Opportunities and Challenges for a shared, cooperative satellite AIS system

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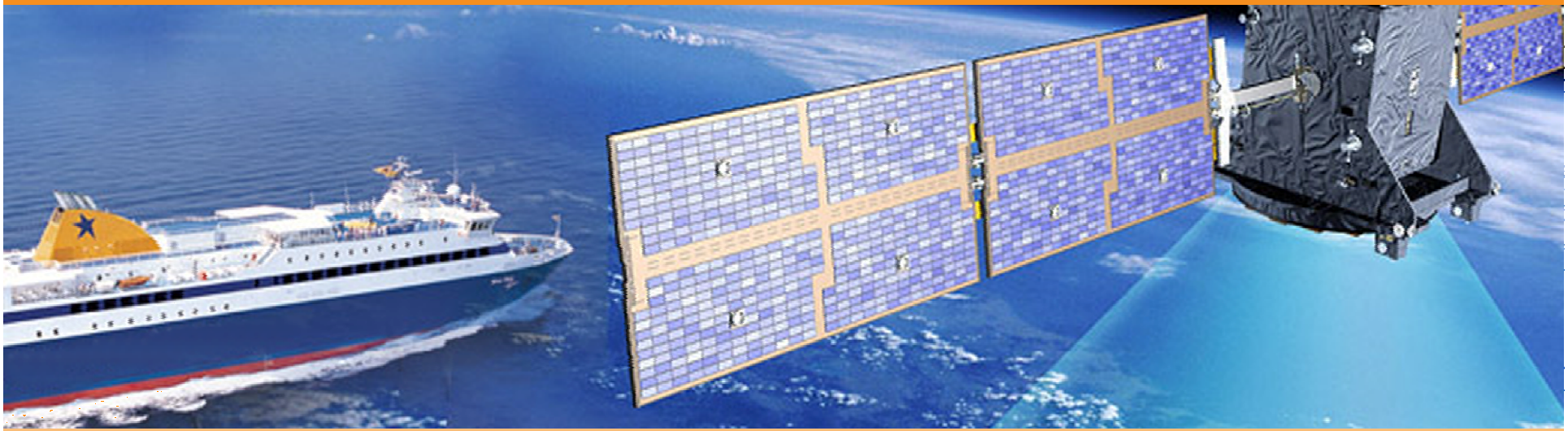


ISIS Group

- Spin-off of Delfi-C3 nanosatellite project of TU Delft
- Founded January 06, 2006
- Office locations:
  - Delft, near Delft University of Technology Campus
  - Noordwijk, in the European Space Incubator at ESTEC
- Current team: 20+ engineers, plus management, support

Innovative Data Services

- Founded July 2009
- Spin-off from small satellite and RF payload builder ISIS
- Experienced advisory board
- Most Promising Startup 2010 ESA/ESINET
- Offices in the Netherlands
  - Delft, campus TU Delft
  - Noordwijk, campus ESTEC
- Supported by ESA and YES!Delft

Sharing position knowledge with your surroundings is important

Knowing where *you* are is not enough

Solution:

Cell phone cell density, wifi and radio feeds to locate and communicate congestion

Enables:

- Improved knowledge on congestion
- Ability to take an alternative route

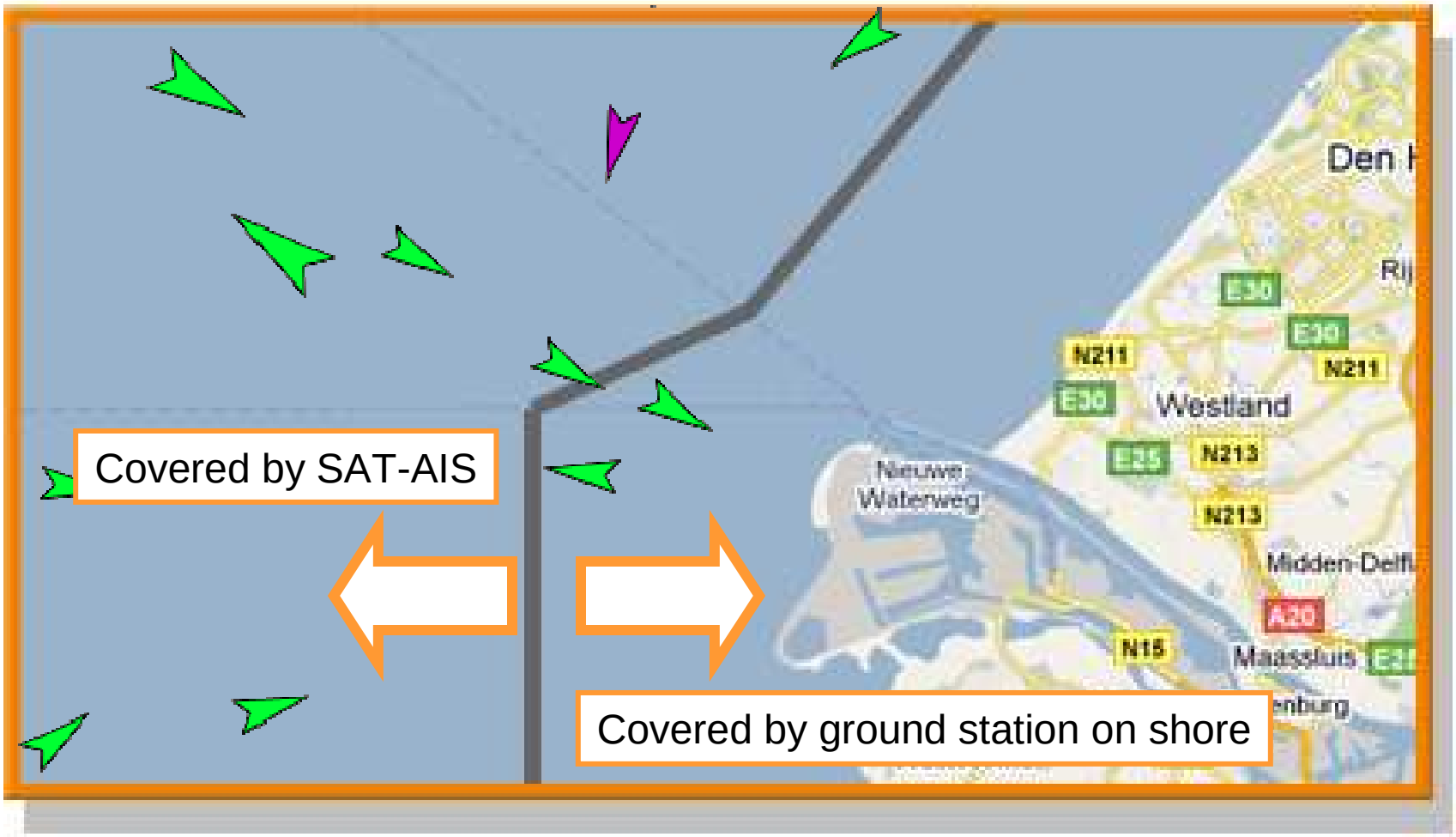
Solution:

IMO mandated transponder system improves local information needs for safety

Enables:

- Improved situational awareness
- Routing and logistic services near ports

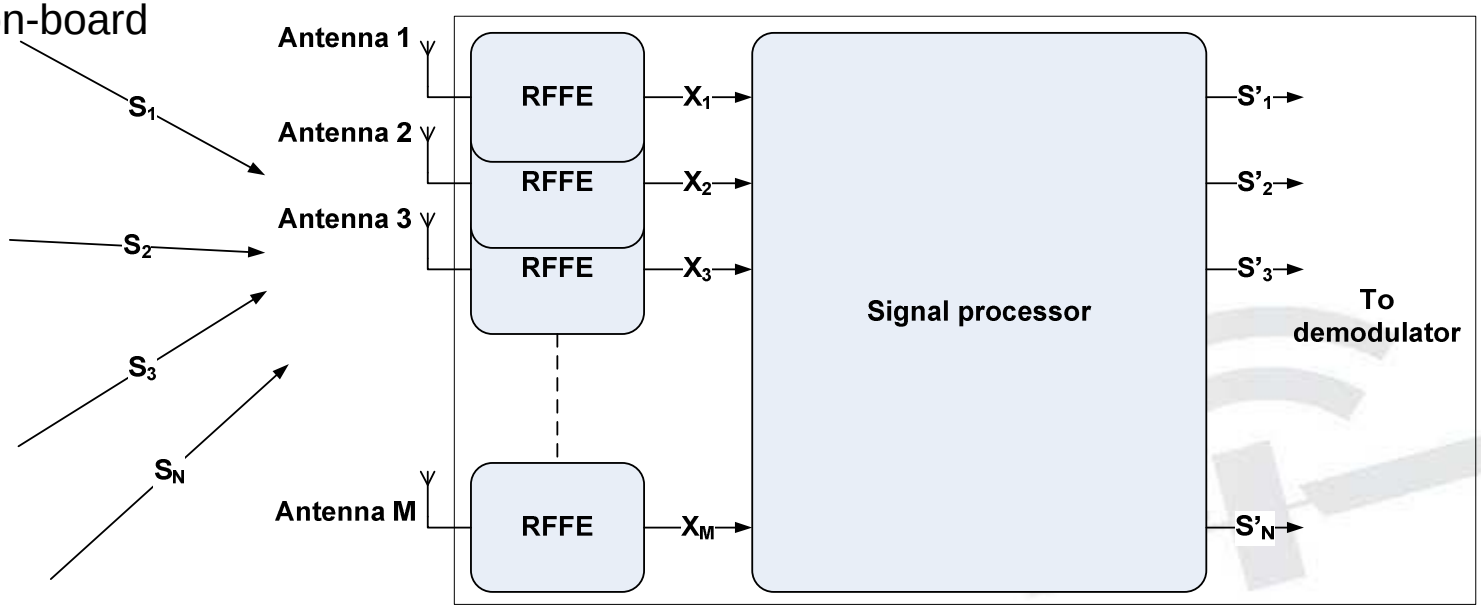
Operational Concept



Payload Technology

- Decollision of overlapping messages
- (acceptable performance in high traffic zones)
- Robustness against interference
- Low power and mass, so suitable for micro- and nanosatellites
- All processing, demodulation and decoding on-board

