DIFI Consortium

ESA Specifications Working Group

Introduction and Status

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ESA WG Executive Summary

Announced: March 2024
Chair: Jeremy Turpin, ALL.SPACE
First Meeting: March 20th
Meeting Cadence: first Wednesday of each month, 11am Eastern

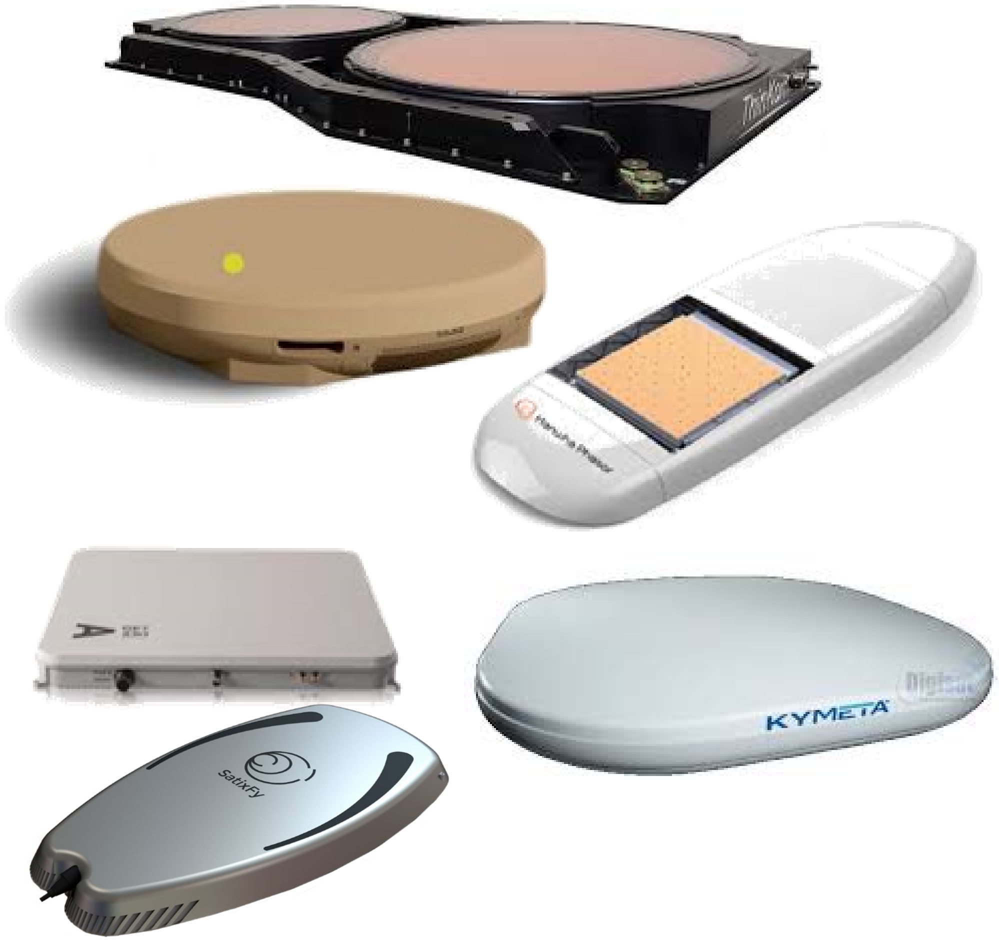
Working Group Participants:

- ALL.SPACE
- Apothym Technology Group
- Bascom Hunter Technologies
- Blue Halo
- Cobham SATCOM
- ETL Systems
- Geon Technologies
- Global Invacom
- Groundspace
- Intellian
- Intelsat
- Keysight
- Kratos
- Kymeta
- Quintech
- Rohde & Schwarz
- Safran Data Systems
- SatixFy
- SES
- St Engineering iDirect
- Systems Technologogies
- TEMIX Communications
- Thinkom
- Viasat
- WORK Microwave

