CONNECTED AVIATION SUMMIT® 2023

Digital Transformation, AI & Innovation

September 6-8, 2023 | Hilton City Center | Denver, CO

SEAMLESS AIR ALLIANCE

Leading Global Standards for Inflight Connectivity

Driving Success in Aviation:

Addressing Key Industry Challenges to Empower Airlines

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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

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Seamless Air Alliance at a Glance

6

Current Working Groups

6

Releases Completed

200+

Participants from Member Companies

Membership Breakout

A Global Collaboration of Airlines and Technology Leaders

OpenIFC

Open Innovation for Inflight Connectivity

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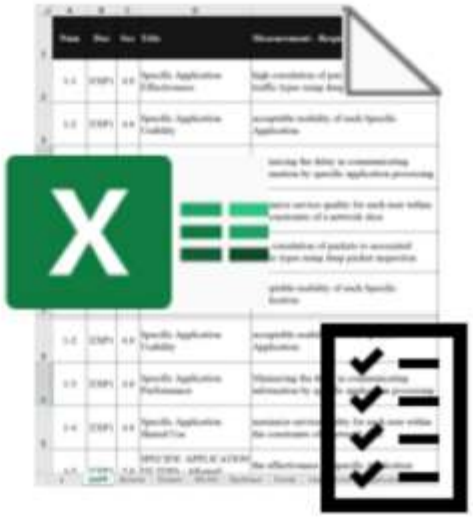
CONTENTS

12 IFC Experience (EXP) Documents | 340 Pages

Number	Topic
EXP-0	Master IFC EXP Program
EXP-1	Measuring Specific Application Service Quali
EXP-2	Measuring Web Browsing Service Quality
EXP-3	Measuring Streaming Service Quality
EXP-4	Measuring Wi-Fi Networking Service Quality
EXP-5	Measuring Backhaul Networking Service Qua
EXP-6	Measuring Portal Service Quality
EXP-7	Measuring User Device Service Quality
EXP-8	Measuring Application Server Service Quality
EXP-9	Measuring Wi-Fi AAA Service Quality
EXP-10	Measuring IFC Product AAA Service Quality
EXP-11	Measuring IFC Platform Quality
EXP-12	Quality Control Agents

Compliance Matrix | 500+ Criteria



Want to know if your passengers are having a great connectivity experience?

SEAMLESS
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CERTIFIED
SERVICE QUALITY

Insist that your service provider is

Seamless Certified

Seamless Expert Working Groups

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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!!**

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for Inflight Connectivity

Brian Kirby

Senior Technical Product Manager

Telesat

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The Quest for Great Connectivity

Seamless Certification Program

Leading Global Standards

for Inflight Connectivity

Brian Kirby
Telesat
CAIS September 2023

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

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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

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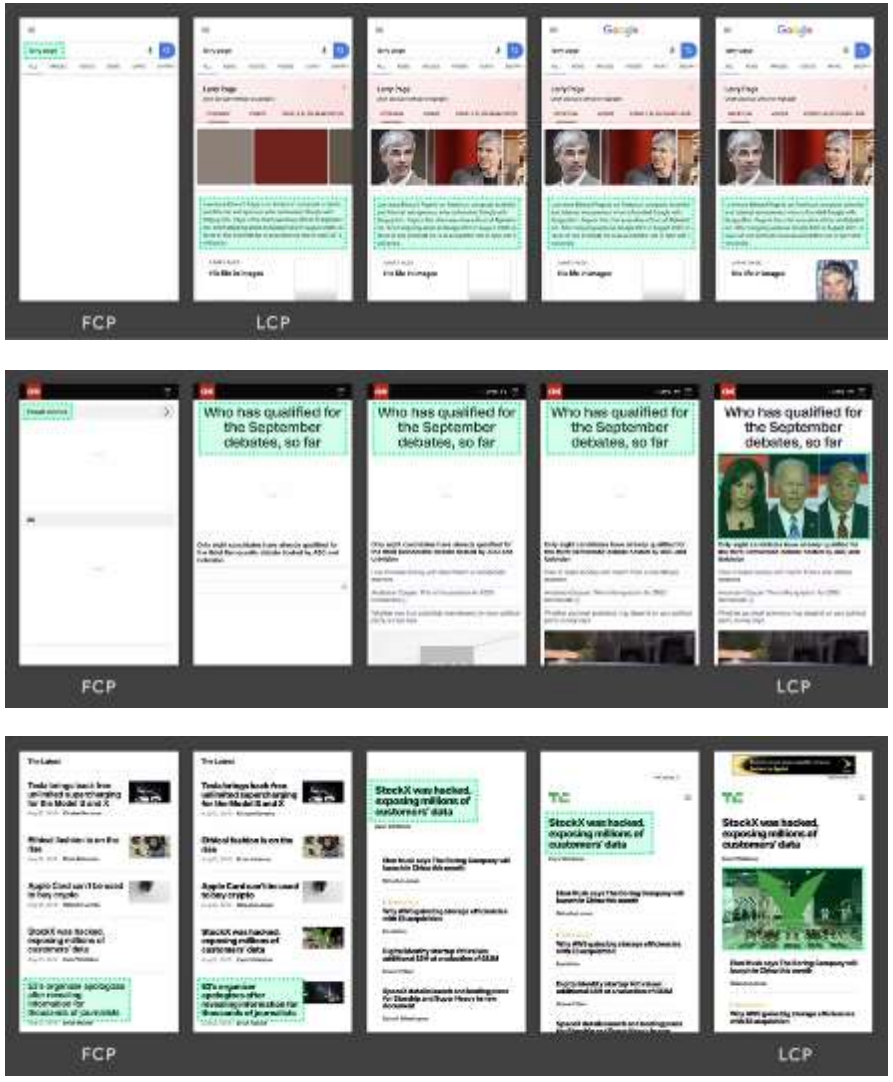
- **Concept**
  - Common tools, measurements, and targets for effective QoS and QoE
  - Start with achievable milestones
  - Set an iterative path for growth

- **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

Press Announcement

Released

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.

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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!

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Questions?

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Leading Global Standards

for Inflight Connectivity

André Patrick

Manager, In-Flight Wi-Fi & Analytics

Air Canada

IFC Airline Forum

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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

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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

SEAMLESS AIR ALLIANCE

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

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Leading Global Standards

for Inflight Connectivity

Thomas Locke

Chief Technology Officer

GlobalReach

Technologiey

Who are GlobalReach ?

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What is passpoint ?

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

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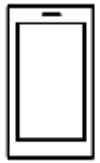
Who is using Passpoint ?



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

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Why use Passpoint ?

PREMIUM WI-FI SERVICE

Seamless and secure (WPA2/3)

TAKE-UP RATES

Automatic connectivity

REVENUE

Portal Upsell and MNO Carrier offload

MAC RANDOMIZATION

Subscriber based authentication

INSIGHTS

Who
Where
When

LOYALTY / FFP

Tier based service offering

ENGAGEMENT

Portal redirect and APP Push Notifications

APP LEVERAGE

Device Provisioning

PERSONALIZATION

User aware on network association

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Airline vs MNO identities

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

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for Inflight Connectivity

Mark Nash

Head of Commercial Roaming

Panasonic Avionics

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Connected Aviation Intelligence Summit

Mobile Roaming via Wi-Fi

07th September 2023

Mark Nash, Head of Commercial Roaming | Panasonic Avionics

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What is Mobile Roaming via Wi-Fi?

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.

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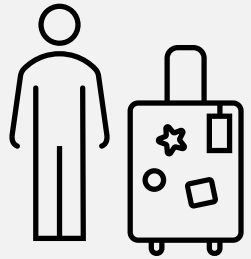
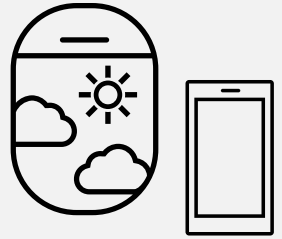
Mobile Operators in the IFC Ecosystem

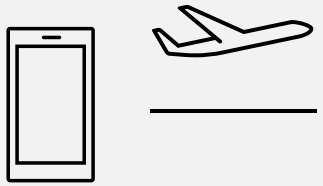
- According to Juniper Research, over 4.5 billion airline eTickets or boarding passes will be issued in 2023.
- Insights from a Panasonic Avionics Passenger Engagement Metrics Survey show that in 2022 nearly all flyers (88%) brought a smartphone on their last flight.
- All smartphones are connected to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



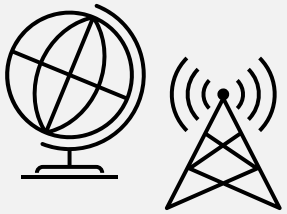
4.5 billion
Passengers flying



88%
of flyers bring a smartphone onboard



All phones onboard are connected to a mobile operator



750+
The GSMA has over 750+ mobile operators a globally

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SAA | GSMA Cooperation Agreement

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.

GSMA

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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.

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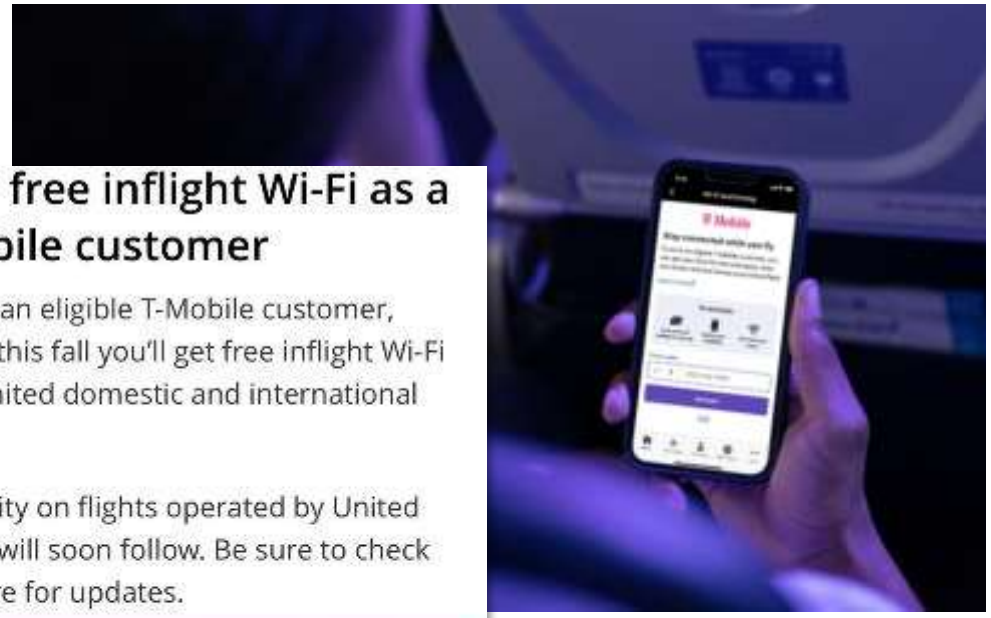
Roaming Examples

Panasonic Avionics has 380+ roaming relationships that we can leverage to offer mobile roaming via Wi-Fi.