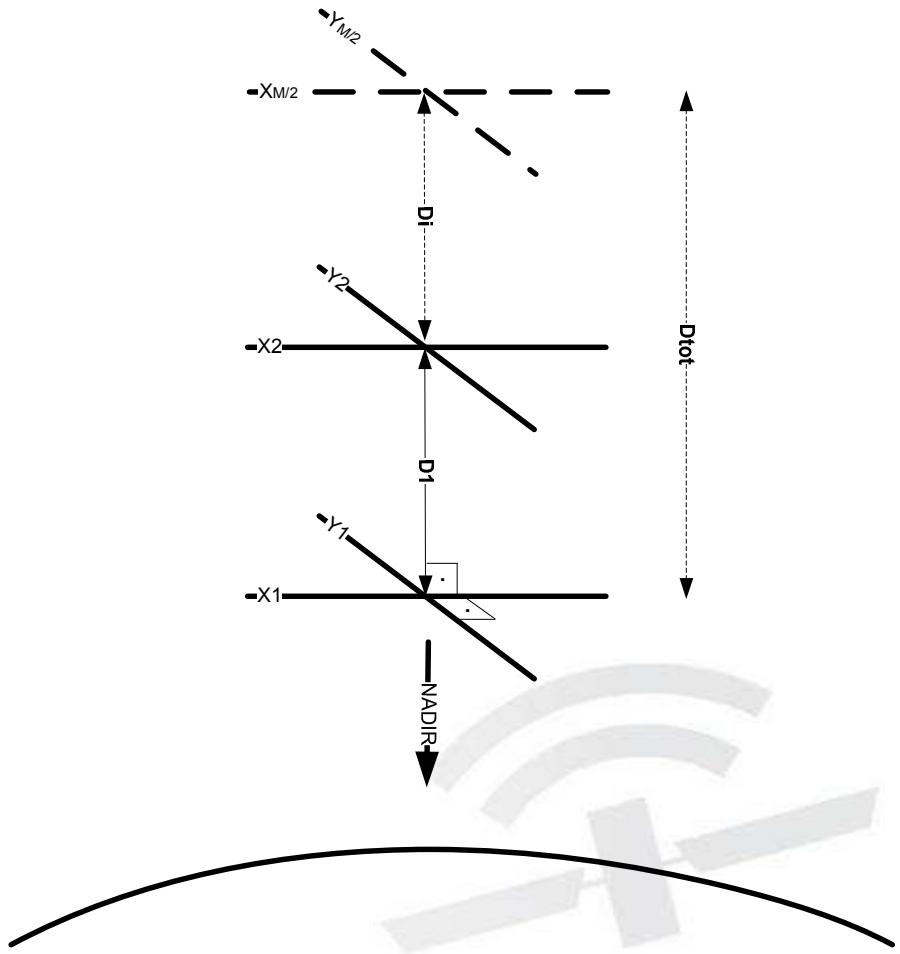
- Scalability
- No antenna calibration required
- No complex antennas required; high performances are achieved with simple monopoles or dipole antennas
- Reduced algorithm complexity
- No footprint reduction



