Enhancing Aviation Efficiency and Safety via Performance-based Communications and Surveillance (PBCS)
Virtual Workshop | 2-4 February 2021

APEC Transportation Working Group
June 2021
<table>
<thead>
<tr>
<th>Table of Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACRONYM AND TERMS LIST............................ii</td>
</tr>
<tr>
<td>EXECUTIVE SUMMARY........................................1</td>
</tr>
<tr>
<td>1. INTRODUCTION ........................................1</td>
</tr>
<tr>
<td>2. BACKGROUND..............................................1</td>
</tr>
<tr>
<td>3. PARTICIPATION............................................2</td>
</tr>
<tr>
<td>4. MAIN DOCUMENT/AGENDA DISCUSSION.............2</td>
</tr>
<tr>
<td>5. POST-WORKSHOP FEEDBACK.........................8</td>
</tr>
<tr>
<td>6. RECOMMENDATION/CONCLUSION.......................8</td>
</tr>
<tr>
<td>APPENDICES..................................................9</td>
</tr>
<tr>
<td>Appendix A: Presentation - What is Performance Based Communications and Surveillance</td>
</tr>
<tr>
<td>Appendix B: Presentation - What are the Benefits of Performance Based Communications and Surveillance</td>
</tr>
<tr>
<td>Appendix C: Presentation - Day 1 Recap of PBCS Putting it All Together</td>
</tr>
<tr>
<td>Appendix D: Presentation - PBCS An Implementation Outline</td>
</tr>
<tr>
<td>Appendix E: Presentation - PBCS An Operator’s Perspective</td>
</tr>
<tr>
<td>Appendix F: Presentation - PBCS A Flight Operations Regulator’s Perspective</td>
</tr>
<tr>
<td>Appendix G: Presentation - Day 2 Recap PBCS Putting it All Together from the Operator and Flight Operations Regulator Perspective</td>
</tr>
<tr>
<td>Appendix H: Presentation - PBCS An Air Navigation Service Provider’s Perspective</td>
</tr>
<tr>
<td>Appendix I: Presentation - PBCS Monitoring</td>
</tr>
<tr>
<td>Appendix J: Presentation - PBCS An ANSP Regulator’s Perspective</td>
</tr>
<tr>
<td>Appendix K: Presentation - Day 3 Recap of PBCS Putting it All Together</td>
</tr>
<tr>
<td>ENDNOTES AND SELECTED BIBLIOGRAPHY................202</td>
</tr>
</tbody>
</table>
## Abbreviations and Acronyms List

<table>
<thead>
<tr>
<th>Acronym/Abbreviation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAMA</td>
<td>Australian Airspace Monitoring Agency</td>
</tr>
<tr>
<td>AC</td>
<td>Advisory Circular</td>
</tr>
<tr>
<td>ACARS</td>
<td>Aircraft Communications, Addressing and Reporting System</td>
</tr>
<tr>
<td>ACID</td>
<td>Aircraft Identification</td>
</tr>
<tr>
<td>ACP</td>
<td>Actual Communication Performance</td>
</tr>
<tr>
<td>ACTP</td>
<td>Actual Communication Technical Performance</td>
</tr>
<tr>
<td>ADCC</td>
<td>Air Defense Control Centre</td>
</tr>
<tr>
<td>ADS</td>
<td>Automatic Dependent Surveillance</td>
</tr>
<tr>
<td>ADS-C</td>
<td>Automatic Dependent Surveillance-Contract</td>
</tr>
<tr>
<td>AEROTHAI</td>
<td>Aeronautical Radio of Thailand</td>
</tr>
<tr>
<td>AIP</td>
<td>Aeronautical Information Publication</td>
</tr>
<tr>
<td>AIMS</td>
<td>Airplane Information Management System</td>
</tr>
<tr>
<td>AIP</td>
<td>Aeronautical Information Publication</td>
</tr>
<tr>
<td>AMI</td>
<td>Aircraft Modifiable Information</td>
</tr>
<tr>
<td>ANS</td>
<td>Air Navigation Service</td>
</tr>
<tr>
<td>ANSP</td>
<td>Air Navigation Service Provider</td>
</tr>
<tr>
<td>AOC</td>
<td>Aeronautical Operational Control</td>
</tr>
<tr>
<td>APAC</td>
<td>Asia Pacific</td>
</tr>
<tr>
<td>APEC</td>
<td>Asia-Pacific Economic Cooperation</td>
</tr>
<tr>
<td>Apr</td>
<td>April</td>
</tr>
<tr>
<td>ARINC</td>
<td>Aeronautical Radio, Incorporated</td>
</tr>
<tr>
<td>ARMA</td>
<td>African and Indian Ocean Regional Monitoring Agency</td>
</tr>
<tr>
<td>ASP</td>
<td>Aviation Security Policy</td>
</tr>
<tr>
<td>ASP</td>
<td>Actual Surveillance Performance</td>
</tr>
<tr>
<td>ASPAC</td>
<td>Asia and Pacific</td>
</tr>
<tr>
<td>ASPIRE</td>
<td>Asia and Pacific Initiative to Reduce Emissions</td>
</tr>
<tr>
<td>ATC</td>
<td>Air Traffic Control</td>
</tr>
<tr>
<td>ATM</td>
<td>Air Traffic Management</td>
</tr>
<tr>
<td>ATN</td>
<td>Aeronautical Telecommunication Network</td>
</tr>
<tr>
<td>ATS</td>
<td>Air Traffic Services</td>
</tr>
<tr>
<td>ATSP</td>
<td>Air Traffic Service Provider</td>
</tr>
<tr>
<td>ATSU</td>
<td>Air Traffic Services Unit</td>
</tr>
<tr>
<td>Aug</td>
<td>August</td>
</tr>
<tr>
<td>Bn</td>
<td>Billion</td>
</tr>
<tr>
<td>CAA</td>
<td>Civil Aviation Authority</td>
</tr>
<tr>
<td>CAAS</td>
<td>Civil Aviation Authority of Singapore</td>
</tr>
<tr>
<td>CARSAMMA</td>
<td>Caribbean and South American Monitoring Agency</td>
</tr>
<tr>
<td>CMA</td>
<td>Continuous Monitoring Approach</td>
</tr>
<tr>
<td>CMF AMI</td>
<td>Communication Management Function Airline Modifiable Information</td>
</tr>
<tr>
<td>CMU</td>
<td>Communication Management Unit</td>
</tr>
<tr>
<td>CNS</td>
<td>Communication, Navigation and Surveillance</td>
</tr>
<tr>
<td>cnt</td>
<td>Count</td>
</tr>
<tr>
<td>COM</td>
<td>Communication</td>
</tr>
<tr>
<td>CPDLC</td>
<td>Controller Pilot Data Link Communication</td>
</tr>
<tr>
<td>CRA</td>
<td>Central Reporting Agency</td>
</tr>
<tr>
<td>CSP</td>
<td>Communication Service Provider</td>
</tr>
<tr>
<td>Acronym</td>
<td>Full Form</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------------------------------</td>
</tr>
<tr>
<td>DARP</td>
<td>Dynamic Airborne Reroute Procedures</td>
</tr>
<tr>
<td>DCPC</td>
<td>Direct Controller-Pilot Communications</td>
</tr>
<tr>
<td>Dec</td>
<td>December</td>
</tr>
<tr>
<td>DLMA</td>
<td>Data Link Monitoring Agency</td>
</tr>
<tr>
<td>Doc</td>
<td>Document</td>
</tr>
<tr>
<td>DSP</td>
<td>Datalink Service Provider</td>
</tr>
<tr>
<td>DT</td>
<td>Delivery Time</td>
</tr>
<tr>
<td>EBIT</td>
<td>Earnings Before Interest and Taxes</td>
</tr>
<tr>
<td>Est</td>
<td>Estimated</td>
</tr>
<tr>
<td>Eur RMA</td>
<td>European Regional Monitoring Agency</td>
</tr>
<tr>
<td>ex</td>
<td>Example</td>
</tr>
<tr>
<td>FAA</td>
<td>Federal Aviation Administration</td>
</tr>
<tr>
<td>FANS</td>
<td>Future Air Navigation Systems</td>
</tr>
<tr>
<td>FANS-CRA</td>
<td>Future Air Navigation Systems-Central Reporting Agency</td>
</tr>
<tr>
<td>FDX</td>
<td>Flight Data Exchange</td>
</tr>
<tr>
<td>Feb</td>
<td>February</td>
</tr>
<tr>
<td>FIR</td>
<td>Flight Information Region</td>
</tr>
<tr>
<td>FIT</td>
<td>FANS Interoperability Team</td>
</tr>
<tr>
<td>FL 330/320/310</td>
<td>Flight Level 330 (33,000 feet above mean sea level)</td>
</tr>
<tr>
<td>FMS</td>
<td>Flight Management System</td>
</tr>
<tr>
<td>FTK</td>
<td>Freight-Tonne Kilometres</td>
</tr>
<tr>
<td>GNSS</td>
<td>Global Navigation Satellite Systems</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GOLD</td>
<td>Global Operational Data Link</td>
</tr>
<tr>
<td>Govt</td>
<td>Government</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>HF</td>
<td>High Frequency</td>
</tr>
<tr>
<td>HFDL</td>
<td>High Frequency Data Link</td>
</tr>
<tr>
<td>hr</td>
<td>Hour</td>
</tr>
<tr>
<td>HSP</td>
<td>HF Subnetwork Provider</td>
</tr>
<tr>
<td>IATA</td>
<td>International Air Transport Association</td>
</tr>
<tr>
<td>ICAO</td>
<td>International Civil Aviation Organization</td>
</tr>
<tr>
<td>ITC</td>
<td>In-trail climb</td>
</tr>
<tr>
<td>ITP</td>
<td>In-trail procedure</td>
</tr>
<tr>
<td>ISPACG</td>
<td>Informal South Pacific ATS Coordinating Group</td>
</tr>
<tr>
<td>ITV</td>
<td>Interval</td>
</tr>
<tr>
<td>JANS</td>
<td>Japan Air Navigation Services</td>
</tr>
<tr>
<td>Jan</td>
<td>January</td>
</tr>
<tr>
<td>Jul</td>
<td>July</td>
</tr>
<tr>
<td>Jun</td>
<td>June</td>
</tr>
<tr>
<td>kg</td>
<td>Kilogram</td>
</tr>
<tr>
<td>km</td>
<td>Kilometers</td>
</tr>
<tr>
<td>KZAK</td>
<td>Oakland Oceanic Flight Information Region</td>
</tr>
<tr>
<td>LatSM</td>
<td>Lateral Separation Minimum</td>
</tr>
<tr>
<td>LongSM</td>
<td>Longitudinal Separation Minimum</td>
</tr>
<tr>
<td>Mar</td>
<td>March</td>
</tr>
<tr>
<td>MAAR</td>
<td>Monitoring Agency for Asia Region</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>MAS</td>
<td>Message Assurance</td>
</tr>
<tr>
<td>MEL</td>
<td>Minimum Equipment List</td>
</tr>
<tr>
<td>mi</td>
<td>Miles</td>
</tr>
<tr>
<td>Mid RMA</td>
<td>Middle East Regional Monitoring Agency</td>
</tr>
<tr>
<td>Min</td>
<td>Minimum</td>
</tr>
<tr>
<td>mph</td>
<td>Miles per hour</td>
</tr>
<tr>
<td>MTSAT</td>
<td>Multi-Functional Transport Satellite</td>
</tr>
<tr>
<td>NAARMO</td>
<td>North American Approvals Registry and Monitoring Organization</td>
</tr>
<tr>
<td>NAT</td>
<td>North Atlantic</td>
</tr>
<tr>
<td>NAT CMA</td>
<td>North Atlantic Central Monitoring Organization</td>
</tr>
<tr>
<td>NAT HLA</td>
<td>North Atlantic Track High Level Airspace</td>
</tr>
<tr>
<td>NAT OPS</td>
<td>North Atlantic Operations</td>
</tr>
<tr>
<td>NAT TIG</td>
<td>North Atlantic Technology and Interoperability Group</td>
</tr>
<tr>
<td>NAV</td>
<td>Navigation</td>
</tr>
<tr>
<td>NM</td>
<td>Nautical Mile</td>
</tr>
<tr>
<td>No</td>
<td>Number</td>
</tr>
<tr>
<td>Nov</td>
<td>November</td>
</tr>
<tr>
<td>OCS</td>
<td>Oceanic Control System</td>
</tr>
<tr>
<td>OPER</td>
<td>Note – cannot find this in monitoring presentation? Could be Operator?</td>
</tr>
<tr>
<td>Oct</td>
<td>October</td>
</tr>
<tr>
<td>OPS</td>
<td>Operations</td>
</tr>
<tr>
<td>ORT</td>
<td>Operator Requirement Table</td>
</tr>
<tr>
<td>OT</td>
<td>Overdue Time</td>
</tr>
<tr>
<td>P2</td>
<td>Flight Plan Code Indicating Required Communication Performance of 240 or better</td>
</tr>
<tr>
<td>PAC</td>
<td>Pacific</td>
</tr>
<tr>
<td>PANS</td>
<td>Procedures for Air Navigation Services</td>
</tr>
<tr>
<td>PANS-ATM</td>
<td>Procedures for Air Navigation Services- Air Traffic Management</td>
</tr>
<tr>
<td>PANS-OPS</td>
<td>Procedures for Air Navigation Services – Aircraft Operations</td>
</tr>
<tr>
<td>PARMO</td>
<td>Pacific Approvals Registry and Monitoring Organization</td>
</tr>
<tr>
<td>PBCS</td>
<td>Performance Based Communications and Surveillance</td>
</tr>
<tr>
<td>PBN</td>
<td>Performance Based Navigation</td>
</tr>
<tr>
<td>POA</td>
<td>Plain Old ACARS</td>
</tr>
<tr>
<td>PORT</td>
<td>Pilot Operational Response Time</td>
</tr>
<tr>
<td>RASMA</td>
<td>Regional Airspace Safety Monitoring Advisory Group</td>
</tr>
<tr>
<td>RC</td>
<td>Required Communication</td>
</tr>
<tr>
<td>RCMP</td>
<td>Required Communication Monitored Performance</td>
</tr>
<tr>
<td>RCP</td>
<td>Required Communication Performance</td>
</tr>
<tr>
<td>RCTP</td>
<td>Required Communication Technical Performance</td>
</tr>
<tr>
<td>Reg</td>
<td>Registration</td>
</tr>
<tr>
<td>RGS</td>
<td>Remote Ground Station (note: moved FIR designators to own reference under FIR)</td>
</tr>
<tr>
<td>RMA</td>
<td>Regional Monitoring Agency</td>
</tr>
<tr>
<td>RN</td>
<td>Required Navigation</td>
</tr>
<tr>
<td>RNAV</td>
<td>Area Navigation</td>
</tr>
<tr>
<td>RNP</td>
<td>Required Navigation Performance</td>
</tr>
<tr>
<td>RPK</td>
<td>Revenue Passenger Kilometers</td>
</tr>
<tr>
<td>RSMP</td>
<td>Required Surveillance Monitored Performance</td>
</tr>
<tr>
<td>RSP</td>
<td>Required Surveillance Performance</td>
</tr>
<tr>
<td>RSTP</td>
<td>Required Surveillance Technical Performance</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>SARPS</td>
<td>Standards and Recommended Practices</td>
</tr>
<tr>
<td>SARS</td>
<td>Severe Acute Respiratory Syndrome</td>
</tr>
<tr>
<td>SAT</td>
<td>Satellite</td>
</tr>
<tr>
<td>SATCOM</td>
<td>Satellite Communications</td>
</tr>
<tr>
<td>SATMA</td>
<td>South Atlantic Monitoring Agency</td>
</tr>
<tr>
<td>SATVOICE</td>
<td>Satellite Voice</td>
</tr>
<tr>
<td>SBs</td>
<td>Software Bulletins</td>
</tr>
<tr>
<td>SBB</td>
<td>SwiftBroadband</td>
</tr>
<tr>
<td>SBD</td>
<td>Short Burst Data</td>
</tr>
<tr>
<td>sec</td>
<td>Seconds</td>
</tr>
<tr>
<td>Sep</td>
<td>September</td>
</tr>
<tr>
<td>SILs</td>
<td>Service Information Letters</td>
</tr>
<tr>
<td>SITA</td>
<td>Society of International Telecommunications Aeronautics</td>
</tr>
<tr>
<td>SPR</td>
<td>Safety and Performance</td>
</tr>
<tr>
<td>SSP</td>
<td>Satellite Service Provider</td>
</tr>
<tr>
<td>STIME</td>
<td>Sent Time</td>
</tr>
<tr>
<td>SUR</td>
<td>Surveillance</td>
</tr>
<tr>
<td>SWA</td>
<td>Southwest Airlines</td>
</tr>
<tr>
<td>TBO</td>
<td>Time Based Operations</td>
</tr>
<tr>
<td>TYP</td>
<td>Non-standard Aircraft Type on Field 18 of a Flight Plan</td>
</tr>
<tr>
<td>UPRs</td>
<td>User-Preferred Routes</td>
</tr>
<tr>
<td>USD</td>
<td>United States Dollar</td>
</tr>
<tr>
<td>USOAP</td>
<td>Universal Safety Oversight Audit Programme</td>
</tr>
<tr>
<td>VDL</td>
<td>Very High Frequency Digital Network</td>
</tr>
<tr>
<td>VHF</td>
<td>Very High Frequency</td>
</tr>
<tr>
<td>VSP</td>
<td>VHF Subnetwork Provider</td>
</tr>
<tr>
<td>WILCO</td>
<td>Will Comply</td>
</tr>
</tbody>
</table>
Executive Summary

The United States led a three-day virtual workshop series on Enhancing Aviation Efficiency and Safety via Performance Based Communications and Surveillance (PBCS). The workshop occurred 2-4 February 2021. The tailored program provided an overview of PBCS framework to deliver capacity building in PBCS implementation. The PBCS framework promotes efficiency of air traffic operations by supporting the safe application of air traffic management (ATM) initiatives that reduce aircraft spacing and streamline communication. If economies do not implement PBCS, they may

i) restrict their aircraft operators’ ability to operate in parts of the global aviation network that require PBCS, negatively affecting connectivity, and/or

ii) restrict their Air Navigation Service Providers (ANSP’s) ability to reduce aircraft spacing.