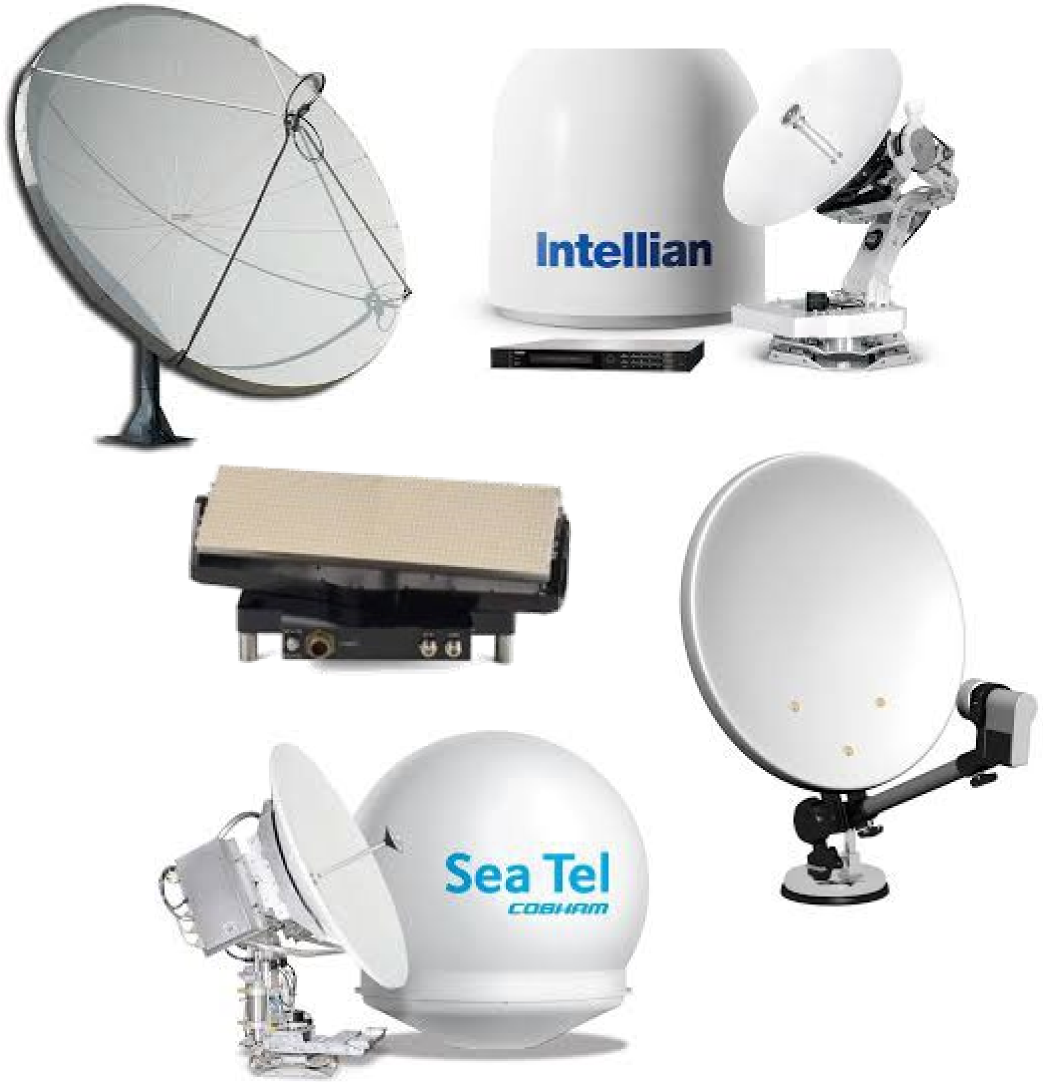
Origin

- Conversation on the Specification Working Group Mailing List around January 2024
- Identified a shortfall in the definition of reference planes for ESA
  - Most ESA will not have a single cable or connector over which a reference power level can be measured
- To address this and similar questions, Simon Swift created the ESA Specification WG as a subgroup of the DIFI Specification WG

Differences for DIFI?



vs.



