State Requirements

Global Operational Data Link (GOLD)

Familiarization with Performance Based Communications and Surveillance (PBCS) Workshop

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FAA

Federal Aviation Administration

Overview

- State Responsibilities
- Safety Oversight
- RCP/RSP Specification
- RCP 240 Details
- RSP 180 Details
- Compliance Determination
- Safety Requirements
- Summary

One Slide Summary of ICAO PBCS Provision

State, ANSP **and** Operator **each have responsibility**

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 air traffic 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

* RCP/RSP specifications include allocated criteria to the communication service provider (CSP). These criteria are applied to the CSP through service agreements with theANSP and/or operator.

Impact to States

- For All States with aircraft intending to utilize airspace with PBCS requirements:
  1) Develop and promulgate PBCS policies for issuing operator RCP240/RSP180 approvals and filing of respective flight plan codes
- For States with ATM operations requiring RCP240/RSP180 (see slide 5):
  1) Promulgate intended use of RCP240/RSP180 specifications and applicable to ATM operations
     - Aeronautical Information Publication (AIP), Aeronautical Information Circulars (AIC), etc.
  2) Update policies and objectives supporting safety oversight for ANSP to reflect PBCS
     - Aeronautical Information Manual, orders/documentation for flight services, etc.
  3) Contribute to and ensure applicable updates to Doc 7030 regional supplementary procedures to reflect intended applicable of PBCS

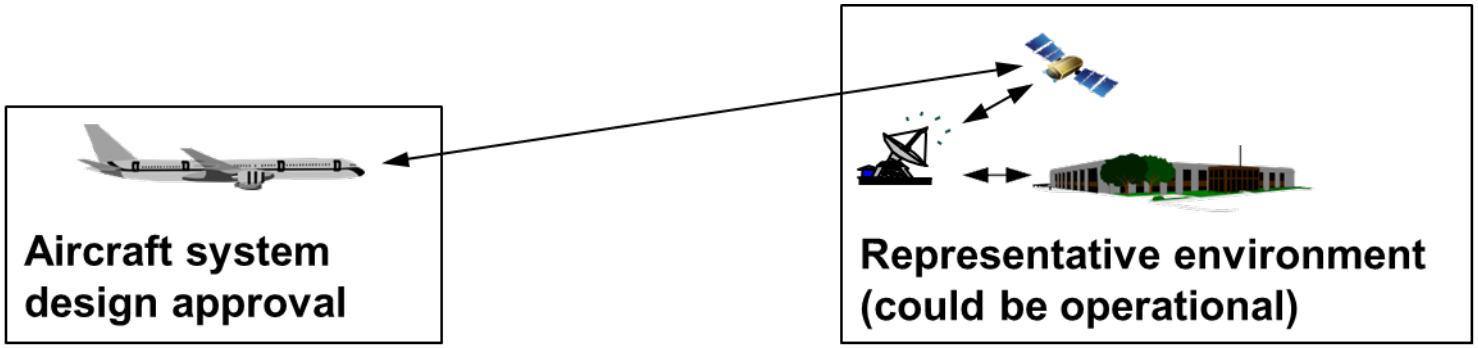
PBCS Concept and State Safety Oversight

PBCS Manual 1.3.5

- In accordance with Annex 19, the State provides safety oversight to ensure safe, regular and efficient conduct of operations.
- The PBCS concept applies RCP and RSP specifications to support State safety oversight in accordance with the following:
  - Annex 1 contains standards for training and qualification of personnel associated with licensing a flight crew member, aircraft maintenance personnel, flight operations officer/flight dispatcher, air traffic controller or aeronautical station operator;
  - Annex 6 contains standards for safety oversight of aircraft operators, including airworthiness of aircraft systems and equipment in accordance with Annex 8.
  - Annex 8 contains standards for safety oversight in the type design and manufacture of aircraft; and
  - Annex 11 contains standards for safety management, including monitoring programmes, for the provision and operation of air traffic services.

