ICAO provisions on data link implementation

Crystal Kim

- *Technical Officer, Airspace Management and Optimization Section*
- *Secretary of Operational Data Link Working Group (OPDLWG) and Air Traffic Management Requirements and Performance Panel (ATMRPP)*

NAM/CAR/SAM ATS Data Link Implementation Workshop, Philipsburg, Sint Maarten, 18-21 April 2016

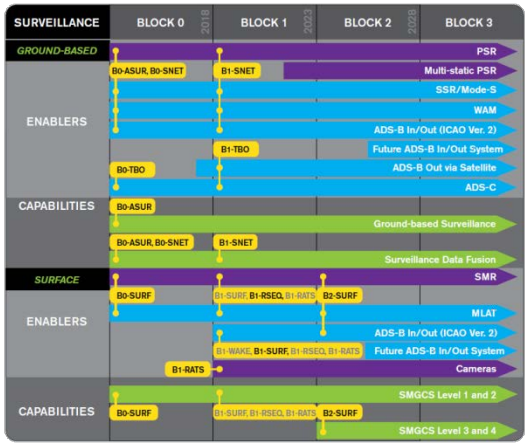
- GANP and ASBUs
- ATS Data Link Today
- ICAO SARPs, PANS and Manuals
- Amendments to Annexes and PANs applicable in Nov 2016

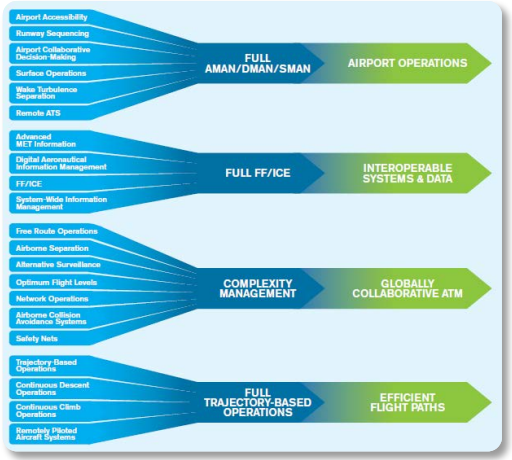
GANP and ASBUs

GANP – A Global Roadmap

GANP – A Global Roadmap

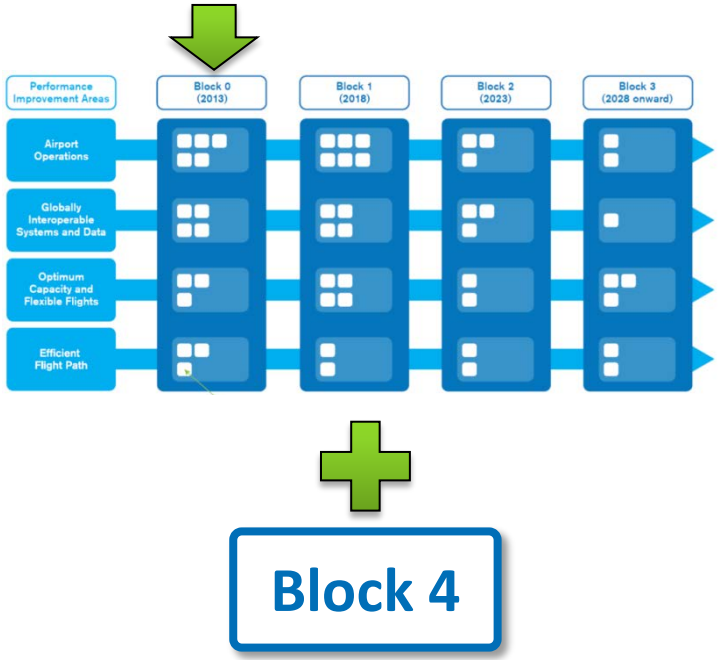
- The Global Air Navigation Plan
- The Roadmaps





GANP – A Global Roadmap

- The Global Air Navigation Plan
- The Roadmaps
- The Content



GANP – A Global Roadmap

- **Provides certainty** :
  - In equipage
  - For industry
  - For investment
  - In research and development direction

ICAO's 10 Key Air Navigation Policy Principles

06 Regional and State Air Navigation Priorities

– ICAO regions, sub-regions and individual States through the PIRGs should **establish their own Air Navigation priorities** to meet their individual needs and circumstances in line with the Global Air Navigation Priorities