PBCS, which is not widely implemented in the region, provides an innovative approach to enhance airspace capacity safely. The workshop’s purpose was to increase PBCS awareness, explain how regulators can establish PBCS policies for the aircraft operators and ANSPs, and highlight how ANSPs can provide PBCS-compliant services and monitor the performance of the operations enabled by PBCS in their airspace. Two economies and two guests (the International Air Transport Association (IATA), and the International Civil Aviation Organization, (ICAO)) presented on the topic.

1. Introduction

The PBCS virtual workshop was designed to provide an opportunity to increase PBCS awareness. The workshop also filled gaps in understanding for those economies that may not be familiar with the relatively new concept. It focused on sharing best practices for:

i) regulators of aircraft operators to establish PBCS policies, specifications and requirements;

ii) regulators of ANSPs that implement reduced separation standards, predicated on PBCS requirements to establish PBCS policies, specifications and requirements;

iii) ANSPs that implement reduced separation standards predicated on PBCS requirements to provide PBCS compliant services; and

iv) aircraft operators to obtain authorization to use reduced separation standards and mitigate safety risks.

The participants provided a lot of positive feedback on the workshop and indicated that their knowledge of PBCS increased. During the workshop and immediately following the conclusion of the workshop, the FAA encouraged APEC economies to implement PBCS. The FAA also asked APEC economies to reach out to the FAA if interested in implementing PBCS. No participants expressed such interest at that time; however, the FAA remains ready to help if asked for further assistance.

Although virtual, the FAA self-funded this project in the amount of $15,574.14.

Background

PBCS is the framework that enables implementation of reduced separation standards. PBCS accomplishes this by ensuring a baseline level of safety and performance through the application of policies for aircraft operators and ANSPs. PBCS also ensures continued safety and performance through an ongoing monitoring program. PBCS is similar to how Performance Based Navigation (PBN) ensures that the navigation systems are technically safe and perform at a required level (RNP) to support a particular separation or operation. PBCS ensure the communication and surveillance systems are
technically safe and perform at a required level (RCP and RSP) to support a particular separation or operation.

Data link services, based on controller pilot data link communication (CPDLC) and automatic dependent surveillance – contract (ADS-C), provide communications that are intended to support safer and more efficient air traffic management and increase airspace capacity. There are different and emerging communication and surveillance technologies for the air, ground, and network that enable data link services. These different technologies may be used to support various air traffic management (ATM) operations.

The PBCS concept is intended to provide objective operational criteria to evaluate and monitor various technologies ability to support specific ATM operations. The core of the PBCS concept is the required communication performance (RCP) and required surveillance performance (RSP) specifications. These specifications are developed to characterize the communication and surveillance capability and performance needed to support a specific ATM operation.

The RCP and RSP specifications are intended to be applied globally for identical or similar ATM operations. This will reduce training requirements and errors resulting from confusion in operations across airspace boundaries. This ensures that the operational communication and surveillance capabilities will be conducted in an acceptably safe manner wherever the respective ATM operation is conducted around the world.

Only three APEC economies have published PBCS implementation plans. This workshop encouraged APEC economies to implement PBCS with the aim to enhance the APEC region’s capability to safely implement this technology and the air traffic process that helps expand airspace capacity.

3. Participation

All 21 economies were invited and a total number of 16 economies attended the webinar: Australia; Brunei Darussalam; Chile; Hong Kong, China; Indonesia; Japan; Malaysia; Mexico; New Zealand; Papua New Guinea; Peru; the Philippines; Singapore; Chinese Taipei; the United States; and Thailand. Two non-member participants also attended – from the International Air Transportation Association (IATA) and International Civil Aviation Organization (ICAO). A detailed list of participants to this workshop is attached.

4. Main Body/Agenda Discussion

The United States, IATA and ICAO provided briefings across the three-day workshop, as outlined below:

<table>
<thead>
<tr>
<th>Day 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 AM – 8:10 AM</td>
</tr>
</tbody>
</table>

*Speaker: Lirio Liu, Executive Director, Office of International Affairs, U.S. Federal Aviation Administration*

- Ms Lirio Liu welcomed the participants and explained that the three-day PBCS workshop series will cover the framework that enables implementation of reduced separation standards, explain the benefits of PBCS, and describe best practices to enhance the APEC economies’ capability toward the objective to safely implement its technology and air traffic processes to help expand airspace capacity. Ms Liu indicated that the audience will hear key perspectives from an operator, regulator and an integrated perspective of both. She affirmed a shared
commitment to promoting a safe and secure airspace system, and emphasized that working with APEC economies to engage in technical, policy and commercial cooperation assists regional aviation experts and regulators to develop and operate a safe and efficient aviation infrastructure. Ms Liu concluded by thanking the participants for attending the webinar.

8:10 AM – 8:15 AM Outline of Day 1, Introduction of Speakers

Speaker: Riley Downing, Senior FAA Representative, Southeast Asia, Office of International Affairs

Mr Riley Downing introduced the speakers for the day, which included Mr Shane Sumner and Mr Michael Watkins, in addition to the facilitators, Ms Carol Siboni and Mr Walter Bogert. Mr Downing also provided a brief high-level overview of the content that Mr. Sumner and Mr Watkins would cover for Day 1.

8:15 AM – 9:00 AM What is Performance-Based Communications and Surveillance (PBCS)?

Speaker: Shane Sumner, Regional Officer, Air Traffic Management, ICAO

Mr Shane Sumner begin his presentation by introducing the concept of PBCS. After defining Performance-Based Navigation (PBN), Area Navigation (RNAV) Specification, Required Navigation Performance (RPN) Specification, he explained performance-based standards, procedures and specification to support overall system safety and efficiency. Mr Sumner discussed what PBCS is and the reasons to implement it. He reviewed the applicable ICAO provisions for PBCS and its framework, provided an overview of PBCS implementation monitoring and associated monitoring programs, described ICAO Asia Pacific PBCS regional implementation, and provided an overview of the PBCS Charter.

9:00 AM – 9:45 AM What are the benefits of Performance-Based Communications and Surveillance (PBCS)?

Speaker: Michael Watkins, FAA’s Senior Representative for Air Traffic Organization in Asia Pacific, U.S. Federal Aviation Administration

Mr Michael Watkins briefed the benefits of implementing PBCS, how it improves safety and efficiency and supports future airspace developments. He provided an overview of air mass, jet stream, air route structure, and ASPIRE partners. Mr Watkins noted that actions are required, even if you are not managing PBCS airspace, and emphasized that failure to implement PBCS will result in less efficient routes for aircraft operators.

9:45 AM – 9:55 AM Recap of PBCS: Putting it All Together

Speaker: Michael Watkins, FAA’s Senior Representative for Air Traffic Organization in Asia Pacific, U.S. Federal Aviation Administration; Shane Sumner, Regional Officer, Air Traffic Management, ICAO
Mr Watkins provided a recap of the Day 1 presentations. He summarized that the PBCS framework addresses the need for appropriate means to quantify, measure and improve system performance while mitigating safety risks. He also emphasized the benefits of PBCS, including:

- aircraft flying with PBCS approvals and lower RSP and RCP values can fly closer together;
- more aircraft can optimize flight paths for winds, routing, flight levels and weather avoidance;
- improves airspace efficiency, capacity and safety;
- reduces aircraft fuel burn and carbon emissions;
- reduces system delay and improves schedule performance; and
- enhances safety, saves money and time, and helps preserve the global environment.

9:55 AM – 10:00 AM Brief Concluding Remarks from Moderator
Speaker: FLLI Facilitator

The workshop facilitator, Ms Carol Siboni, thanked the participants for joining and reminded them to join Day 2 of the Workshop.

Day 2

8:00 AM – 8:05 AM Outline of Day 2, Introduction of Speakers
Speaker: Riley Downing, Senior FAA Representative, Southeast Asia, Office of International Affairs

Mr Riley Downing introduced the speakers for the day, which included Ms Theresa Brewer, Mr Blair Cowles, Mr Shawn Silverman and Mr Scott Bender, and provided a brief high-level overview of the content that each presenter would cover for Day 2.

8:05 AM – 8:20 AM PBCS: An Implementation Outline
Speaker: Theresa Brewer, ICAO PBCS Project Team Lead, Office of NextGen, U.S. Federal Aviation Administration

Ms Theresa Brewer provided a presentation consisting of the following:

- an overview of the PBCS framework;
- an outline of the implementation tasks by stakeholder type
  - civil aviation authority (CAA)
  - air navigation service provider (ANSP)
  - aircraft operator
- information to help each stakeholder determine their PBCS responsibilities;
- a brief introduction to the importance of monitoring; and
- information on how the communication service provider (CSP) is addressed in the PBCS framework.

Mr Brewer emphasized that stakeholders should carefully assess their PBCS responsibilities and identify applicable group(s) of PBCS implementation tasks, and that monitoring is an integral component of the overall PBCS framework. She also discussed the PBCS Global Charter and that it is an important tool in achieving initial compliance for CSP oversight, and ensuring continued compliance of end-to-end system performance.
Mr Blair Cowles briefed that the airline industry is in crisis due to the negative impact of COVID-19, and that airlines are in an extremely perilous financial position. He encouraged ANSPs and regulators to do everything they possibly could to help airlines save costs and stay in business. He noted that PBCS is a key efficiency enabler that helps airlines to fly as cost effectively as possible, that the absence of a PBCS regulatory framework may put an economy’s airlines at a competitive disadvantage, and emphasized the potential impact of the system as a whole if PBCS generated efficiencies cannot be fully utilized by other airlines. Mr Cowles concluded by encouraging the region economies to do everything possible to create an aviation ecosystem that allows operators to save every dollar/mile/kg possible.

Mr Shawn Silverman and Mr Scott Bender explained PBCS requirements as it pertains to authorization from a flight operations regulators perspective. They discussed requirements as established by ICAO documents, operational authorization, aircraft manufacturer/equipment supplier requirements and compliance, and operator eligibility. They mentioned that Civil Aviation Authorities should establish guidance for PBCS implementation, and noted that ICAO and FAA have examples of comprehensive job aides that should make the process easier. The following key points were emphasized:

- Original Equipment Manufacturer’s (OEM) Statement of Compliance (SOC) is a basis for aircraft’s capability;
- PBCS Global Charter is vital to the success of the PBCS framework;
- training, procedures and proper flight plan filing/coding are the operator’s primary responsibilities; and
- addressing poor monitoring performance is important to the success and safety of the PBCS process.

Mr Shawn Silverman recapped the following:

- the airline industry is in crisis due to the negative impact of COVID-19;
- Civil Aviation Authorities should develop a process and publish guidance for operators that desire to obtain a PBCS Operational Authorization;
- ICAO and FAA have examples of comprehensive job aides that should make implementing a process easier;
- Original Equipment Manufacturer’s (OEM) Statement of Compliance (SOC) is a basis for aircraft’s capability;
- the PBCS Global Charter is vital to the success of the PBCS framework;
- training, procedures and proper flight plan filing/coding are the operator’s primary responsibilities; and
addressing poor monitoring performance is important to the success and safety of the PBCS process.

Day 3

8:00 AM – 8:05 AM Outline of Day 3, Introduction of Speakers

Speaker: Riley Downing, Senior FAA Representative, Southeast Asia, Office of International Affairs

Mr Riley Downing introduced the speakers for the day, which included Mr Paul Radford, Ms Theresa Brewer, and Ms Jennifer Kileo. Mr Downing also provided a brief high-level overview of the content that Mr Radford, Ms Brewer, and Ms Kileo would cover for Day 3.

8:05 AM – 8:50 AM PBCS: An Air Navigation Service Provider’s Perspective

Speaker: Paul Radford, Oceanic Systems Development Specialist, Airways (NZ)

Mr Paul Radford provided an overview of an ANSP’s implementation of PBCS and a summary of guidance material and aids available to ANSPs when implementing PBCS. He also provided a roadmap for ANSPs on PBCS, including the need to register on the CRA website, establish means to extract analysis data using the ICAO guidance, perform analysis at a suitable interval, investigate any performance degradation identified in analysis, report non-compliance, and support CRA non-compliance investigations. Mr Radford also discussed ATM system modifications for PBCS, SPR safety requirements, the online PBCS analysis tool, and post implementation monitoring. In concluding, he encouraged the participants to utilize the guidance material and examples he presented to support their PBCS implementation activities.

8:50 AM - 9:35 AM PBCS: Monitoring Programs

Speaker: Theresa Brewer, ICAO PBCS Project Team Lead, NextGen, U.S. Federal Aviation Administration

Ms Theresa Brewer provided an overview of the ICAO requirements and guidance for PBCS monitoring programs, information and resources to support implementation of a PBCS monitoring program, and significant lessons learned from existing PBCS monitoring programs. She also discussed:

- actual service performance (ASP);
- actual communication performance;
- reporting airspace performance;
- regional reporting of aircraft performance;
- global coordination for aircraft non-compliance; and
- problem reporting, investigation and resolution.

In concluding, Ms Brewer encouraged participants to utilize the resources provided to support PBCS implementation activities.

9:35 AM – 9:50 AM PBCS: An Air Navigation Service Provider Regulator’s Perspective

Speaker: Jennifer Kileo, Aviation Safety, U.S. Federal Aviation Administration
Ms Jennifer Kileo briefed the ICAO PBCS Air Navigation Service (ANS) Safety Oversight Standards, discussed ANSP PBCS compliance, and PBCS ANS safety oversight concepts. Ms Kileo emphasized that ANS Regulators should ensure the ANSP:
- establish means to assess the actual performance of communication and surveillance services in a particular airspace;
- perform ATM operations predicated on RCP/RSP;
- establish a means to notify the operator when the actual performance of the operator’s fleet does not comply with an RCP/RSP specification; and
- establish a means to assess the risk of any non-compliance.

Ms Kileo concluded by encouraging ANS Regulators to establish a formal internal policy or process to ensure compliance that would determine roles and responsibilities, effective data management and analysis, and a surveillance and audit process.

9:50 AM – 10:20 AM Recap of PBCS: Putting it All Together

Speaker: Theresa Brewer, ICAO PBCS Project Team Lead, NextGen, U.S. Federal Aviation Administration

Ms Theresa Brewer provided a recap of key points for ANSPs, including:
- Guidance materials and aids are available to assist an ANSP with PBCS implementation, and implementation examples are available demonstrating ANSP implementation;
- Participants are encouraged to make sure of the guidance materials and examples to support their PBCS implementing activities.

Ms Brewer briefed the following monitoring key points:
- Monitoring ensures continued compliance of the end-to-end system as well as the individual airspace, aircraft, and networks;
- Monitoring enables continuous system improvement through the reporting, investigation, and resolution of problems; and
- Information to support implementation of a PBCS monitoring program is provided at www.FANS-CRA.com.

Ms Brewer reemphasized the following ANSP Regulator key points:
- Based on ICAO PBCS Safety Oversight Standards, ANS Regulators should ensure the ANSP:
  - establish means to assess the actual performance of communication and surveillance services in a particular airspace;
  - perform ATM operations predicated on RCP/RSP;
  - establish a means to notify the operator when the actual performance of the operator’s fleet does not comply with an RCP/RSP specification; and
  - establish a means to assess the risk of any non-compliance.

Ms Brewer concluded that ANS Regulators should establish a formal internal policy or process to ensure compliance that would determine roles and responsibilities, effective data management and analysis, and a surveillance and audit process. She also indicated that economies may reach out to FAA if an economy is interested in implementing PBCS.

10:20 AM – 10:30 AM Conclusions, Resources, and Distribution of Feedback Survey

Speaker: FLLI Facilitator

Ms Carol Saboni concluded the 3-day workshop by thanking the participants and informing them that the presentation materials will be posted on the APEC website no later than February 18, 2021. She also provided notification that a feedback email will be sent to the emails of participants following the workshop.
5. Post-Workshop Feedback

Following the conclusion of the three-day workshop series, an email was sent to the participants for an opportunity to provide any feedback the participants may have about the webinar and suggestions for future webinars. The email also indicated that participants may respond back to the email if they are interested in further assistance to help implement PBCS in their economy. Numerous participants responded positively that they appreciated the workshop and that the information was interesting and helpful.

One participant proposed Global Navigation Satellite Systems (GNSS) technology for the virtual workshops. Out of the responses received, no participants expressed interest in receiving further assistance to help implement PBCS in their economy. The overall responses received were positive and indicated that the workshop provided valuable information that gave a better understanding of the PBCS concept and its application to flight operations.

6. Recommendation/Conclusion

PBCS optimizes airspace use, provides performance level assurance to support the underlying PBCS-predicated separation standards, and mitigates safety risks. It promotes efficiency – safely reducing aircraft spacing and offering direct routes, which supports harmonization and connectivity. If economies do not implement PBCS, they may i) restrict their aircraft operators’ ability to operate in parts of the global aviation network that require PBCS, negatively affecting connectivity, and/or ii) restrict their ANSP’s ability to reduce aircraft spacing.