Enjoy free inflight Wi-Fi as a T-Mobile customer

If you're an eligible T-Mobile customer, starting this fall you'll get free inflight Wi-Fi on all United domestic and international flights.

Availability on flights operated by United Express will soon follow. Be sure to check back here for updates.

Enjoy your Inflight Connection.

Includes unlimited Wi-Fi, texting, and streaming – where available.

T-Mobile

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

AT&T

CONNECT IN-FLIGHT

Access is now available on select international flights

Stay connected with unlimited talk, text, and high-speed data* in 210+ destinations, plus select flights from participating airlines—for $10/day.

See details

Get started →

AT&T includes in-flight roaming in their popular Day Roaming Pass.

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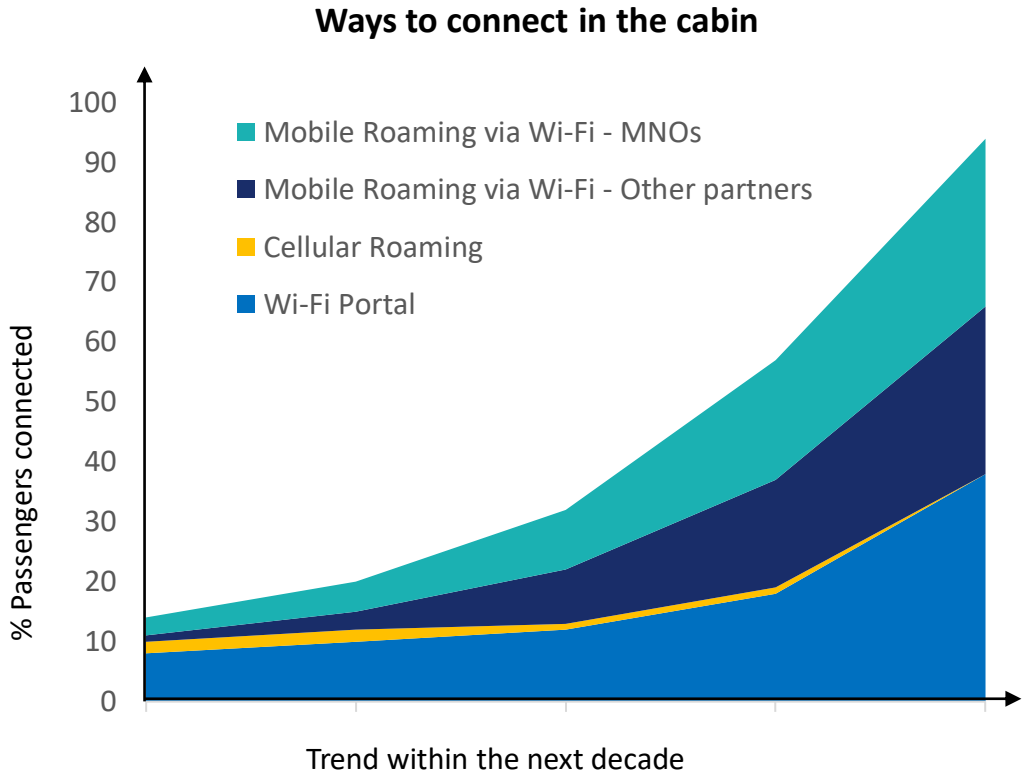
Making Connectivity Accessible by all Passengers

- 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.



Source: estimated based on Panasonic Avionics data.

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for Inflight Connectivity

Sean Yarborough

Vice President, Product Management

ST Engineering iDirect,

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WG SR7 – Architecture and Interoperability

Software-Defined Modem (SDM/SDR)

Sean Yarborough
Vice President, Product Management
ST Engineering iDirect

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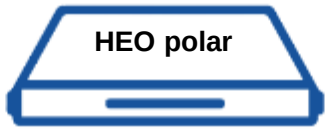
Today's Modem Limitations and Airline Challenges

Airlines have to equip planes with more modmans requiring **more space, power and coordination**

Airlines alternatively have **gaps in coverage**

Airlines require **contracts with multiple service providers** to cover flight routes thoroughly

Airlines face **difficulty to leverage NGSO** constellations and need better options to integrate



Airlines see more **complex network management required** to maintain multi-provider coverage

A Software-Defined Modem Future

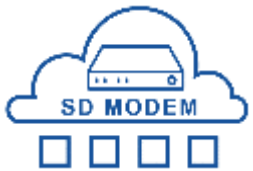
ST Engineering

Select and use coverage across multiple networks and orbits for true global connectivity