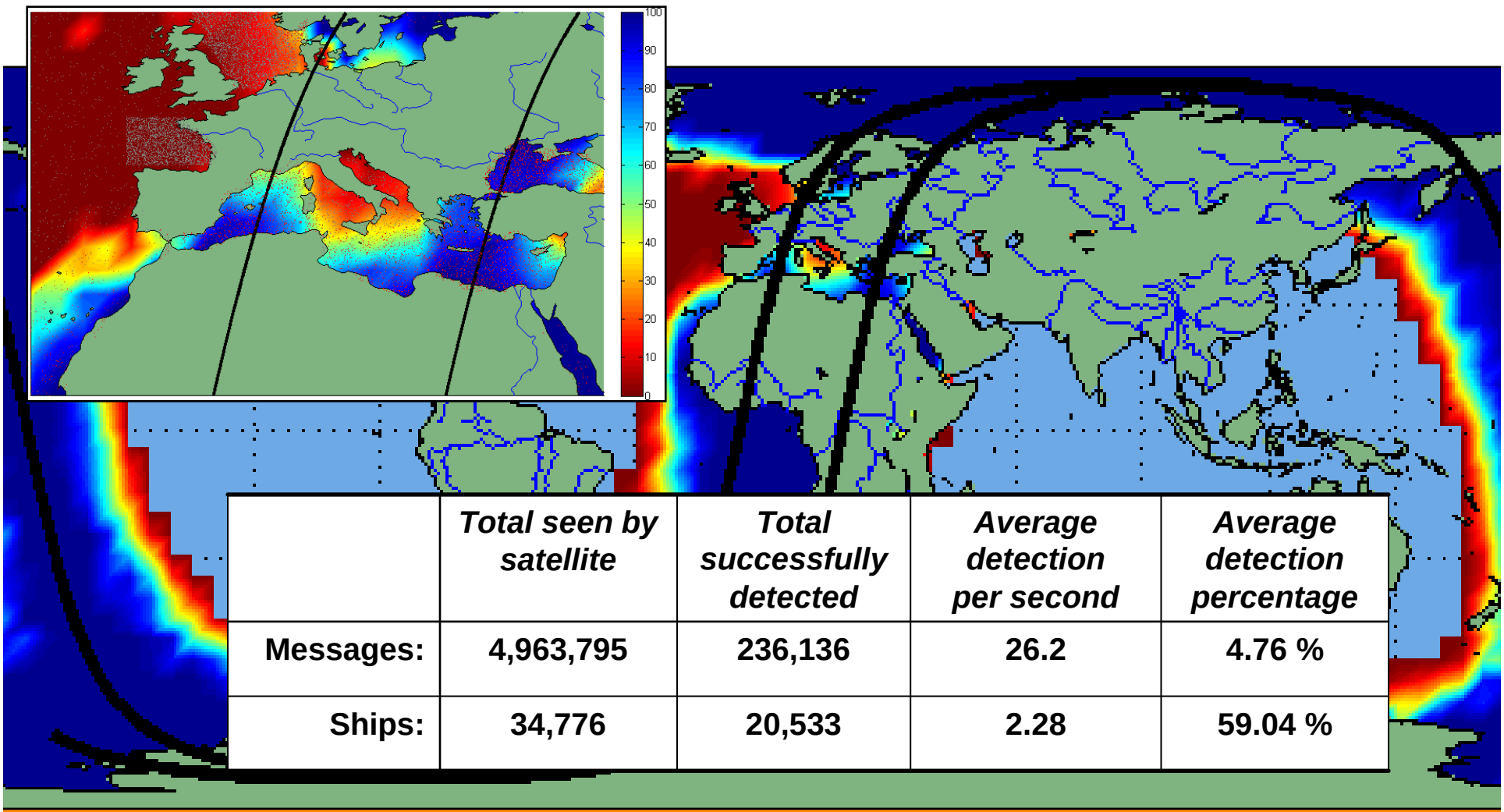
Expected Performance

- Very dependent on the scenario

- Example: Mediterranean
  - 150 minutes of flight time
    (2 passes over the Mediterranean)
  - 1 Spacecraft
    - 4 antennas
    - 500 kilometers altitude
    - 98º elevation
  - 70,000 ships
    - - Class A ships only
    - - 50.000 uniform distributed
    - - 9.500 Europe (additional)
    - - Rest: America / Asia
    - Reporting Rate:
    - 16.7 % - 3.3 seconds
    - 41.7 % - 6.0 seconds
    - 41.7 % - 10.0 seconds