Initial Compliance – Aircraft/Avionics

- **Aircraft/avionics manufacturer obtains design approval in accordance with State policies (State of Design and State of Manufacture); ensures avionics meet allocated interoperability and RCP – RSP criteria**
  - Aircraft/avionics manufacturer shows operational performance with a representative ATS system
  - Flight manual and master minimum equipment list (MMEL)
  - Compliance cannot be practically exhaustive



PBCS Framework

PBCS Manual Definitions

- **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 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*

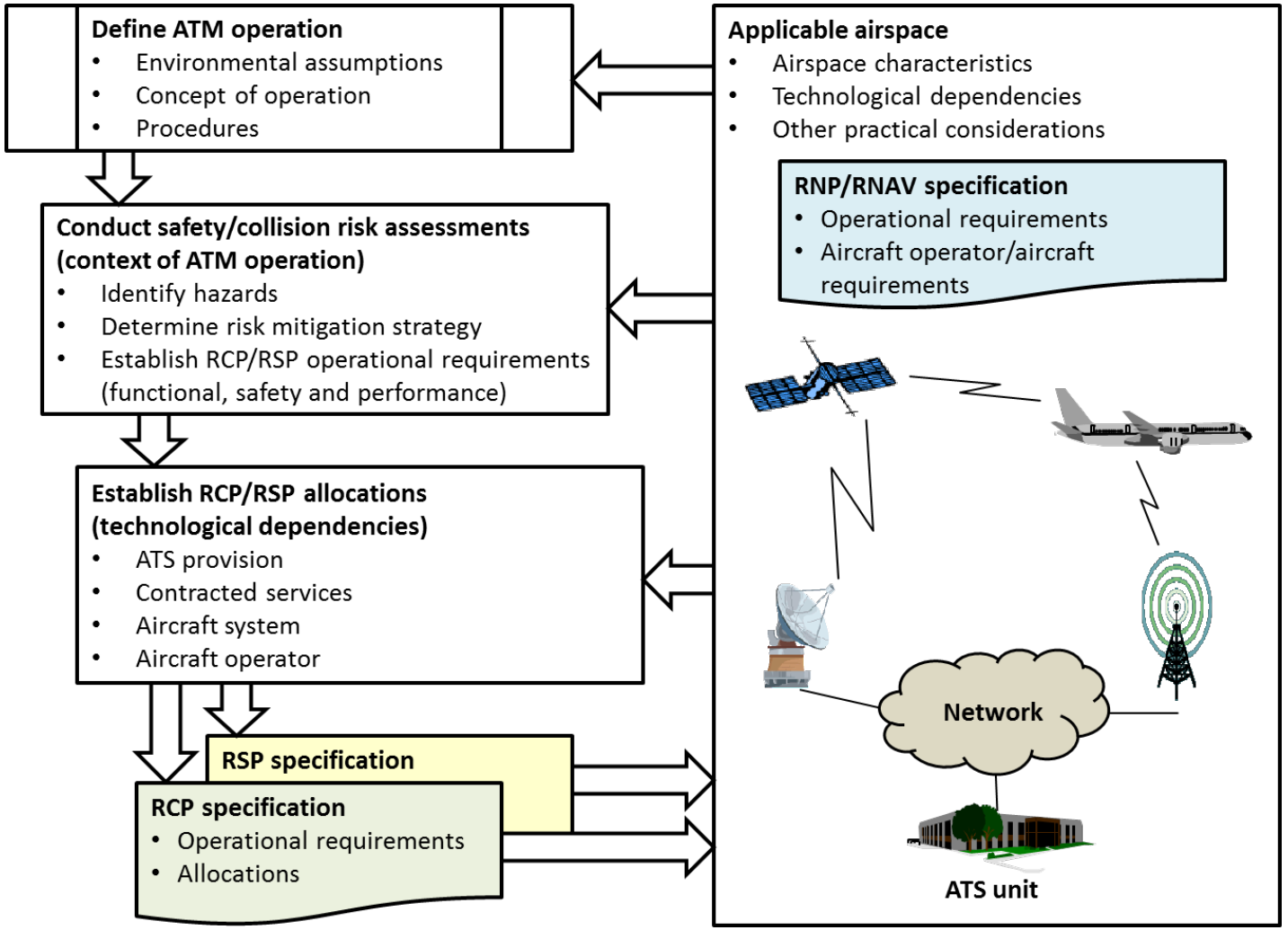
Specification Development

PBCS Manual 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.
- The specification is globally harmonized and applied for the same or similar ATM operations
- Global harmonization 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.