PBCS, which is not widely implemented in the region, provides an innovative approach to enhance airspace capacity safely. Only three APEC economies have published PBCS implementation plans. The workshop encouraged other APEC economies to implement PBCS with the aim to enhance the APEC region’s capability to safely implement this technology and the air traffic process that helps expand airspace capacity.

With the target audience of regulators of aircraft operators, regulators of ANSPs, ANSPs, and aircraft operators, the workshop provided an overview of PBCS framework to deliver capacity building in PBCS implementation. The PBCS framework promotes efficiency of air traffic operations by supporting the safe application of ATM initiatives that reduce aircraft spacing and streamline communication. The workshop’s purpose was to increase PBCS awareness, explain how regulators can establish PBCS policies for the aircraft operators and ANSPs, and highlight how ANSPs can provide PBCS-compliant services and monitor the performance of the operations enabled by PBCS in their airspace.

During the workshop, the FAA asked APEC economies reach out to the FAA if an economy is interested in implementing PBCS. No participants expressed such interest while the workshop was in progress. Following the workshop’s conclusion, the FAA sent out a suggestion/feedback email to participants, asking participants to respond back to the email if they are interested in further assistance to help implement PBCS in their economy; however, out of the responses received no one expressed such interest at that time. The overall responses received were positive and indicated that the workshop provided valuable information that gave a better understanding of the PBCS concept and its application to flight operations. The FAA remains ready to help if any economy asks for further assistance.
APPENDICES
What is Performance-Based Communications and Surveillance (PBCS)?
ICAO Perspective and Provisions
Day 1 – APEC PBCS Webinar

Presented by
Shane Sumner
International Civil Aviation Organization (ICAO)
Asia/Pacific Regional Office
ssumner@icao.int
Outline

- Performance-Based Separation and PBCS
- What is PBCS?
- ICAO Provisions for PBCS
- PBCS Implementation Monitoring
PERFORMANCE-BASED SEPARATION AND PBCS
Growth of Air Transport

Source: ICAO Annual Report of the Council 2019
Growth of Air Transport

Forecasted Passenger Traffic in 2034

Forecasted Freight Traffic in 2034
Growth of Air Transport

Our collective responsibility is to allow the aviation system to safely realize this air transport growth and optimize the use of available airspace.

- Reduced Separation
- Dynamic Airborne Reroute Procedure (DARP)
- 4D Trajectory Based Operations (TBO)

Required safety and performance assurance for communications, navigation and surveillance.
Why PBCS?

- Previously:
  - performance-based separation

  supported by

- **Performance-based navigation** (PBN) specification (RNAV/RNP)

  Non-RADAR Airspace     No Voice DCPC
Performance-Based Navigation (PBN)

Area navigation based on performance requirements for aircraft operating along an Air Traffic Services (ATS) route, on an instrument approach procedure or in a designated airspace.

Note.— Performance requirements are expressed in navigation specifications in terms of accuracy, integrity, continuity and functionality needed for the proposed operation in the context of a particular airspace concept.

ICAO Doc 9613 – PBN Manual
Area Navigation (RNAV) Specification
A navigation specification based on area navigation that does not include the requirement for on-board performance monitoring and alerting, designated by the prefix RNAV, e.g. RNAV 5, RNAV 1.

Required Navigation Performance (RNP) Specification
A navigation specification based on area navigation that includes the requirement for on-board performance monitoring and alerting, designated by the prefix RNP, e.g. RNP 4, RNP APCH.

ICAO Doc 9613 – PBN Manual
Why PBCS?

Performance-based separation

- Example: **Longitudinal separation** – **Required Navigation Performance** (RNP) specification

<table>
<thead>
<tr>
<th>Separation minima</th>
<th>RNP type</th>
</tr>
</thead>
<tbody>
<tr>
<td>93 km (50 NM)</td>
<td>10</td>
</tr>
<tr>
<td>55.5 km (30 NM)</td>
<td>4</td>
</tr>
</tbody>
</table>

PBN (RNP) (RNAV)
Why PBCS?

Performance-based separation

PBN (RNP) (RNAV)

Communications?

Surveillance?

- Example: **Longitudinal separation** – *Required Navigation Performance (RNP)* specification

<table>
<thead>
<tr>
<th>Separation minima</th>
<th>RNP type</th>
</tr>
</thead>
<tbody>
<tr>
<td>93 km (50 NM)</td>
<td>10</td>
</tr>
<tr>
<td>55.5 km (30 NM)</td>
<td>4</td>
</tr>
</tbody>
</table>
Why PBCS?

The CNS Loop
Why PBCS?

Aeronautical Mobile Satellite System

Airborne equipment (avionics)

Global Navigation Satellite System

Satellite Ground Station(s)

CSP Networks

VHF & HF Radio Remote Ground Station(s)

ATS Unit(s)
WHAT IS PBCS?
What is PBCS

Performance-Based Communication

Communication based on performance specifications applied to the provision of air traffic services.

Includes communication performance requirements allocated to system components:

• communication to be provided
• associated transaction time
• continuity, availability, integrity, safety and functionality

ICAO Doc 9869 – PBCS Manual
What is PBCS?

Performance-Based Surveillance

Surveillance based on performance specifications applied to the provision of air traffic services.

Includes surveillance performance requirements allocated to system components:

- surveillance to be provided;
- associated data delivery time
- continuity, availability, integrity, accuracy, safety and functionality

ICAO Doc 9869 – PBCS Manual
What is PBCS?

**Required Communication Performance (RCP) Specification**
A set of requirements for air traffic services provision and associated ground equipment, aircraft capability, and operations needed to support performance-based communication.

**Required Surveillance Performance (RSP) Specification**
A set of requirements for air traffic services provision and associated ground equipment, aircraft capability, and operations needed to support performance-based surveillance.

ICAO Doc 9869 – PBCS Manual
ICAO PROVISIONS FOR PBCS
ICAO Provisions

Chicago Convention

Annexes to the Convention

Procedures for Air Navigation Services (PANS)

Manuals and other Guidance Material
Address the need for appropriate means to quantify, measure and improve system performance

Provide a framework that assures that the required level of communication and surveillance performance is managed in accordance with globally accepted specifications (RCP/RSP)

Mitigate safety risks - misapplying current evolving ATM operations to inappropriate aircraft pairs
PBCS Provisions

- **PBCS, RCP and RSP**
  - *PBCS Framework (Prescription, Approval and Monitoring)*
  - *Continuity, Integrity, Availability and Safety Requirements*

- **Application (services and messages)**
  - *Functionality, Content, and Procedures*

- **Medium and Network**
  - *Various media and the network supporting them*
• **Prescription of RCP and RSP** for air traffic services that are predicated on communication and surveillance performance *(Annex 11)*

• **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)*.
## Performance-Based Separation

### Lateral Separation Minimum (LatSM)

<table>
<thead>
<tr>
<th></th>
<th>COM</th>
<th>NAV</th>
<th>SUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 NM</td>
<td>-</td>
<td>RNP4</td>
<td>-</td>
</tr>
<tr>
<td>50 NM</td>
<td>-</td>
<td>RNP4 or 10</td>
<td>-</td>
</tr>
</tbody>
</table>

### Longitudinal Separation Minimum (LongSM)

<table>
<thead>
<tr>
<th></th>
<th>COM</th>
<th>NAV</th>
<th>SUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Min</td>
<td>See Note 1</td>
<td>See Note 2</td>
<td>Procedural Position Report</td>
</tr>
<tr>
<td>50 NM</td>
<td>Direct pilot-controller communications (DCPC: Voice or CPDLC)</td>
<td>RNP10</td>
<td></td>
</tr>
<tr>
<td>30 NM</td>
<td>CPDLC</td>
<td>RNP4</td>
<td>ADS-C</td>
</tr>
<tr>
<td>50 NM</td>
<td>CPDLC</td>
<td>RNP4 or 10</td>
<td>ADS-C</td>
</tr>
</tbody>
</table>

### 10 November 2016

<table>
<thead>
<tr>
<th></th>
<th>COM</th>
<th>NAV</th>
<th>SUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 NM</td>
<td>RCP240</td>
<td>RNP4</td>
<td>RSP180</td>
</tr>
<tr>
<td>50 NM</td>
<td>-</td>
<td>RNP4 or 10</td>
<td>-</td>
</tr>
</tbody>
</table>

---

**Note 1:** Suitable to comply with the requirements for position reporting contained in 4.11 of Doc 4444.

**Note 2:** Navigation aids permitting frequent determination of position and speed.

Separation minimum applicable only to PBCS capable aircraft.
PBN Provisions

Annex 10
Annex 11

PANS-OPS (Doc 8168)
PANS-ATM (Doc 4444)

PBN Manual (Doc 9613)

- Standards and Recommended Practices (SARPS) for Performance-based Navigation Systems
- SARPS for application of PBN in ATM

- Procedures for the application of RNAV and RNP specifications to aircraft operations and ATM services

- PBN concept and implementation guidance for Aeronautical Regulatory Authorities, ANSPs, Aircraft Operators
PBCS Provisions

Annex 6
Annex 11

PANS-ATM (Doc 4444)

- Prescription of RCP and/or RSP for the provision of ATS
- Approval for aircraft and operators
- PBCS monitoring and information/data exchange

PBCS Manual (Doc 9869)

- ATM services requiring RCP/RSP (e.g. performance-based separation minima)
- Flight planning requirements

- Development of new specifications
- PBCS framework implementation guidance for Aeronautical Regulatory Authorities, ANSPs, CSPs, Operators, Monitoring agencies
- Content of RCP and RSP specifications
Data Link Application Provisions

**Annex 10 Vol II**
- Functional requirements of ATS data link
- Operational procedures on the use of ATS data link

**PANS-ATM (Doc 4444)**
- Communication requirements for ATS services
- Operational procedures on the use of ATS data link
- Data link phraseology (i.e. CPDLC Message Set)

**GOLD Manual (Doc 10037)**
- Overview of ATS data link applications
- Guidance for State, ATSP, CSP and Operators for planning and implementation of data link
- Controller/pilot procedures and recommended use of associated CPDLC messages
7.1.3 For operations where communication equipment is required to meet an RCP specification for performance-based communication (PBC), an aeroplane shall, in addition to the requirements specified in 7.1.1:

a) be provided with communication equipment which will enable it to operate in accordance with the prescribed RCP specification(s);

b) have information relevant to the aeroplane RCP specification capabilities listed in the flight manual or other aeroplane documentation approved by the State of Design or State of Registry; and

c) have information relevant to the aeroplane RCP specification capabilities included in the MEL.

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).

7.1.4 The State of the Operator shall, for operations where an RCP specification for PBC has been prescribed, ensure that the operator has established and documented:

a) normal and abnormal procedures, including contingency procedures;

b) flight crew qualification and proficiency requirements, in accordance with appropriate RCP specifications;

c) a training programme for relevant personnel consistent with the intended operations; and

d) appropriate maintenance procedures to ensure continued airworthiness, in accordance with appropriate RCP specifications.
7.1.5 The State of the Operator shall ensure that, in respect of those aeroplanes mentioned in 7.1.3, adequate provisions exist for:

a) receiving the reports of observed communication performance issued by monitoring programmes established in accordance with Annex 11, Chapter 3, 3.3.5.2; and

b) taking immediate corrective action for individual aircraft, aircraft types or operators, identified in such reports as not complying with the RCP specification(s).
Chapter 4. Complying with RCP/RSP specifications

- Guidance for CAAs
- Initial compliance determination and related approvals
- Flight plan requirements
- Continued operational compliance
PBCS IMPLEMENTATION MONITORING
Monitoring Programmes

Regional Airspace Safety Monitoring
(ICAAP APAC Region – Regional Airspace Safety Monitoring Group - RASMAG)

PBCS Implementation Monitoring
(ICAAP APAC - FANS Interoperability Teams)

Central Reporting Agencies
(PBCS problem reporting and rectification)

Airspace Safety Monitoring Agencies
(En-route Monitoring Agencies)
• PBCS approvals databases
• Non-compliance coordination

Civil Aviation Authorities
Air Navigation Service Providers
## ICAO Asia/Pacific PBCS Implementation

**FIT-Asia PBCS Planning Chart (Administrations with FIR/s)**

<table>
<thead>
<tr>
<th>Task Group</th>
<th>Task ID</th>
<th>TASK descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>A-1</td>
<td>AIP (Prescription of an RCP/RSP specification)</td>
</tr>
<tr>
<td></td>
<td>A-2</td>
<td>ANSP (PBCS policies, objectives supporting safety oversight)</td>
</tr>
<tr>
<td></td>
<td>A-3</td>
<td>Operator and aircraft System- PBCS policies, objectives supporting safety oversight</td>
</tr>
<tr>
<td></td>
<td>A-4</td>
<td>Regional Supplementary Procedures (Doc. 7030) for PBCS operations, if applicable</td>
</tr>
<tr>
<td>Group B</td>
<td>B-1</td>
<td>PBCS implementation Plan</td>
</tr>
<tr>
<td></td>
<td>B-2</td>
<td>Target dates for PBCS and relevant ATM operations</td>
</tr>
<tr>
<td></td>
<td>B-3</td>
<td>RCP/RSP specifications</td>
</tr>
<tr>
<td></td>
<td>B-4</td>
<td>PBCS awareness</td>
</tr>
<tr>
<td>Group C</td>
<td>C-1</td>
<td>Operational concepts and procedures for PBCS operations</td>
</tr>
<tr>
<td></td>
<td>C-2</td>
<td>ATC automation changes to use flight plan RCP/RSP indicators</td>
</tr>
<tr>
<td></td>
<td>C-3</td>
<td>ATC automation changes for PBCS monitoring</td>
</tr>
<tr>
<td></td>
<td>C-4</td>
<td>Confirm initial ANSP compliance with RCP/RSP specifications</td>
</tr>
<tr>
<td>Group D</td>
<td>D-1</td>
<td>Aircraft operator readiness</td>
</tr>
<tr>
<td></td>
<td>D-2</td>
<td>Confirm initial operator and/or aircraft type/system compliance with RCP/RSP</td>
</tr>
<tr>
<td>Group E</td>
<td>E-1</td>
<td>PBCS monitoring - post implementation</td>
</tr>
</tbody>
</table>

### Communication Specifications & Interoperability Standards

- **Normal**: RCP240, FANS1A CPDLC
- **Alternate**: RCP400, SATVOICE, HF

### Surveillance Specifications & Interoperability Standards

- **Normal**: RSP180, FANS1A ADS-C
- **Alternate**: RSP400, SATVOICE, HF

### Navigation Specifications & Applicable ATM Operations

- **RNAV/RNP 10**: 50 NM Lateral Separation, 50 NM Longitudinal Separation
- **RNAV/RNP 4**: 30 NM Lateral Separation, 30 NM Longitudinal Separation (pre-existing std), 30 NM Longitudinal Separation (new std), 20NM Climb-Descend Through
- **RNAV/RNP 2**: 20NM Lateral Climb-Descend Through

### Does your State submit data?

- X: Yes
- -: Yes
- X: No

### Other Information

- ADS-B
- 07 - 15 NM VHF Lateral Separation
- 9NM VHF Climb-Descend Through
- NOT YET SURVEYED
### PBCS Planning Chart

(Non-FIT-Asia Administrations)

<table>
<thead>
<tr>
<th>Task Group</th>
<th>Task ID</th>
<th>TASK descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>AIP (Prescription of an RCP/RSP specification)</td>
<td></td>
</tr>
<tr>
<td>A-2</td>
<td>ANSP (PBCS policies, objectives supporting safety oversight)</td>
<td></td>
</tr>
<tr>
<td>A-3</td>
<td>Operator and aircraft System-PBCS policies, objectives supporting safety oversight</td>
<td></td>
</tr>
<tr>
<td>A-4</td>
<td>Regional Supplementary Procedures (Doc. 7030) for PBCS operations, if applicable</td>
<td></td>
</tr>
<tr>
<td>B-1</td>
<td>PBCS Implementation Plan</td>
<td></td>
</tr>
<tr>
<td>B-2</td>
<td>Target dates for PBCS and relevant ATM operations</td>
<td></td>
</tr>
<tr>
<td>B-3</td>
<td>RCP/RSP specifications</td>
<td></td>
</tr>
<tr>
<td>B-4</td>
<td>PBCS awareness</td>
<td></td>
</tr>
<tr>
<td>C-1</td>
<td>Operational concepts and procedures for PBCS operations</td>
<td></td>
</tr>
<tr>
<td>C-2</td>
<td>ATC automation changes to use flight plan RCP/RSP indicators</td>
<td></td>
</tr>
<tr>
<td>C-3</td>
<td>ATC automation changes for PBCS monitoring</td>
<td></td>
</tr>
<tr>
<td>C-4</td>
<td>Confirm initial ANSP compliance with RCP/RSP specifications</td>
<td></td>
</tr>
<tr>
<td>D-1</td>
<td>Aircraft operator readiness</td>
<td></td>
</tr>
<tr>
<td>D-2</td>
<td>Confirm initial operator and aircraft type/system compliance with RCP/RSP</td>
<td></td>
</tr>
<tr>
<td>E-1</td>
<td>PBCS monitoring - post implementation</td>
<td></td>
</tr>
</tbody>
</table>

#### PBCS Implementation Task List

<table>
<thead>
<tr>
<th>Communication Specifications &amp; Interoperability Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal RCP240 FANS1/CPDLC</td>
</tr>
<tr>
<td>Alternate RCP400 SATVOICE</td>
</tr>
<tr>
<td>Surveillance Specifications &amp; Interoperability Standards</td>
</tr>
<tr>
<td>Normal RSP180 FANS1/ADS-C</td>
</tr>
<tr>
<td>Alternate RSP400 SATVOICE</td>
</tr>
<tr>
<td>Applicable ATM Operations</td>
</tr>
<tr>
<td>RNP10 50 NM Lateral Separation</td>
</tr>
<tr>
<td>RNP2 20NM Lateral Climb-Descent Through</td>
</tr>
</tbody>
</table>

#### Does your State submit data link problem reports to a recognized Central Reporting Agency (CRA)?

| | X | X | X | X |

---

**ICAO Asia/Pacific PBCS Implementation**
Raise problem reports against the FANS1/A System

View problem reports
- Raised by or assigned to the stakeholder; or
- De-identified problem reports

View information on system performance

Sign up to the PBCS Charter
PBCS Charter

Charter Stakeholders

- Aircraft Manufacturers and Aircraft Equipment Suppliers
- Communication Service Providers and Satellite Service Providers
- ANSP and CAA
- Aircraft Operators

ICAO Asia/Pacific Region CAAs/ANSPs

ANSP and CAA

- Airways New Zealand
- NAV Portugal
- Japan Air Navigation Service
- Airports Fiji Limited
- DECEA Brazil
- DGAC-Chile
- CAA Philippines
- FAA (United States)
- ISAVIA ANS (Iceland)
- ATMB of CAAC (China ANSP)
- NATS (United Kingdom)
- NAV CANADA
- AirNav Indonesia
Summary

- Performance-Based Separation
  - Traffic Growth
  - Performance-based standards, procedures and specifications to support overall system safety and efficiency
  - the CNS Loop
- What is PBCS?
- ICAO Provisions for PBCS
  - Annexes, PANS, Guidance Material, USOAP
- PBCS Implementation Monitoring
  - ICAO Asia/Pacific Region Implementation
- PBCS Charter
Follow us on social media

www.apec.org

www.facebook.com/APECnews

www.linkedin.com/company/asia-pacific-economic-cooperation-apec-secretariat
What are the Benefits of PBCS?

