ANSP Requirements

Global Operational Data Link (GOLD)

Familiarization with Performance Based Communications and Surveillance (PBCS) Workshop

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Federal Aviation Administration

Overview

➤ Impact to ANSPs

➤ Initial Compliance

➤ Applicable Airspace: Datalink and Surveillance

➤ Transactions and Assurance

➤ CPDLC Connection

➤ ADS-C Connection

➤ ADS-C Contracts

➤ ANSP Service Provision

➤ Monitoring Requirements

➤ ICAO Annex Material

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.

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Impact to ANSPs

*   Operators currently eligible for and using performance-based separation minima (50 long, 30 long, 30 lat) will require a State issued approval for RCP240 and RSP180 to declare eligibility on and following 29 March 2018

1) CONOPs for use of PBCS for designated ATM operations

2) Modify ATM automation to use applicable "P" codes in Field 10 and "RSP" codes in Field 18 SUR/

    *   ANSPs not using "P" and "RSP180" should ensure flight plans with these codes are not rejected by ATM automation

3) Modify ATM automation to record and maintain ADS-C, CPDLC, flight plan data and produce monitoring data according to guidance in Appendix D of PBCS Manual

4) Use assembled data to assess actual communication performance (ACP) and actual surveillance performance (ASP) against required communication performance (RCP) 240 and required surveillance performance (RSP) 180

Initial Compliance – ANSP
PBCS Manual Section 4.3.1 Summary

- **Consistent with State Safety Program, ANSP provides services in accordance with State policies → ensures ATS system meets allocated interoperability and RCP–RSP criteria → specifies operator requirements in AIP**

  – ATC system design and procedures

  – Controller and other ATS staff training, as appropriate

  – Service agreements with CSP(s)

  – Operational trials

  – Notification of data link services, operator requirements, including aircraft equipage and flight plan requirements (e.g. P[n] codes)

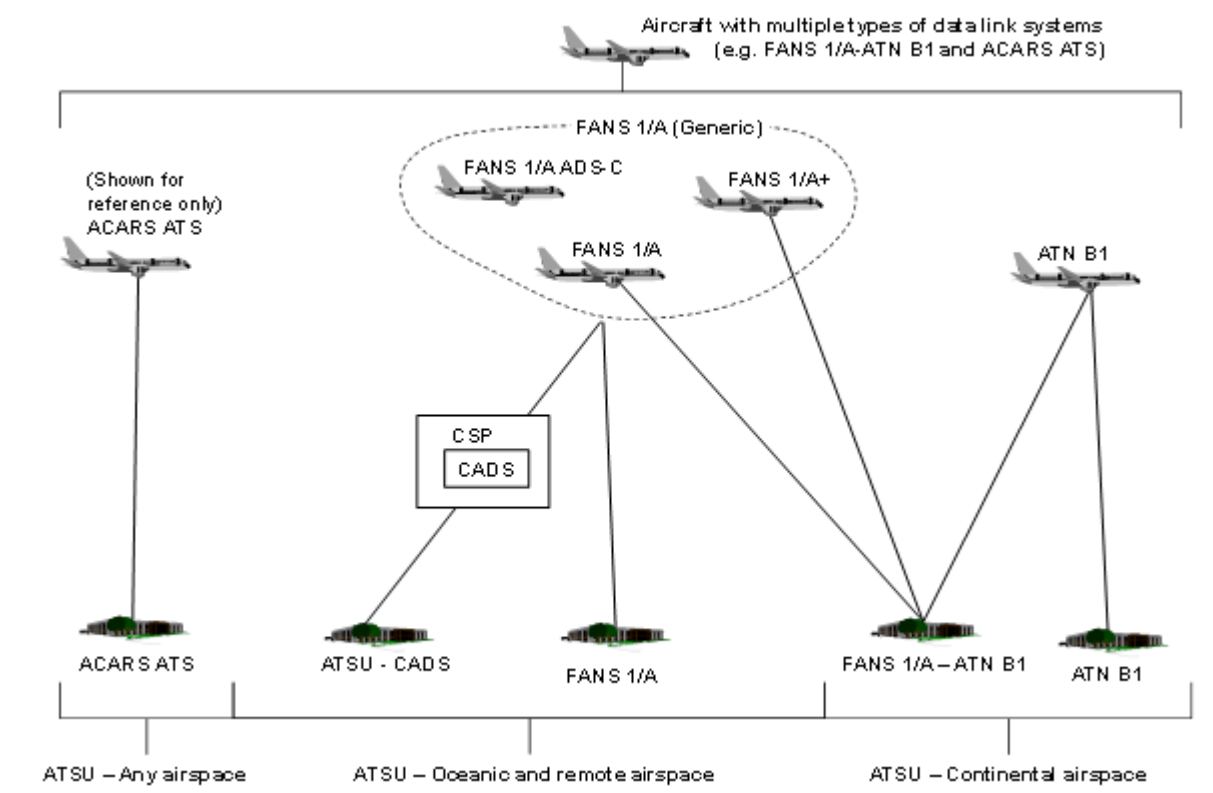 – Contingency and restoration of service procedures