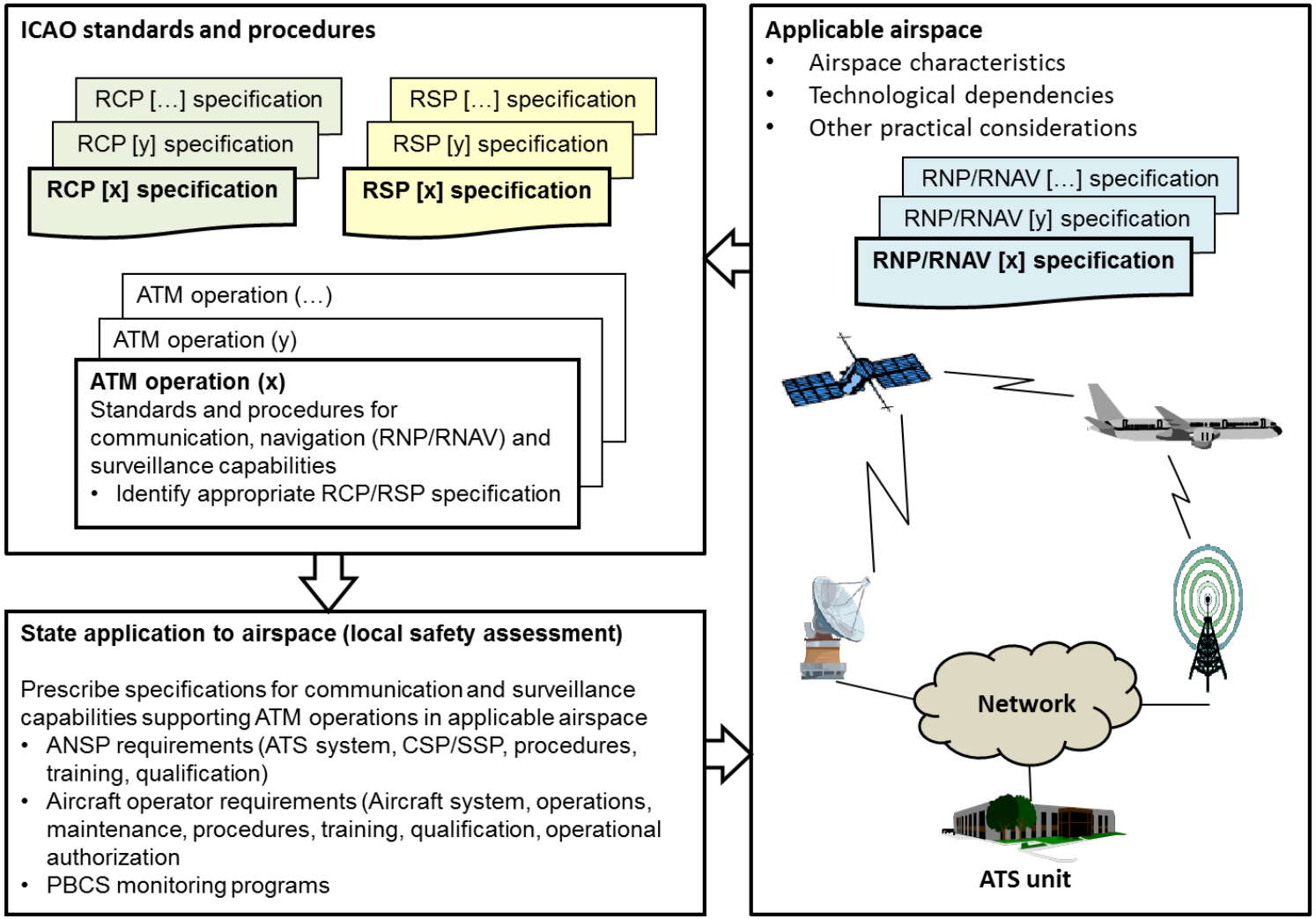
Developing an RCP/RSP Specification

PBCS Manual Figure 1-3



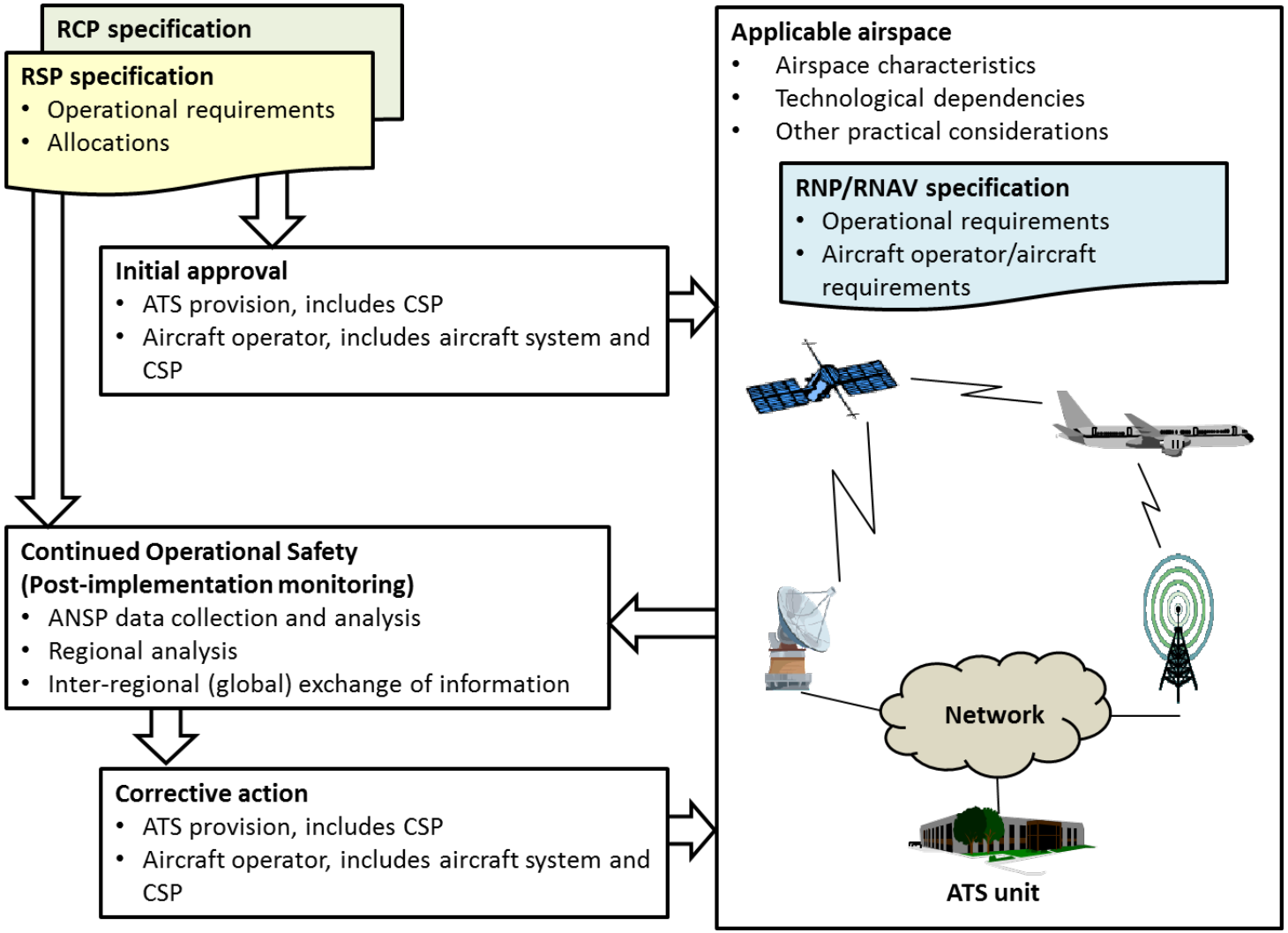
Applying an RCP/RSP Specification

PBCS Manual Figure 1-4



Complying with an RCP/RSP Specification

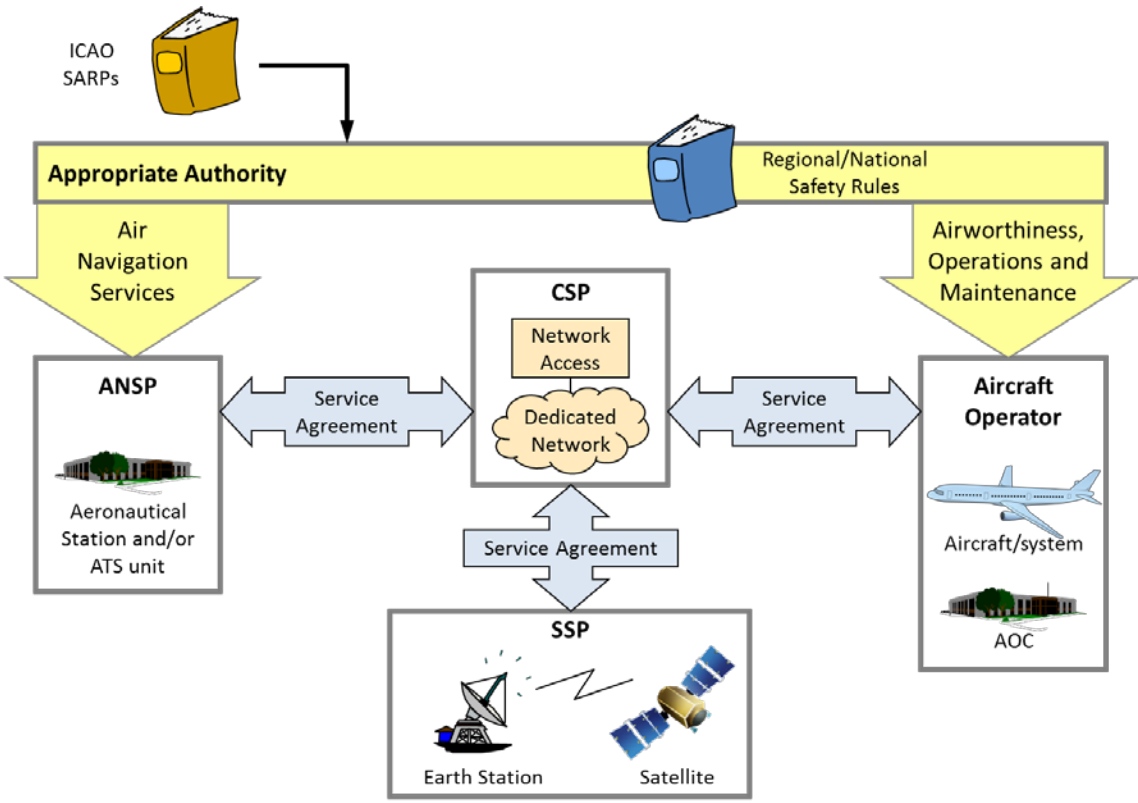
PBCS Manual Figure 1-5



State Safety Oversight Framework

Means of compliance guidance → Doc 9869

- **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



9869 Figure 1-2