ICAO's 10 Key Air Navigation Policy Principles

08 Use of ASBU Blocks and Modules

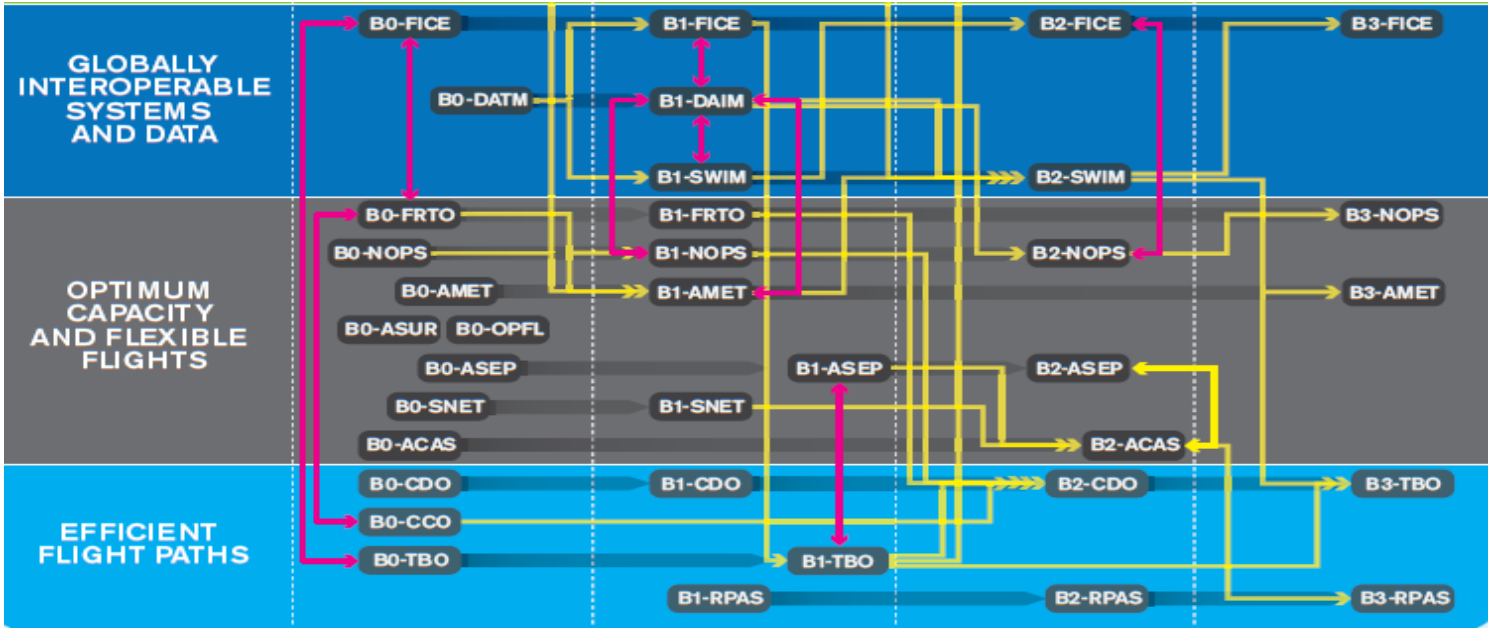
- Although the GANP has a global perspective, it is not intended that all ASBU modules are to be applied around the globe.
- When the ASBU blocks and modules **are adopted by regions**, sub-regions or States they should be followed **in close accordance with the specific ASBU requirements** to ensure **global interoperability and harmonization** of air traffic management
- It is expected that **some ASBU modules will be essential** at the global level and therefore may eventually be the subject of **ICAO mandated implementation dates.**

Relevant Modules in ASBU

Performance Improvement Area 4:
Efficient Flight Paths – Through Trajectory-based Operations

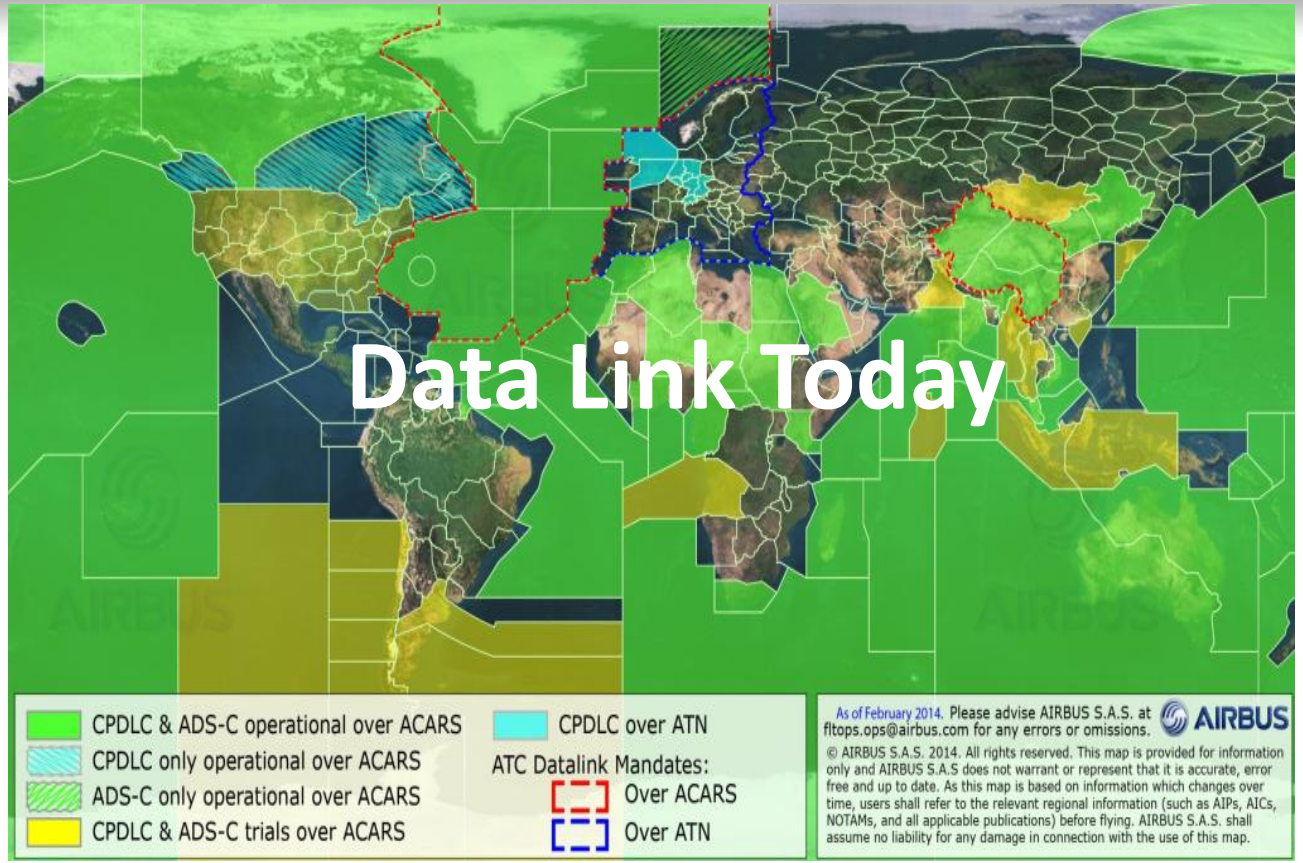
Block 0	Block 1	Block 2	Block 3
B0-TBO **Improved Safety and Efficiency through the initial application of Data Link En-Route** Implementation of an initial set of data link applications for surveillance and communications in ATC.	B1-TBO **Improved Traffic Synchronization and Initial Trajectory-Based Operation** Improve the synchronization of traffic flows at en-route merging points and to optimize the approach sequence through the use of 4DTRAD capability and airport applications, e.g. D-TAXI, via the air-ground exchange of aircraft derived data related to a single controlled time of arrival (CTA).		B3-TBO **Full 4D Trajectory-based Operations** Trajectory-based operations deploys an accurate four-dimensional trajectory that is shared among all of the aviation system users at the cores of the system. This provides consistent and up-to-date information system-wide which is integrated into decision support tools facilitating global ATM decision-making.