Data Link System
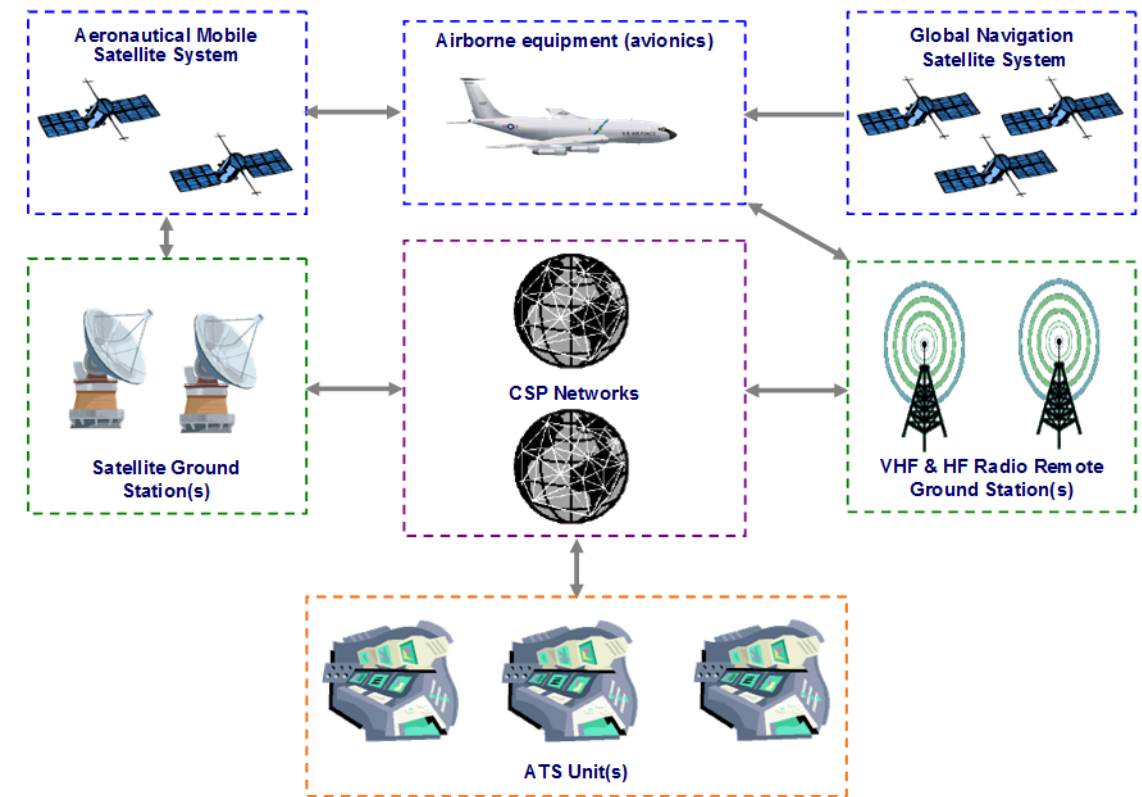
Overview of a data link system
GOLD Figure 1-2

ATS Unit/Aircraft Connectivity

Different ATS unit/aircraft interoperable connectivity

GOLD Figure 1-2

Applicable Airspace – Data link
GOLD 1.1.4.2.1

➢ The data link system in airspace where procedural separation is being applied comprises a variety of ground systems that may provide data link services to FANS 1/A (generic) aircraft and ACARS ATS aircraft.

➢ The data link services improve communications, surveillance and route conformance monitoring to support operational capabilities that enable:

- reduced separations, for example:
    - 50 NM (93 km) longitudinal separation;
    - 30 NM (55.5 km) longitudinal separation; and
    - 30 NM (55.5 km) lateral separation.
- user preferred route (UPR) may require data link in some airspace;
- re-route may require data link in some airspace; dynamic airborne re-route procedure (DARP) requires FANS 1/A aircraft and FANS 1/A ATSU;
- weather deviation management may require data link in reduced separation environments;
- more efficient air traffic management and increases in airspace capacity. For example, ADS-C provides automatic surveillance capability that an ANSP may use to replace CPDLC and/or voice position reporting; and
- reduced flight crew workload through, for example, automatic position reporting and the ability to load clearance information directly into the flight management system.