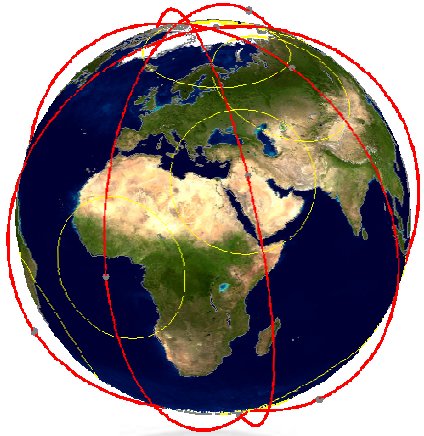
Expected Results



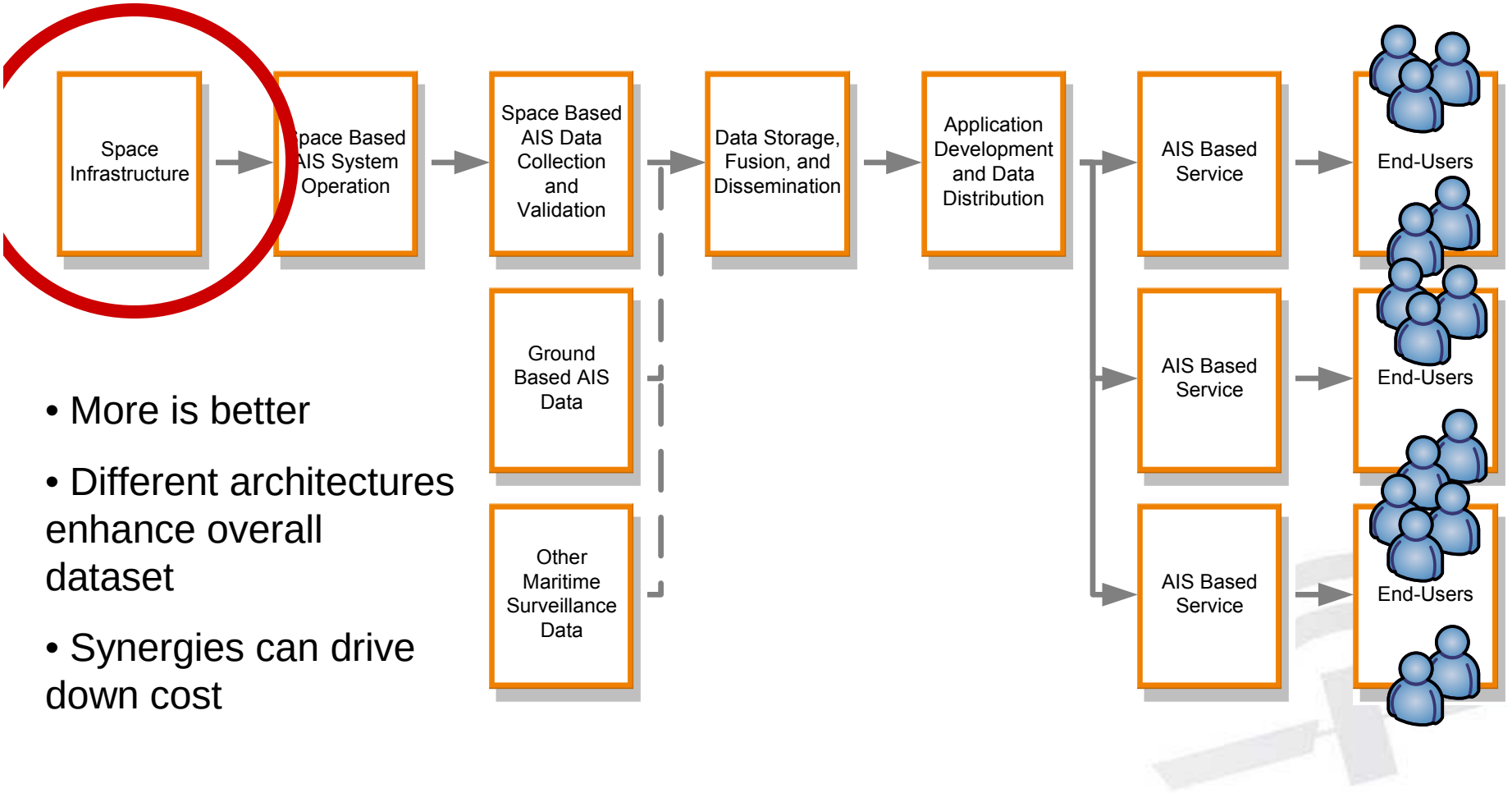
	Total seen by satellite	*Total successfully detected*	*Average detection per second*	*Average detection percentage*
Messages:	**4,963,795**	**236,136**	**26.2**	**4.76 %**
Ships:	**34,776**	**20,533**	**2.28**	**59.04 %**

AIS System Implementation

- *A network of nanosatellites is proposed to fulfil the user requirements at moderate cost:*
  - *4 sun-synchronous orbital planes*
  - *Mimimum of 3 satellites per orbital plane*
  - *Constellation altitude between 500 – 800 kilometres*
  - Use of a network of ground stations for to obtain low data latency