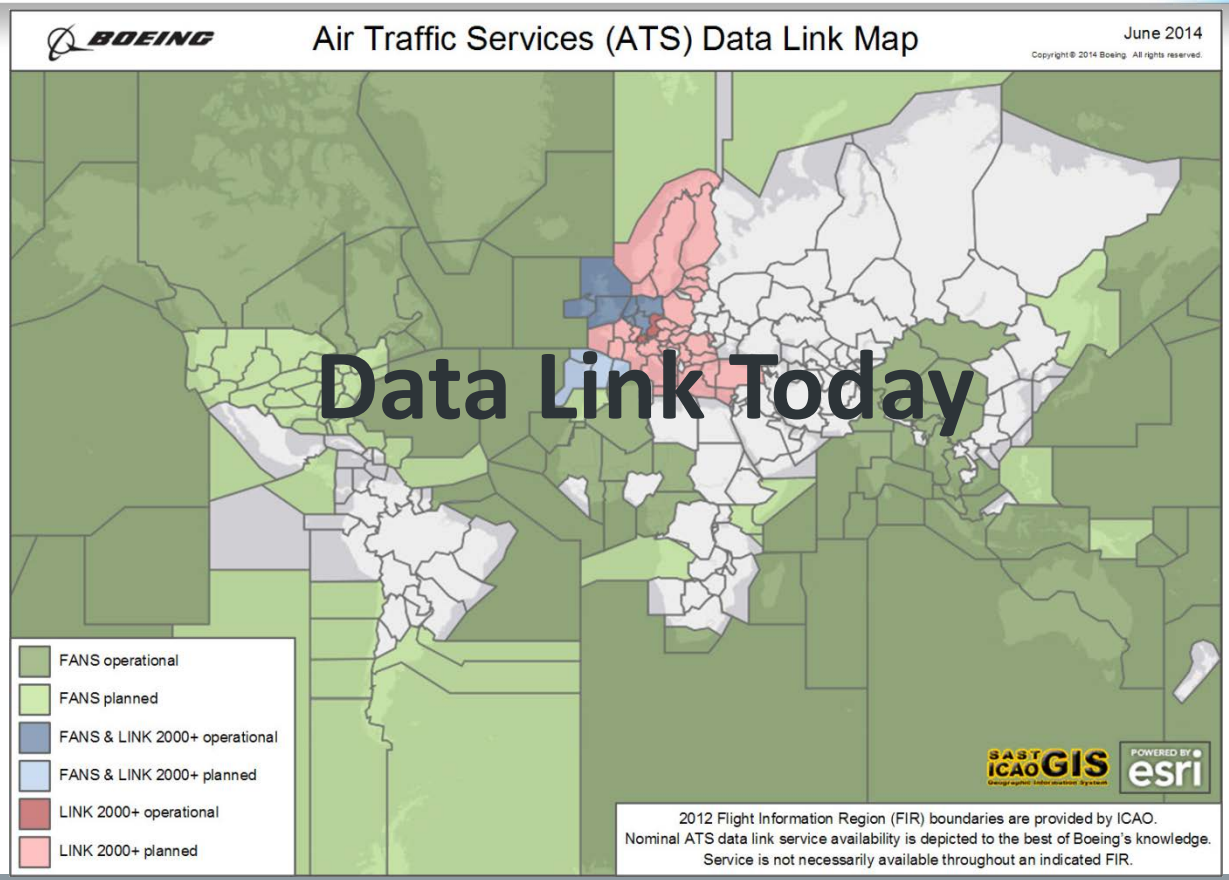
Dependencies of TBO modules



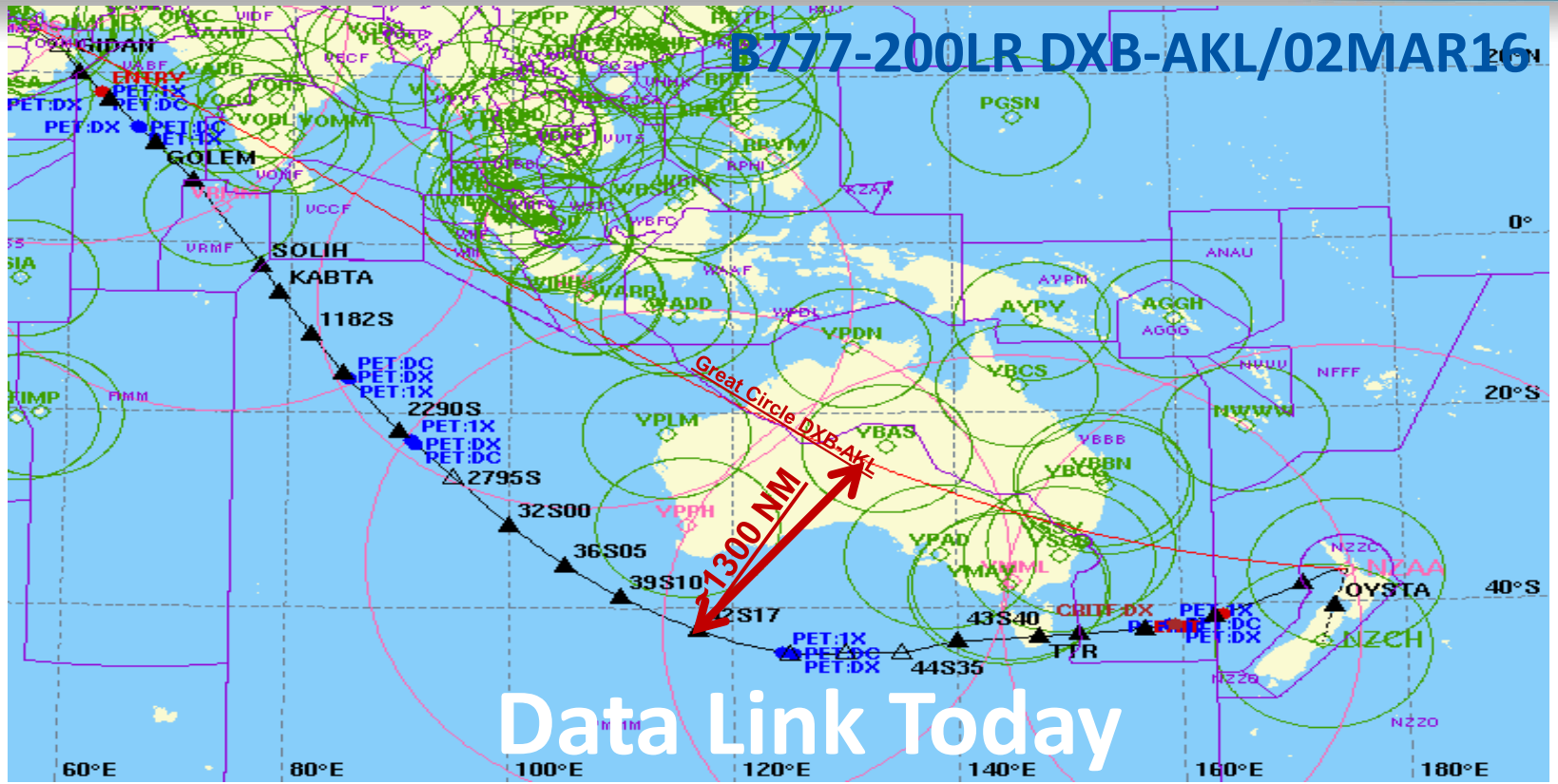
ATS Data Link Today

Data Link Today




BOEING
Air Traffic Services (ATS) Data Link Map
June 2014
Copyright © 2014 Boeing. All rights reserved.
Data Link Today
FANS operational
FANS planned
FANS & LINK 2000+ operational
FANS & LINK 2000+ planned
LINK 2000+ operational
LINK 2000+ planned
SAST ICAO GIS
POWERED BY esri
2012 Flight Information Region (FIR) boundaries are provided by ICAO.
Nominal ATS data link service availability is depicted to the best of Boeing's knowledge.
Service is not necessarily available throughout an indicated FIR.

Trip Time: 16:32 / Block Time: 17:15 / Trip Fuel: 217652 / GND DIST: 8020NM / GC DIST: 7683NM



Trip Time: 15:29 / Block Time: 15:55 / Trip Fuel: 121350 / GND DIST: 8010NM / GC DIST: 7683NM

Why Data Link ?

- **Enhanced conformance monitoring capability** in the airspace over remote and oceanic areas
- clear messages with **less risk of misunderstandings**
- additional, independent and secure channel, which **reduces the strain on busy sector frequencies**
- **Increased capacity and the day-to-day efficiency** of communications between controllers and pilots

Why Data Link ?

- Air traffic is predicted to **double** in the next 15 years
- Our collective responsibility is to **allow the aviation system** to safely realize this growth