Applicable Airspace – Surveillance
Gold 1.1.4.3

➢ The data link system in airspace where ATS surveillance services are provided comprises a variety of ground systems:

- ATN B1 ground systems, that may provide data link services to ATN B1 aircraft and FANS 1/A ATN B1 aircraft;

- FANS 1/A-ATN ground systems, that may provide data link services to ATN B1 aircraft, FANS 1/A aircraft and FANS 1/A-ATN B1 aircraft;

- FANS 1/A ground systems, that may provide data link services to FANS 1/A aircraft, FANS 1/A+ aircraft and FANS 1/A-ATN B1 aircraft; and

- ACARS ATS ground systems, that may provide data link services to ACARS ATS aircraft.

Note.— FANS 1/A aircraft are technically interoperable with a FANS 1/A-ATN ATSU. However, operationally, FANS-1/A+ may be required for data link operations in applicable airspace as specified in Regional SUPPs and/or AIP (or other appropriate publication, such as AIC or NOTAM) (refer to Table 1 1).

Transactions and Assurance
Gold Section 1.2.1.1.4
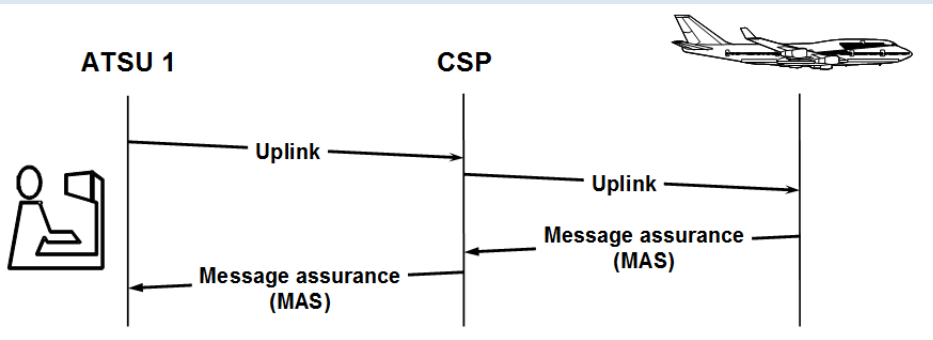
Uplink and message assurance
GOLD Figure 1-3

## Uplink CPDLC message from ATC via a CSP to the aircraft

The ATS unit to receives a message assurance (MAS) indicating that an uplink message has been delivered to the aircraft

Downlink message from ATC via a CSP to the aircraft

The aircraft to receives a network acknowledgement indicating that a downlink message has been delivered to the CSP system