Standardized interfaces between hardware and software

Interoperable modem hardware; a single modman per airplane

Lower power and size requirements, reducing total cost

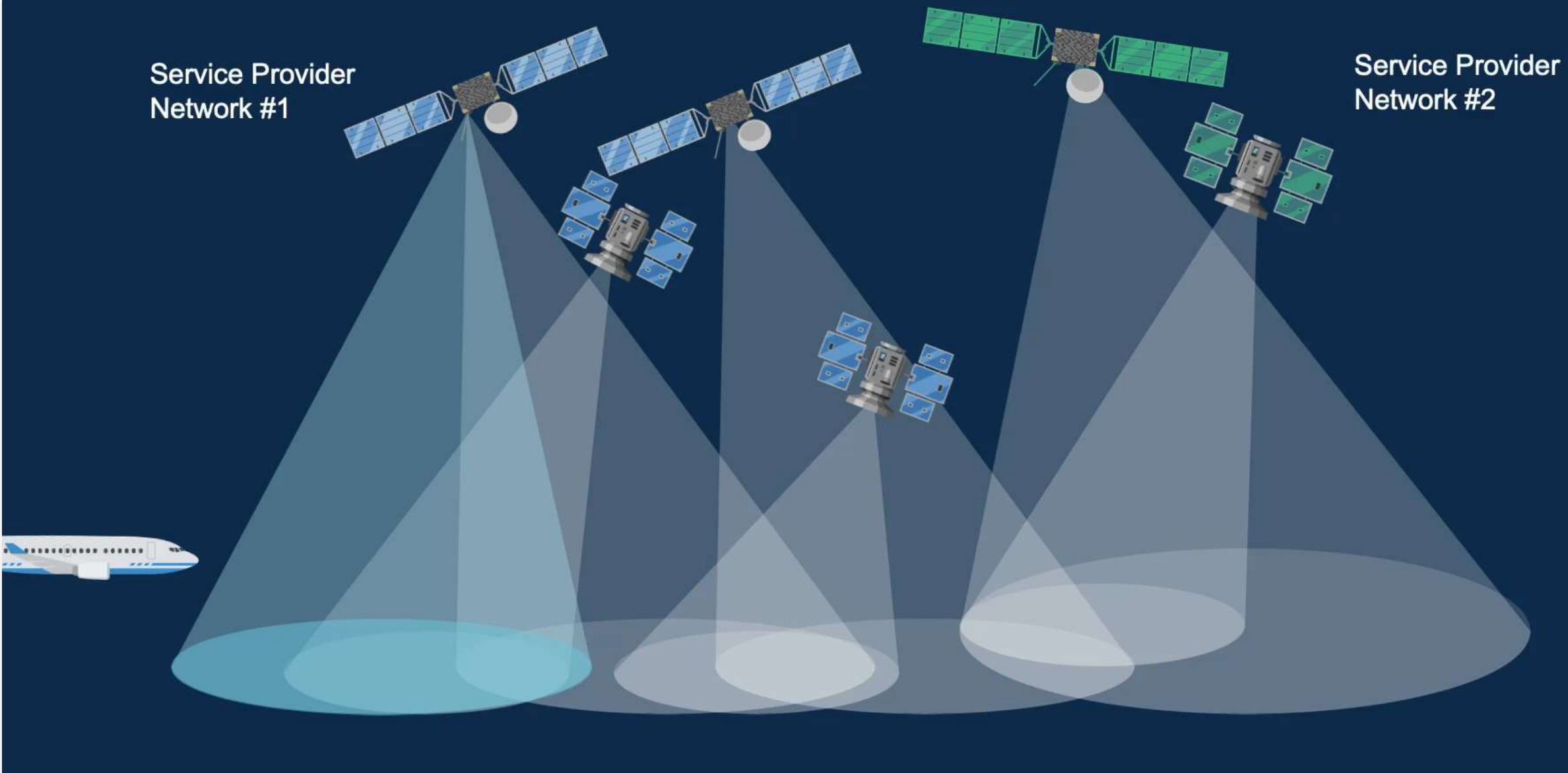


Multiple software-defined modem images

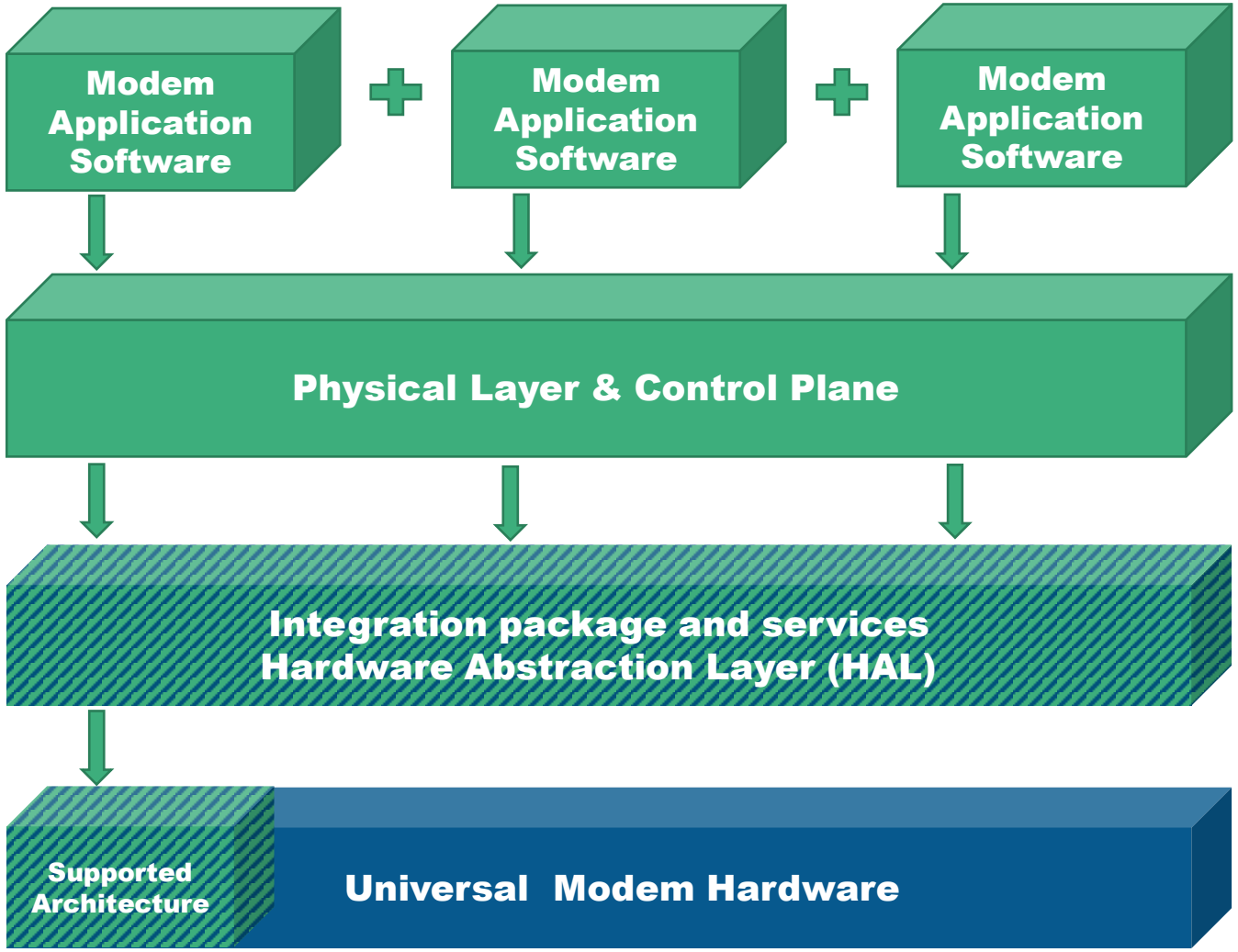
Uninterrupted Service to Airline, Aircraft, and Passenger

iDirect

Next Generation Advanced Mobility



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

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Leading Global Standards

for Inflight Connectivity

Peter Lemme

Chief Consultant

Seamless Air Alliance

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Leading Global Standards
for Inflight Connectivity

Architecture and Interoperability Expert Group

Peter Lemme
Thought Leader
Seamless Air Alliance

Architecture and Interoperability

Expert Group

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

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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

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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

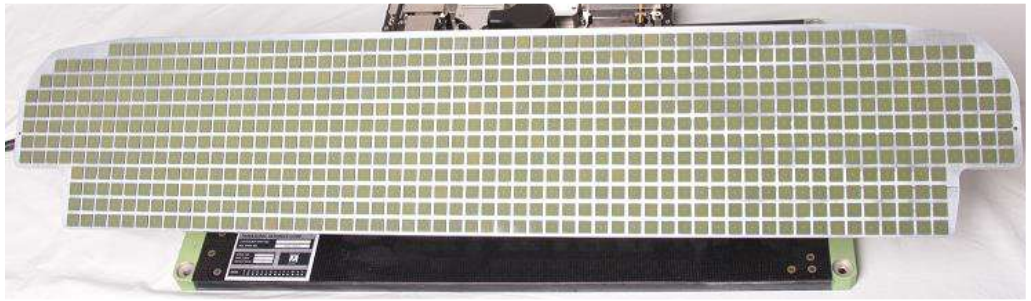
KuStream® 1000:
Finalist for the Crystal Cabin Award 2010 in the category Entertainment and Communication

CRYSTAL CABIN AWARD®

SATELLITE ANTENNA ASSEMBLY FEED (SAA)

- Precision horn array aperture with integrated feeding network
- Dual linear polarizations (co-pol or cross-pol), integrated diplexer architecture
- Two-axis pedestal

Transmit frequency	13.75-14.5 GHz
Receive frequency	10.7-12.75 GHz
Receive G/T	11.8 dB/K @ 11.7 GHz
Transmit EIRP	Up to 42.5 dBW (depend



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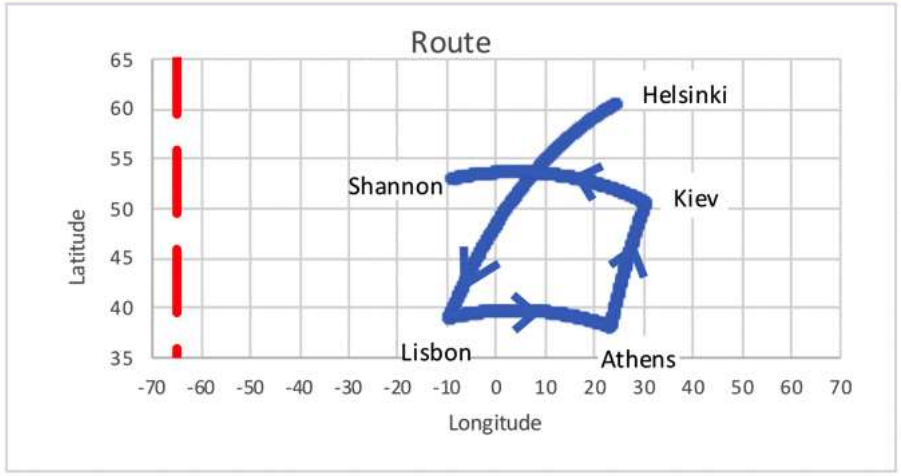
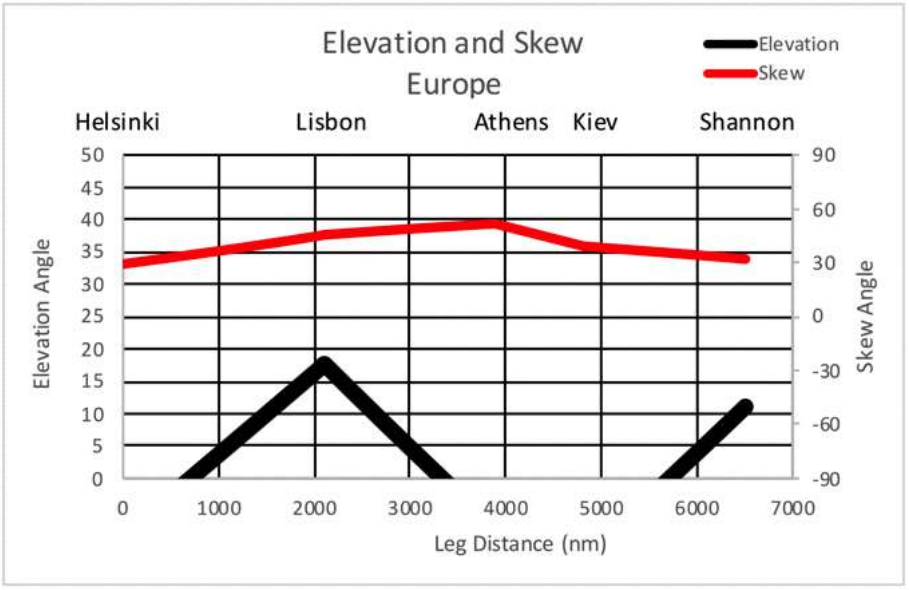
Aircraft operate typically with GEO satellites below 45 deg elevation

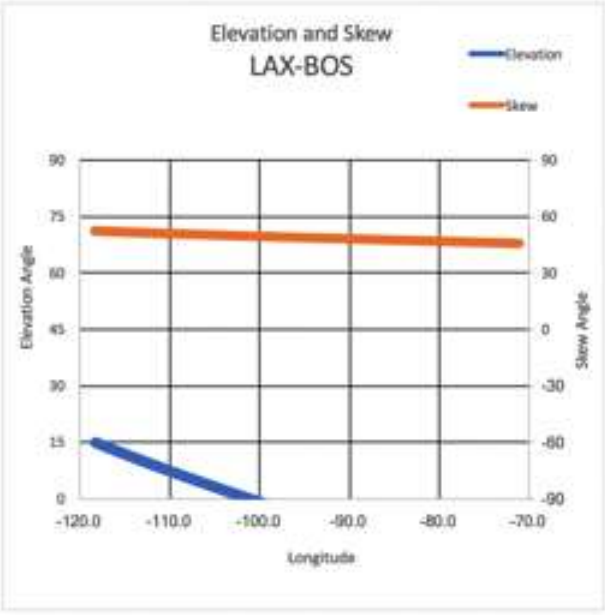
Satellite Longitude
-65





longitude	**180W**
Skew - elevation trigger	**90**
Skew Limit	**55**

	Average Elevation	Skew Mute
LAX - BOS	-4	0%



longitude	**180W**
Skew - elevation trigger	**90**
Skew Limit	**55**

	Elev	Skew
LAX - Sao Paulo	2	90%

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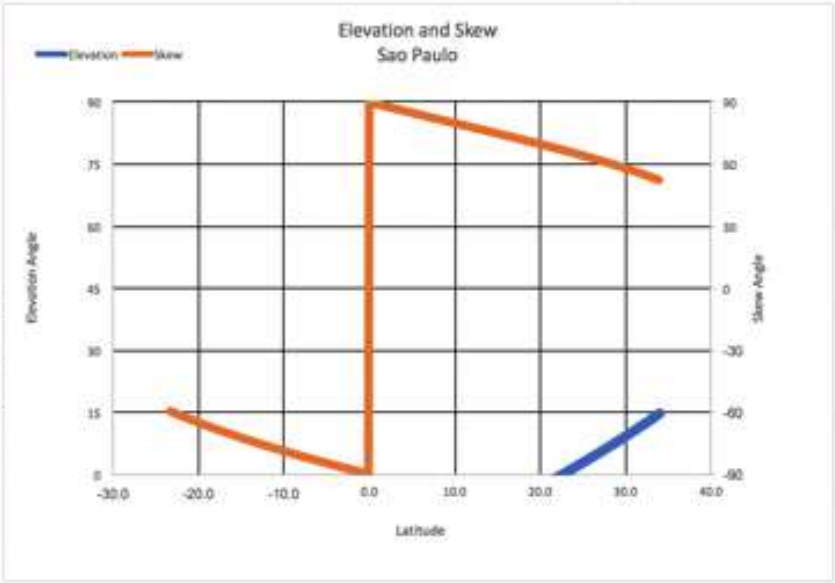