RCP 240 Specification

PBCS B.2.1.1 Figure B-1

RCP 240 specification (communication transaction times and RCP continuity)										
RCP	**240**									**RCP**
95%	210									95%
	RCP 240/D allocations – CPDLC example									
ATM	**Controller issues ATC instruction**	**Monitored operational performance**							**Controller receives response**	**ATM**
99.9%	$P_{C/ATSU}(30)$	210							$P_{C/ATSU}(30)$	ET
95%	$P_{C/ATSU}(30)$	180							$P_{C/ATSU}(30)$	TT
RCMP		RCTP			RCP PORT	RCTP				**RCMP**
99.9%		$P_{RCTP}(150)$			60	$P_{RCTP}(150)$				99.9%
95%		$P_{RCTP}(120)$			60	$P_{RCTP}(120)$				95%
RCTP		ATSU system	Network	Aircraft system		Aircraft system	Network	ATSU system		**RCTP**
99.9%		$P_{ATSU}(15)$	$P_{NET}(120)$	$P_{AIR}(15)$		$P_{AIR}(15)$	$P_{NET}(120)$	$P_{ATSU}(15)$		99.9%
95%		$P_{ATSU}(10)$	$P_{NET}(100)$	$P_{AIR}(10)$		$P_{AIR}(10)$	$P_{NET}(100)$	$P_{ATSU}(10)$		95%

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.