TPTWG Workshop

Presented by
Michael Watkins, FAA Senior Air Traffic Representative – Asia Pacific
Topics

Air Mass and Jet Streams

Air Route Structure

Routing Options - ASPIRE

Benefits

Airspace

Actions
Air Mass

Aircraft move with the air around them

Enroute
- Tailwinds - good
- Headwinds - bad

Takeoff and Landing
- Headwinds - good
- Tailwinds - bad
Jet Streams are predictable currents of fast moving air.

West to East flights fly in the Jet Stream when possible.

East to West flights avoid the Jet Stream.
Effective Jet Stream use can reduce flight time of a long haul flight by an hour or more!
Air Route Structure

Air routes designed to minimize distance

A few are adjusted daily for winds

Operators flight plan to minimize time and cost
Routing Options - ASPIRE

A 2008 partnership between the FAA, Airways New Zealand, Air Services Australia, AEROTHAI, CAAS, JANS and airlines to reduce aviation’s impact on the environment Disbanded in 2018 after implementing many safety and efficiency improvements including:

- User-Preferred Routes (UPRs)
- Dynamic Airborne Reroute Procedure (DARP)
- Reduced Oceanic Separation
Real PBCS Benefits

Aircraft flying with PBCS approvals and lower RSP and RCP values can fly closer together

More aircraft can optimize flight paths for winds, routing, flight levels, and weather avoidance

Improves airspace efficiency, capacity, and safety

Reduces aircraft fuel burn and carbon emissions

Reduces system delay and improves schedule performance
Real PBCS Benefits

PBCS reduces verbal transmissions and improves situational awareness

Reduces verbal miscommunication, particularly for non-native English speakers

Improves remote airspace situational awareness

Allows earlier conflict detection and resolution

Simplifies Quality Assurance Assessments
Currently the only PBCS exclusive airspace is the North Atlantic High Level Airspace (NAT HLA)

Air Traffic Services working with airlines to develop PBCS required routes

Non-PBCS aircraft operators may receive suboptimal routing or flight levels in the future
Why Now?

- ICAO implementation date has past
- Most aircraft are equipped
- Airspace is ready
- Some routes developing for PBCS only
- Soon non-approved aircraft given reroutes, delays, or sub-optimal flight levels
- Less efficient flights are less competitive
- Allows the development of future ASPIRE type measures

This workshop provides head start for Regulators, Aircraft Operators, and Air Traffic Services
Action Required

Action required if your registered aircraft will fly in PBCS airspace.

PBCS supports new procedures which improve efficiency, safety and reduce environmental impact.

<table>
<thead>
<tr>
<th>CIVIL AVIATION AUTHORITY RESPONSIBILITY</th>
<th>In accordance with the ICAO PBCS Provisions</th>
<th>In accordance with domestic regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishes PBCS policies for ANSP, operator, airworthiness, etc.</td>
<td>□ Provides RCP/RSP-compliant services</td>
<td>□ Files RCP/RSP capabilities in flight plan in accordance with State PBCS policy</td>
</tr>
<tr>
<td>Prescribes RCP/RSP specifications in the applicable airspace for the relevant operations</td>
<td>□ Recognizes RCP/RSP capabilities in air traffic control (ATC) automation</td>
<td>□ Participates in ANSP PBCS monitoring programs</td>
</tr>
<tr>
<td>Publishes PBCS requirements in aeronautical information publication (AIP)</td>
<td>□ Establishes PBCS monitoring program</td>
<td></td>
</tr>
</tbody>
</table>

Inaction places your airlines at a competitive disadvantage!
The performance-based communication and surveillance (PBCS) framework allows for higher safety standards and more efficient airspace use.

**Equipped aircraft also require regulatory approval.**

When all aircraft in an airspace have a lower RSP value and a lower RCP value, ANSPs can optimize routing.

Saves time and money while enhancing safety and reducing carbon emissions.
Conclusion

- PBCS Implementation improves Safety and Efficiency
- Actions are required, even if you are not managing PBCS airspace
- PBCS supports future airspace developments
- Failure to act will result in less efficient routes for your aircraft operators

Ask questions during the rest of the workshop!
Follow us on social media

www.apec.org

www.facebook.com/APECnews

www.linkedin.com/company/asia-pacific-economic-cooperation-apec-secretariat
Day 1 Recap of PBCS: Putting it All Together

Presented by
Shane Sumner, Regional Officer, Air Traffic Management, ICAO
Michael Watkins, FAA’s Senior Representative for ATO in Asia Pacific
PBCS Framework:

- **Addresses the need for appropriate means** to quantify, measure and improve system performance

- **Provides a framework** that assures that the required level of communication and surveillance performance is managed in accordance with globally accepted specifications (RCP/RSP)

- **Mitigates safety risks** - misapplying current evolving ATM operations to inappropriate aircraft pairs
Day 1 Wrap-up

PBCS Benefits

- Aircraft flying with PBCS approvals and lower RSP and RCP values can fly closer together.
- More aircraft can optimize flight paths for winds, routing, flight levels, and weather avoidance.
- Improves airspace efficiency, capacity, and safety.
- Reduces aircraft fuel burn and carbon emissions.
- Reduces system delay and improves schedule performance.

Or...

Enhances safety, Saves Money and Time and Helps Preserve the Global Environment.
PBCS: An Implementation

Outline

Day 2

Presented by
Theresa Brewer, United States, ICAO PBCS Project Team lead
Objective

This presentation will provide:

• an overview of the PBCS framework
• an outline of the implementation tasks by stakeholder type
  – civil aviation authority (CAA)
  – air navigation service provider (ANSP)
  – aircraft operator
• information to help each stakeholder determine their PBCS responsibilities
• a brief introduction to the importance of monitoring
• information on how the communication service provider (CSP) is addressed in the PBCS framework
The PBCS Framework

**SARPS**: standards and recommended practices

**ANSP**: air navigation service provider

**ATS**: air traffic services

**DSP**: datalink service provider

**VSP**: VHF subnetwork provider

**HSP**: HF subnetwork provider

**SSP**: Satellite service provider

**AOC**: aeronautical operational control
Group A tasks — CAA/region preparation;

Group B tasks — air navigation services provider (ANSP) general project development and management;

Group C tasks — ANSP implementation activities – air traffic services (ATS) provision;

Group D tasks — Aircraft operator, aircraft type/system (airworthiness) eligibility; and

Group E tasks — All stakeholders – post-implementation monitoring.
What responsibilities does your CAA have for PBCS?

1. Does your **ANSP** provide or plan to provide an ATM operation that has an associated required communication performance (RCP) and/or required surveillance performance (RSP)?
   - see **Annex 11** (paragraphs 2.8.1-2.8.2, 2.9.1-2.9.3, 3.3.5.2-3.3.5.3, 6.1.1.2)
   - see **ICAO Document 4444** (paragraphs 5.4.1.2.1.6, 5.4.2.9.2)

**YES** – you will need to work with your ANSP to develop PBCS policy/plan for safety oversight of the relevant ATM operation and ensure the applicable RCP and/or RSP is identified in the Aeronautical Information Publication (AIP) or equivalent; move to question 2

**NO** – you have no ANSP oversight responsibilities, move to question 2 (next slide)
What responsibilities does your CAA have for PBCS?

2. Do your Operators fly in any airspace where one or more ATM operations that have an associated RCP and/or RSP are provided?
   
   – see Annex 6 (Part I, paragraphs 7.1.3-7.1.5, 7.3.2-7.3.4; Part II, paragraphs 2.5.1.6-2.5.1.9, 2.5.3.2-2.5.3.5)

   YES – you will need to develop PBCS policy for operational approval of your operators and issue authorizations to operators/aircraft, where the requirements are met

   NO – this is an unlikely response
What responsibilities does your ANSP have for PBCS?

1. Do you provide an ATM operation that has an associated RCP and/or RSP?
   - see Annex 11 (paragraphs 2.8.1-2.8.2, 2.9.1-2.9.3, 3.3.5.2-3.3.5.3, 6.1.1.2)
   - see Doc 4444 (PANS-ATM) (paragraphs 5.4.1.2.1.6, 5.4.2.9.2)

**YES** – you will need to develop PBCS policy and implementation plan and ensure the applicable RCP and/or RSP is identified in the Aeronautical Information Publication (AIP) or equivalent

**NO** – determine whether your operation may still benefit from a monitoring program
What responsibilities does your ANSP have for PBCS?

2. Do your current or future plans for ATM operations include the use of data link or SATVOICE?

**YES** – consider whether a monitoring program would provide benefit for identifying performance or safety issues, and stay tuned for developments of RCP for ATM operations enabled by voice technologies such as SATVOICE

**NO** – PBCS may not be of interest to you at the current time
What responsibilities does your company have for PBCS?

1. Do you operate in airspace where an ATM operation that has an associated RCP and/or RSP is provided and would your operations benefit from utilizing them?
   - Review relevant AIPs

**YES** – you will need to consult your CAA to determine the policy for obtaining necessary authorization, and if there is no policy in place, work with them to develop one

**NO** – PBCS may not be of interest to you at the current time
Who has responsibilities related to PBCS monitoring?

- Every **CAA** with ANSP providing ATM operations enabled by PBCS
- Every **CAA** with one or more Operators flying in airspace providing ATM operations enabled by PBCS
- Every **ANSP** providing ATM operations enabled by PBCS (all ANSPs using data link would benefit from a monitoring program)
- Every **operator** with authorization or seeking authorization to participate in ATM operations enabled by PBCS
- Every **communication service provider (CSP)** providing service in airspace where ATM operations enabled by PBCS are offered
- Every **aircraft/avionics manufacturer** with aircraft eligible or authorized for an RCP/RSP
What is the purpose of the monitoring?

- Ensure continued compliance of the airspace
- Ensure continued compliance of each aircraft
- Ensure continued compliance of each CSP and subnetwork
- Report, investigate, resolve problems
  - Correction of inefficient/incorrect settings at aircraft, CSP, ANSP level
  - Development of aircraft software fixes
  - Development of ground and network automation fixes/improvements
  - Development of improvements to technical and interoperability standards
  - Development of improved procedures and training
What about the CSP?

- Compliance of CSP performance is crucial to end-to-end performance and is assured through ANSP and operator because no direct safety oversight requirements exist under current Annex provisions
  - **ATS provision and aircraft operation are subject to the certification and/or safety management system (SMS) requirements under Annexes 6, 11 and 19**
- PBCS framework initially intended to ensure compliance via contractual arrangements but challenges include:
  - Significant cost/effort to re-negotiate individual contracts currently in place between CSPs and each operator/ANSP
  - No ability to clearly isolate contribution by CSP from that of aircraft and certain ground implementations, as well as by subnetworks (i.e. Satellite, VHF data link, HF data link)
Developed as an alternative means of compliance for CSP “contract/agreement” needed for operator and ANSP approval

Facilitates cooperation among all PBCS stakeholders to achieve PBCS objectives

Hosted on the www.FANS-CRA.com website where stakeholders will go to sign and obtain proof of respective CSP signature, as required by approval process

A change of charter membership by any stakeholder may affect status of authorization/eligibility of other stakeholders
# Charter Stakeholders

## Aircraft Manufacturers and Aircraft Equipment Suppliers
- Boeing
- Airbus
- Gulfstream
- Collins Aerospace (Flight Test)
- Bombardier / Learjet

## Communication Service Providers and Satellite Service Providers
- Inmarsat
- ADCC
- Iridium
- AVICOM JAPAN CO., LTD.
- GoDirect
- ARINCDirect
- SITAONAIR
- Collins IMS (ARINC)

## ANSP and CAA
- Airways New Zealand
- DECEA Brazil
- ATMB of CAAC (China ANSP)
- FAA (United States)
- NAV Portugal
- DGAC-Chile
- Japan Air Navigation Service
- CAA Philippines
- NAV CANADA
- Airports Fiji Limited
- ISAVIA ANS (Iceland)
- NATS (United Kingdom)

## Aircraft Operators
https://www.fans-cra.com/charter/stakeholders/
Key Points

- Stakeholders should carefully assess their PBCS responsibilities and identify applicable group(s) of PBCS implementation tasks
  - More details on specific tasks will be provided in following presentations
- The monitoring is an integral component of the overall PBCS framework
- The PBCS Global Charter is an important tool in achieving initial compliance for CSP oversight, and ensuring continued compliance of end-to-end system performance
  - All major data link CSPs, aircraft manufacturers and aircraft equipment suppliers are signatories
  - All ANSPs providing performance-based ATM operations are signatories
PBCS: An Operator’s Perspective

Day 2

Presented by
Blair Cowles, Regional Director
Safety and Flight Operations - ASPAC
Enhancing Aviation Efficiency and Safety

Every dollar/mile/kg counts

“If you want to be a millionaire, start with a billion dollars and launch a new airline”

Richard Branson
AN INDUSTRY IN CRISIS

TOTAL LOSSES IN 2020: $118 BILLION

DEMAND: DOWN 61% vs 2019
2020 Overview

**Every day in 2019...**

- 12.4 million passengers
- 106,600 flights
- $17.8 billion worth of goods carried

**Every day in 2020...**

- 4.9 million passengers
- 44,900 flights
- $16 billion worth of goods carried
COVID19 Impact - RPKs

RPKs fell 20% after 9-11, 12% after SARS, 95% in April 2020

Global RPKs, indexed to 100 at start date of crisis event

SARS

9-11

Global Financial Crisis

Source: IATA Economics using data from IATA Statistics
After $118 billion net loss in 2020 we forecast further losses of $38 billion in 2021

COVID19 Impact - Revenues

EBIT: Earnings Before Interest and Taxes

Source: IATA Economics 12 January 2021 update
Per passenger (net) losses show regional variation

Profit per passenger (US$)

- 2019
- 2020F
- 2021F

North America: -86
Latin America: -39
Europe: -51
Asia Pacific: -66
Africa: -68
Middle East: -68
Industry: -68

Source: IATA Economics
COVID19 Impact – Government Aid by Type

Majority of aid will leave airlines with more debt

USD 67 billion of aid creates new liabilities

$67bn or 55% of Government aid creates debt – only $11bn of equity
Airlines will enter ‘restart’ with very high levels of debt

US$120bn rise in debt but <$30bn new equity ($11bn from Govt)
November: international traffic down 88%, while the domestic recovery halted at -41% year-on-year

Rising COVID-19 cases stopped further progress

Source: IATA Economics using data from IATA statistics
COVID19 Impact - Travel

International traffic in Asia Pacific worst performing

Rising COVID-19 cases stopped further progress

RPK: Revenue Passenger Kilometers

Source: IATA Economics
Why is all this so important?
87.7 million
Jobs supported by aviation worldwide

$3.5 trillion
Aviation's global economic impact (including direct, indirect, induced and tourism catalytic)

4.1%
Global GDP supported by aviation

Source: IATA
Air transport across the APEC economies

Total jobs and GDP generated by air transport in the APEC economies, 2018.

- **TOURISM CATALYTIC**
  - 40.1 m JOBS
  - $2.2 tn GDP
  - 19.2 m JOBS
  - $483 bn GDP

- **INDUCED**
  - 6.7 m JOBS
  - $528 bn GDP

- **INDIRECT**
  - 7.5 m JOBS
  - $585 bn GDP

- **AVIATION DIRECT**
  - 6.7 m JOBS
  - $615 bn GDP

- **2.7 billion passengers**
- **59%** share of global passenger traffic
- **473** airlines
- **1,924** airports
- **19,085** aircraft in service
Every dollar/mile/kg counts

- Airlines are in extremely perilous financial position
- ANSPs and regulators to do everything they possibly can to help airlines save costs and stay in business
- PBCS is a key efficiency enabler that helps airlines to fly as cost effectively as possible
The absence of a PBCS regulatory framework may put an economy’s airlines at a competitive disadvantage.

