Driving Success in Aviation:
Addressing Key Industry Challenges to Empower Airlines
Driving Success in Aviation: Seamless Air Alliance Returns to Address Key Industry Challenges and Empower Airlines
Thursday, September 7, 2023; 4:00pm – 5:15pm

Jack Mandala
Chief Executive Officer
Seamless Air Alliance
Moderator

Brian Kirby
Senior Technical Product Manager
Telesat

André Patrick
Manager, In-Flight Wi-Fi & Analytics
Air Canada

Thomas Locke
Chief Technology Officer
GlobalReach Technologies

Mark Nash
Head of Commercial Roaming
Panasonic Avionics

Sean Yarborough
Vice President, Product Management
ST Engineering iDirect,

Peter Lemme
Chief Consultant
Seamless Air Alliance
Seamless Air Alliance at a Glance

- Current Working Groups: 6
- Releases Completed: 6
- Participants from Member Companies: 200+
- Membership Breakout:
  - Airlines
  - Technology Suppliers
  - MNO
  - SAT
A Global Collaboration of Airlines and Technology Leaders

OpenIFC
Open Innovation for Inflight Connectivity
12 IFC Experience (EXP) Documents | 340 Pages

<table>
<thead>
<tr>
<th>Number</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXP-0</td>
<td>Master IFC EXP Program</td>
</tr>
<tr>
<td>EXP-1</td>
<td>Measuring Specific Application Service Quality</td>
</tr>
<tr>
<td>EXP-2</td>
<td>Measuring Web Browsing Service Quality</td>
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<tr>
<td>EXP-3</td>
<td>Measuring Streaming Service Quality</td>
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<td>EXP-4</td>
<td>Measuring Wi-Fi Networking Service Quality</td>
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<td>EXP-5</td>
<td>Measuring Backhaul Networking Service Quality</td>
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<td>EXP-6</td>
<td>Measuring Portal Service Quality</td>
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<td>EXP-7</td>
<td>Measuring User Device Service Quality</td>
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<tr>
<td>EXP-8</td>
<td>Measuring Application Server Service Quality</td>
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<td>EXP-9</td>
<td>Measuring Wi-Fi AAA Service Quality</td>
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<td>EXP-10</td>
<td>Measuring IFC Product AAA Service Quality</td>
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<td>EXP-11</td>
<td>Measuring IFC Platform Quality</td>
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<td>EXP-12</td>
<td>Quality Control Agents</td>
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</table>

Compliance Matrix | 500+ Criteria
Want to know if your passengers are having a great connectivity experience?

Insist that your service provider is Seamless Certified.
Seamless Expert Working Groups

1. Architecture and Interoperability (Airbus+Boeing)
   • Generic onboard terminal
   • Open stack radio access nodes - WAP and eNodeB/gNodeB

2. Airline Forum
   • Certified IFC Service Quality (set requirements, feedback/approval)

3. Technical Forum
   • Certified IFC Service Quality (design, test, proposals to airline forum)

4. Hosted Platforms
   • General purpose HW, software defined applications/marketplace

5. Personalization
   • Ancillary revenues, advanced authentication, secure attachment

6. Standards
   • GSMA collaboration for widespread MNO roaming agreements
   • 5G NTN ←NEW!!
Leading Global Standards
for Inflight Connectivity

Brian Kirby
Senior Technical Product Manager
Telesat
The Quest for Great Connectivity

Begins with how and what you measure!

- Service Level Agreements history
  - Focus on Backhaul
  - Quality of Service

- Challenges
  - Competing apps
  - App response to latency, jitter
  - Heavy users
  - Onboard constraints
The Quest for Great Connectivity

Developing Useful SLA's
Approach to Solution

Define the end-to-end system, elements

Define and set the service measures for QoS, QoE (IFC Toolkit)

Relate IFC Toolkit to QoS/QoE metrics, Define Onboard Agent process

Measurements, definition & scoring for QoS/QoE

Progressive Design Process
Seamless Certified Philosophy

• **Concept**
  • Common tools, measurements, and targets for effective QoS and QoE
  • Start with achievable milestones
  • Set an iterative path for growth

• **Constraints and Challenges**
  • Employ industry-available, effective network tools
  • Avoid network burden
  • Avoid analysis paralysis
Seamless Certified Example

Web-browsing QoE metrics – First Contentful Paint, Largest Contentful Paint

Tools consist of:
- Standardized reference webpage
- Scoring methodology
- Scoring criteria – Unusable, Poor, OK, Good, Great
SEAMLESS AIR ALLIANCE LAUNCHES FIRST-OF-ITS-KIND CERTIFIED SERVICE QUALITY PROGRAM FOR INFLIGHT CONNECTIVITY

Thales announced as the first connectivity provider qualified for new Seamless-Certified Service Quality program

Hamburg, 1 June 2023 – Seamless Air Alliance, the leading developer of global standards for Inflight Connectivity (IFC), today announced launch of the Seamless-Certified Service Quality program for connectivity service providers and the first member company to achieve Seamless-Certification.