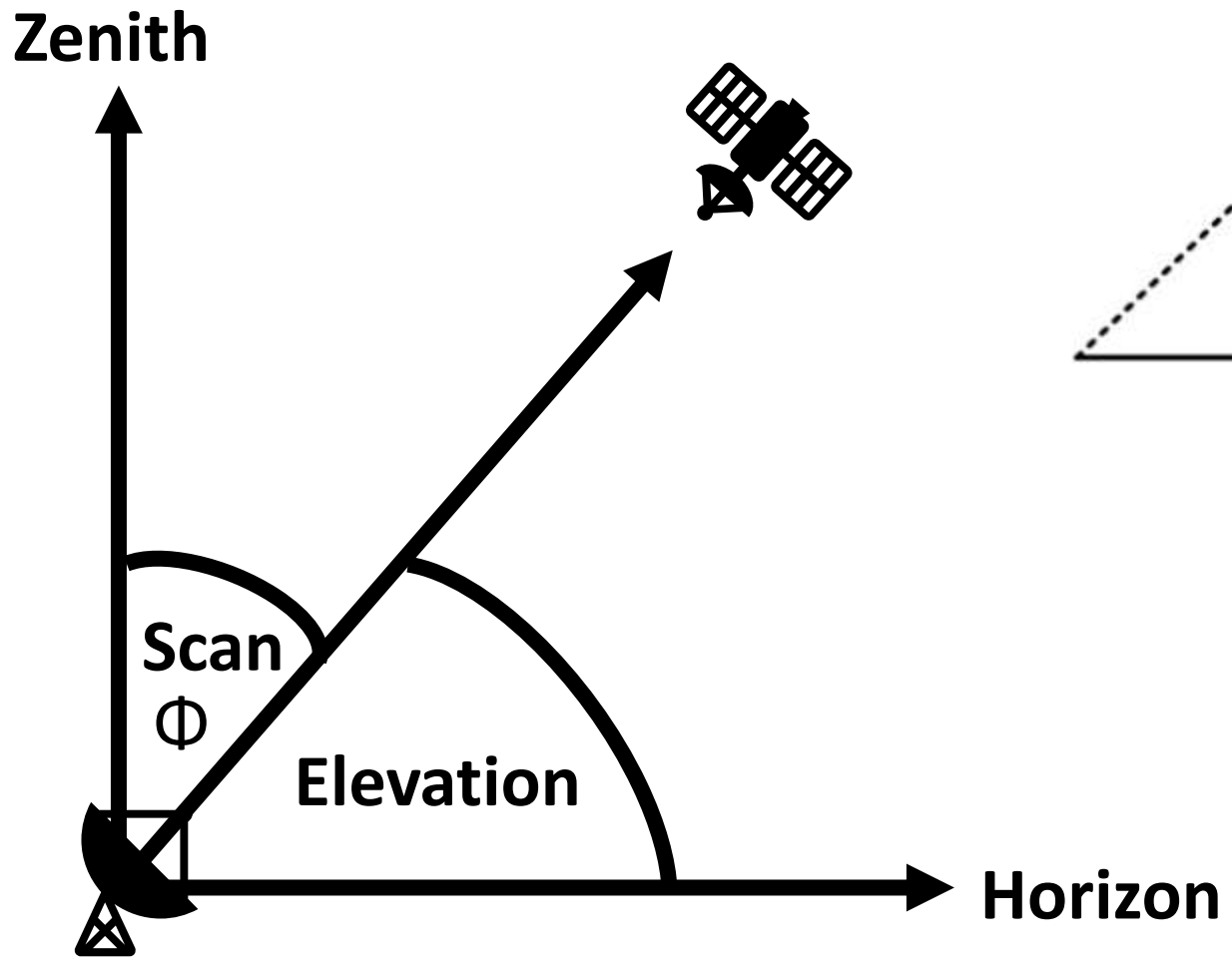

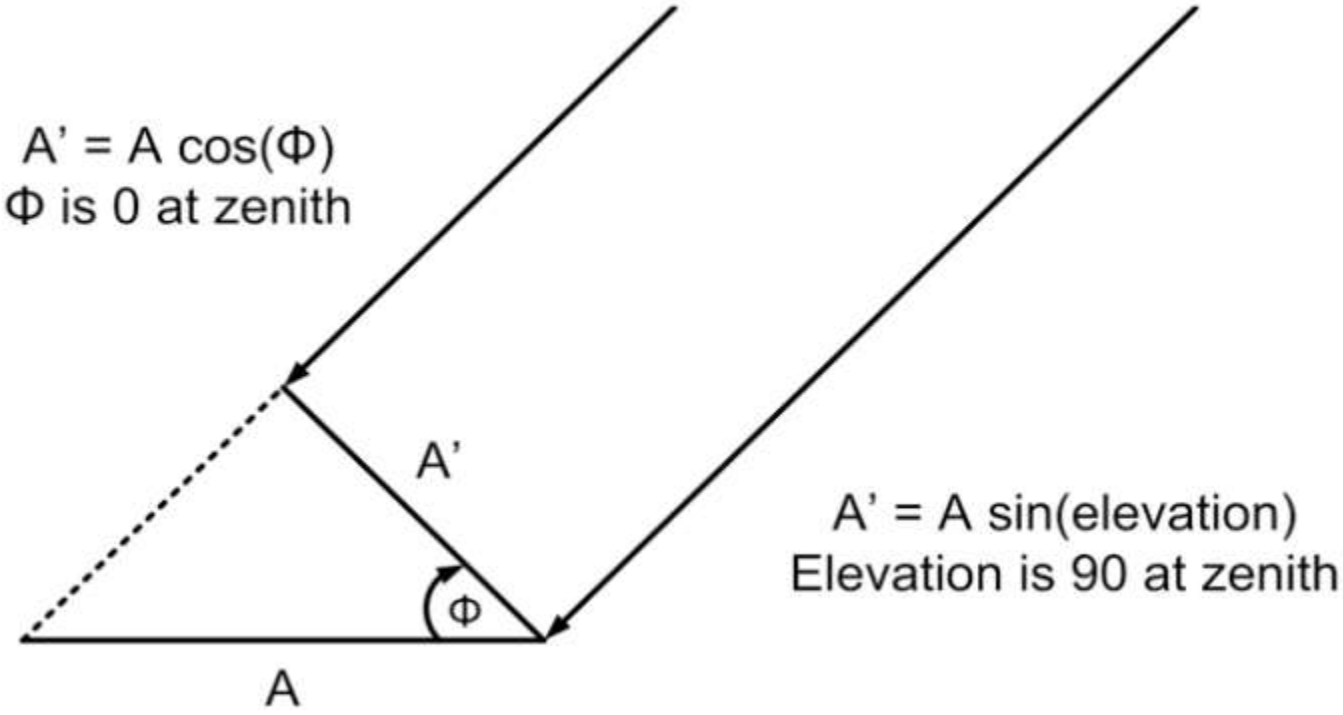

Flat Panel apparent aperture shrinks with scan angle

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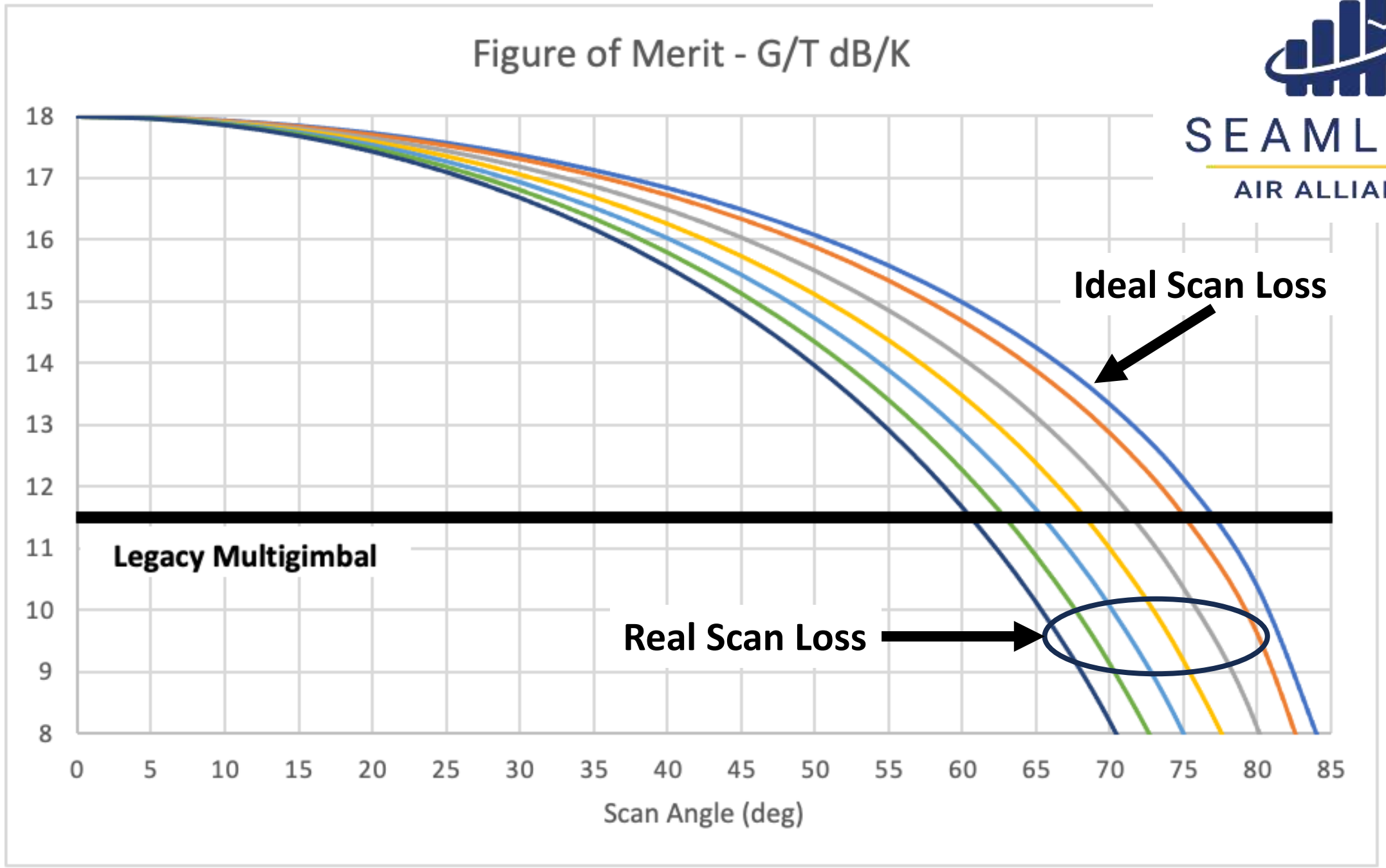

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Type 2 – LEO Only

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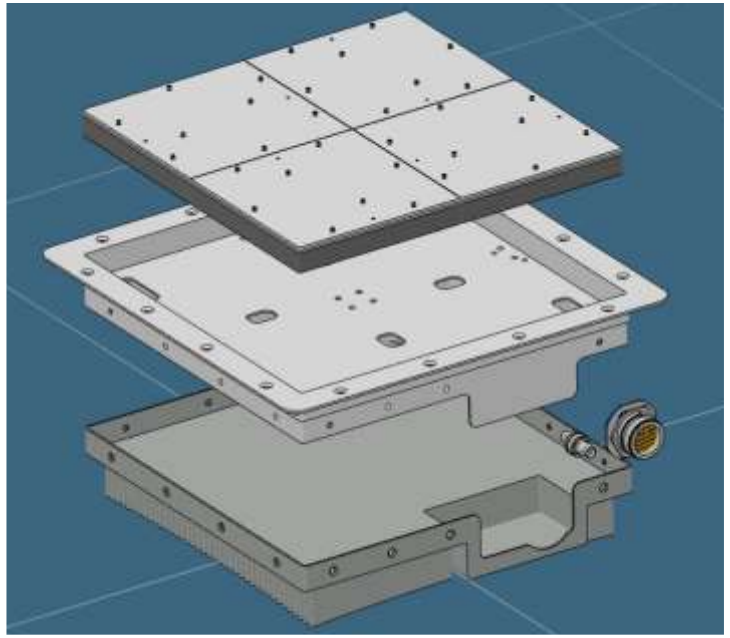