And potentially impact the system as a whole if PBCS generated efficiencies cannot be fully utilized by other airlines.

We need the region’s economies to be doing *everything possible* to create an aviation ecosystem that allows operators to save every dollar/mile/kg they can.
Thank you

cowlesb@iata.org

www.iata.org
PBCS: A Flight Operations Regulator’s Perspective

Day 2

Presented by
Scott Bender (FAA Aviation Safety)
Shawn Silverman (FAA Aviation Safety Contractor)
Purpose/Overview

Provide an understanding of the PBCS requirements as it pertains to the authorization

We will discuss...

- Requirements
- Authorization
- Aircraft
- Operator
### Requirements

**International Civil Aviation Organization (ICAO)**

<table>
<thead>
<tr>
<th>Document ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annex 6</td>
<td>Operation of Aircraft</td>
</tr>
<tr>
<td>Part I</td>
<td>Commercial Air Transport</td>
</tr>
<tr>
<td>Part II</td>
<td>General Aviation - Aeroplanes</td>
</tr>
<tr>
<td>Part III</td>
<td>Operations - Helicopters</td>
</tr>
<tr>
<td>Annex 11</td>
<td>Air Traffic Services</td>
</tr>
<tr>
<td>Annex 15</td>
<td>Aeronautical Information Services</td>
</tr>
<tr>
<td>Doc 4444</td>
<td>PANS – Air Traffic Management</td>
</tr>
<tr>
<td>Doc 8400</td>
<td>PANS – Abbreviations and Codes</td>
</tr>
</tbody>
</table>
## International Civil Aviation Organization

<table>
<thead>
<tr>
<th>Document ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doc 10037</td>
<td>Global Operational Data Link (GOLD) Manual, Edition 1</td>
</tr>
</tbody>
</table>

How the FAA Meets the Requirements

- FAA AC 90-117 Datalink Communications
- FAA AC 20-140C Guidelines for Design Approval of Aircraft Data Link Communication Systems Supporting Air Traffic Services (ATS)
- Datalink Communications Compliance Guide
- Other documents applicable to Data Link Authorizations
  - ICAO Global Operational Data Link Document (GOLD)
  - ICAO Doc 9869 (Manual on Required Communication Performance)
  - ICAO Oceanic Errors Safety Bulletin
  - FAA Orders
  - FAA Inspector Guidance (e.g. Notices)
Authorization

Operational authorization should be a specific approval obtained from an assessment of the following:

- Aircraft eligibility and airworthiness
- Maintenance and operations procedures for data link systems
- Means of ensuring compliance of contracted services
- Procedures to control of configuration of aircraft systems, software, and communications subnetworks
- Training of flight crew, dispatchers, and maintenance
Authorization Example

U.S. Department of Transportation
Federal Aviation Administration

14 CFR Part 91 Operations

Letter of Authorization
Data Link Communications

1. The operator XYZ Aviation is authorized to conduct data link communications in accordance with the limitations and provisions of this Letter of Authorization (LOA).

2. Authorized Aircraft and Equipment for Data Link Communications. The operator is authorized to conduct data link communications using the following aircraft and FAA-certified data link communication systems with the selected performance specified in Table 1:

<table>
<thead>
<tr>
<th>Aircraft M/M/S</th>
<th>Data Link System</th>
<th>INTEROP Designator</th>
<th>Subnetworks</th>
<th>CSP</th>
<th>RCP</th>
<th>RSP</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>BD-700-1A10</td>
<td>Honeywell IC-810</td>
<td>FANS 1/A (+) with push to load</td>
<td>SATCOM Imarsat</td>
<td>Rockwell Collins/ARINC</td>
<td>RCP 240</td>
<td>RSP 180</td>
<td>N/A</td>
</tr>
</tbody>
</table>

3. Pilot Training. The operator must provide training for pilots using data link communications. This training is conducted by Computer Training Systems (CTS). Pilots must be knowledgeable of and comply with:

(a) All provisions applicable to the use and operation of the installed data link system; and

(b) Flight planning designators and requirements.
PBCS Global Charter

- Under ICAO guidance, Air Navigation Service Providers (ANSP), Operators and Communications Service Providers (CSP) are required to ensure adequate performance via a contract.
- Charter membership serves as a means of compliance for operator/CSP contract and/or service agreements
- Developed in response to CSP concerns:
  - Significant cost/effort to re-negotiate current individual contracts between operator/CSP as well as each ANSP
  - Many contributors affecting performance are outside of the CSP domain/control
- Facilitates cooperation among all PBCS stakeholders to achieve PBCS objectives
- Operators must remain as Charter members or notify their authorizing agency of change of status

→ A change of charter membership status affects operational authorization
Aircraft

- Aircraft manufacturer or equipment supplier should demonstrate that aircraft system meets the required communication performance (RCP)/required surveillance performance (RSP) specifications allocated to the aircraft system as contained in the PBCS Manual (Doc 9869)

- Demonstration of compliance with the RCP and RSP specifications should be specific to each individual airframe or the combination of the aircraft type and configuration
Aircraft Statement of Compliance

<table>
<thead>
<tr>
<th>Network</th>
<th>ICAO designator of aircraft datalink system</th>
<th>Applications</th>
<th>Subnetwork used</th>
<th>ATC datalink performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACARS</td>
<td>FANS 1/A +</td>
<td>CPDLC</td>
<td>If installed : HFDL</td>
<td>No RCP demonstrated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If installed : VDL Mode 2(1)</td>
<td>RCP 240</td>
</tr>
<tr>
<td>ADS-C</td>
<td></td>
<td></td>
<td>If installed : HFDL</td>
<td>No RSP demonstrated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If installed : VDL Mode 2(1)</td>
<td>RSP 180</td>
</tr>
</tbody>
</table>

(1) The VDL Mode 2 supports the multiple frequency capability.

(2) HFDL is used as a supplementary communication means in addition to VHF and SATCOM datalink means.

Aircraft systems involved in ATC datalink performance as mentioned in the above table, are compliant with RCP 240 and RSP 180 requirements allocated to aircraft as specified in the ED-122/DO-306 and as prescribed in the Performance-Based Communication and Surveillance (PBCS) Manual (ICAO Doc 9869). Nevertheless, some ANSPs may decide to exclude subnetwork as acceptable means for a given RCP/RSP specification. Compliance with the above does not constitute an operational approval. Such authorization must be obtained by the operator from the appropriate authorities.
Operator eligibility should be determined by:

- Operational Procedures
  - Establish procedures for normal and non-normal data link system use and problem reporting

- Training
  - Flight crew and other personnel (dispatch and maintenance) are proficient with PBCS operations

- CSP Compliance
  - Ensure that contracted CSPs comply with the RCP/RSP specification allocations as well as monitoring, recording and notification (PBCS Charter)
Operator eligibility should be determined by:

- Participation in PBCS Monitoring
  - Establish a process to participate in local and/or regional PBCS monitoring

- Flight Planning
  - Ensure that the planned use of communication and surveillance capabilities for the flight are in accordance with regulations, policies and procedures in control areas for the flight as published guidance
  - Ensure that the proper information indicating PBCS operational authorization for RCP/RSP capabilities is included in the ICAO flight plan
Key Points

- Civil Aviation Authorities should establish guidance for PBCS implementation. ICAO & FAA have examples of comprehensive job aides that should make the process easier.

- Original Equipment Manufacturer's (OEM) Statement of Compliance (SOC) is basis for aircraft's capability.

- PBCS Global Charter is vital to the success of the PBCS framework for all involved.

- Training, procedures and proper flight plan filing/coding are the operators primary responsibilities.

- Addressing poor monitoring performance is important to the success and safety of the PBCS process.
Contact Info

- Scott Bender
  - United States FAA Aviation Safety Inspector
  - Scott.W.Bender@faa.gov

- Shawn Silverman
  - United States FAA Aviation Safety Contractor
  - Shawn.G-CTR.Silverman@faa.gov
Follow us on social media

www.apec.org

www.facebook.com/APECnews

www.linkedin.com/company/asia-pacific-economic-cooperation-apec-secretariat
Day 2 Recap of PBCS: Putting it All Together

Presented by
Blair Cowles, Regional Director, Safety and Flight Operations, IATA
Scott Bender, Flight Standards, U.S. Federal Aviation Administration
Shawn Silverman, Flight Standards Support, U.S. Federal Aviation Administration
AN INDUSTRY IN CRISIS

TOTAL LOSSES IN 2020: $118 BILLION

DEMAND: DOWN 61% vs 2019
Day 2 Wrap-up

The global air transport industry

87.7 million
Jobs supported by aviation worldwide

$3.5 trillion
Aviation’s global economic impact (including direct, indirect, induced and tourism catalytic)

4.1%
Global GDP supported by aviation

Source: IATA
Day 2 Wrap-up

Every dollar, mile, and kg counts!

Total jobs and GDP generated by air transport in the APEC economies, 2018.

- **TOURISM CATALYTIC**
  - Jobs: 40.1 m
  - GDP: $2.2 tn
  - Jobs: 19.2 m
  - GDP: $483 bn

- **INDUCED**
  - Jobs: 6.7 m
  - GDP: $528 bn

- **INDIRECT**
  - Jobs: 7.5 m
  - GDP: $585 bn

- **AVIATION DIRECT**
  - Jobs: 6.7 m
  - GDP: $615 bn

- **2.7 billion passengers**
- **59% share of global passenger traffic**
- **473 airlines**
- **1,924 airports**
- **19,085 aircraft in service**
Day 2 Wrap-up

- Civil Aviation Authority should develop a process and publish guidance for operators that desire to obtain a PBCS Operational Authorization.
- ICAO & FAA have examples of comprehensive job aides that should make implementing a process easier.
- Original Equipment Manufacturer's (OEM) Statement of Compliance (SOC) is basis for aircraft's capability.
- PBCS Global Charter is vital to the success of the PBCS framework for all involved.
- Training, procedures and proper flight plan filing/coding are the operators primary responsibilities.
- Addressing poor monitoring performance is important to the success and safety of the PBCS process.
Follow us on social media

www.apec.org

www.facebook.com/APECnews

www.linkedin.com/company/asia-pacific-economic-cooperation-apec-secretariat
PBCS: An ANSP Perspective

DAY 3

Presented by
Paul Radford, Airways New Zealand
This presentation will provide:

• A summary of guidance material and aids available to ANSP when implementing PBCS.
• An overview of an ANSP’s implementation of PBCS.
Contents

- **Section 1** – Guidance Material and Implementation Aids
  - PBCS implementation plan (Doc 9869 PBCS Manual)
  - ANSP action list (RASMAG)
  - Datalink performance monitoring (RASMAG)
  - CRA website

- **Section 2** – Airways New Zealand PBCS Implementation
  - ATM system modifications
  - Oceanic SPR safety requirements
  - Online PBCS analysis tool
  - Post implementation monitoring and reporting

RASMAG: Regional Airspace Safety Monitoring Advisory Group
SPR: Safety and Performance Requirements
Section 1 – Guidance Material and Implementation Aids

This section lists some of the guidance material and aids available to ANSP when implementing PBCS in their airspace.
PBCS Implementation - Guidance

• PBCS Implementation Plan (Doc 9869 PBCS Manual Appendix A)
  • Group B tasks – ANSP general project development and management;
  • Group C tasks – ANSP implementation activities – ATS service provision;
  • Group E tasks – All stakeholders – post-implementation monitoring.

• Regional Airspace Safety Monitoring Advisory Group (RASMAG)
  • ANSP action list (RASMAG/23 Report – Appendix C)
  • Conclusion RASMAG/24-2: Continuous Data Link Performance Monitoring
### Group B tasks – ANSP general project development and management

<table>
<thead>
<tr>
<th>B-3</th>
<th>RCP and RSP specifications</th>
<th>Identify and confirm applicable RCP/RSP specifications that will be used for operational implementation of communication and surveillance capabilities supporting specified ATM operation(s).</th>
<th>Chapter 3 Appendix B Appendix C</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-4</td>
<td>PBCS awareness</td>
<td>Establish means to raise awareness on PBCS implementation in a particular region or airspace through workshops and distribution of information. Establish a planning team to work with ICAO and subject matter experts to develop relevant material.</td>
<td>Doc 9869 Doc 10037 Doc 10038</td>
</tr>
</tbody>
</table>
### Doc 9869 PBCS Implementation Plan

#### Group C tasks – ANSP implementation activities – ATS provision

| C-1 | Operational concepts and procedures for PBCS operations | Develop operational concepts for implementation of any ATM operation predicated on an RCP/RSP specification. Consider the following:  
|     |                                                      | a) applicable ATM operation(s);  
|     |                                                      | b) relevant interoperability requirements for communication and surveillance capabilities;  
|     |                                                      | c) provision for PBCS operations and appropriate RCP/RSP specifications;  
|     |                                                      | d) operating procedures for PBCS operations;  
|     |                                                      | e) operator/flight crew and/or ATS unit/controller contingency procedures when system degrades below that required by RCP/RSP specifications; and  
|     |                                                      | f) procedures for resuming specified ATM operation(s) after system is restored to an acceptable level of performance. | Doc 9869  
|     |                                                      | Doc 10037  
<p>|     |                                                      | Doc 10038 |</p>
<table>
<thead>
<tr>
<th>C-2</th>
<th>ATC automation changes to use flight plan RCP/RSP indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Implement changes to recognize and use flight plan RCP/RSP indicators to apply ATM operation(s) predicated on the RCP/RSP specifications only to eligible operators/aircraft, and/or adapt other system parameters, if applicable (e.g. set timer threshold values), based on different performance levels). This task should be complete prior to operational implementation of ATM operation(s) predicated on RCP/RSP specifications.</td>
</tr>
</tbody>
</table>

Chapter 4 Section 4.4


| C-3  | ATC automation changes for PBCS monitoring | Implement post-implementation monitoring capability in ATC automation. This task should be completed to obtain a sufficient sample to confirm ACP and ASP comply with RCP/RSP specifications prior to implementation of specified ATM operation(s). | Chapter 4 Section 4.5 Appendix D Appendix E |

Doc 9869 PBCS Implementation Plan
### Group C tasks – ANSP implementation activities – ATS provision

<table>
<thead>
<tr>
<th>C-4</th>
<th>Confirm initial ANSP compliance with RCP/RSP specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prior to operational implementation, confirm CPDLC and ADS-C comply with RCP/RSP specifications:</td>
</tr>
<tr>
<td></td>
<td>a) measure actual performance against RCP/RSP specifications for compliance to support initial approval of ATS provision, including CSP/SSP service agreement, if applicable;</td>
</tr>
<tr>
<td></td>
<td>b) identify any aspect of service performance that is not compliant with the RCP/RSP specifications; and</td>
</tr>
<tr>
<td></td>
<td>c) take appropriate action to mitigate.</td>
</tr>
</tbody>
</table>

- **Chapter 4 Section 4.2.2**
- **Section 4.3.1**
- **Section 4.3.2**
- **Appendix D**
- **Appendix E**
### Group E tasks – All stakeholders – post-implementation monitoring

<table>
<thead>
<tr>
<th>C-4</th>
<th>Confirm initial ANSP compliance with RCP/RSP specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>On-going post-implementation data collection, monitoring, problem reporting and tracking, analysis and corrective action. When performance falls below specified levels, or problems are reported, operational judgment may be a consideration in determining appropriate actions.</td>
</tr>
</tbody>
</table>

Chapter 4
Section 4.5
Appendix D
Appendix E
Doc 9937
Doc 10063
1.1 Register on CRA website at www.fans-cra.com.

1.2 Establish means to extract FANS1A analysis data for CPDLC and ADS-C using guidance provided in ICAO Doc 9869 PBCS Manual Appendix D.

1.3 Filter extracted data FANS1A analysis data for CPDLC and ADS-C using guidance in PBCS Manual Appendix D.

1.4 Establish means to perform analysis of CPDLC RCP and ADS-C RSP at a suitable interval (usually monthly, but specific interval will be determined by local factors such as volume of data).

1.5 Investigate any performance degradation identified during monthly analysis.

1.6 Report non-compliance with RCP/RSP specifications to CRA.

1.7 Support CRA non-compliance investigations.
1.8 Report any aircraft that are filing as PBCS qualified but showing non-compliance with RCP and RSP 95% normal operating criteria to your CAA and RMA.

1.9 Withdraw the use of performance-based separation minima requiring PBCS where aircraft data link performance is not compliant with RCP and RSP 95% operating criteria.

1.10 Implement an analysis of service availability to determine the impact of reported unplanned outages in your airspace (usually annually).

1.11 Implement local procedures and training to ensure operational staff log FANS1/A problems identified during operations to enable subsequent investigation.

1.12 Implement local investigation process for reported FANS1/A problems.

1.13 Implement CRA website reporting of confirmed FANS1/A problems.

1.14 If implementing PBCS, sign up to Global PBCS Charter on CRA website.
Conclusion RASMAG/24-2: Continuous Data Link Performance Monitoring

That, ANSP providing ADS-C and CPDLC services are urged to undertake the following actions, in accordance with ICAO Doc 9689 - PBCS Manual and Doc 10037 - GOLD Manual, and the Asia/Pacific PBCS Action List for ANSPs:

1. Continuously monitor data link performance;

2. Conduct monthly data link performance analyses on a rolling three-month basis, and report problems and significantly poor performance to the CRA and RMA in accordance with the Asia/Pacific PBCS Action List for ANSPs;

3. Take steps to identify any local cause of poor performance identified in each monthly analysis;

ICAO Letter Ref. T 3/ 10.1.17 - API00/19 (ATM) 17 September 2019
Conclusion RASMAG/24-2: Continuous Data Link Performance Monitoring (continued)

4. Compile monthly performance report data in reporting periods from January to June and July to December each year;

5. Provide the compiled performance report data to the ANSP responsible for the compilation and analysis of Regional aggregated data;

6. Include narrative information on efforts made to determine the causes of poor performance, action taken to rectify poor performance, and the results of that action, in annual performance monitoring analysis reports to FIT-Asia;

7. Make airframe and fleet performance data available on request to all Administrations for regulatory oversight purposes.