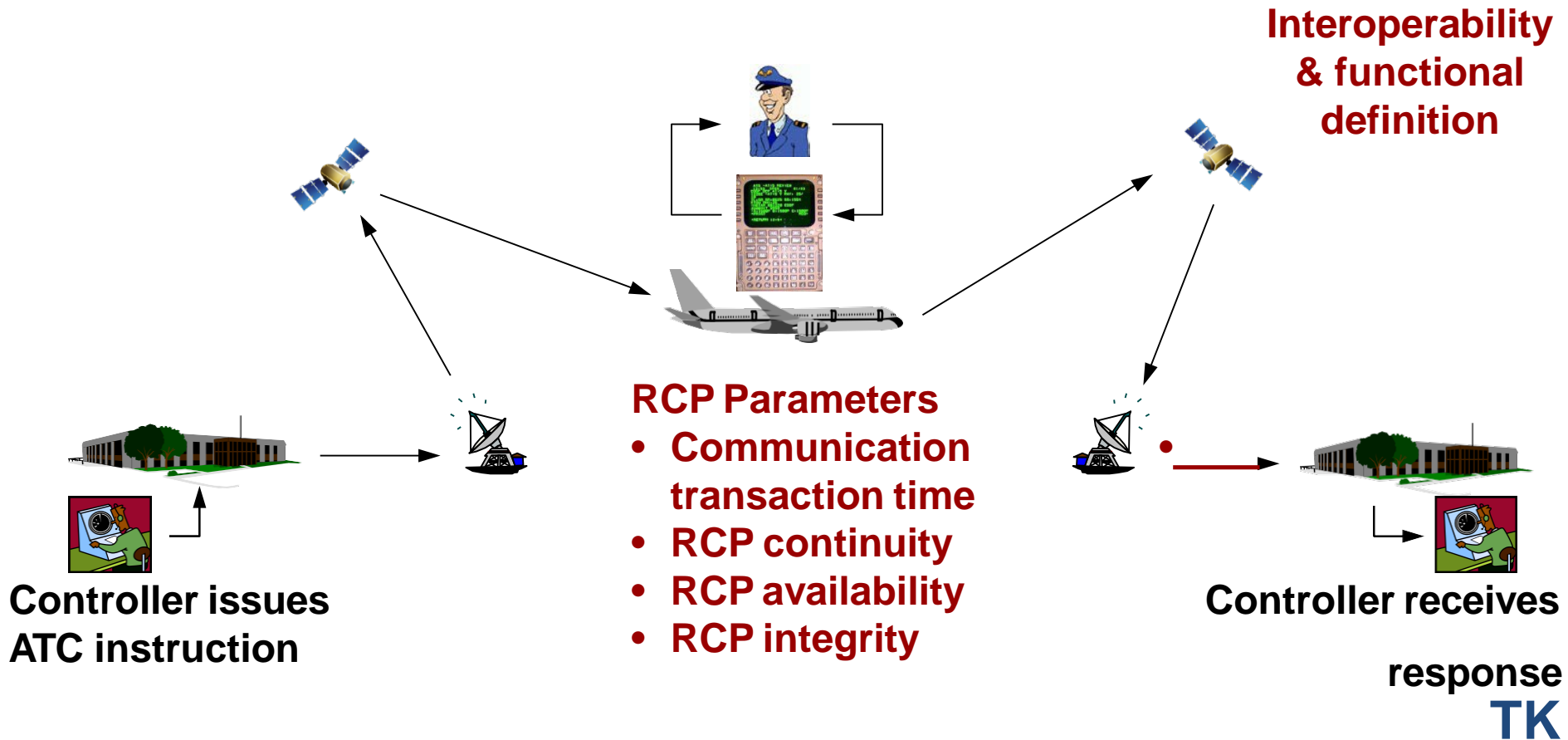Downlink and network acknowledgement
GOLD Figure 1-4
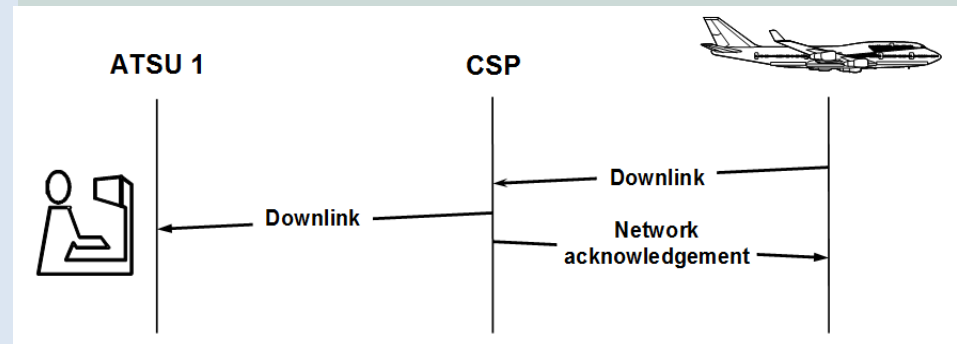
CPDLC Connection
GOLD 1.2.3.1

➢ The purpose of a CPDLC connection is to allow the exchange of CPDLC messages between an aircraft and an ATS unit (active connection)

➢ An active CPDLC connection can be established upon completion of the logon procedure if no previous CPDLC connection exists with the aircraft.

- The ATS unit with which an aircraft has an active CPDLC connection is referred to as the Current Data Authority (CDA)

➢ The CPDLC connection also provides an advance connection with the next ATS unit (inactive connection)

- The ATSU with an inactive CPDLC connection is referred to as the Next Data Authority (NDA)

➢ An aircraft can have a maximum of two CPDLC connections established concurrently, each with a different ATS unit.

- Only one CPDLC connection can be active at any given time; any second connection is inactive.

RCP 240 Specification

Applies to controller's intervention capability

Interoperability & functional definition

RCP Parameters
- **Communication transaction time**
- **RCP continuity**
- **RCP availability**
- **RCP integrity**

Controller issues ATC instruction

Controller receives response

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RCP 240 Specification
PBCS B.2.1.1 Figure B-1(Discussed in the State Session)