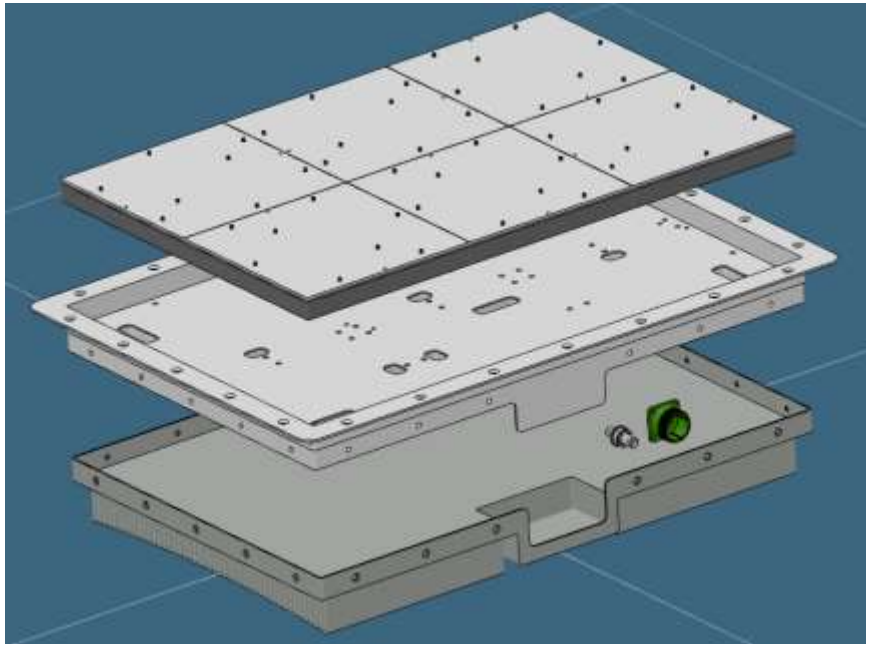
Scalable ESA

ANTENNA CONFIGURATION (SUBARRAYS)		ESTIMATE ANTENNA PERFORMANCE		APERTURE SIZE		WEIGHT (SUBARRAYS ONLY)
Tx	Rx	EIRP (dBW)	G/T (dB/K)	Tx (in)	Rx (in)	(lbs)
2	4	40.5	9	13x7	15x15	18
4	6	46.5	10.8	13x13	15x23	30
9	9	53.6	12.5	19x19	23x23	50





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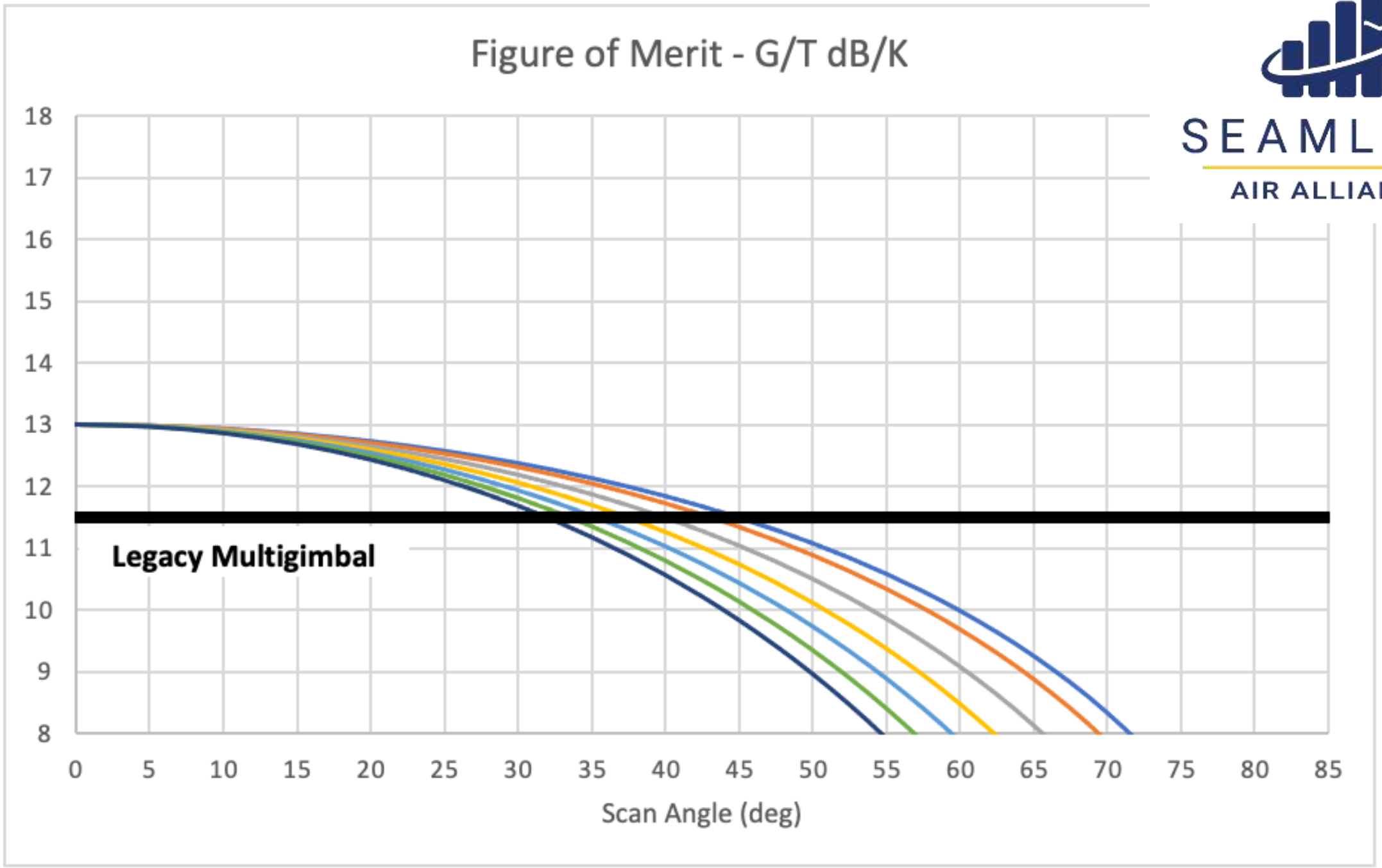