ESA vs. Gimbaled Differences

ESA

- Widely different technology and implementation
- Varying performance across field of view
- Limited field of view
- Dynamic and frequently changing performance capabilities during operation
- Often distributed amplification / receivers / frequency conversion (multiple LNA/LNB/HPA/BUC)
  - DIFI reference plane not necessarily well-defined
- Potential for multiple and even dynamic number of beams / links per antenna
- Potential for multiple points of digitization
- Very fast beam changes

Gimbaled

- Same performance throughout field of view (other than asymmetric antennas and spectral masks…)
- Single set of performance capabilities
- Single LNB / BUC
  - DIFI reference plane well-defined
- Single beam / link per antenna
- Single point of digitization
- Slow Beam changes (repointing)

Commonalities

- Waveform data from modem to antenna
- Need for communication of performance between terminal and modem

ESA WG Objectives

Objectives:

1. Identify the set of DIFI-supported use cases for ESA
2. Identify the M&C features, capabilities, and data required to meet the use cases
3. Propose the mechanism for implementing the ESA-specific M&C features
    - Many-to-Many relationship between modems, beams / streams, panels, and satellites
    - Rapid, synchronized beam / link control and IF data streams
    - Dynamic / configuration-dependent beam performance and behavior

- Implemented through some combination of:
    - Existing OpenAMIP functionality
    - New Extensions to OpenAMIP (i.e., timing sync, stream ID)
    - Existing DIFI functionality
    - DIFI extension (i.e., OpenAMIP over DIFI, or equivalent DIFI command packets)

Participant's Goal

Ensure that the benefits provided by ESA (to and on behalf of end users, terminal manufacturers, network and satellite operators, and modem and waveform vendors) can be fully supported by DIFI, without simplifying assumptions that turn ESAs in practice into…poorly performing parabolic antennas.

ESA Physical Use Cases for DIFI (1/2)

One Modem Endpoint, One Antenna Endpoint

- Pointing direction / target, frequency, polarization, and Gain/Power/EIRP control required from modem to terminal, with time synchronization
- Angular pointing range, achievable power, achievable PSD capabilities required from terminal to modem
- Frequent power / modcod / frequency / satellite changes due to moving satellite / terminal

Multiple Modem Endpoints, One Antenna Endpoint

- Control/capabilities required as above
- Control over which modem is active and controlling the terminal at a moment in time
- Handover of the signal from the one antenna endpoint from one Modem endpoint to the other

Multiple (dynamic) modem endpoints, multiple (dynamic) antenna endpoints

- Dynamic number of endpoints over time
- Control over which modem is connected to which antenna endpoint (i.e., beam)
- Capabilities of each beam (antenna endpoint) may be different from eachother
- Capabilities of each beam may change when other beams are configured
- Some combinations of modem-antenna endpoint pairings may need to operate independently from eachother (i.e., LEO / GEO), requiring a high dynamic range between the signal levels of the two links.
- Other combinations of modem-antenna endpoint pairings may need to operate synchronously / cooperatively

ESA Physical Use Cases for DIFI (2/2)

Land, Maritime Mobility operation on small platforms

- Highly dynamic and unpredictable (on a second-by-second basis) power, blockage, satellite, and link environment
- Frequent changes in the number of beams, network connectivity, and antenna configuration
- Rapid changes in modem/antenna state, frequent link drop and re-acquisition

Aero ARINC 793-compliant installations

- One or more modems, one or more panels / antenna endpoint
- Separate fiber links per modem

Gateway many (static) modem endpoint to many (static) antenna endpoint ESA

- Gateway (LEO or otherwise)
- Highly Static modem endpoint-antenna endpoint assignment
- Frequent satellite changes, infrequent network changes.

Conclusions

- The ESA WG is progressing well from the start of the conversation in March
- More participants in the WG are welcome! Please join on the portal.

- Questions?