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.
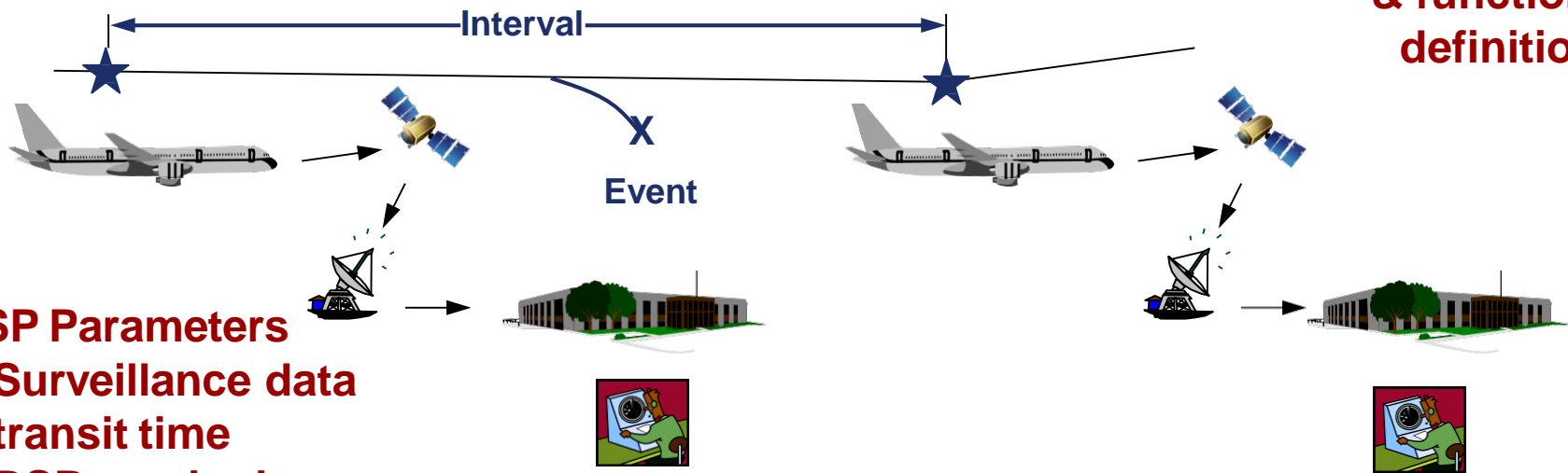
ADS-C Connection
GOLD 1.2.5

➢ Automatic dependent surveillance – contract (ADS-C) uses various systems on board the aircraft to automatically provide aircraft position, altitude, speed, intent and meteorological data, which can be sent in a report to an ATS unit or AOC facility ground system for surveillance and route conformance monitoring

➢ One or more reports are generated in response to an ADS contract, which is requested by the ground system

➢ An ADS contract identifies the types of information and the conditions under which reports are to be sent by the aircraft

➢ Some types of information are included in every report, while other types are provided only if specified in the ADS contract request

➢ The aircraft can also send unsolicited ADS-C emergency reports to any ATS unit that has an ADS connection with the aircraft

RSP 180 Specification

Applies to surveillance data

Time at position

Interoperability & functional definition

Interval

X

Event

RSP Parameters
- **Surveillance data transit time**
- **RSP continuity**
- **RSP availability**
- **RSP integrity**

ATSU/controller receives the surveillance data

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RSP 180 Specification
PBCS C.2.1.2 Figure C-1 (Discussed in the State Session)

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%

ADS-C Contracts (1)
GOLD 1.2.5.3.1

➢ After receiving a logon request, the ATS unit will need to establish ADS contract(s) with the aircraft before it can receive any ADS-C reports. There are three types of ADS contracts:

- periodic contract – optional time interval and data groups
- demand contract – a single periodic report
- event contract – an report whenever a specific event occurs
  - An ATS unit can establish only one event contract with an aircraft at any one time. However, the event contract can contain multiple event types as follows:
    - waypoint change event (WCE)
    - level range deviation event (LRDE)
    - lateral deviation event (LDE)
    - vertical rate change event (VRE)
- Note.— In accordance with ICAO Doc 4444, paragraph 13.4.3.4.3.2, in airspace where procedural separation is being applied, the all event types shall be contained in ADS-C agreements.

ADS-C Contracts (2)
GOLD 1.2.5.3.2

➢ The ground system can establish ADS contracts without flight crew action provided that ADS-C in the aircraft system is not selected off

➢ An ATS unit can establish only one periodic contract with an aircraft at any one time.

➢ A number of ATS units can each establish their own periodic contract and specify their own conditions for the report with the same aircraft at the same time

ADS-C Contracts (3) GOLD 1.2.5.6.2.3

Multiple ADS periodic contracts with different reporting intervals
Gold Figure 1-49

The ATS unit cancels an ADS contract and terminates the ADS-C connection when it no longer needs ADS-C reports to avoid unnecessary loading of the data link system.

When a triggering event occurs, the aircraft sends the event report to each of the contracted ATSU

Events are sent in the sequence of the contracts, and the last ATSU can experience additional delay in receiving the event report
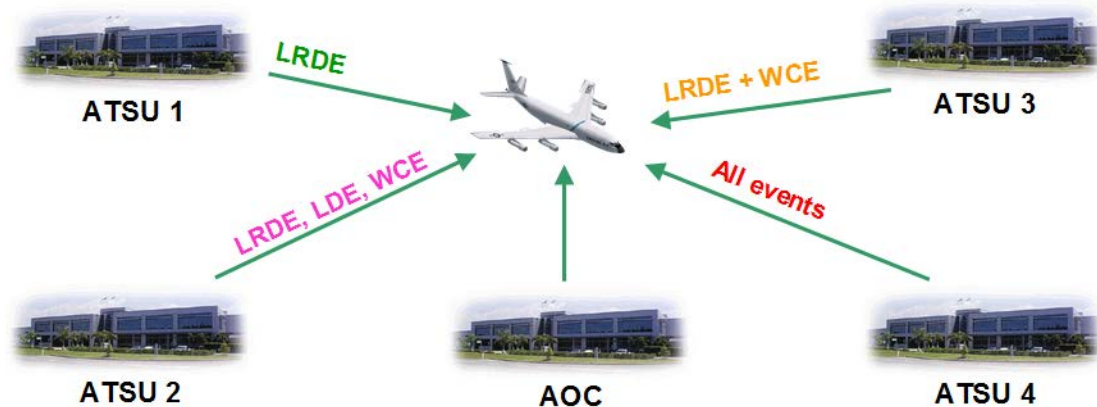
Multiple and different ADS event contracts
GOLD Figure 1-50