Set of Requirements for RCP

PBCS Manual 2.2.1.11

- RCP transaction time. The maximum time for the completion of the operational communication transaction after which the initiator should revert to an alternative procedure;
- 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
  - 0.999 for RCP240 and RCP400
- RCP availability. The required probability that an operational communication transaction can be initiated
  - 0.999 for RCP 240 and RCP400
- RCP integrity. The required probability that an operational communication transaction is completed with no undetected errors.
  - 10^{-5} acceptable rate/flight hour for RCP240 and RCP400

RCP Transaction Time and Allocations PBCS Manual 2.2.2

- The value for the RCP transaction time is based on the time needed to complete the most stringent transaction for controller intervention.
  - Collision risk modelling considers the RCP transaction times in the communications and controller intervention buffer supporting separation assurance
  - Transaction Time (TT) is evaluated in post-implementation statistical analysis and is a 95% value
  - Expiration Time (ET) is the time at which a real time alert is provided by the ATC system to the controller

RSP 180 Specification

PBCS C.2.1.2

RSP 180 specification (surveillance data delivery times and RSP continuity)				
RSP	**180**			**RSP**
95%	90			95%
	RSP 180/D allocations – CPDLC or ADS-C example			
Time +/- 1 second at position (RNP at UTC)	**Monitored operational performance**			**ATM (ATSU system updated)**
99.9%	180			OT
95%	90			DT
RSMP/RSTP	Aircraft system	Network	ATSU system	**RSMP/RSTP**
99.9%	5	170	5	99.9%
95%	3	84	3	95%