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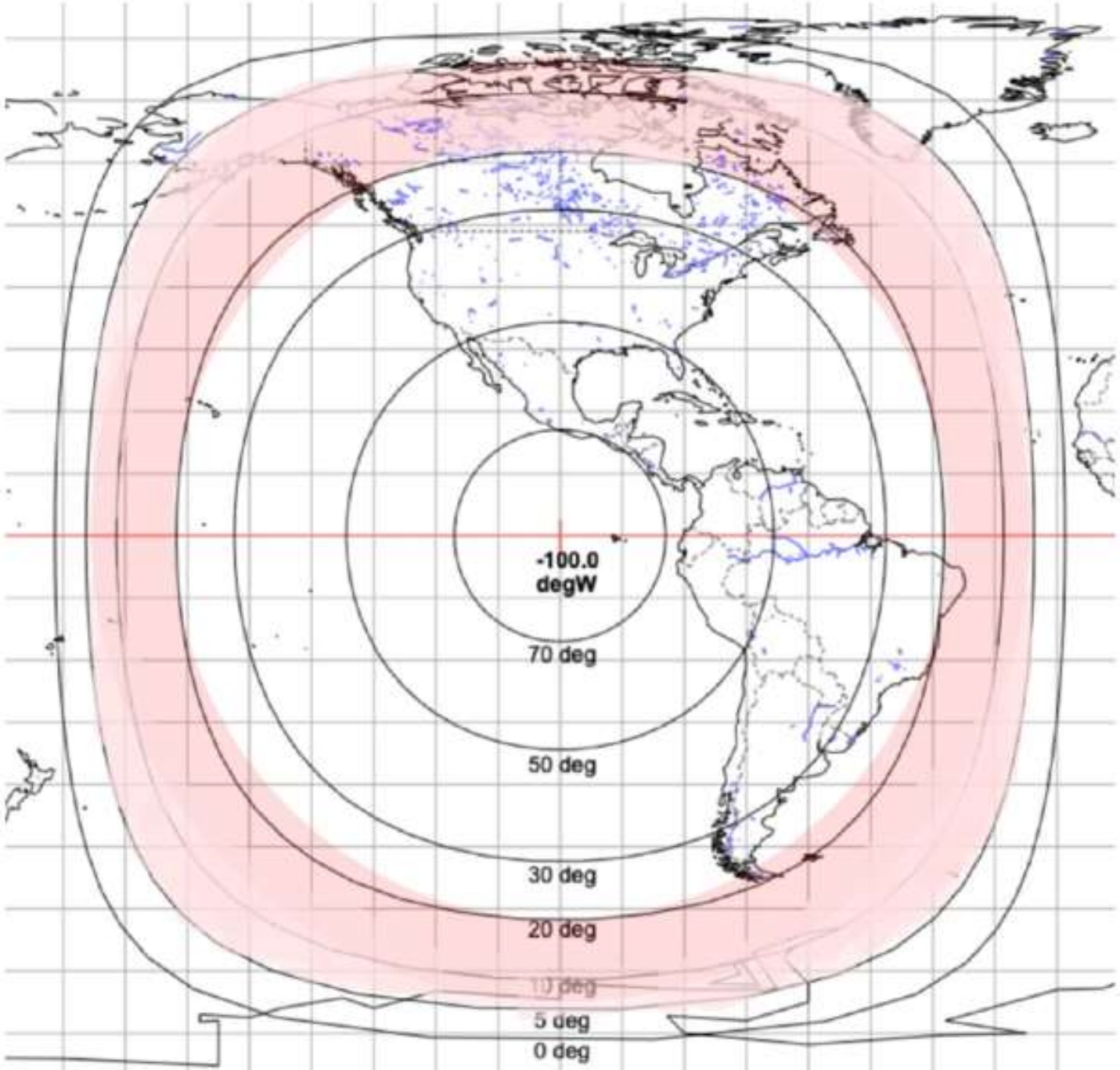

Satellite Elevation

70 deg
scan range
shown

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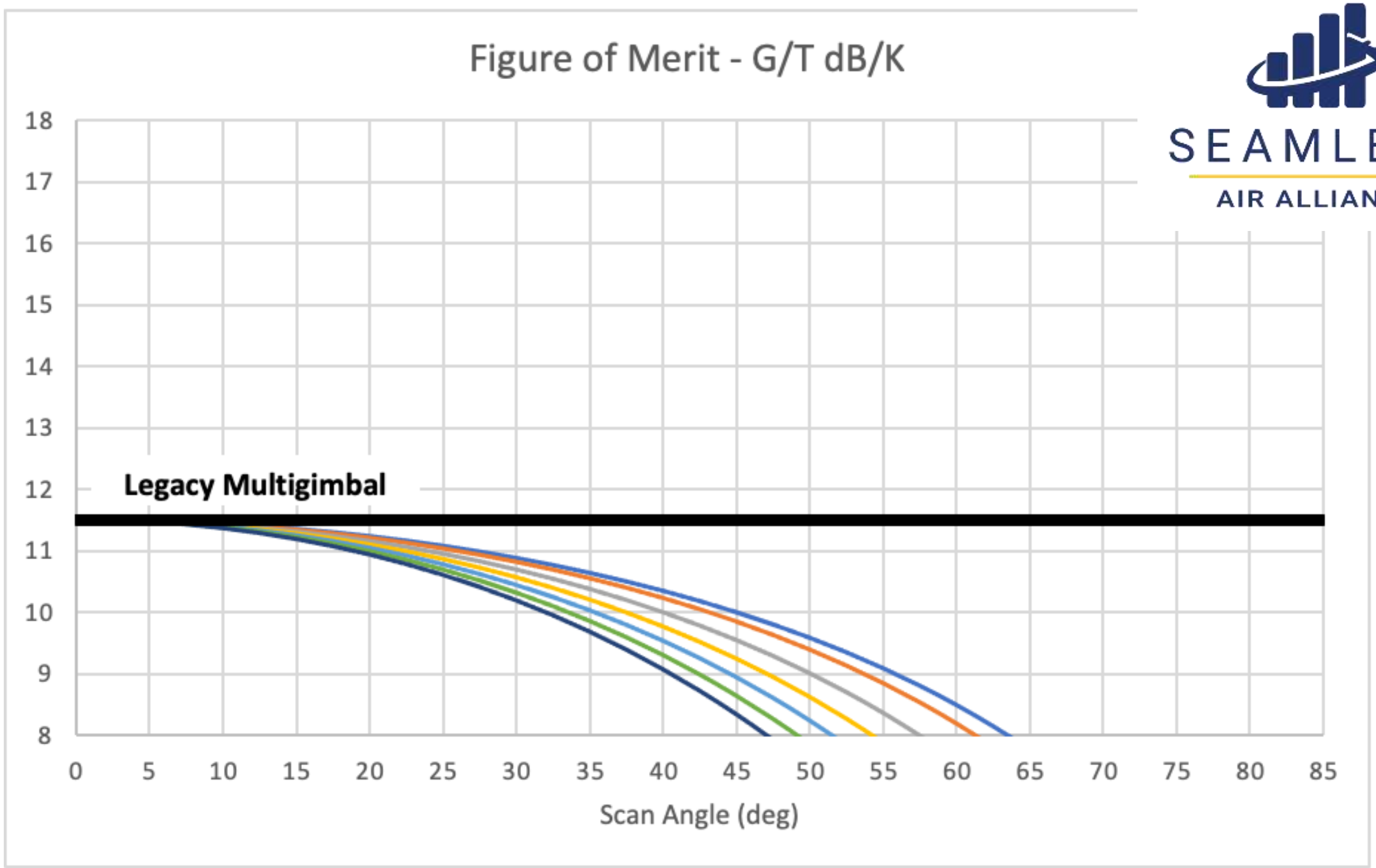