ANSP Service Provision Gold 2.1.1.1
Initial Operational Implementation of CPDLC and ADS-C

➢ Prior to operational implementation, the ANSP should confirm that their equipment and procedures meet system integrity requirements. This process should include:

- A system safety assessment
- Integration testing and operational trials confirming interoperability
- Confirmation that the ATS manual are compatible with those of adjacent providers

➢ The system safety assessment should be conducted through a functional hazard analysis or a documented system safety case for initial implementation as well as for future enhancements which should include:

- identifying failure conditions
- assigning levels of criticality
- determining probabilities for occurrence
- identifying mitigating measures

RCP240/RSP180 Specifications ANSP

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: ANSP**
Ref:	**Criteria**	**Compliance means**
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. *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 paragraph B.2.1.3, RCP availability criteria.
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 paragraph B.2.1.3, 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.

RCP240/RSP180 Specifications ANSP (2)

RCP/RSP related safety requirements		
Specification: RCP 240/D, RSP180/D		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 with the route clearance via data link.
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.

RCP240/RSP180 Specifications ANSP (2)

RCP/RSP related safety requirements		
Specification: RCP 240/D, RSP180/D		Component: ANSP
Ref:	Related RCP parameter	Safety requirement
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 operational processing by controller 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.
SR-26 (ANSP)	I	The ATS unit end system shall be capable of detecting errors resulting in corruption introduced by the communication service.

ANSP Service Provision Gold 2.1.1.2
Mitigation of Identified Failure Conditions

➢ Following the safety assessment, the ANSP should institute measures through automation or procedures to mitigate the identified failure conditions. For example:

- if the ANSP uses integrated measurement tools for the purpose of determining separation, they may need to publish limitations on the use of such tools for establishing and monitoring separation standards;

- if an ANSP receives both an ADS-C and a CPDLC position report containing ETA that differ by 3 minutes or more, the controller should request confirmation of the estimate for the waypoint in question; and

- to fulfill the requirements of Annex 10, paragraph 8.2.8, the controller should be provided with automation and/or procedures to ensure that the appropriate ATC unit has established an active CPDLC connection with the aircraft.