- **Use of data link may not be optional** anymore to increase efficiency and optimize the use of available airspace

Why Data Link ?

- When you apply **separation standards that rely on data link capability and performance**
  - 30 NM and 50 NM longitudinal separation,
  - RLatSM – 23 NM lateral separation,
  - RLongSM – 5 Minutes longitudinal separation
- If you **lose the data link connection**, you **may have lost separation**

- ✓ *Is data link connection always satisfactory ?*
- ✓ *Do all data link systems have same performance ?*
- ✓ *Are all personnel involved well-trained ?*

The answer is……????

Annexes, PANS and Manuals

Related to Data Link Implementation

Two Aspects to Data Link

- **The "Service and Message"**
  - *"Content" and "Procedures"*
  - *Handled by OPLINKP (Now OPDLWG)*

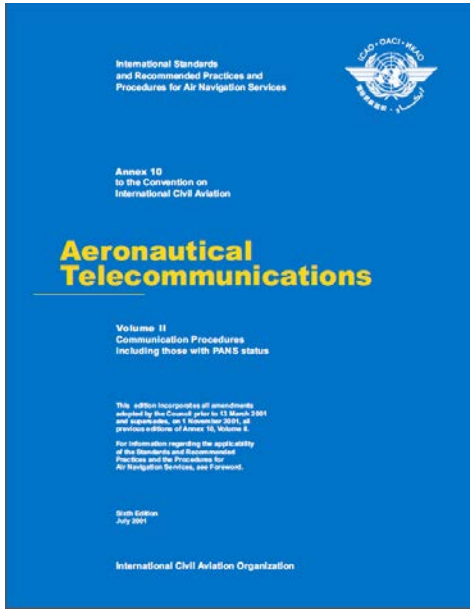
- **The "*Medium*"**
  - *Various media and the network supporting them*
  - *Handled by ACP (Now DCIWG)*

OPDLWG and DCIWG???

- In 2014, the Communications Panel (CP) was formed by the merging of the OPLINKP and ACP.
- The CP has two “specific” Workings Group
  - ***Operational Data Link Working Group***
    - Former OPLINKP, dealing with Operational Issues
  - ***Data Communications Infrastructure Working Group***
    - Former ACP, dealing with Technical Issues

For Services and Messages ….