Set of Requirements for RSP

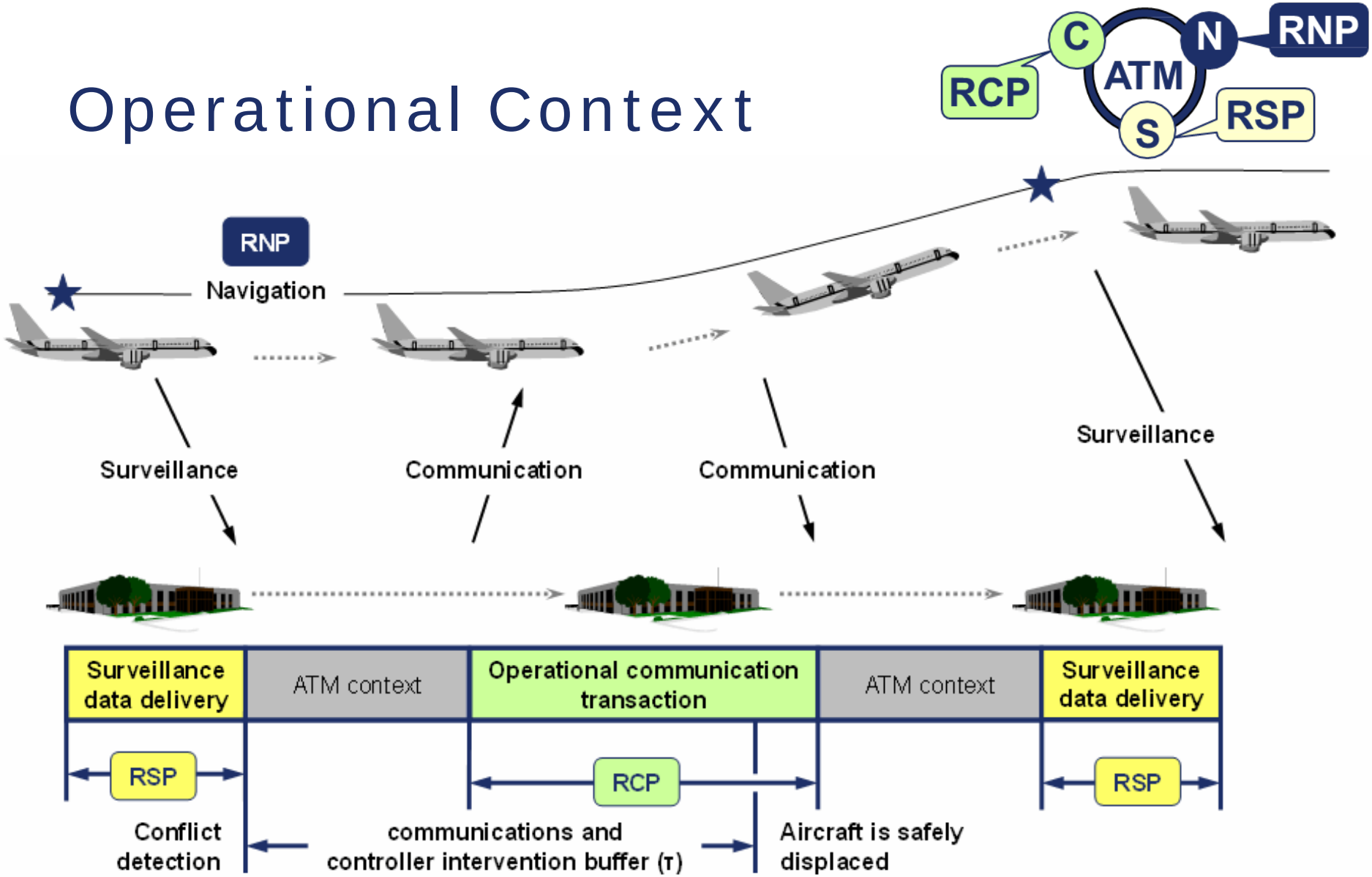
PBCS Manual 2.4.1.8

- RSP surveillance data transit time. The maximum time for the reception of the surveillance data after which the controller should revert to an alternative procedure;
- 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
  - 0.999 for RSP180 and RSP400
- RSP availability. The required probability that surveillance data can be provided
  - 0.999 for RSP180 and RSP400
- RSP integrity. The required probability that surveillance data delivery is completed with no undetected errors.
  - Data Integrity 10^{-5} RSP240 and RSP400
  - FOM Time at Position +/- 1 sec RSP 180; +/-30 sec RSP400

RSP Delivery Time and Allocations PBCS Manual 2.4.2

- The value for the RSP delivery time based on the time when the surveillance data delivery is considered overdue and takes into consideration the time needed to safely execute the contingency procedure
  - Collision risk modelling considers the RSP delivery times in the surveillance data delivery and controller intervention buffer supporting separation assurance.
  - Delivery Time (DT) is evaluated in post-implementation statistical analysis and is a 95% value
  - Overdue Time (OT) is associated with the time the controller takes action upon receiving an alert provided by the expiration of the ground timer

Operational Context



9869 Figure 2-1 Operational Context

RCP240/RSP180 Specifications
Aircraft System

1. Transaction time/data delivery time and continuity
   - RCP240: 95% within 10 sec, 99.9% within 15 sec
   - RSP180: 95% within 3 sec, 99.9% within 5 sec
2. Availability: 99.9%
3. Integrity: Malfunction = 10^{-5} per flight hour
4. Monitoring and alerting criteria:

RCP monitoring and alerting criteria		
Specification: RCP 240/D	**Application: CPDLC**	**Component: Aircraft system**

Ref:	Criteria	Compliance means
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.

RCP240/RSP180 Specifications
Aircraft System (2)

RCP related safety requirements		
Specification: RCP 240/D, RSP180/D	Application: CPDLC, ADS-C	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 shall execute the route clearance 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 at 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.

RCP240/RSP180 Specifications
Aircraft System (3)

RCP/RSP related safety requirements		
Specification: RCP 240/D, RSP180/D	Application: CPDLC, ADS-C	Component: Aircraft system
Ref:	Related RCP parameter	Safety requirement
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.
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.

Summary and Question

- Identified the State's role in PBCS oversight
- Reviewed the detailed RCP and RSP specifications
- Identified the aircraft system safety requirements
- Questions?