  - Mitigating measures for the confirming CDA are found in GOLD Appendix B

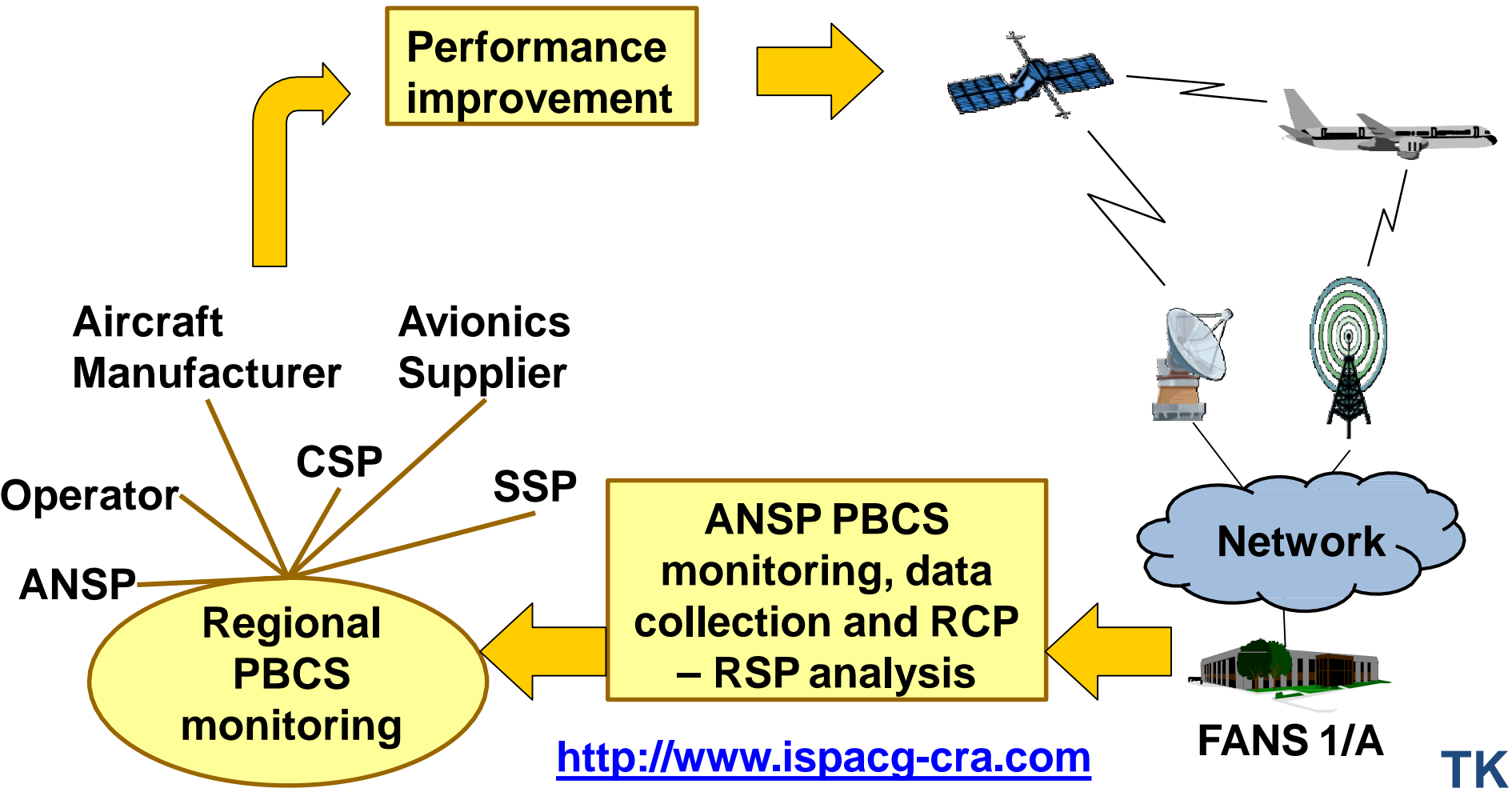# ANSP Service Provision Gold 2.1.1.3
Confirmation of CSP Performance

➢ The ANSP should ensure that it provides communication and surveillance services that meet the performance specifications provided in ICAO Doc 9869 and that the contracted CSP meets its performance allocations.

  - The risks represented by the requirements in Doc 9869 are regarded as being minimum for the specified ATM operation to maintain operational efficiency while meeting its required safety needs.

Monitoring and Data Recording
Gold Paragraph 2.1.5.1

➢ The CNS/ATM environment is an integrated system including physical systems (hardware, software, and communication network), human elements (the flight crew and the controller), and the related procedures.

➢ The ANSP should establish end-to-end system monitoring in accordance with the guidelines provided in ICAO Doc 9869

- The guidelines aim to ensure end-to-end system integrity through post-implementation monitoring, identifying, reporting and tracking of problems, and corrective action.

➢ The ANSP and its CSP(s) should retain records for at least 30 days to allow for accident/incident investigation purposes

- The ANSP and CSPs should make these records available for air safety investigative purposes on demand
- These recordings should allow replaying of the situation and identifying the messages that the ATS unit sent or received

Continued Compliance – ANSPs and All

Performance improvement

Aircraft Manufacturer

Avionics Supplier

CSP

SSP

Operator

ANSP

Regional PBCS monitoring

ANSP PBCS monitoring, data collection and RCP – RSP analysis

Network

FANS 1/A

http://www.ispacg-cra.com

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Administering PBCS Monitoring Programs (1)
PBCS 4.5.1.2-4

➢ The ANSPs within a region 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.

➢ The ANSPs should administer the PBCS monitoring programmes taking into account 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.

Administering PBCS Monitoring Programs (2)
PBCS 4.5.1.2-4

➢ The ANSPs within a region should establish the policies and procedures for administering the regional PBCS monitoring programme, including:

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

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

- formats and intervals of reports the PBCS monitoring programme will provide to the ANSPs and other participants.

Administering PBCS Monitoring Programs (3)
PBCS 4.5.1.2-4

➢ When administering the PBCS monitoring programmes, the ANSPs within a region should consider the following:

- collecting data, monitoring and analyzing data, investigating problem reports, and coordinating corrective actions.

- establish means to report, track and resolve internal problems in accordance with local policies and procedures and to report problems to the regional PBCS monitoring programme.

Local PBCS Monitoring (1)
PBCS 4.5.2

➢ 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.