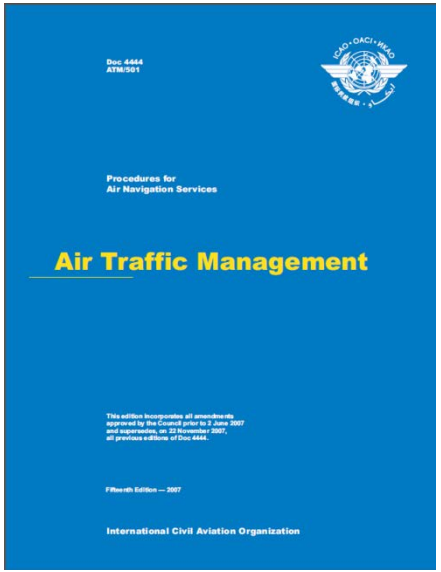
- **Annex 10 Volume II is the key “standard”**
  - Composition of data link messages
  - Display of data link messages
  - CPDLC procedures
- **Supported by PANS-ATM and Manuals**



PANS-ATM (Doc 4444)

Chapter 4 General Provisions for Air Traffic Services

- 4.11 Position Reporting
  - 4.11.4 Transmission of ADS-C reports
  - 4.11.5 Contents of ADS-C reports
- 4.15 Data Link Communications initiation Procedures

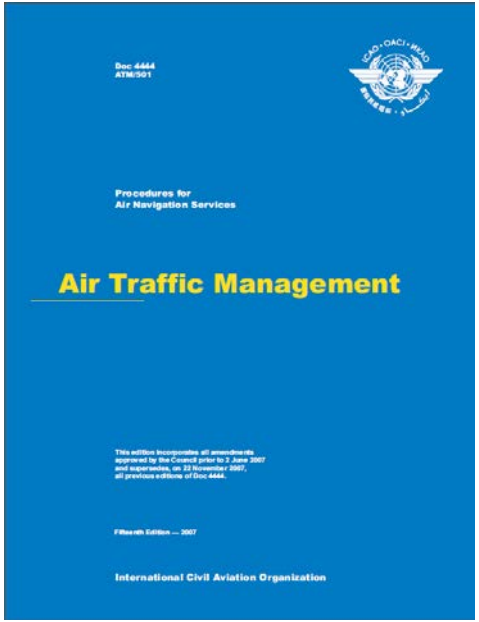


PANS-ATM (Doc 4444)

Chapter 5 Separation methods and minima

Chapter 13 ADS-C Services

- ADS-C Ground system capabilities
- ADS-C related aeronautical information
- Use of ADS-C in the provision of ATC service
- Use of ADS-C in the application of separation minima



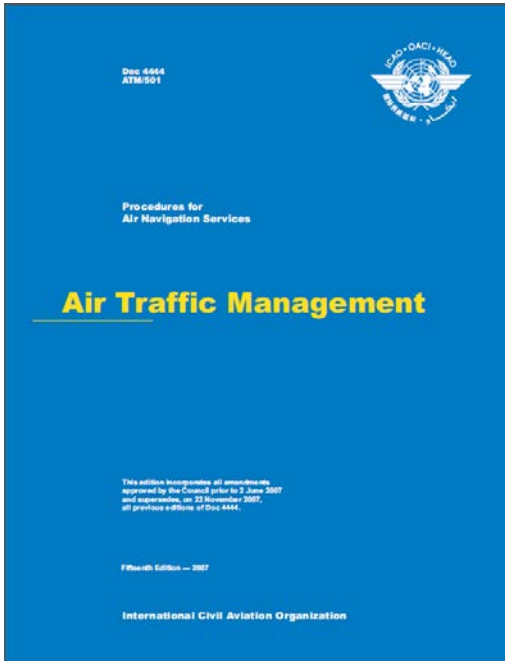
PANS-ATM (Doc 4444)

Chapter 14 CPDLC

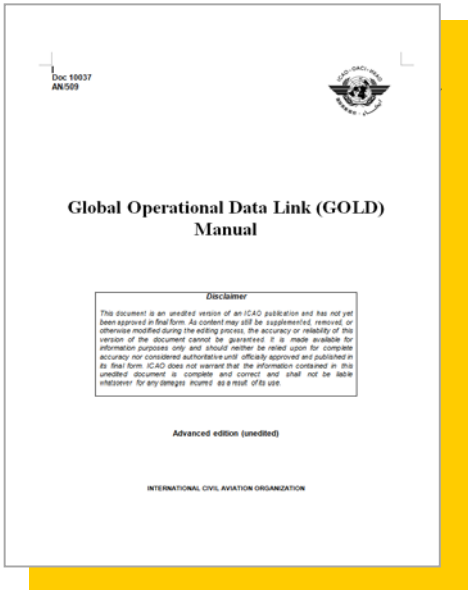
- Establishment of CPDLC
- Exchange of operational CPDLC messages

Appendix 2 Flight Plan, Item 10

Appendix 5 CPDLC Message Set



Global Operational Data Link (GOLD) Manual (Doc 10037, Edition 1)


Doc 10037
AN/509

Global Operational Data Link (GOLD) Manual

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Advanced edition (unedited)

INTERNATIONAL CIVIL AVIATION ORGANIZATION

- Supersedes regional GOLD V.2 dated 26 April 2013
- RCP/RSP specifications and post-implementation monitoring removed from regional GOLD and moved to PBCS Manual
- Additional changes made to ensure that No conflicts with provisions in Annex and PANS including and up to 2016 amendment
- To be published in July/August 2016

Global Operational Data Link Manual (Doc 10037, Edition 1)