ICAO Letter Ref. T 3/10.1.17 - API00/19 (ATM) 17 September 2019
The FANS1/A CRA website at https://www.fans-cra.com facilitates problem reporting for stakeholders.

FANS1/A Problem Reporting

This website provides a means for FANS1/A stakeholders to:

- Raise problem reports against the FANS1/A system
- View de-identified problem reports.
- View problem report reports raised by the stakeholder.
- View those problem reports assigned to the stakeholder by the regional monitoring authority (CRA or DLMA).
- View information on system performance.

Only authorised users may raise problem reports and only authorised users have access to the detail in problem reports. The level of user access granted to individual stakeholders is approved by the regional monitoring authority (CRA or DLMA).

FANS1/A stakeholders wishing to register as an authorised user should complete the “Sign Up” form accessed from this page. All “Sign Up” requests will be reviewed by the appropriate CRA/DLMA and the appropriate access permissions assigned.

When a problem report is raised by a stakeholder the CRA/DLMA will be advised by email. The CRA/DLMA will use email to advise the originator of the outcome of an investigation and any status change.

This website is maintained by Airways New Zealand as a service to the global FANS community.
ALL REGIONS

PAC PBCS Monitoring Results - Jan-Jun 2020

(Uploaded by Airways New Zealand at 14 Dec 2020)
Monitoring results by fleet and by individual airframe for ADS-C ASP and CPDLC RCP in Anchorage, Auckland, Fukuoka, Oakland, Nadi and Tahiti FIRs during Jan-Dec 2020. Observed filing of P2/RSP180 has been included where available. Any questions or concerns please reach out to the respective points of contact.

FANS1/A Problem Solution Tracker

(Uploaded by Airways New Zealand at 06 Oct 2020)
The Problem Solution Tracker provides a consolidated list of FANS1/A problems, recommended aircraft software versions, and performance improvement options.

This version updated by NAT TIG October 2020

NAT PBCS Monitoring Results - Jan-Jun 2020

(Uploaded by FAA (United States) at 21 Sep 2020)
Performance-Based Communication and Surveillance (PBCS) Global Charter
Charter Document Version June 8, 2018

1. Charter Purpose and Applicability

1.1 This PBCS Charter facilitates co-operation among all PBCS stakeholders to achieve the objectives of PBCS. Each Charter stakeholder agrees to take the actions herein for which the required communication performance (RCP) and required surveillance performance (RSP) specifications have been prescribed.

The entities eligible to become a PBCS Charter stakeholder include:
- ANSPs using PBCS to support ATM operations in their airspace.
- Aircraft operators participating in PBCS operations.
- Communication service providers (CSPs).
- Satellite service providers (SSPs).
- Aircraft manufacturers.
- Aircraft equipment suppliers.

1.2 This Charter may be used to show ANSP and operator stakeholder compliance to PBCS Manual guidance specifying contractual/service agreements with the CSP. This commitment to compliance is shown when the ANSP or operator PBCS stakeholder has become a charter stakeholder through signing this charter and the CSP(s) they use have also signed the charter. Should an ANSP or operator PBCS stakeholder subsequently withdraw their charter signature or any of their contracted CSPs withdraw their charter signature, the ANSP and/or operator must notify their authority since such withdrawal will affect their PBCS operational authorization.

2. References
Section 2 – Airways PBCS Implementation

This section contains some implementation examples specific to the Airways New Zealand PBCS implementation.
ATM System Modifications for PBCS

- The Conflict Prediction algorithms for the application of performance based separation standards verify from the filed FPL that the aircraft meets RCP240 and RSP180 before application of the separation is allowed.

- A ‘degraded PBCS’ button allows the controller to prevent the application of the performance based separation standards on an aircraft if they are advised or consider that either RCP/RSP is degraded.
SPR Safety Requirement #14

The Oceanic Safety and Performance Requirements, DO-306/ED-22 Safety Requirement #14 requires the air traffic service provider to notify the controller when a required response is not received within the required time.

- The RCP 240/D expiry time (210”) is used for those CPDLC equipped aircraft where performance based separations are enabled.
- The RCP 400/D expiry time (370”) is used for all other data-link connected aircraft.
- The controller receives the following message: “Clearance read-back expected at [time] is overdue for aircraft [ACID].”
The Oceanic Safety and Performance Requirements, DO-306/ED-22 Safety Requirement #15 requires the air traffic service provider to notify the controller when a late message is received.

For WILCO responses that are automatically processed by the system, a message is sent to the controlling sector:

“[acid]: Late WILCO response received with timestamp [hh:mm:ss] for clearance sent at [hh:mm:ss] UL: [clearance text]”
SPR Safety Requirement #15 (Aircraft)

- The Oceanic Safety and Performance Requirements, DO-306/ED-22 Safety Requirement #15 also applies to aircraft.

- All FANS1/A aircraft should have implemented an uplink delay timer (latency monitor) per DO-258A 4.6.6.9 and GOLD 1st Edition 2.1.2.6.

- This is set by the crew on receipt of an ATC instruction: *UM169: “SET MAX UPLINK DELAY VALUE TO 300 SECONDS”*

- The latency monitor uplink is sent to all FANS1/A aircraft on entering New Zealand Oceanic Airspace.
Online PBCS Analysis Tool

Airways developed an online tool to facilitate processing of PBCS analysis data extracted in accordance with PBCS Manual guidance. [https://pbcsanalysis.herokuapp.com](https://pbcsanalysis.herokuapp.com)
## CPDLC Tabular Data Selection

### Aircraft Company
- ANZ
- B789

### Aircraft Type
- ANZ
- B789

### Tail Number
- NZZO

### ATSP
- NZZO

### RGS
- All

### Media Type
- All

### Date From
- 2020-09-01

### Date To
- 2020-11-30

### Field
- ACP

### Filter
- FULL

### Title
- Analysis by

### RCP
- RCP240

### Hide Rows Fewer Than
- 1

### CPDLC Performance

<table>
<thead>
<tr>
<th>Media Type</th>
<th>RGS</th>
<th>Aircraft Type</th>
<th>Operating Company</th>
<th>Tail Number</th>
<th>ATSP</th>
<th>Message Count</th>
<th>RCP &lt;= 180 sec</th>
<th>95% RCP240 Benchmark</th>
<th>RCP &lt;= 210 sec</th>
<th>99.9% RCP240 Benchmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>All</td>
<td>B789</td>
<td>ANZ</td>
<td>All</td>
<td>NZZO</td>
<td>544</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Load table data: Table rows to be generated: 1
Airways uses performance-based separations utilizing PBCS RCP240/RSP180 specifications.

Our local PBCS monitoring program, ensures that the communication and surveillance capabilities continue to meet the RCP/RSP specification, through monitored data, analysis, and corrective action.

Airways monitors PBCS RCP240/RSP180 performance on a monthly basis.

A monthly PBCS performance report is submitted to the responsible authority (New Zealand Civil Aviation Authority).

Identified PBCS performance degradations are raised as problem reports to the Informal South-Pacific ATS Coordinating Group (ISPACG) CRA through the CRA website.

PBCS aircraft not meeting RCP240/RSP180 95% normal operating requirements are reported to our Regional Monitoring Agency (PARMO).
Airways extracts ADS-C and CPDLC data points every month from the Airways Oceanic Control System (OCS) in formats specified in Doc 9869 PBCS Manual Annex D.

These records are extracted from OCS as .csv files and are manually processed before importing to a website based PBCS analysis tool. The monthly records are also stored as excel files for subsequent analysis.

The PBCS analysis website can produce combined reports of ADS-C and CPDLC performance over specified periods.

Airways uses these combined reports for our monthly performance analysis.

These combined reports are also used as input to the regional reporting of PBCS performance on the CRA website.
Post Implementation Monitoring

- Excel reports of observed ASP and ACP are created from the analysis tool combined reports.

<table>
<thead>
<tr>
<th>Operator</th>
<th>Aircraft Type</th>
<th>Tail No</th>
<th>ADS-C downlink Message counts</th>
<th>ASP &lt;= 90 sec</th>
<th>ASP &lt;= 180 sec</th>
<th>CPDLC Transaction Counts (WILCO received)</th>
<th>ACP &lt;= 180 sec</th>
<th>ACP &lt;= 210 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAL</td>
<td>B77W</td>
<td>N723AN</td>
<td>99</td>
<td>100.00%</td>
<td>100.00%</td>
<td>2</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
<tr>
<td>AAL</td>
<td>B77W</td>
<td>N725AN</td>
<td>106</td>
<td>98.11%</td>
<td>99.06%</td>
<td>5</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
<tr>
<td>ACA</td>
<td>B77W</td>
<td>CFIVR</td>
<td>105</td>
<td>100.00%</td>
<td>100.00%</td>
<td>3</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
<tr>
<td>ACA</td>
<td>B789</td>
<td>CFVLU</td>
<td>23</td>
<td>100.00%</td>
<td>100.00%</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ACI</td>
<td>A339</td>
<td>FONET</td>
<td>189</td>
<td>100.00%</td>
<td>100.00%</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AIC</td>
<td>B77L</td>
<td>VTALG</td>
<td>20</td>
<td>100.00%</td>
<td>100.00%</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ANZ</td>
<td>A20N</td>
<td>ZKNHA</td>
<td>989</td>
<td>97.88%</td>
<td>99.70%</td>
<td>16</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
<tr>
<td>ANZ</td>
<td>A20N</td>
<td>ZKNHC</td>
<td>759</td>
<td>96.44%</td>
<td>99.34%</td>
<td>18</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
<tr>
<td>ANZ</td>
<td>A20N</td>
<td>ZKNHD</td>
<td>677</td>
<td>96.45%</td>
<td>98.82%</td>
<td>9</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

We have been using a number of different combined reports to assist in analysis. These include combined reports of individual tail number performance, combined reports of aircraft operator and aircraft type for the current month, and combined reports of the previous three months consolidated data to increase the number of data points available for analysis.
Post Implementation Monitoring

- Individual records in the combined reports are not assessed where the number of data points is less than 100.
- Where records with 100 or greater data points indicate performance deterioration below ASP or ACP criteria, data is extracted from the raw data files for periods where the latency exceeds requirements to facilitate further investigation.

<table>
<thead>
<tr>
<th>Date</th>
<th>RGS</th>
<th>REP_TYPE</th>
<th>Latitude</th>
<th>Longitude</th>
<th>AC_time</th>
<th>OCS_time</th>
<th>Downlink_time</th>
</tr>
</thead>
<tbody>
<tr>
<td>20200121</td>
<td>XXH</td>
<td>P</td>
<td>-24.4298</td>
<td>177.5677</td>
<td>19:58:15</td>
<td>19:58:56</td>
<td>41</td>
</tr>
<tr>
<td>20200121</td>
<td>XXH</td>
<td>W</td>
<td>-25.0039</td>
<td>177.3341</td>
<td>20:03:03</td>
<td>20:07:45</td>
<td>282</td>
</tr>
<tr>
<td>20200122</td>
<td>XXP</td>
<td>P</td>
<td>-34.415</td>
<td>176.7161</td>
<td>02:15:31</td>
<td>02:26:46</td>
<td>675</td>
</tr>
<tr>
<td>20200122</td>
<td>XXP</td>
<td>W</td>
<td>-34.1443</td>
<td>176.9305</td>
<td>02:17:47</td>
<td>02:27:53</td>
<td>606</td>
</tr>
<tr>
<td>20200122</td>
<td>XXP</td>
<td>P</td>
<td>-32.5626</td>
<td>178.0324</td>
<td>02:30:27</td>
<td>02:30:43</td>
<td>16</td>
</tr>
<tr>
<td>20200122</td>
<td>XXP</td>
<td>P</td>
<td>-32.0013</td>
<td>178.4125</td>
<td>02:34:54</td>
<td>02:36:28</td>
<td>94</td>
</tr>
<tr>
<td>20200122</td>
<td>XXH</td>
<td>P</td>
<td>-30.6692</td>
<td>179.2931</td>
<td>02:45:23</td>
<td>02:56:06</td>
<td>643</td>
</tr>
<tr>
<td>20200122</td>
<td>XXH</td>
<td>W</td>
<td>-29.9973</td>
<td>179.7264</td>
<td>02:50:42</td>
<td>02:56:31</td>
<td>349</td>
</tr>
<tr>
<td>20200122</td>
<td>XXH</td>
<td>P</td>
<td>-29.0291</td>
<td>-179.661</td>
<td>02:58:18</td>
<td>02:59:02</td>
<td>44</td>
</tr>
<tr>
<td>20200207</td>
<td>XXH</td>
<td>W</td>
<td>-34.482</td>
<td>177.4898</td>
<td>21:27:49</td>
<td>21:27:59</td>
<td>10</td>
</tr>
<tr>
<td>20200208</td>
<td>XXA</td>
<td>P</td>
<td>-36.4909</td>
<td>174.8304</td>
<td>02:11:01</td>
<td>02:11:07</td>
<td>6</td>
</tr>
</tbody>
</table>
Post Implementation Monitoring

The extracted raw data records are then assessed, and an action plan developed.

For the data illustrated in the previous slide:

**Assessment:**
*Data analysis shows significant latency delays when transitioning between satellite RGS 21/22 January and 7 February and at initial contract establishment on 22 January”*

**Action Plan:**
1. 16/3 Raise FANS problem report to investigate (ACNZ_2020_04).
2. Check Oakland performance for this tail on same dates.
3. Wait for Oakland feedback before action on ASP observed below 95% normal operating. A bad day at the office on 22/1 has skewed performance. If Oakland results OK recommend monitor only at this stage.

The performance degradations assessed each month are consolidated into a report for the New Zealand CAA.
Post Implementation Monitoring

The monthly report to NZ CAA has two parts:

• Previous analysis update – an update on the previous months report.
• Current months analysis.

**PBCS Performance Analysis**

This month’s analysis reviewed both the November, and the consolidated September/October/November data and evaluated performance where data points exceeded 100.

**PBCS Performance Summary – November 2020**

Previous analysis update:

- **A20N**. Significant degradation in vicinity of YSNF continues while performance is met elsewhere in NZZO. See update below.

- **B77W** – Mixed fleet operations with Iridium and Inmarsat satcom in use on different tails. Some aircraft with Iridium satcom not meeting RSP180 95% normal operating. See update below.

- **B77W** - performance was below the 99.0% requirement at 180 seconds in October but no obvious reason for the two delayed reports. No issues with this fleet in November.

- **A332** - from August analysis. See update below.

- **A333 (Non-PBCS)** – Was below 95% normal operating in October. Meets performance requirements in November showing 95.37% at 95% 90 seconds from 216 data points.
Post Implementation Monitoring

Current Month Analysis:
Each item has a description of the issue followed by an operational impact assessment and our planned follow-up.

November 2020 Analysis

Four A20N operated in November with showing a continuation of the poor RSP performance seen in previous months indicating below 95% normal operating.

<table>
<thead>
<tr>
<th>Tail No</th>
<th>ADS-C downlink Message counts</th>
<th>ASP &lt;= 90 sec</th>
<th>ASP &lt;= 180 sec</th>
<th>CPDLC Transaction Counts (WILCO received)</th>
<th>ACP &lt;= 180 sec</th>
<th>ACP &lt;= 210 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>233</td>
<td>94.85%</td>
<td>97.85%</td>
<td>13</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
<tr>
<td>208</td>
<td>98.75%</td>
<td>98.56%</td>
<td>6</td>
<td>100.00%</td>
<td>106.00%</td>
<td>106.00%</td>
</tr>
<tr>
<td>13</td>
<td>100.00%</td>
<td>100.00%</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>294</td>
<td>91.15%</td>
<td>96.94%</td>
<td>9</td>
<td>100.00%</td>
<td>106.00%</td>
<td>106.00%</td>
</tr>
</tbody>
</table>

Again, the deterioration can be attributed to poor performance in the vicinity of Norfolk Island and RSP is achieved in remainder of the NZ20 FIR when the NF flight sectors are excluded – see table below.

<table>
<thead>
<tr>
<th>Tail No</th>
<th>ADS-C downlink Message counts</th>
<th>ASP &lt;= 90 sec</th>
<th>ASP &lt;= 180 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>709</td>
<td>97.74%</td>
<td>99.72</td>
</tr>
</tbody>
</table>

Minimal operational impact other than in the vicinity of YSNF. Oceanic are aware of the deterioration in the YSNF area and we will continue monitoring.

Monthly report to CAA – de-identified sample from November 2020
In addition to monitoring RCP240/RSP180, availability is monitored by maintaining a monthly record of notified CSP outages and an assessment on the operational impact of each outage as shown below for June 2020.

<table>
<thead>
<tr>
<th>CSP</th>
<th>Date</th>
<th>Advice Received</th>
<th>Outage Start</th>
<th>Outage End</th>
<th>Duration (minutes)</th>
<th>Reason</th>
<th>Operational Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC</td>
<td>10-Jun</td>
<td>1622</td>
<td>1508</td>
<td>1605</td>
<td>57</td>
<td>XXA Network Degradation</td>
<td>No operational impact</td>
</tr>
<tr>
<td>RC</td>
<td>29-Jun</td>
<td>1932</td>
<td>1806</td>
<td>1936</td>
<td>90</td>
<td>XXS Pamalau, HI</td>
<td>No operational impact</td>
</tr>
</tbody>
</table>
Post Implementation Monitoring

• Most FANS problem reports raised by NZZO are generated through the monthly PBCS performance monitoring process and are always accompanied by the appropriate data points and investigation notes to facilitate the CRA investigation.