➢ 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.
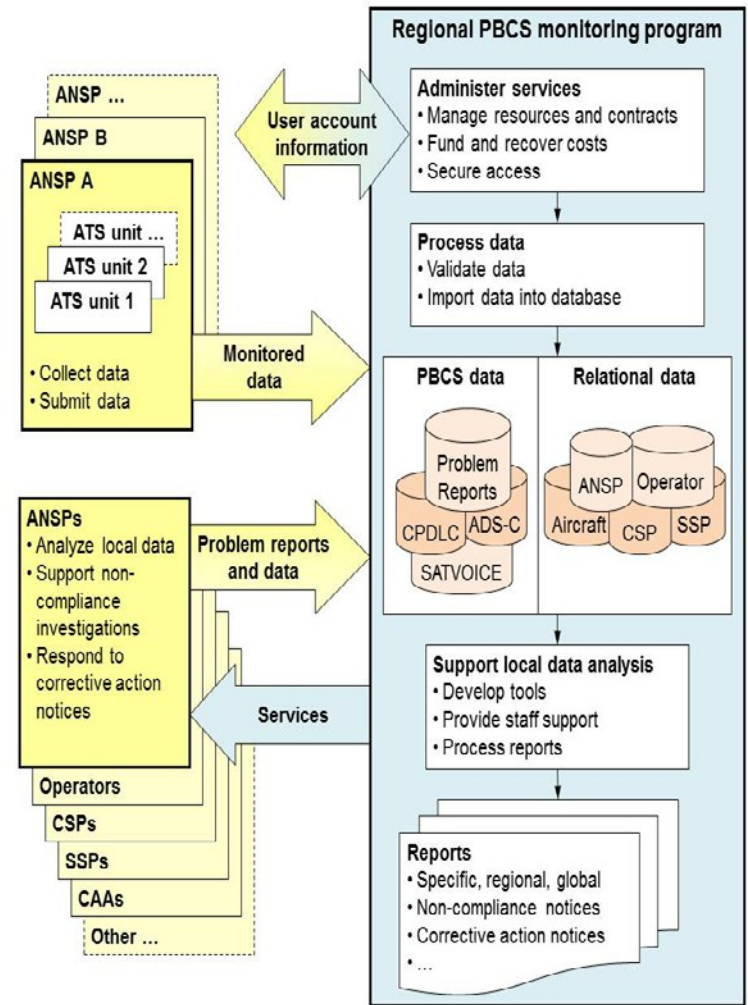
Local PBCS Monitoring (2)
PBCS 4.5.2

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

➢ The ANSP should perform 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.

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

➢ 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.

Regional PBCS Monitoring Program

- **Determine area of operation to which the information applies**
  - Such as one or more regions

- **You need**
  - Host
  - Information security policy
  - Cost recovery mechanism

- **Supports local analysis and global exchange of information**

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

Annex 11: Air Traffic Services
2.9 Performance-based surveillance (PBS) operations

2.9.1 In applying performance-based surveillance (PBS), RSP specifications shall be prescribed by States. When applicable, the RSP specification(s) shall be prescribed on the basis of regional air navigation agreements.

Note.— In prescribing an RSP specification, limitations may apply as a result of surveillance infrastructure constraints or specific surveillance functionality requirements.

2.9.2 The prescribed RSP specification shall be appropriate to the air traffic services provided.

2.9.3 Where an RSP specification has been prescribed by States for performance-based surveillance, ATS units shall be provided with equipment capable of performance consistent with the prescribed RSP specification(s).

Note.— Information on the PBCS concept and guidance material on its implementation are contained in the Performance-based Communication and Surveillance (PBCS) Manual *(Doc 9869).*

3.3.5.2 Where RCP/RSP specifications are applied, programmes 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. The scope of monitoring programmes shall be adequate to evaluate communication and/or surveillance performance, as applicable.

Note.— Guidance material relating to RCP and RSP specifications and monitoring of communication and surveillance performance is contained in the Performance-based Communication and Surveillance (PBCS) Manual *(Doc 9869).*

3.3.5.3 *Recommendation. — Arrangements should be put in place, through interregional agreement, for the sharing between regions of data and/or information from monitoring programmes.*

6.1.1.2 Where an RCP specification has been prescribed by States for performance-based communication, ATS units shall, in addition to the requirements specified in 6.1.1.1, be provided with communication equipment which will enable them to provide ATS in accordance with the prescribed RCP specification(s).

Note.— Information on the performance-based communication and surveillance (PBCS) concept and guidance material on its implementation are contained in the Performance-based Communication and Surveillance (PBCS) Manual (*Doc 9869).*

Summary and Question

➤ Described the impact to ANSPs

➤ Selected details of the ANSP guidance from the Gold Manual Doc 10037 and the PBCS Manual Doc 9869 were presented

➤ Identified the RCP/RSP Safety Requirements

➤ ANSP Monitoring responsibility was identified and discussed (More details later)

➤ Specific references to ANSP from Doc 4444 and Annex 11 were provided

Questions Please!