Organization and implementation

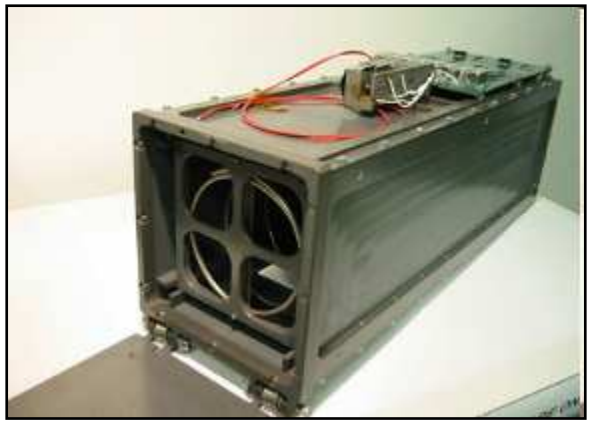


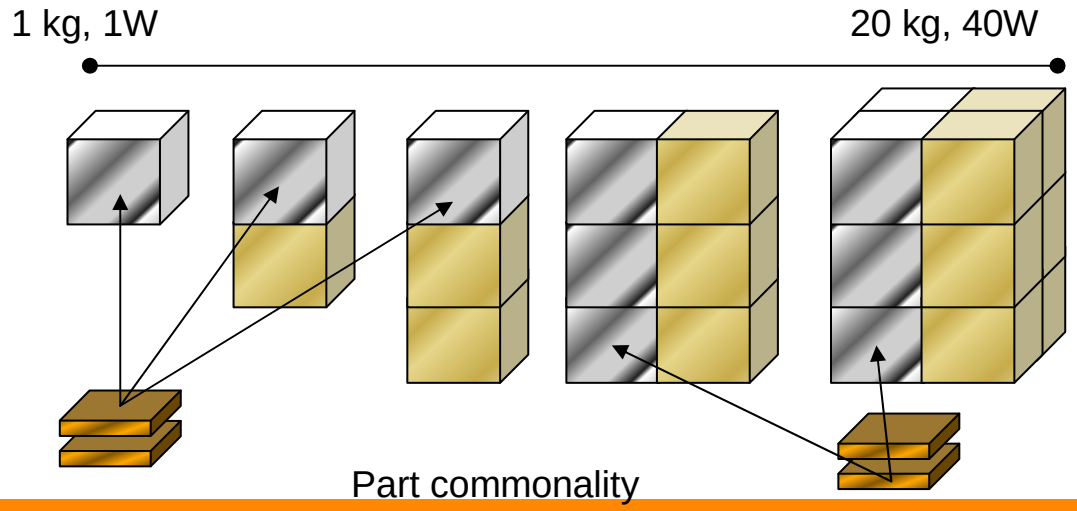
- More is better
- Different architectures enhance overall dataset
- Synergies can drive down cost

CubeSat Design Philosophy

Why is it so popular

- Standard form factor
- Open innovation, IPR sharing
- Low Cost Systems
- Modular systems based on harmonized interfaces
- Availability of off-the-shelf parts
- Sharing of groundstations (GENSO)
- Sharing launches (cluster launches)