Chapter 1. Overview of data link operations

Chapter 2. Administrative provisions related to data link operations

Chapter 3. Controller and radio operator procedures

Chapter 4. Flight crew procedures

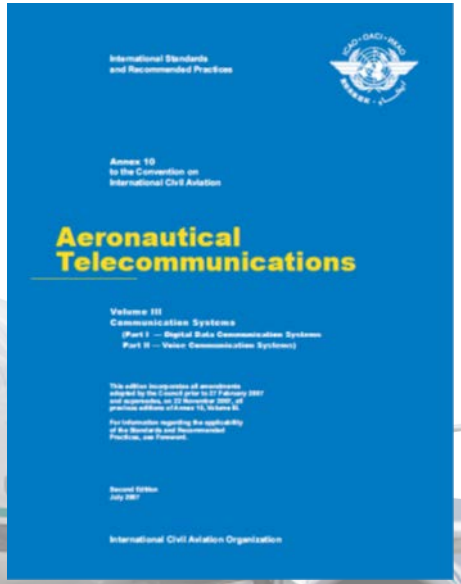
Chapter 5. Advanced ATS supported by data link

Chapter 6. State aircraft data link operations

Appendix A CPDLC message elements and standardized free text message elements
Appendix B Regional/State specific information
Appendix C Operator/aircraft specific information

For the Media…

- Annex 10 Volume III is the key "standards" document.
- Supported by a number of ICAO Manuals



ICAO Manuals on Data Link Media (1)

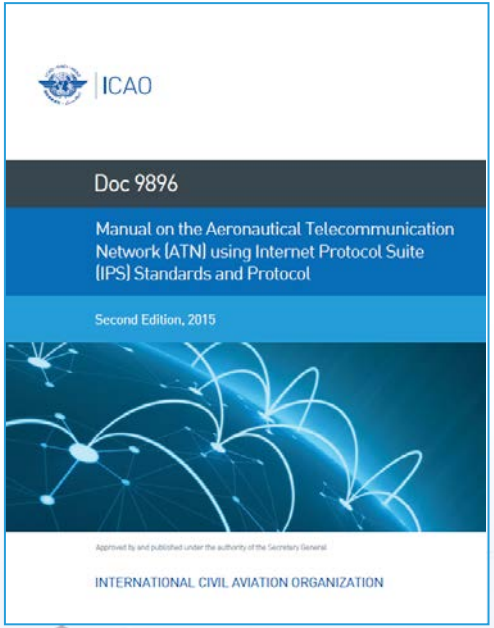
- **For the ATN,** there are two key documents
  - **Doc 9880:** *Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols*
  - **Doc 9896:** *on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocols*

Doc 9880

- **Air-Ground Applications**
  - *CPDLC, CM, ADS-C (tbd), FIS (tbd)*
- **Ground-Ground Applications**
  - *AMHS, AFTN/AMHS Gateway*
- **Upper-Layer Communications Services; Internet Communications Services**
- **Directory Services, Security and Indentifier Registration**
- **2nd Edition to be published in late 2016.**

Doc 9896

- **Detailed Tech Specs**
  - Network, Transport and Security
- **IPS Applications**
  - VOIP
  - Including convergence functions for legacy (OSI) applications
- **Guidance Material**

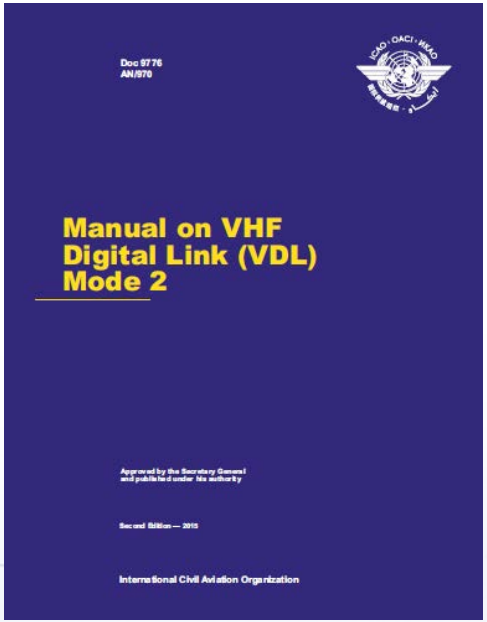


ICAO Manuals on Data Link Media (2)

- **For individual media:**
  - **Doc 9776:** *Manual on VHF Digital Link (VDL) Mode 2*
  - **Doc 9925:** *Manual on Aeronautical Mobile (Route) Service*
  - **Doc 10044:** *Manual on Aeronautical Mobile Airport Communications System (AeroMACS) (to be published in 2016)*

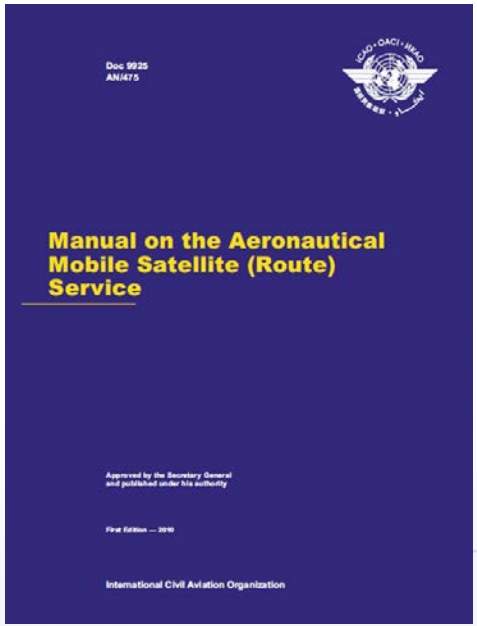
Doc 9776

- **2nd Edition in 2015**
  - Has multi-frequency support for NextGen/SESAR
  - Solves congestion-based problems to date.
- **Is OSI-based and is part of LINK2000.**



Doc 9925

- **First Edition**
  - INMARSAT Classic, ACARS-based plus supports OSI but never used.
  - Iridium, ACARS-based
- **2nd Edition - late 2016**
  - SwiftBroadband (SBB)
  - Supports ACARS and IPS