• In addition to monthly performance reports Airways provides PBCS performance data to the Informal South Pacific Coordinating Group (ISPACG) for the annual report to ICAO, and to the FAA who consolidate performance reports for the CRA website.

• The PBCS analysis website is regularly used within Airways to review PBCS performance and update our operators on performance when requested.
Key Points

• This presentation provided a summary of the guidance material and aids available to assist an ANSP with PBCS implementation, and provided implementation examples from an ANSP implementation.

• Attendees are encouraged to make use of the guidance material and examples in this presentation to support their PBCS implementation activities.
PBCS Monitoring

Day 3

Presented by
Theresa Brewer, United States, ICAO PBCS Project Team lead
This presentation will provide:

• an overview of the ICAO requirements and guidance for PBCS monitoring programs
• practical information and resources to support implementation of a PBCS monitoring program
• significant lessons learned from existing PBCS monitoring programs
Annex 11, Air Traffic Services, 3.3.5.2

- Where RCP/RSP specifications are applied, programs shall be instituted for monitoring the performance of the infrastructure and the participating aircraft against the appropriate RCP and/or RSP specifications.
- The purpose is to ensure that operations in the applicable airspace continue to meet safety objectives.

Annex 6, Operation of Aircraft, Part I, 7.1.5, 7.3.4; Part II, 2.5.1.9, 2.5.3.5

- The appropriate authority shall ensure that adequate provisions exist for:
  - receiving reports of observed communication performance issued by monitoring programs established in accordance with Annex 11, Chapter 3, 3.3.5.2.
  - taking immediate corrective action for individual aircraft, aircraft types or operators, identified in such reports.

RCP: Required Communication Performance
RSP: Required Surveillance Performance
4.5.2.3 To determine continued operational compliance, the ANSP should monitor communication and surveillance capabilities in the applicable airspace to detect and correct performance degradations due to potential instabilities or variations in overall system performance, or changes to any of the various subsystems.

4.5.2.4 The ANSP should also be the entity to perform local analysis, as it possesses the necessary operational expertise, local area knowledge and control, when identifying problems and taking corrective action.
4.5.2.6 The ANSP should perform an 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.

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

4.5.2.8 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.
Important note: ANSP changing to ATSP

- To better align with Annex 11, Air Traffic Services, the term air navigation service provider (ANSP) currently used in ICAO Doc 9869, Edition 2, PBCS Manual will be replaced with air traffic service provider (ATSP) for Edition 3.
- Note that some PBCS monitoring programs have begun incorporating this change in anticipation of Edition 3 publication.
Actual Surveillance Performance (ASP)

**ATM**: air traffic management  
**ATSU**: air traffic service unit  
**ADS-C**: automatic dependent surveillance - contract  
**CPDLC**: controller pilot data link communication  
**RSMP**: required surveillance monitored performance  
**RSTP**: required surveillance technical performance  
**ASP**: actual surveillance performance
Actual Communication Performance (ACP)

| RCP 240 specification (communication transaction times and RCP continuity) |
|-----------------|-----------------|-----------------|
| RCP             | 240             | RCP             |
| 95%             | 95%             |

| RCP 240 D allocations - CPDL C example |
|----------------------------------------|------------|
| ATM                                    | Controller issues ATC instruction |
| 99.9%                                  | P_CTRL (30) |
| 95%                                    | P_CTRL (30) |
| RCP CPT                               | RCP PORT   |
| 99.9%                                  | P_RCP(150) |
| 95%                                    | P_RCP(120) |
| RCP CPT                               | RCP TCF   |
| 99.9%                                  | P_RCP(150) |
| 95%                                    | P_RCP(120) |

Note: — P_RCP(150) means part of the specified value, and that the combination of all the allocations in the row, denoted by P_CTRL(30), equals the [value] specified.

**CPDLC**: controller pilot data link communication  
**ATM**: air traffic management  
**ATSU**: air traffic service unit  
**RCMP**: required communication monitored performance  
**RCTP**: required communication technical performance  
**ACP**: actual communication performance  
**ACTP**: actual communication technical performance  
**PORT**: pilot operational response time  
**MAS**: message assurance
### Reporting on ADS-C Actual Surveillance Performance (ASP)

**Period:** Jan 01, XXXX to Jun 30, XXXX (6 months)

#### Color key:
- Meets criteria
- 99.0%-99.9%
- Under criteria

<table>
<thead>
<tr>
<th>Media Type</th>
<th>95% RSP 180 RSP Benchmark &lt;=90 sec</th>
<th>99.9% RSP 180 RSP Benchmark &lt;=180 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VHF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Reporting on CPDLC Actual Communication Performance (ACP)

**Period:** Jan 01, XXXX to Jun 30, XXXX (6 months)

#### Color key:
- Meets criteria
- 99.0%-99.9%
- Under criteria

<table>
<thead>
<tr>
<th>Media Type</th>
<th>95% RCP 240 benchmark ACP &lt;=180 sec</th>
<th>ACTP &lt;=120 sec</th>
<th>99.9% RCP 240 benchmark ACP &lt;=210 sec</th>
<th>ACTP &lt;=150 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VHF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAT/VHF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VHF/SAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ATSP:** air traffic service provider  
**SAT:** satellite  
**VHF:** very high frequency  
**HF:** high frequency
### Regional Airspace Report Example

#### REQUIRED SURVEILLANCE PERFORMANCE

<table>
<thead>
<tr>
<th>Region</th>
<th>2019 January-June</th>
<th>2019 July-December</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Criteria</td>
<td>No. Messages</td>
<td>Criteria</td>
</tr>
<tr>
<td><strong>RGS</strong></td>
<td></td>
<td>95%</td>
</tr>
<tr>
<td><strong>KZAK</strong></td>
<td>4,880,557</td>
<td>% &lt;= 90sec 98.40%</td>
</tr>
<tr>
<td><strong>NFFF</strong></td>
<td>285,717</td>
<td></td>
</tr>
<tr>
<td><strong>NTTT</strong></td>
<td>74,795</td>
<td></td>
</tr>
<tr>
<td><strong>NZZO</strong></td>
<td>428,959</td>
<td></td>
</tr>
<tr>
<td><strong>PAZA</strong></td>
<td>1,315,506</td>
<td></td>
</tr>
<tr>
<td><strong>RJJI</strong></td>
<td>2,454,906</td>
<td></td>
</tr>
<tr>
<td><strong>RPHI</strong></td>
<td>232,422</td>
<td></td>
</tr>
<tr>
<td><strong>VCCF</strong></td>
<td>598,937</td>
<td></td>
</tr>
<tr>
<td><strong>VOMM</strong></td>
<td>501,815</td>
<td></td>
</tr>
<tr>
<td><strong>VVTS</strong></td>
<td>244,731</td>
<td></td>
</tr>
<tr>
<td><strong>VYYF</strong></td>
<td>312,442</td>
<td></td>
</tr>
<tr>
<td><strong>WAFF</strong></td>
<td>290,831</td>
<td></td>
</tr>
<tr>
<td><strong>WZFC</strong></td>
<td>648,166</td>
<td></td>
</tr>
<tr>
<td><strong>WSJC</strong></td>
<td>1,189,990</td>
<td></td>
</tr>
<tr>
<td><strong>YBDD</strong></td>
<td>1,325,093</td>
<td></td>
</tr>
<tr>
<td><strong>YMM</strong></td>
<td>1,003,859</td>
<td></td>
</tr>
<tr>
<td><strong>ZLLL</strong></td>
<td>344,490</td>
<td></td>
</tr>
<tr>
<td><strong>ZWW</strong></td>
<td>190,925</td>
<td></td>
</tr>
</tbody>
</table>

#### REQUIRED COMMUNICATION PERFORMANCE

<table>
<thead>
<tr>
<th>Region</th>
<th>2019 January-June</th>
<th>2019 July-December</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Criteria</td>
<td>No. Messages</td>
<td>ACP Criteria</td>
</tr>
<tr>
<td><strong>RGS</strong></td>
<td></td>
<td>95%</td>
</tr>
<tr>
<td><strong>KZAK</strong></td>
<td>295,992</td>
<td>99.10%</td>
</tr>
<tr>
<td><strong>NFFF</strong></td>
<td>9,533</td>
<td>99.55%</td>
</tr>
<tr>
<td><strong>VVTS</strong></td>
<td>1,315,506</td>
<td></td>
</tr>
<tr>
<td><strong>VYYF</strong></td>
<td>2,454,906</td>
<td></td>
</tr>
<tr>
<td><strong>WAFF</strong></td>
<td>1,189,990</td>
<td></td>
</tr>
<tr>
<td><strong>WZFC</strong></td>
<td>1,003,859</td>
<td></td>
</tr>
<tr>
<td><strong>WSJC</strong></td>
<td>29,676</td>
<td>98.31%</td>
</tr>
<tr>
<td><strong>YBDD</strong></td>
<td>344,490</td>
<td></td>
</tr>
<tr>
<td><strong>ZWW</strong></td>
<td>190,925</td>
<td></td>
</tr>
</tbody>
</table>

**RGS**: remote ground station
Regional Reporting of Aircraft Performance

- Semi-annual reports compiled and posted on www.FANS-CRA.com for:
  - North Atlantic - Gander, New York, Santa Maria, Shanwick, Reykjavik
  - Pacific - Anchorage, Auckland, Fukuoka, Nadi, Oakland, Tahiti
- Annual reports for Asia-Pacific
  - Data compiled through and reported to the FANS Interoperability Team – Asia (FIT-Asia) group
- When “red” performance is observed operators are directed to contact relevant monitoring programs for more details to confirm any need for corrective action
Global Coordination for Aircraft Non-compliance

ATSP responsible for provision of ATS in the FIR in which non-compliant aircraft is observed

Designated RMA (FIR)

RMA with airspace responsibility of FIR associated with reporting ATSP

Designated RMA (CAA)

RMA with responsibility for CAA of aircraft observed with non-compliant performance

CAA

CAA of aircraft observed with non-compliant performance

RMA: regional monitoring agency
FIR: flight information region
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAMA</td>
<td>Australian Airspace Monitoring Agency</td>
</tr>
<tr>
<td>ARMA</td>
<td>African and Indian Ocean (AFI) Regional Monitoring Agency</td>
</tr>
<tr>
<td>CARSAMMA</td>
<td>Caribbean and South American Monitoring Agency</td>
</tr>
<tr>
<td>China RMA</td>
<td>China Regional Monitoring Agency</td>
</tr>
<tr>
<td>EurAsia RMA</td>
<td>Regional Monitoring Agency Eurasia</td>
</tr>
<tr>
<td>Eur RMA</td>
<td>European Regional Monitoring Agency</td>
</tr>
<tr>
<td>Japan RMA</td>
<td>Japan Regional Monitoring Agency</td>
</tr>
<tr>
<td>MAAR</td>
<td>Monitoring Agency for Asia Region</td>
</tr>
<tr>
<td>Mid RMA</td>
<td>Middle East Regional Monitoring Agency</td>
</tr>
<tr>
<td>NAARMO</td>
<td>North American Approvals Registry and Monitoring Organization</td>
</tr>
<tr>
<td>NAT CMA</td>
<td>North Atlantic Central Monitoring Agency</td>
</tr>
<tr>
<td>PARMO</td>
<td>Pacific Approvals Registry and Monitoring Organization</td>
</tr>
<tr>
<td>SATMA</td>
<td>South Atlantic Monitoring Agency</td>
</tr>
</tbody>
</table>
Monitoring Aircraft Performance for Non-compliance

Compile data

Identify airframes below 95% for RSP180 and/or RCP240

Check if aircraft filed P2/RSP180

Investigate further

If aircraft DID file P2/RSP180: Submit non-compliance report to relevant RMA

If aircraft DID NOT file P2/RSP180: Contact operator if possible, or submit problem report to FANS-CRA for further investigation

FANS-CRA: future air navigation system – central reporting agency
ATSP Investigation Considerations

- Check if performance issue occurred on one leg during monitoring period and was subsequently resolved.
- Check media types of reports > 90 seconds (and reports before and after)
  - Helps identify or confirm HF data link problems, media transition problems, specific media/path problem.
- Plot position reports and check locations of reports > 90 seconds
  - Helps identify if delays occur in VHF/SAT or SAT/SAT transition areas, FIR boundaries.
- Check performance in 2 previous months
  - Helps identify ongoing vs. new problems, scope of problem.
- Check estimated PORT if ACP < 95%
  - *May* help identify abnormal pilot response behavior.
### All Airframes by Media Type

<table>
<thead>
<tr>
<th>COMTYPE</th>
<th>ADS-C Message download counts</th>
<th>95% RSP 180 benchmark ASP &lt; 90 secs</th>
<th>99.9% RSP 180 benchmark ASP &lt; 180 secs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate</td>
<td>1,643</td>
<td>94.45%</td>
<td>96.14%</td>
</tr>
<tr>
<td>SAT</td>
<td>1,457</td>
<td>99.25%</td>
<td>99.92%</td>
</tr>
<tr>
<td>VHF</td>
<td>66</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
<tr>
<td>HF</td>
<td>12</td>
<td>53.85%</td>
<td>53.85%</td>
</tr>
<tr>
<td>HP-SAT</td>
<td>57</td>
<td>92.98%</td>
<td>92.98%</td>
</tr>
<tr>
<td>SAT-VHF</td>
<td>6</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
<tr>
<td>VHF-SAT</td>
<td>5</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

### All Airframes Map

### Data of Airframe report under 95% by operator/aircraft type

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME</th>
<th>DEL (in)</th>
<th>ACD</th>
<th>LAT</th>
<th>LONG</th>
<th>RESI</th>
<th>TYP</th>
<th>COMTYPE</th>
<th>ITV</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/7/2020</td>
<td>8:11-11:30 AM</td>
<td>3</td>
<td>F64502</td>
<td>25.9717</td>
<td>-133.6817</td>
<td>ITD</td>
<td>VHF</td>
<td>9099</td>
<td></td>
</tr>
<tr>
<td>8:20-23:14 AM</td>
<td>3</td>
<td>F64502</td>
<td>22.2360</td>
<td>-152.4213</td>
<td>ITD</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:20-23:14 AM</td>
<td>3</td>
<td>F64502</td>
<td>22.2361</td>
<td>-152.4213</td>
<td>ITD</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:20-23:14 AM</td>
<td>3</td>
<td>F64502</td>
<td>22.3502</td>
<td>-151.8228</td>
<td>AME1</td>
<td>WCE</td>
<td>SAT</td>
<td>9099</td>
<td></td>
</tr>
<tr>
<td>8:24-00:39 AM</td>
<td>3</td>
<td>F64502</td>
<td>22.4334</td>
<td>-151.7067</td>
<td>AME1</td>
<td>WCE</td>
<td>SAT</td>
<td>9099</td>
<td></td>
</tr>
<tr>
<td>8:27-44:11 AM</td>
<td>111</td>
<td>F64502</td>
<td>22.6839</td>
<td>-151.1803</td>
<td>AME1</td>
<td>WCE</td>
<td>SAT</td>
<td>9099</td>
<td></td>
</tr>
<tr>
<td>8:30-21:43 AM</td>
<td>1</td>
<td>F64502</td>
<td>22.8633</td>
<td>-150.3127</td>
<td>AME1</td>
<td>WCE</td>
<td>SAT</td>
<td>9099</td>
<td></td>
</tr>
<tr>
<td>8:40-00:00 AM</td>
<td>705</td>
<td>F64502</td>
<td>23.5</td>
<td>-149.4739</td>
<td>H5</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:44-11:38 AM</td>
<td>382</td>
<td>F64502</td>
<td>23.7742</td>
<td>-151.8933</td>
<td>H5</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:59-12:19 AM</td>
<td>771</td>
<td>F64502</td>
<td>24.7661</td>
<td>-146.7736</td>
<td>M2</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:17-45:46 AM</td>
<td>641</td>
<td>F64502</td>
<td>25.2447</td>
<td>-154.1874</td>
<td>M2</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:19-14:39 AM</td>
<td>430</td>
<td>F64502</td>
<td>25.2772</td>
<td>-154.1079</td>
<td>M2</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:18-48:50 AM</td>
<td>627</td>
<td>F64502</td>
<td>25.3069</td>
<td>-154.4826</td>
<td>AME1</td>
<td>WCE</td>
<td>SAT</td>
<td>9099</td>
<td></td>
</tr>
<tr>
<td>9:19-24:36 AM</td>
<td>63</td>
<td>F64502</td>
<td>25.6856</td>
<td>-144.115</td>
<td>AME1</td>
<td>WCE</td>
<td>SAT</td>
<td>9099</td>
<td></td>
</tr>
<tr>
<td>9:32-15:27 AM</td>
<td>134</td>
<td>F64502</td>
<td>25.6456</td>
<td>-142.1894</td>
<td>M2</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:37-37:12 AM</td>
<td>12</td>
<td>F64502</td>
<td>25.9244</td>
<td>-141.4794</td>
<td>M2</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:47-13:47 AM</td>
<td>7</td>
<td>F64502</td>
<td>27.4227</td>
<td>-140.1814</td>
<td>AME1</td>
<td>WCE</td>
<td>SAT</td>
<td>9099</td>
<td></td>
</tr>
<tr>
<td>9:56-49:57 AM</td>
<td>517</td>
<td>F64502</td>
<td>27.9669</td>
<td>-138.8972</td>
<td>M2</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:57-09:57 AM</td>
<td>780</td>
<td>F64502</td>
<td>27.9128</td>
<td>-138.8531</td>
<td>M2</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:01-16:53 AM</td>
<td>513</td>
<td>F64502</td>
<td>28.1247</td>
<td>-138.1688</td>
<td>M2</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:09-15:19 AM</td>
<td>519</td>
<td>F64502</td>
<td>28.3472</td>
<td>-137.8392</td>
<td>M2</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:20-13:47 AM</td>
<td>627</td>
<td>F64502</td>
<td>29.1494</td>
<td>-134.794</td>
<td>M2</td>
<td>VHF</td>
<td>9099</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### PBCS ATSP Non-compliance Report Form