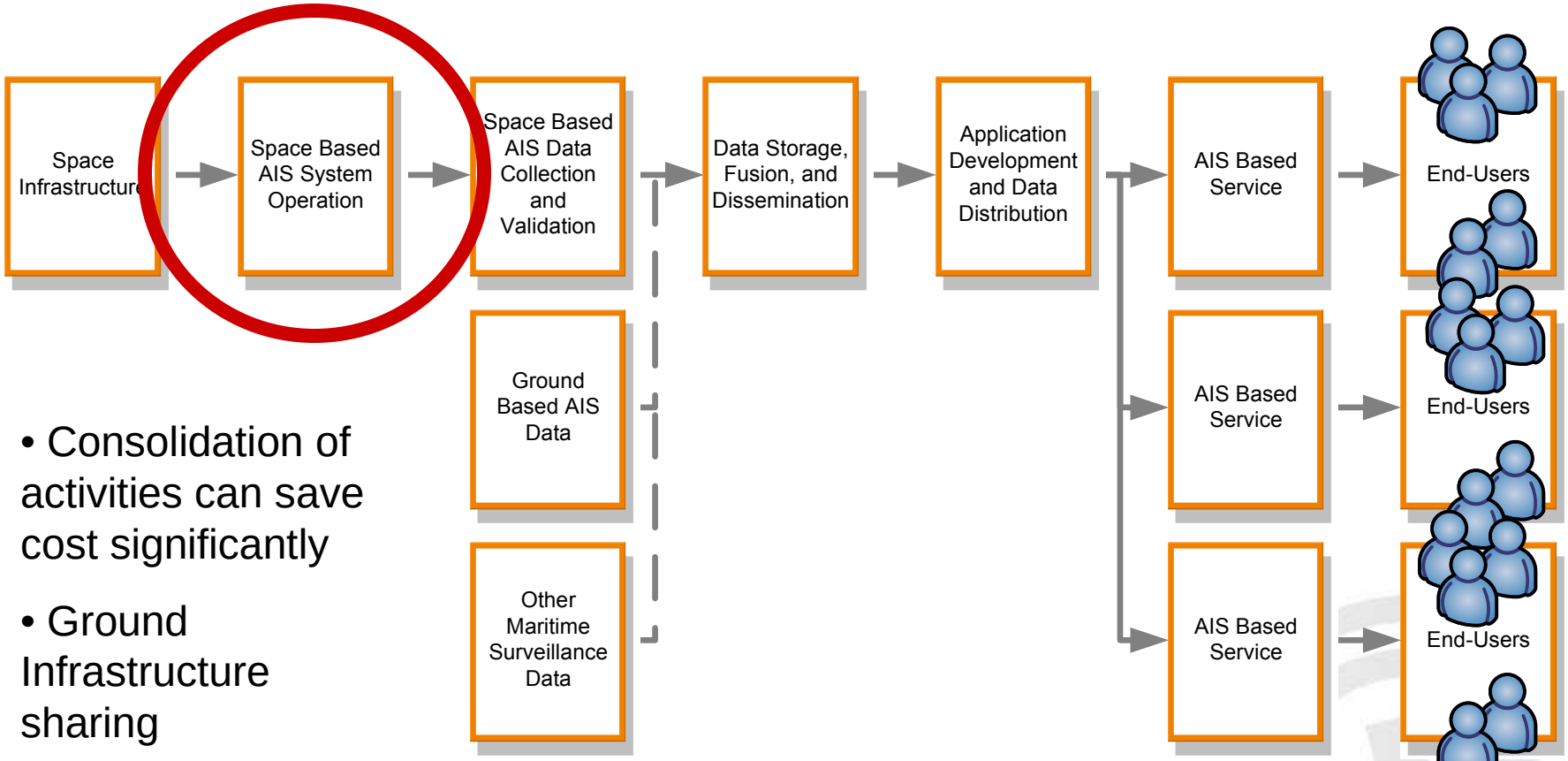




What could be done for S-AIS:

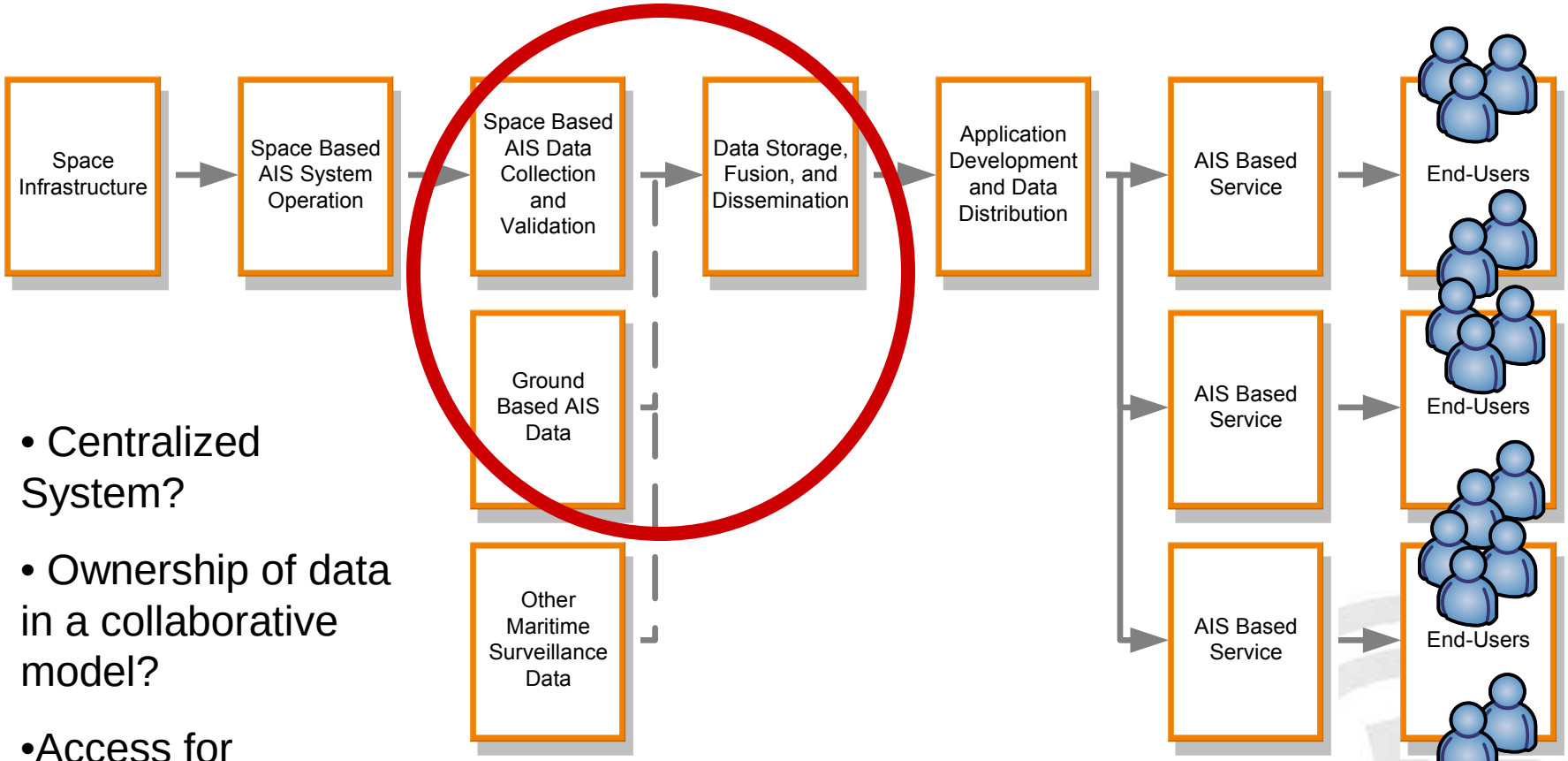
- Harmonizing payload interfaces
- Standardized modules
- Ground station sharing
- Clustered launches
- Functions Sharing
- Fractionating AIS Satellites?