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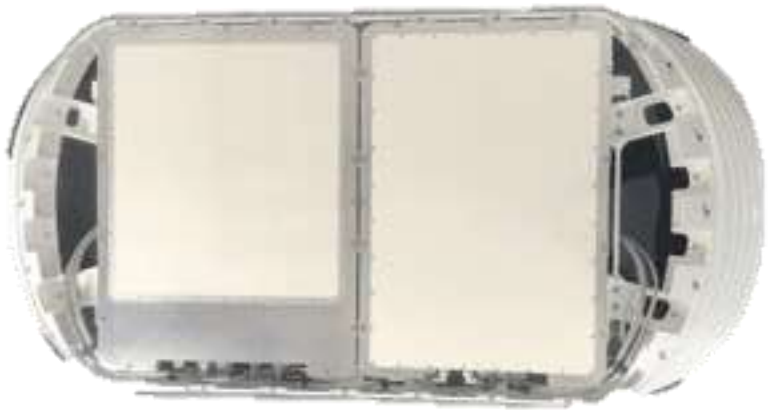
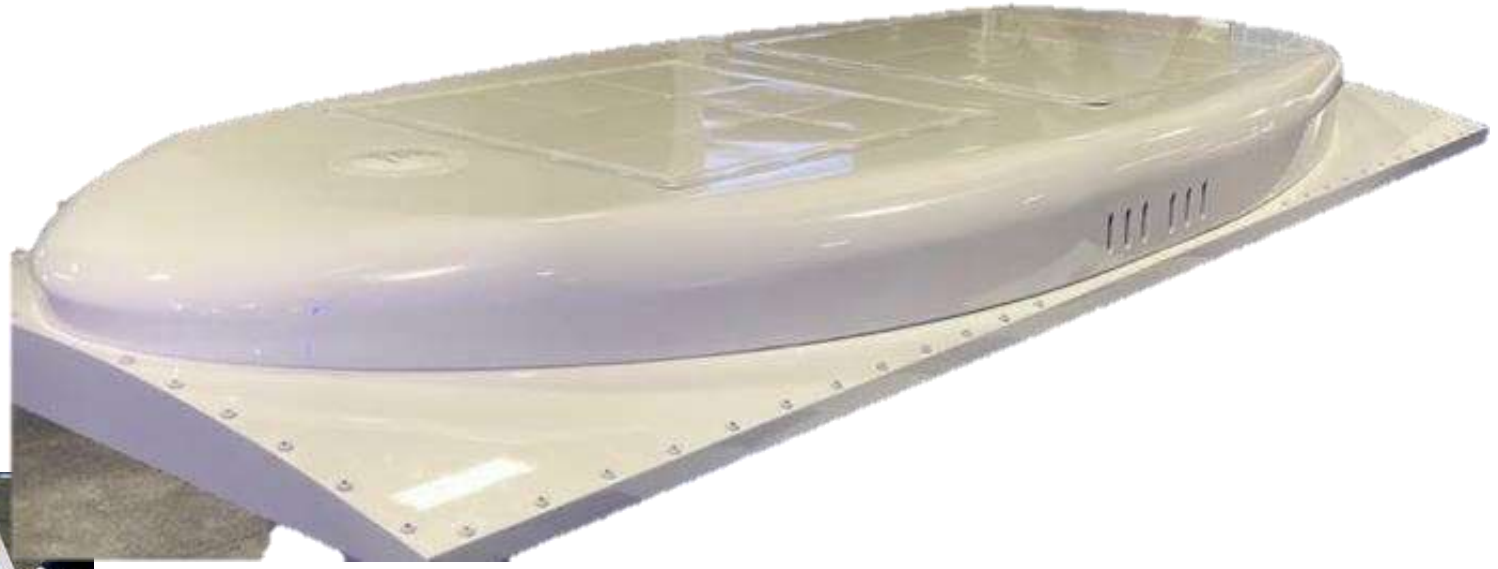
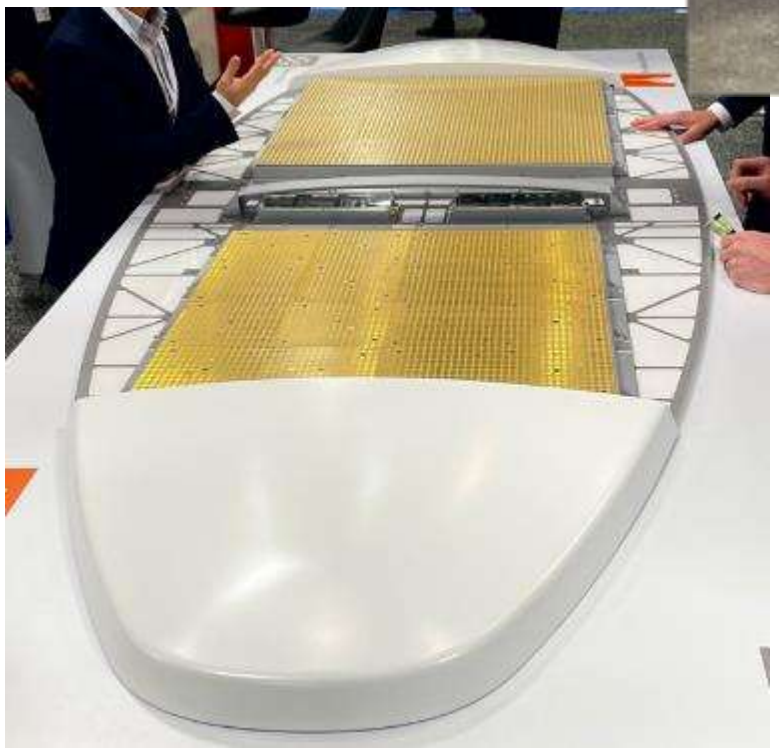
Type 3 – Hybrid (Full LEO + Limited GEO)







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Type 4 – Hybrid (Full LEO/MEO + Full GEO)

Ka GEO
OneWeb

Ka GEO
Telesat Lightspeed
SES O3b mPower

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Type M – Multiband

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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

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Modem Interoperability

Roaming between Satellite Networks

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Dual-Modem Modman

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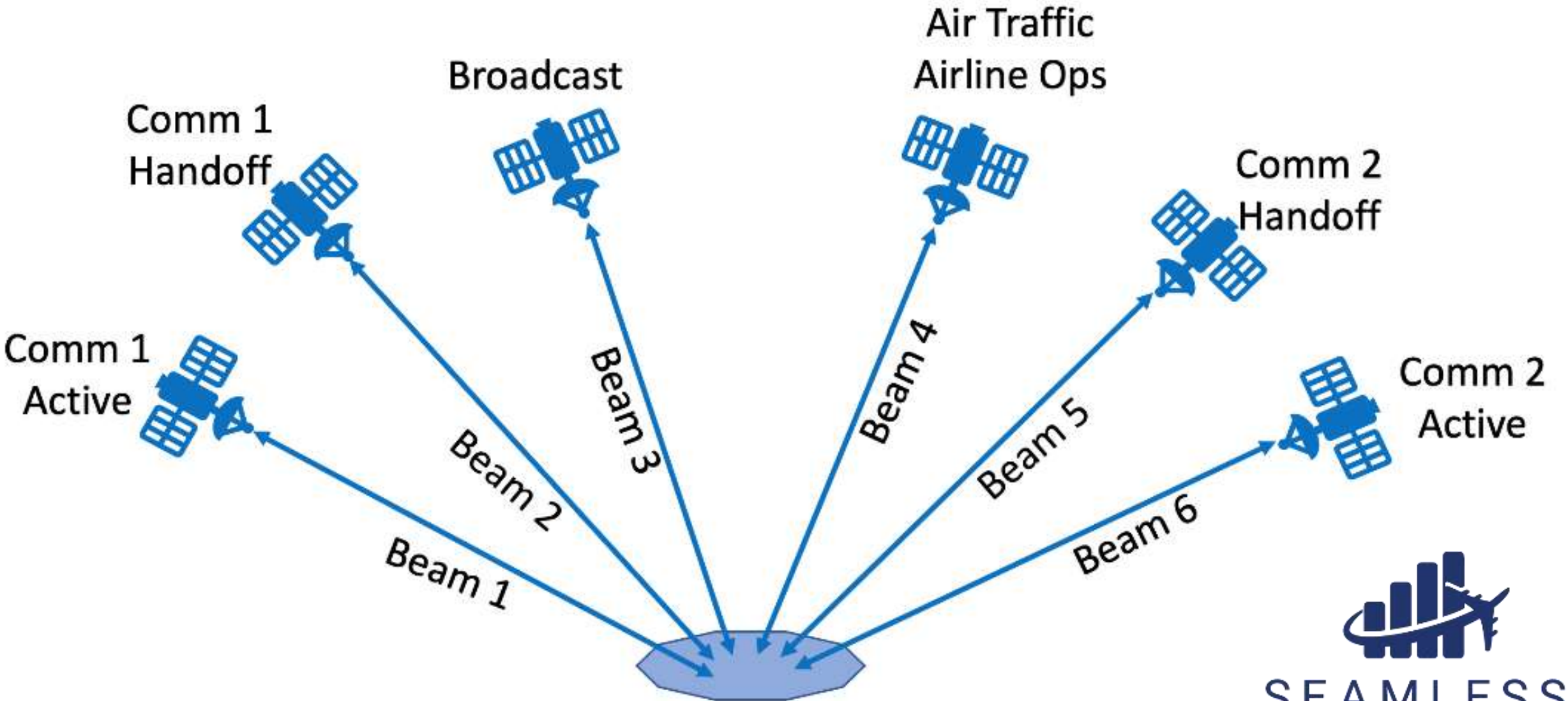
Multibeam



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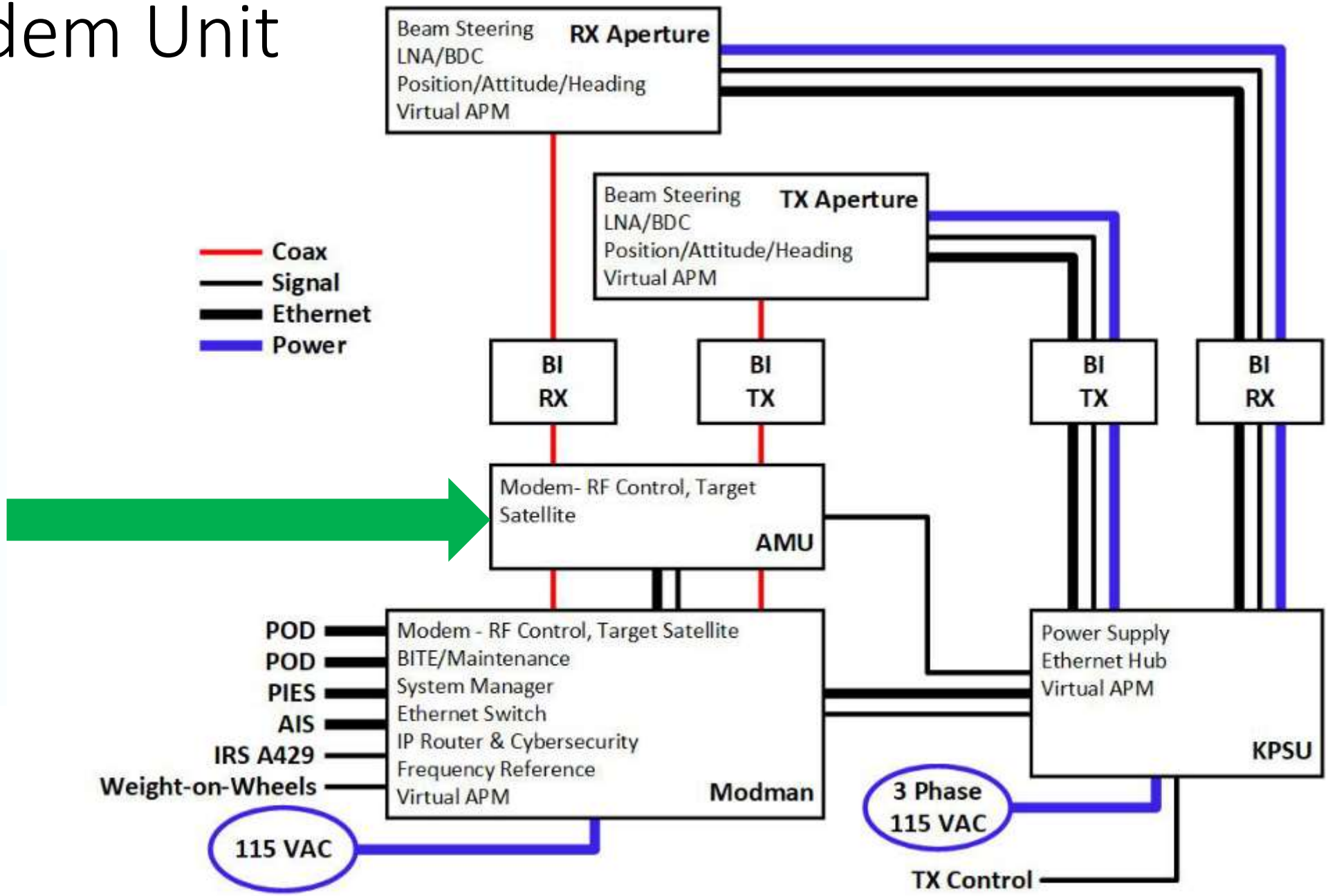
Auxiliary Modem Unit (AMU)