<table>
<thead>
<tr>
<th>Report Date:</th>
<th>7/27/2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period of observed non-compliance:</td>
<td>January-March 2020</td>
</tr>
<tr>
<td>Reporting Air Traffic Service Provider (ATSP):</td>
<td>FAA - Oakland</td>
</tr>
<tr>
<td>Contact email address(es) at Reporting ATSP:</td>
<td><a href="mailto:FAAAPBCSmonitoring@faa.gov">FAAAPBCSmonitoring@faa.gov</a></td>
</tr>
<tr>
<td>Reporting to Regional Monitoring Agency (RMA):</td>
<td>PARMO</td>
</tr>
<tr>
<td>ICAO CODE:</td>
<td>XXX</td>
</tr>
<tr>
<td>Airline Operator:</td>
<td>XXX Inc.</td>
</tr>
<tr>
<td>Economy of Operator/Registry:</td>
<td>United States</td>
</tr>
</tbody>
</table>

### PBCS Data

<table>
<thead>
<tr>
<th>FIR</th>
<th>4-letter ICAO Aircraft Type</th>
<th>Registration</th>
<th>ADS-C downlink Message Counts</th>
<th>95% RSP 180 Benchmark</th>
<th>CPDLC Transaction Counts</th>
<th>95% RCP 240 benchmark</th>
<th>Issue code</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ASP &lt;=90 sec</td>
<td>ACP &lt;=180 sec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KZAK</td>
<td>B772</td>
<td>Reg 1</td>
<td>410</td>
<td>93.41%</td>
<td>25</td>
<td>96.00%</td>
<td>(*1)(*3)</td>
</tr>
<tr>
<td>KZAK</td>
<td>B772</td>
<td>Reg 2</td>
<td>290</td>
<td>94.48%</td>
<td>21</td>
<td>95.24%</td>
<td>(*1)</td>
</tr>
</tbody>
</table>
ICAO Doc 9869, Edition 2, PBCS Manual, 4.2.3.8 states that the CAA should establish a means to verify that aircraft operators filing PBCS capabilities in the flight plan are authorized. RMAs have agreed to support this activity, but require the necessary data, which consists of:

- Records from CAAs indicating which aircraft have obtained operational authorization for RCP240 and/or RSP180.
- Traffic movement data from ATSPs that includes whether each flight filed P2 in item 10 and RSP180 in item 18.

CAAs should coordinate with their RMA to ensure that the necessary data is provided, as appropriate.
Monitoring Availability of Network

- Difficult to measure (ongoing work by PBCS Project Team)
- ATSPs should track reports from communication service providers and collect data on impacts to determine acceptability of network performance
  - Impacts detected by observations of:
    - Increase in delays of ADS-C Reports (>180 seconds)
    - Increase in CPDLC uplink failures
    - Increase in controller workload
  - Air traffic impacts not always matched to CSP impacts
    - Depends on traffic loading at the time of outage and redundancies in place (e.g. overlapping satellite coverage, multiple ground stations)
Problem Reporting, Investigation and Resolution

• Data collection typically involves obtaining logs from involved parties

• May include:
  – aircraft maintenance system logs
  – built-in test equipment data dumps for some aircraft systems
  – SATCOM (satellite communications) activity logs
  – logs/printouts from the flight crew and recordings/logs from the ATSPs involved in the problem

• Crucial for events to be reported shortly after event so that entity conducting investigation can request and obtain necessary data in a timely manner (much of it subject to limited retention)
NAT and PAC Central Reporting Agency (CRA) www.FANS-CRA.com

1. Users register for account to obtain secure access
   – Available to any FANS (future air navigation system) data link stakeholder
   – Only 1 account per company/organization

2. Users can:
   – Log data link problem reports
   – View common data link problems, solutions, and recommended software versions in the “FANS Problem Solution Tracker”
   – Sign up for the PBCS Charter
   – View semi-annual regional monitoring results provided by fleet and by registration numbers for contributing FIRs
Performance deterioration occurred May and June 2018
  – notable increase in HF Datalink messaging

Feedback from Boeing to modify subnetwork order of preferences for ATC (FANS CPDLC and ADS-C) downlink messages
  – order should be (1) VHF, then (2) SATCOM, and then (3) HF (provide successively poorer performance)
  – **Note**: Boeing’s statement that 787 meets RCP240 and RSP180 is based on HF being the last preference (or not a preference at all) for ATC downlink messages in the CMF (communication management function) AMI (airline modifiable information)

Performance notably improved in October 2018 after changes made
Oakland FIR - Oper X B788
Actual Surveillance Performance (ASP)

- 95%
- 99.9%
- May-18 (4492)
- Jun-18 (4459)
- Jul-18 (6439)
- Aug-18 (6225)
- Sep-18 (5503)
- Oct-18 (4702)
- Nov-18 (3890)
- Dec-18 (3800)
- Jan-19 (3576)
Monitoring Example 2:
Poor Performance for B738 Fleet

Comparison of actual surveillance performance before and after Core-14 upgrade/Disable Next-on-busy

- Sep-19
- Nov-19
- RSP180 criteria - 95% < 90 sec
Monitoring Example 3: Network Delivery Path

- Significant increase in delays > 180 sec via Iridium SITA delivery path - end of January into February 2018
- Assessment of performance by day traced problem to SITA maintenance work in late January

<table>
<thead>
<tr>
<th>ANCHORAGE</th>
<th>Dec 2017</th>
<th>Feb 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provider</td>
<td>ADS-C cnt</td>
<td>% &lt; 90</td>
</tr>
<tr>
<td>ARINC Iridium</td>
<td>7,514</td>
<td>93.8%</td>
</tr>
<tr>
<td>SITA Iridium</td>
<td>5,347</td>
<td>95.6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fleets using SITA Iridium</th>
<th>ADS-C cnt</th>
<th>% &lt; 90</th>
<th>% &lt; 180</th>
<th>ADS-C cnt</th>
<th>% &lt; 90</th>
<th>% &lt; 180</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fleet 1</td>
<td>433</td>
<td>98.9%</td>
<td>99.8%</td>
<td>275</td>
<td>86.6%</td>
<td>91.3%</td>
</tr>
<tr>
<td>Fleet 2</td>
<td>1,610</td>
<td>96.2%</td>
<td>98.1%</td>
<td>1,359</td>
<td>88.7%</td>
<td>92.6%</td>
</tr>
<tr>
<td>Fleet 3</td>
<td>1,132</td>
<td>93.0%</td>
<td>95.3%</td>
<td>419</td>
<td>89.3%</td>
<td>93.3%</td>
</tr>
<tr>
<td>Fleet 4</td>
<td>1,092</td>
<td>95.5%</td>
<td>98.7%</td>
<td>1,623</td>
<td>82.9%</td>
<td>88.5%</td>
</tr>
<tr>
<td>Fleet 5</td>
<td>13</td>
<td>100%</td>
<td>100%</td>
<td>16</td>
<td>56.2%</td>
<td>75%</td>
</tr>
</tbody>
</table>
Key Points

• This presentation provided a summary of:
  – ICAO requirements and guidance for PBCS monitoring programs
  – practical information to support implementation
  – notable examples of problems identified through monitoring
• Attendees are encouraged to make use of the resources provided throughout this presentation to support PBCS implementation activities
Follow us on social media

www.apec.org

www.facebook.com/APECnews

www.linkedin.com/company/asia-pacific-economic-cooperation-apec-secretariat
PBCS: An ANSP Regulator’s Perspective

Day 3

Presented by
Jennifer Kileo, Manager, International Integration Staff, Air Traffic Safety Oversight Service, FAA
This presentation will provide information on:

- ICAO PBCS Air Navigation Service (ANS) Safety Oversight Standards
- ANSP PBCS Compliance
- PBCS ANS Safety Oversight Concepts
In accordance with Annex 19, the Civil Aviation Authority (CAA) provides safety oversight to ensure safe, regular and efficient conduct of operations.

The PBCS concept applies RCP and RSP specifications to support CAA 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.
PBCS Compliance

Performance improvement

Aircraft Manufacturer
Avionics Supplier
Operator
CSP
SSP
Regional PBCS monitoring
ANSP

ANSP PBCS monitoring, data collection and RCP – RSP analysis

Network
FANS 1/A

Operator CSP SSP

ANSP PBCS monitoring
4.2.2 CAA safety oversight of an ANSP

4.2.2.1 When an RCP/RSP specification is prescribed, the CAA should ensure that the ANSP establishes means to assess the actual performance of communication and surveillance services in a particular airspace prior to operational implementation of associated ATM operations. In addition to ensuring that the ANSP adheres to the guidelines of section 4.3.1, the ANSP should determine that the actual performance within the applicable airspace complies with the RCP/RSP specification.

4.2.2.2 The CAA should also ensure that the ANSP performs ATM operations predicated on RCP/RSP specifications in the applicable airspace only to aircraft operators that file the appropriate PBCS capability in the flight plan, in accordance with section 4.4.
4.2.2.3 To determine compliance in the applicable airspace, **the CAA should obtain a sufficient sample** from the applicable airspace of the actual communication performance (ACP) of relevant communication transactions and actual surveillance performance (ASP) of surveillance data delivery measured against RCP/RSP (Required) time values...

4.2.2.4 **The CAA should ensure** that the **ANSP establishes a means to notify the operator** and the Economy of the Operator or the CAA of Registry when the actual performance of the operator’s fleet, taking into account different aircraft types/systems, does not comply with an RCP/RSP specification.

4.2.2.5 **The CAA should ensure** that the **ANSP establishes a means to assess the risk of any non-compliance** with the RCP/RSP specification and take appropriate action to correct the related deficiency and provide notification, as appropriate.
Complying with RCP/RSP Specifications

- **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)
1. Establish a formal internal policy or process to ensure compliance that would determine roles and responsibilities in assessing the actual performance of communication and surveillance services in accordance with the PBCS guidance, such as:

The responsible party(s) to:

- Establish and conduct effective monitoring process (para. 4.2.2.1 and 4.2.2.3)
- Publish and receive data reports
- Establish a means to notify when performance does not comply with RCP/RSP specifications (para. 4.2.2.4)
- Oversee the risk assessment process, resolution of issues, and monitoring of corrective action plans (para. 4.2.2.5)
2. Establish effective data management and analysis

- Determine available data and sources
- Determine data required for regulatory activities
  - Reliability of the system (RCP and RSP > 95%)
  - Actual Communication Performance (ACP) and Actual Surveillance Performance (ASP)
- Establish reporting agreements to include format, frequency, tracking and dissemination of information, issue identification and resolution, with the data sources
- Create position description, job aids and guidance materials to capture the responsibilities of the report recipients (data analysis, identification of corrective actions plans and mitigations)
- Conduct data analysis and identify trends
3. Establish a surveillance and audit process
   • Include the authority, and roles and responsibilities of offices involved and Safety Inspectors and management
   • Conduct appropriate surveillance activities (audits, assessments, investigations, inspections), according to safety standards and mandatory requirements (data collection and briefings)
   • Include record management tools, work instructions, and templates
   • Conduct post surveillance activities that would validate findings
   • Resolve non-compliance and non-performance issues and monitor corrective action plans
Key Points

- Based on ICAO PBCS Safety Oversight Standards, ANS Regulators should ensure the ANSP:
  - establishes means to assess the actual performance of communication and surveillance services in a particular airspace
  - performs ATM operations predicated on RCP/RSP
  - establishes a means to notify the operator… when the actual performance of the operator’s fleet does not comply with an RCP/RSP specification
  - establishes a means to assess the risk of any non-compliance

- ANS Regulators should establish a formal internal policy or process to ensure compliance that would determine roles and responsibilities, effective data management and analysis, and a surveillance and audit process
Follow us on social media

www.apec.org

www.facebook.com/APECnews

www.linkedin.com/company/asia-pacific-economic-cooperation-apec-secretariat
Day 3 Recap of PBCS: Putting it All Together

Presented by
Paul Radford, Oceanic Systems Development Specialist, Airways (NZ)
Jennifer Kileo, Aviation Safety, U.S. Federal Aviation Administration
Theresa Brewer, ICAO PBCS Project Team Lead, Office of NextGen
Day 3 Wrap-up

ANSP Key Points:

• Guidance material and aids are available to assist an ANSP with PBCS implementation, and provided implementation examples from an ANSP implementation.
• Attendees are encouraged to make use of the guidance material and examples in this presentation to support their PBCS implementation activities.
Day 3 Wrap-up

Monitoring Key Points:

• Monitoring ensures continued compliance of the end-to-end system as well as the individual airspace, aircraft, and networks.

• Monitoring enables continuous system improvement through the reporting, investigation, and resolution of problems.

• Practical information to support implementation of a PBCS monitoring program is provided on the website: www.FANS-CRA.com
Day 3 Wrap Up

**ANSP Regulator Key Points:**

- Based on ICAO PBCS Safety Oversight Standards, ANS Regulators should ensure the ANSP:
  - establishes means to assess the actual performance of communication and surveillance services in a particular airspace
  - performs ATM operations predicated on RCP/RSP
  - establishes a means to notify the operator... when the actual performance of the operator’s fleet does not comply with an RCP/RSP specification
  - establishes a means to assess the risk of any non-compliance

- ANS Regulators should establish: a formal internal policy or process to ensure compliance that would determine roles and responsibilities, effective data management and analysis, and a surveillance and audit process
Follow us on social media

www.apec.org

www.facebook.com/APECnews

www.linkedin.com/company/asia-pacific-economic-cooperation-apec-secretariat
REFERENCES


ICAO Document 4444 (PANS-ATM). https://store.icao.int

ICAO Document 8168 (PANS-OPS). https://store.icao.int

ICAO Annex 6. https://store.icao.int

ICAO Annex 10 (Volume II). https://store.icao.int

ICAO Annex 11. https://store.icao.int


ICAO Annex 11 (Paragraphs 2.8.1-2.8.2, 2.9.1-2.9.3, 3.3.5.2-3.3.5.3, 6.1.1.2). https://store.icao.int

ICAO Document 4444 (Paragraphs 5.4.1.2.1.6, 5.4.2.9.2). https://store.icao.int

ICAO Annex 6 (Part I, Paragraphs 7.1.3-7.1.5, 7.3.2-7.3.4; Part II, Paragraphs 2.5.1.6-2.5.1.9, 2.5.3.2-2.5.3.5). https://store.icao.int

IATA Economics, IATA Statistics. www.iata.org

IATA Economics, January 2021 update. www.iata.org

ICAO Annex 6, Parts I, II, III. https://store.icao.int


ICAO Annex 19. https://store.icao.int

ICAO Annex 1. https://store.icao.int

ICAO Annex 8. https://store.icao.int

ICAO Document 8400 (PANS Abbreviations and Codes). https://store.icao.int


ICAO 10063 (Manual on Monitoring the Application of Performance-based Horizontal Separation Minima, Edition 1). [https://store.icao.int](https://store.icao.int)


FAA AC 90-117 Datalink Communications. [https://www.faa.gov/documentlibrary/media/advisory_circular/ac_90-117.pdf](https://www.faa.gov/documentlibrary/media/advisory_circular/ac_90-117.pdf)


Datalink Communications Compliance Guide. [http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/enroute/oceanic/data_link/](http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/enroute/oceanic/data_link/)

ICAO Document 9869 (Manual on Required Communication Performance). [https://store.icao.int](https://store.icao.int)

ICAO Oceanic Errors Safety Bulletin. [https://store.icao.int](https://store.icao.int)


ICAO Document 9869 (Chapter 3, Appendix B, Appendix C). [https://store.icao.int](https://store.icao.int)

ICAO Document 10038. [https://store.icao.int](https://store.icao.int)

ICAO Document 9869 (Chapter 4, Section 4.4). [https://store.icao.int](https://store.icao.int)

ICAO Document 9869 (Chapter 4, Section 4.5, Appendix D, Appendix E). [https://store.icao.int](https://store.icao.int)

ICAO Document 9869 (Chapter 4, Sections 4.2.2, 4.3.1, 4.3.2, Appendix D, Appendix E). [https://store.icao.int](https://store.icao.int)

ICAO Document 9937. [https://store.icao.int](https://store.icao.int)

ICAO Letter Ref. T 3/10.1.17 – API00/19 (ATM) 17 September 2019. [https://store.icao.int](https://store.icao.int)

Online PBCS Analysis Tool. [https://pbcsanalysis.herokuapp.com/](https://pbcsanalysis.herokuapp.com/)

ICAO Document 9869 (Paragraph 1.3.5). [https://store.icao.int](https://store.icao.int)

CRA Registration. [https://www.FANS-CRA.COM](https://www.FANS-CRA.COM)

PBCS Charter. [https://www.FANS-CRA.COM/charter/](https://www.FANS-CRA.COM/charter/)

Stakeholder resources. [https://www.FANS-CRA.COM/charter/stakeholders/](https://www.FANS-CRA.COM/charter/stakeholders/)