The program includes a suite of network performance and application-specific test measurements, a consistent method for calculating the measurements, and a composite score that relates the individual measurement scores to overall passenger satisfaction. These industry-agreed measures enhance visibility into the passenger experience to ensure that it is satisfactory or to act when necessary.
What’s Ahead

- Refine performance targets
- Comprehensive Scoring Philosophy
- Change Control process on scoring
- Research new methods for measuring passenger traffic
Join us!

Happy to welcome new Seamless participants to the ongoing TECH discussions!
Questions?
Leading Global Standards for Inflight Connectivity

André Patrick
Manager, In-Flight Wi-Fi & Analytics
Air Canada
IFC Airline Forum

Operates as the counterweight to the Technical forum to review & provide feedback

**Airline Forum**
- Provide initial objectives/requirements based on needs and pain points
- Review TECH proposals and provide feedback (accept or propose changes)
- Provide input for the certification programs

**Technical Forum**
- Technology and use case exploration and assessments
- Submits proposal of new solutions (e.g., definition of QoS/QoE implementation)
- Define strategy for certification programs

- Steering group for Seamless Certification Program
- Create and Manage IFC Issue List
- Create and Manage IFC Wish List (proposed work items)
IFC Airline Forum

Measuring Performance
• Current metrics versus upcoming metrics (QoE)
• In-house methods
• Third-Party vendors

Why it Matters
• Customer experience
• Growing importance/focus/innovation of IFC
• Connected things
• CSAT Scores
IFC Airline Forum

**Rel-6 Achievements**

- Industry-agreed measurements for network performance, web, and streaming QoE
- Launch of the Seamless Certification program!

**Current (Rel-7) Focus**

- A space for airlines to discuss IFC challenges
- Create and maintain IFC issue list
  - IFC problems
  - In-service scoring thresholds and rollup satisfaction levels
  - Personalization and Ancillary Revenue Activity
  - Standardizing touch points, integration, reporting
  - IFC features
Questions?
Leading Global Standards for Inflight Connectivity

Thomas Locke
Chief Technology Officer
GlobalReach Technology
Who are GlobalReach?
Passpoint is a technology that eliminates the need for a user to manually find and connect onto a Wi-Fi network each time they visit a venue.

- One time device provisioning process
- Seamless and Secure connectivity
- Multiple authentication methods
Who is using Passpoint?

**MNOs**
Mobile network operators that want their subscribers to always be connected

**Brands**
Brands that have a strong loyalty program and a well-established app, that want to offer a better end user experience

**Roaming Federations**
Roaming federations like Eduroam and OpenRoaming that want an industry standard
Why use Passpoint?

**PREMIUM WI-FI SERVICE**
- Seamless and secure (WPA2/3)

**MAC RANDOMIZATION**
- Subscriber based authentication

**ENGAGEMENT**
- Portal redirect and APP Push Notifications

**TAKE-UP RATES**
- Automatic connectivity

**APP LEVERAGE**
- Device Provisioning

**REVENUE**
- Portal Upsell and MNO Carrier offload

**LOYALTY / FFP**
- Tier based service offering

**PERSONALIZATION**
- User aware on network association

**INSIGHTS**
- Who
- Where
- When
# Airline vs MNO identities

<table>
<thead>
<tr>
<th>Profile Issuer</th>
<th>Arline Identity</th>
<th>MNO Identity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Provisioning Responsibility</strong></td>
<td>Loyalty app (one time) * Note that if the app is removed, network connectivity is lost, which promotes app stickiness</td>
<td>Carrier bundle: brand has no influence; transparent provisioning to the end user</td>
</tr>
<tr>
<td><strong>Authentication Type</strong></td>
<td>User account, loyalty ID etc.</td>
<td>SIM</td>
</tr>
<tr>
<td><strong>Association Method</strong></td>
<td>Passpoint, 802.1x</td>
<td>Passpoint, 802.1x</td>
</tr>
<tr>
<td><strong>Identity Ownership</strong></td>
<td>User record is owned and managed by Airline</td>
<td>User record is owned and managed by MNO</td>
</tr>
<tr>
<td><strong>Data Ownership</strong></td>
<td>Users are known to Airline</td>
<td>Users on brand network are anonymous to brand</td>
</tr>
<tr>
<td><strong>Proximity Marketing</strong></td>
<td>Arrival, on-premise, departure</td>
<td>Not possible by Airline</td>
</tr>
</tbody>
</table>
Questions?
Leading Global Standards for Inflight Connectivity

Mark Nash
Head of Commercial Roaming
Panasonic Avionics
Mobile Roaming via Wi-Fi

07th September 2023

Mark Nash, Head of Commercial Roaming | Panasonic Avionics
ROAMING
Roaming lets the mobile subscriber use voice, text and data services when outside of their mobile network operator’s (MNO). The subscriber’s PED connects to a visited network.