Doc 1044 (*AeroMACS*)

- **First Edition due late 2016**
  - A10 SARPS become applicable at that time.
- **Supports IPS**
  - Manual will have provisions on Security
  - Also guidance on operation before ATN/IPS becomes operational

Amendments to Annexes and PANS Applicable in Nov. 2016

Amendment Concerning

- Data Link Initiation Capability
- ADS-C and CPDLC
- **Performance-based Communication and Surveillance**
- **Performance-based separation minima**
- Satellite Voice Communication

Applicable in November 2016

- **Affected Documents**
  - Annexes 4, 6 (Parts I, II, III), 10 (Vol II, III), 11 and 15; PANS-ATM; PANS-ABC
- **Improvements:**
  - Harmonized data link and SATVOICE procedures allowing for seamless operations
  - Enhanced communication capabilities for flight operations in remote and oceanic areas
- **Expected Benefits:**
  - Reduction in data link connectivity errors between aircraft and ATS facilities and/or reduction in data link communications error
  - Safer application of reduced separation in the oceanic airspace for aircraft equipped with CPDLC and ADS-C.
  - Transition towards the implementation of a converged data link solution in the future without impacting technical interoperability of current implementation

PBCS Framework

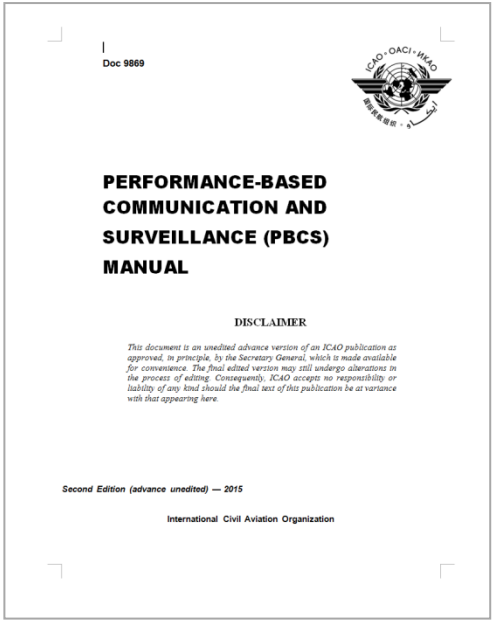
PBN

- ***Prescription of RCP and RSP*** for air traffic services that are predicated on communication and surveillance performance ***(Annex11)***;
- ***Approval of aircraft and operators*** for a communication and/or surveillance capability including aircraft equipage for operations where RCP and/or RSP specifications have been prescribed ***(Annex 6)***;
- ***indication of an aircraft's communication and surveillance capability and performance*** in the form of RCP/RSP specifications in the flight plan ***(PANS-ATM)***;
- ***monitoring programmes to assess actual communication and surveillance performance*** against RCP and RSP specifications ***(Annexes 6 and 11)***
- ***corrective actions,*** as applicable, for the appropriate entity ***(Annexes 6 and 11)***.

RVSM

Performance-based Communication and Surveillance Manual (Doc 9869)

- **Developed based on the RCP Manual (Doc 9869), GOLD, SVGM and other regional material**
- **Expanded the scope to include:**
  - PBCS concept and surveillance capability
  - RCP and RSP specifications;
  - information and guidance provided from several workshops held in the regions; and
  - material from PIRG meetings and their contributory groups
- **To be published in July/August 2016**



Doc 9869

PERFORMANCE-BASED COMMUNICATION AND SURVEILLANCE (PBCS) MANUAL

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Second Edition (advance unedited) — 2015

International Civil Aviation Organization

Performance-based Communication and Surveillance Manual (Doc 9869)

Chapter 1. Definitions

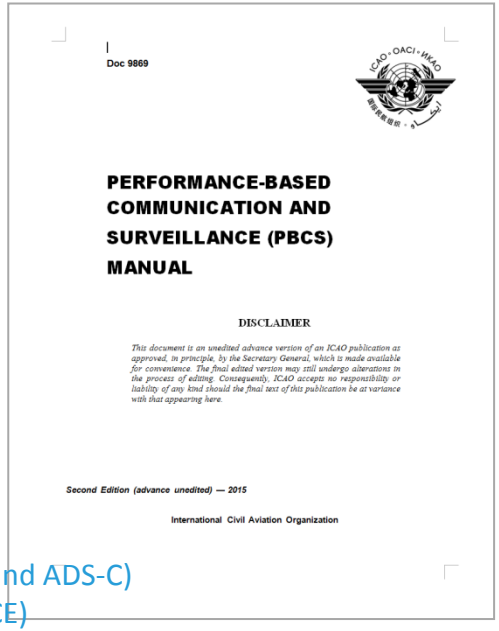
Chapter 2. PBCS concept

Chapter 3. Developing RCP/RSP specification

Chapter 4. Applying RCP/RSP specification

Chapter 5. Complying with RCP/RSP specification

Appendix A. PBCS implementation plan- checklist
Appendix B. RCP specifications
Appendix C. RSP specifications
Appendix D. Post-implementation monitoring and corrective action (CPDLC and ADS-C)
Appendix E. Post-implementation monitoring and corrective action (SATVOICE)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Doc 9869