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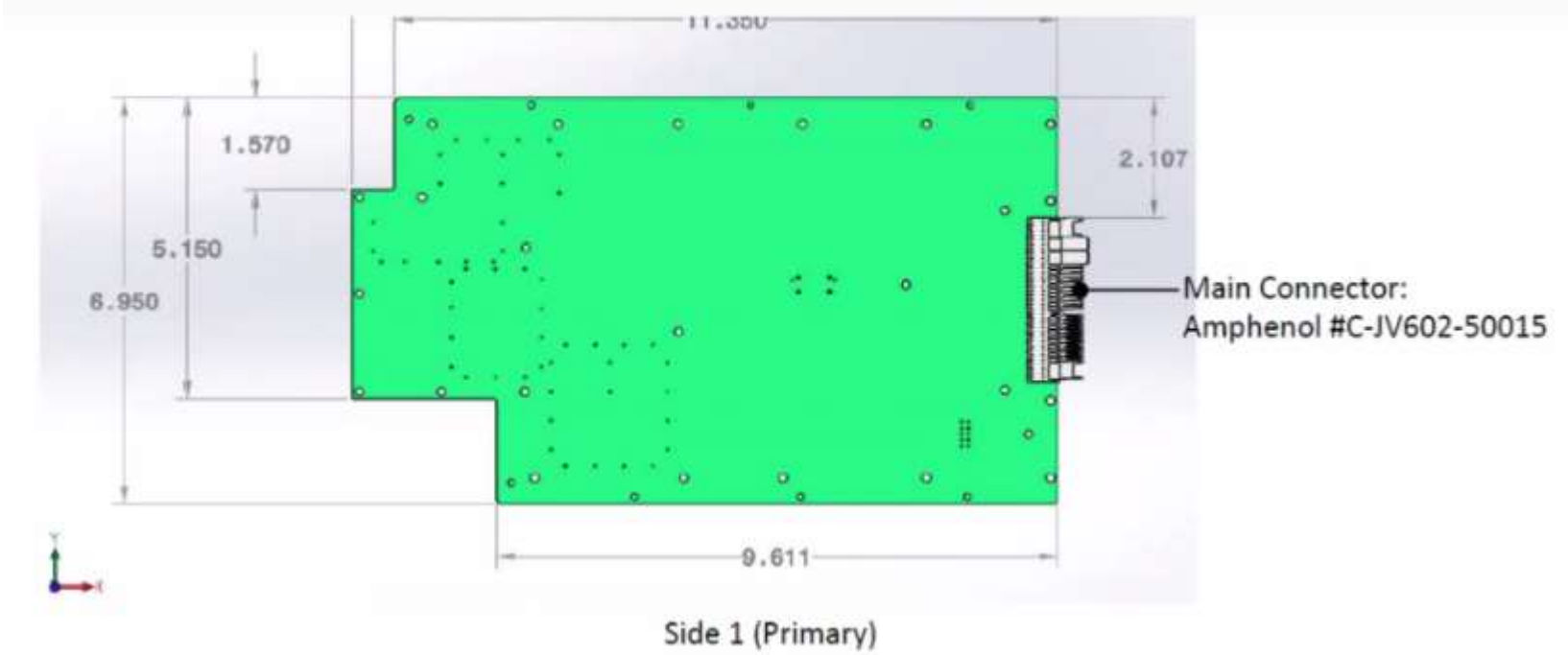
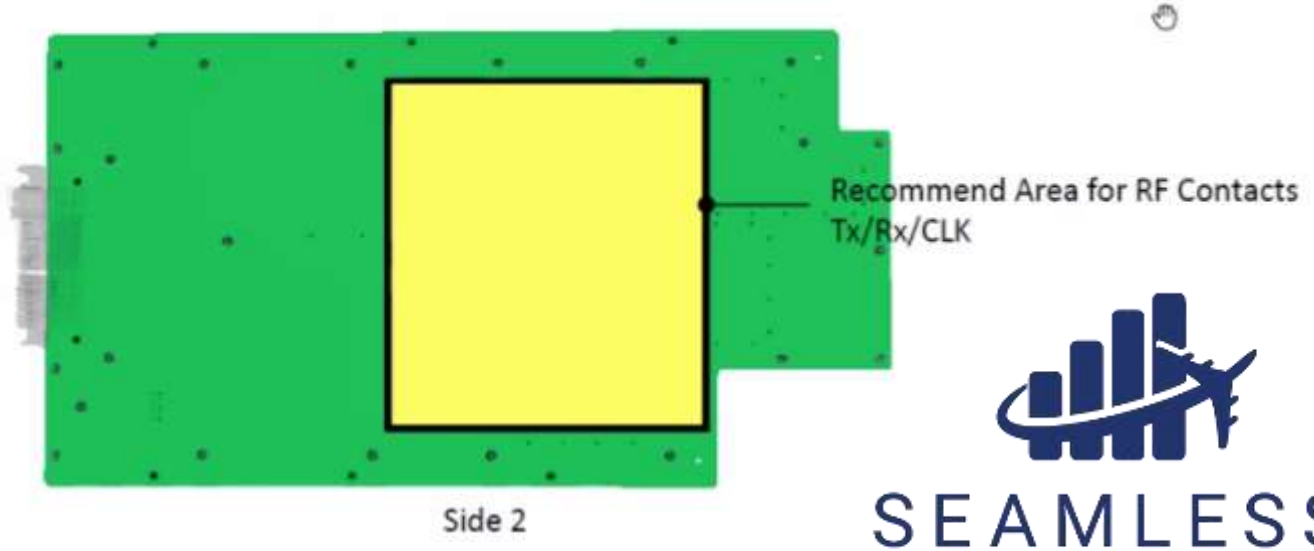
Common Modem Card

-Form Factor
-Edge Connector
-Interconnections





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Fiber Optics and Digital Baseband

ARINC 793

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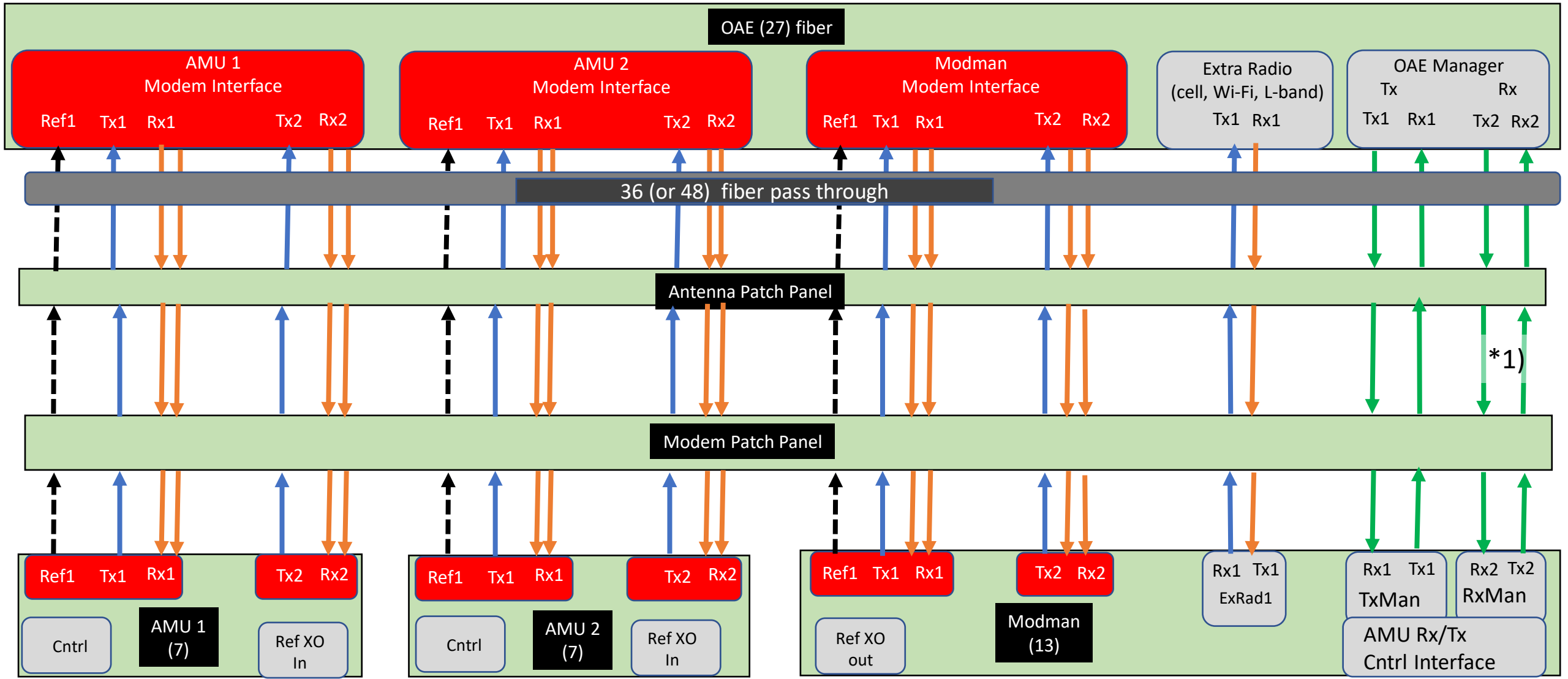

Common Terminal

Modem

- Card-Level Modem Standard
- Software Defined Modem (Radio)
- How many modems
- Power
- Thermal
- Space
- Connections
- Aircraft Provisions
- MSP compatibility

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Questions?