IN-FLIGHT MOBILE ROAMING
Panasonic Avionics operates an in-flight mobile network - where AeroMobile is the visited network - enabling 380+ MNOs around the world to extend their services into the cabin.

MOBILE ROAMING VIA WI-FI
Similar in definition to mobile roaming. In this case, the subscriber connects to data and voice services via the cabin Wi-Fi network rather than a cabin mobile network.

What is Mobile Roaming via Wi-Fi?
Mobile Operators in the IFC Ecosystem

- According to Juniper Research, over 4.5 billion airline eTickets or boarding passes will be issued in 2023.
- Insights from a Panasonic Avionics Passenger Engagement Metrics Survey show that in 2022 nearly all flyers (88%) brought a smartphone on their last flight.
- All smartphones are connected to a mobile network operator.
- 750+ mobile operators globally are members of the GSMA.
- Passengers want to stay connected throughout their journey.
From contract...

The objective of the cooperation Agreement is to co-create the necessary principles to simplify the process and procedures for establishing commercial roaming agreements between GSMA Members and Seamless Air Alliance Members for in-flight connectivity. ("Objectives")

Current Initiative

- Working with the GSMA to add in-flight Wi-Fi annex to existing GSMA roaming agreements.
- Creating a standard framework agreement between mobile network operators and airlines or IFC service providers.
The Value of Mobile Roaming via Wi-Fi for Airlines

**AIRLINES**

- Improve passenger satisfaction and NPS.
- Increase take-up rates of IFC services.
- Increase return on investment (ROI) – reducing costs or increasing revenue.

**PASSENGERS**

- Want to connect and stay connected at home, at work and when they fly – “at-home” experience is expected.
- The connection experience needs to be easy, intuitive and affordable.

**MOBILE ROAMING VIA WI-FI**

- Enable passenger to connect using their mobile subscription, in addition to portal-based connectivity products.
- In-flight roaming is bundled with passengers’ existing mobile packages.
- Leverage our existing, strong presence in the mobile network community.
Roaming Examples
Panasonic Avionics has 380+ roaming relationships that we can leverage to offer mobile roaming via Wi-Fi.

United partnered with T-Mobile to offer free in-flight Wi-Fi to T-Mobile customers.

AT&T includes in-flight roaming in their popular Day Roaming Pass.
• The cabin will be Passpoint capable, enabling mobile roaming via Wi-Fi.
• Passengers will increasingly connect through the MNO, alongside other mechanisms such as frequent flier program or a WISP.
• Connection must be easy and intuitive.
• Price must be affordable.
Questions?
Leading Global Standards for Inflight Connectivity

Sean Yarborough
Vice President, Product Management
ST Engineering iDirect
WG SR7 – Architecture and Interoperability

Software-Defined Modem (SDM/SDR)

Sean Yarborough
Vice President, Product Management
ST Engineering iDirect
Always Onboard
Remarkable Flights

40%
total modems installed
Today’s Modem Limitations and Airline Challenges

- **GEO global**: Airlines have to equip planes with more modems requiring more space, power, and coordination.
- **GEO regional**: Airlines alternatively have gaps in coverage.
- **GEO regional 2**: Airlines require contracts with multiple service providers to cover flight routes thoroughly.
- **LEO**: Airlines face difficulty to leverage NGSO constellations and need better options to integrate.
- **HEO polar**: Airlines see more complex network management required to maintain multi-provider coverage.
Select and use coverage across multiple networks and orbits for true global connectivity

Interoperable modem hardware; a single modman per airplane

Multiple software-defined modem images

Standardized interfaces between hardware and software

Lower power and size requirements, reducing total cost

Uninterrupted Service to Airline, Aircraft, and Passenger
Next Generation Advanced Mobility

Service Provider Network #1

Service Provider Network #2
Software Defined Modem
Enabling Universal Modem Hardware

Modem application software and features (driven by use case) in virtualized “containers”

Software build of the physical layer and control plane for the defined architecture

Reference architecture and documentation supplied for pre-defined interfaces & APIs