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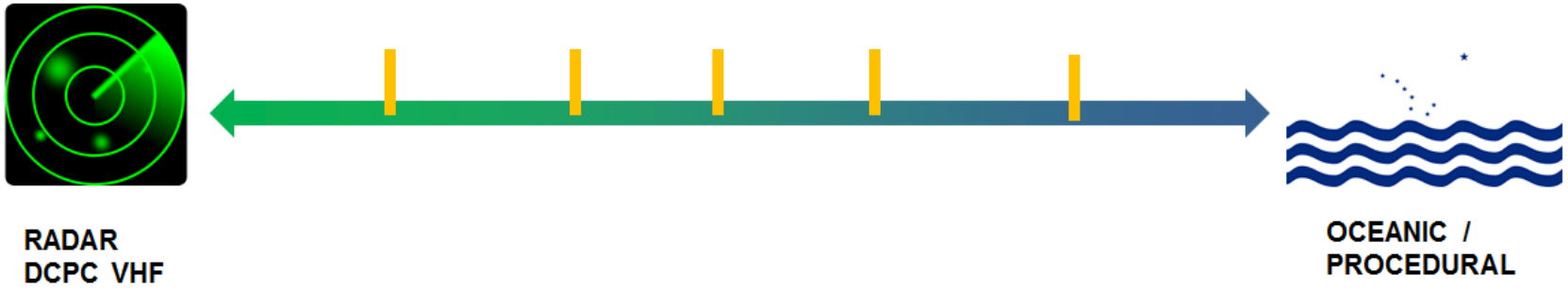
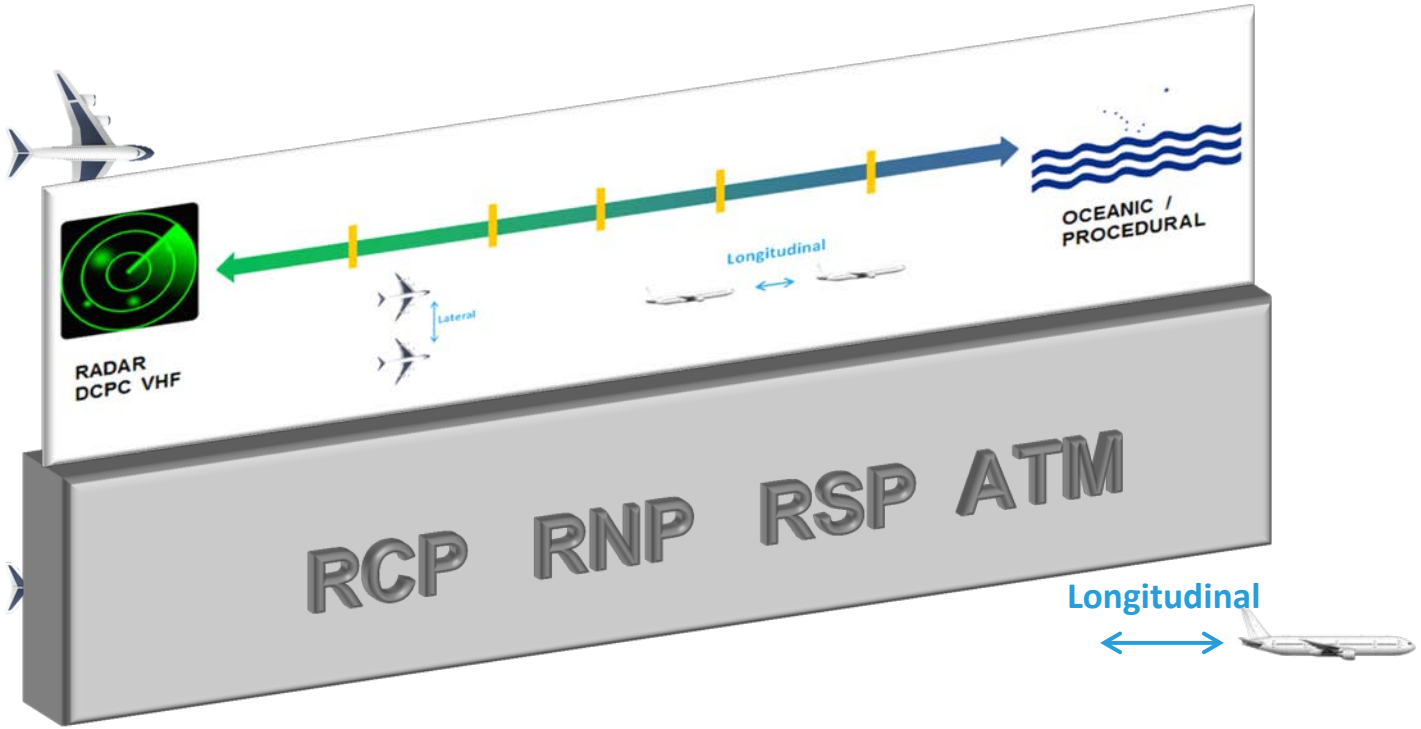
International Civil Aviation Organization

Performance-based Separation



Filling in the Gaps between Radar and Procedural Separations


RADAR
DCPC VHF
Lateral
Longitudinal
OCEANIC /
PROCEDURAL
RCP RNP RSP ATM
Longitudinal

Not less than 30 NM (55.5 Km)

Lateral Separation

- **NAVIGATION :** ***RNP 4 or RNP 2***
- **COMMUNICATION :** ***RCP 240***
- **SURVEILLANCE :** ***RCP 180***
- lateral deviation change event with a maximum of 5 NM threshold and a waypoint change event

Longitudinal Separation

Not less than 10 Minutes

- **NAVIGATION :** ***RNP 10, RNP 4 or RNP 2***
- **COMMUNICATION :** ***RCP 240***
- **SURVEILLANCE :** ***RSP 180***
- Cruising, climbing or descending on the same or crossing track

Longitudinal Separation

Not less than 10 Minutes

- **NAVIGATION :** ***RNP 10, RNP 4 or RNP 2***
- **COMMUNICATION :** ***RCP 240***
- **SURVEILLANCE :** ***RSP 180***
- Cruising, climbing or descending on the same or crossing track

Summary & Conclusions

- ATS Data Link is a fundamental enabler for realizing the concept of future operations (FF-ICE, TBO and SWIM)
- However, further work is needed to ensure seamless and safe implementation of ATS Data Link
- There are a number of ICAO Annexes, PANS and Manual concerning ATS Data Link (Service/Message and Media) and they are evolving.
- There is an increasing need of application of performance-based ATM operations predicated on data link capabilities and performance

Questions?

ICAO

THANK YOU