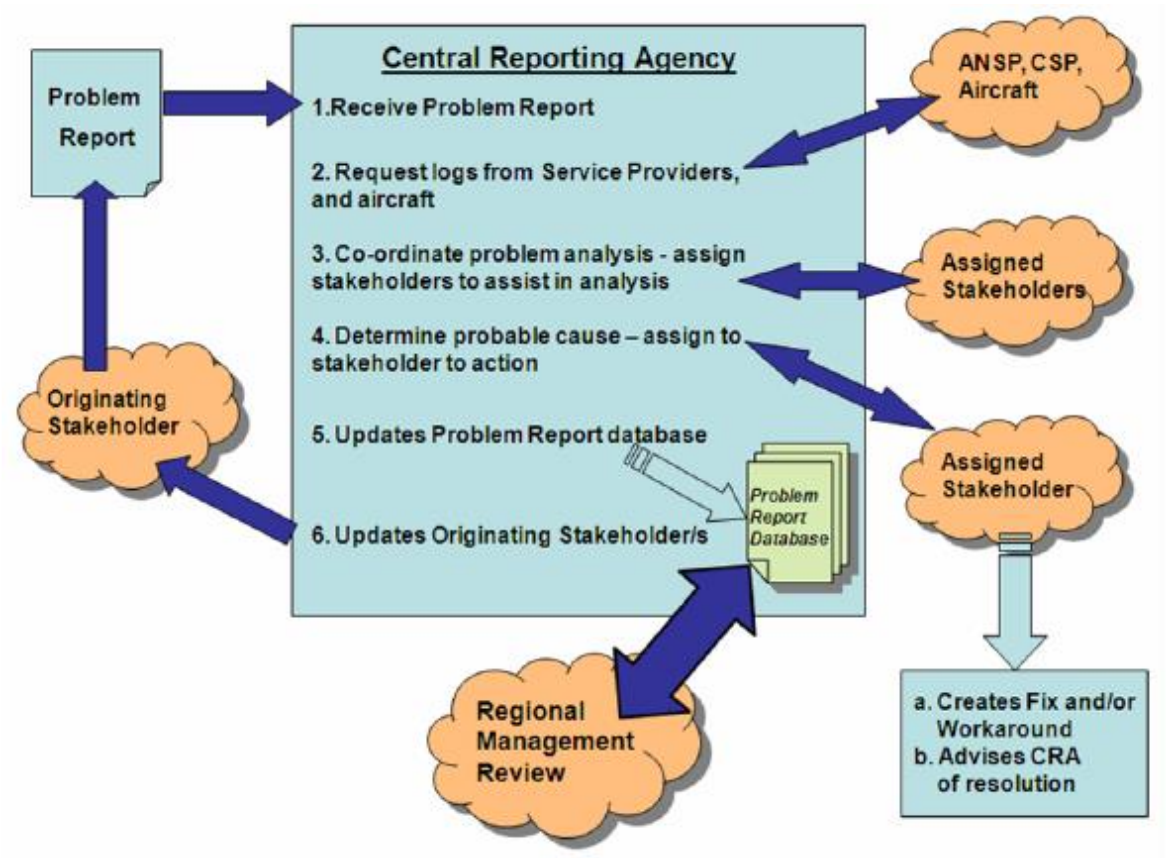
Regional PBCS monitoring program overview



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PBCS Concept Summary

In accordance with the ICAO PBCS Provision, **State**	In accordance with State policies	
	ANSP	**Operator**
❑ Establishes PBCS policies for ANSP, operator, airworthiness, etc. ❑ Prescribes RCP/RSP specifications in the applicable airspace for the relevant operations ❑ Publishes PBCS requirements in aeronautical information publication (AIP)	❑ Provides RCP/RSP-compliant services ❑ Recognizes RCP/RSP capabilities in air traffic control (ATC) automation ❑ Establishes PBCS monitoring program	❑ Prepares to file RCP/RSP capabilities in flight plan ❑ Participates in ANSP PBCS monitoring programs

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PBCS Implementation Plan – Checklist

Task ID	Task Descriptor
Group A tasks – State/Region preparation	
A-1	AIP – Prescription of an RCP/RSP specification
A-2	ANSP – PBCS policies, objectives supporting safety oversight
A-3	Operator and Aircraft System – PBCS policies, objectives supporting safety oversight
A-4	Regional Supplementary Procedures (Doc 7030) for PBCS operations, if applicable
Group B tasks – ANSP general project development and management	
B-1	PBCS Implementation Plan
B-2	Target dates for PBCS and relevant ATM operations
B-3	RCP/RSP specifications
B-4	PBCS awareness

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PBCS Implementation Plan – Checklist

Task ID	Task Descriptor
Group C tasks – ANSP implementation activities – ATS service provision	
C-1	Operational concepts and procedures for PBCS operations
C-2	ATC automation changes to use flight plan RCP/RSP indicators
C-3	ATC automation changes for PBCS monitoring
C-4	Confirm initial ANSP compliance with RCP/RSP specifications
Group D tasks – Aircraft operator, Aircraft type/system (airworthiness) eligibility	
D-1	Aircraft operator readiness
D-2	Confirm initial operator and/or aircraft type/system compliance with RCP/RSP specifications
Group E tasks – All stakeholders – post-implementation monitoring	
E-1	PBCS monitoring – post-implementation

Thank You!

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