Partner will supply modem hardware and use specific supported architectures (FPGA / ASIC / CPU)

iDirect
Shared
Partner/Integrator
Questions?
Leading Global Standards for Inflight Connectivity
Architecture and Interoperability Expert Group

Peter Lemme
Thought Leader
Seamless Air Alliance

Leading Global Standards for Inflight Connectivity
Architecture and Interoperability Expert Group

• Chair: Arnaud Mestrallet (Airbus)
• Chair: Bryan Wiltse (Boeing)
Architecture and Interoperability

Expert Group

• Chair: Arnaud Mestrallet (Airbus)
• Chair: Bryan Wiltse (Boeing)

• AERQ
• Astronics
• Gilat
• Kontron
• Panasonic
• Riverbed

• Safran
• SES
• ST Engineering - iDirect
• Telesat
• Thales
Common Airborne Terminal

Lower Cost of Installation

Select or Change to any Service Provider

Speed Time to Market

Streamline Support and Sparing
Antenna Interoperability
Type 1: Legacy GEO

SATELLITE ANTENNA ASSEMBLY FEED (SAA)

- Precision feed array, aperture with integrated feeding network
- Dual linear polarizations (H-polar or cross-polar) integrated into payload architecture
- Two-axis orientable

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Transmit Frequency</td>
<td>13.7-14.5 GHz</td>
</tr>
<tr>
<td>Receive Frequency</td>
<td>10.7-12.75 GHz</td>
</tr>
<tr>
<td>Receive G/T</td>
<td>38.8 dB/K @ 11.7 GHz</td>
</tr>
<tr>
<td>Transmit EIRP</td>
<td>1.2kW to 2.7kW orbital demand</td>
</tr>
</tbody>
</table>

Figure 10. 2Ku - Largest Aperture, Highest Data Rates

SURFACE AREA
Photos to scale
Aircraft operate typically with GEO satellites below 45 deg elevation.
Flat Panel apparent aperture shrinks with scan angle.

\[ A' = A \cos(\Phi) \]
\[ \Phi \text{ is 0 at zenith} \]

\[ A' = A \sin(\text{elevation}) \]
\[ \text{Elevation is 90 at zenith} \]
Type 2 – LEO Only
Scalable ESA

<table>
<thead>
<tr>
<th>ANTENNA CONFIGURATION (SUBARRAYS)</th>
<th>ESTIMATE ANTENNA PERFORMANCE</th>
<th>APERTURE SIZE</th>
<th>WEIGHT (SUBARRAYS ONLY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tx 2</td>
<td>Rx 4</td>
<td>EIRP (dBW)</td>
<td>G/T (dB/K)</td>
</tr>
<tr>
<td>46.5</td>
<td>10.8</td>
<td>13x7</td>
<td>15x15</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>53.6</td>
<td>12.5</td>
</tr>
</tbody>
</table>
Satellite Elevation

70 deg scan range shown
Figure of Merit - G/T dB/K

Legacy Multigimbal
Type 3 – Hybrid (Full LEO + Limited GEO)
Type 4 – Hybrid (Full LEO/MEO + Full GEO)

Ka GEO
OneWeb

Ka GEO
Telesat Lightspeed
SES O3b mPower
Type M – Multiband
Common Terminal
Antenna

- Tunable Frequency Range
- Instantaneous Bandwidth
- Figure of Merit (receive gain)
- EIRP (transmit power)
- Scan range
- Beam Agility
- Multibeam
- Thermal Management
- Aircraft Provisions
- MSP Compatibility
Modem Interoperability
Roaming between Satellite Networks
Dual-Modem Modman
Auxiliary Modem Unit (AMU)
Common Modem Card

- Form Factor
- Edge Connector
- Interconnections
Fiber Optics and Digital Baseband

ARINC 793

AMU 1
Modem Interface
Ref1 Tx1 Rx1 Tx2 Rx2
AMU 2
Modem Interface
Ref1 Tx1 Rx1 Tx2 Rx2
Modman
Modem Interface
Ref1 Tx1 Rx1 Tx2 Rx2
Extra Radio (cell, Wi-Fi, L-band)
Tx1 Rx1
OAE Manager
Tx Rx
ExRad1
Rx2 Tx2
Rx1 Tx1
AMU Rx/Tx Cntrl Interface

36 (or 48) fiber pass through

Antenna Patch Panel

Modem Patch Panel

*1)
Common Terminal Modem

• Card-Level Modem Standard
• Software Defined Modem (Radio)
• How many modems
• Power
• Thermal
• Space
• Connections
• Aircraft Provisions
• MSP compatibility
Join Seamless Air Alliance and help develop IFC standards.
Questions?