Organization and implementation



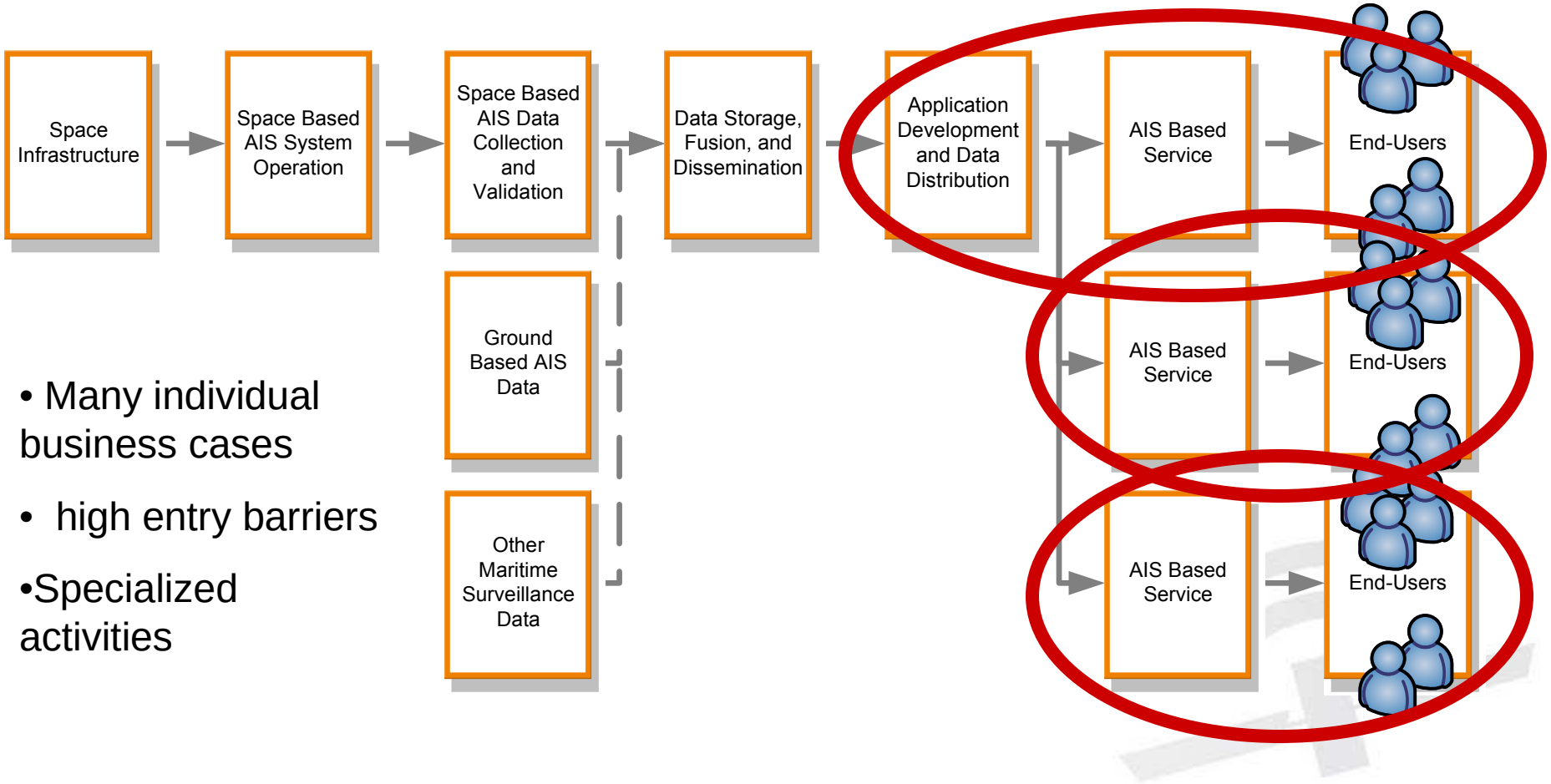
- Consolidation of activities can save cost significantly
- Ground Infrastructure sharing

Organization and implementation



- Centralized System?
- Ownership of data in a collaborative model?
- Access for commercial entities?

Organization and implementation



- Many individual business cases
- high entry barriers
- Specialized activities

Conclusions

- Compact, low power AIS receivers allow for low cost Sat-AIS constellations.
- Multiple SAT-AIS architectures working together will enhance results.
- Synergies and intensified cooperation in IPR sharing, infrastructure sharing, can drive cost down for the space segment.
- A centralized data center needs to address several issues with ownership and access rights for commercial entities to continue to invest.
- Individual business cases are difficult to share or integrate.
- Learn from other successful collaborative space system initiatives.

Thank you for your attention!

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