AEROSPACE

Ground System Architectures Workshop

Leaping into New Space: How to Leverage and Integrate with Traditional Aerospace

February 26–29, 2024
Renaissance Los Angeles Airport Hotel
Classified Session—February 29, 2024

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Working Group F Outbrief

Space Enterprise Integration to advance U.S. Capabilities: Strategic Framework and High-Profile Commercial Use Cases

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Space Enterprise Integration Panel and Objectives

Focus - government leveraging commercial solutions for national missions with emphasis on integrating data/systems/networks with and among owners and operators – all in the national interest.

High profile commercial use cases:

- Ground Networks for Space Communications
- LEO and Cislunar Space Domain Awareness
- Space Logistics / On-Orbit Servicing for National Missions

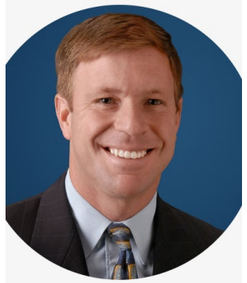
The leadership panel:

- Dr. Claire Leon, Director, Space Systems Integration Office, SSC
- Mark Quinn, Chief Executive Officer, Willis Towers Watson, Global Inspace
- Randy Kendall, Vice President Launch, Missiles, and Mobility, The Aerospace Corporation

Panel

Dr. Claire Leon

Mark Quinn



Randy Kendall

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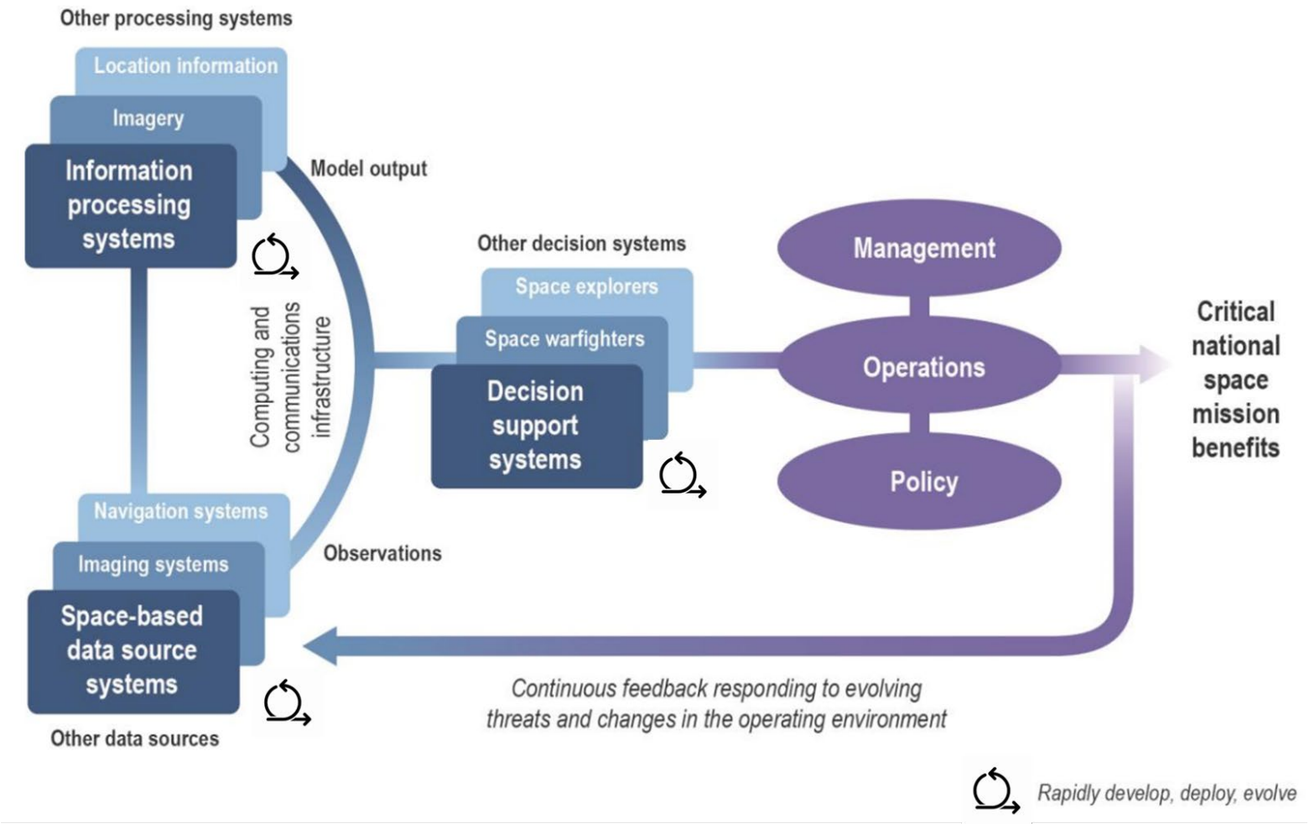
Key Points

Aligning Information across Enterprise to Inform Decisions for Stakeholders

- Part 1: *Panel comprised of Acquirer, Insurer, and Integrator highlighted plans and progress for integrating commercial solutions, with use cases, to advance U.S space capabilities in the national interest.*
- Part 2: *Town hall meeting captured information on best practices and challenges to achieve space enterprise integration going forward.*

Key Points

- Interdependence across space ecosystems
- Testbeds and Proving Grounds to build confidence and trust
- Business Cases for sustainable services and solutions



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Conclusions

Attendee input to 3x3 matrix informing Enterprise Integration going forward

	Ground Networks for Space Communications	LEO and Cislunar Space Domain Awareness	Space Logistics / On-orbit Servicing for National Missions
Interdependencies Across Space Systems	- Synchronization across systems - Standards – intersatellite links – OTC (unclass) SDA standard starting to be adopted – likely 2 standards (networking and orchestration) - IEEE / ISTO digitization interface standards - Mobile ad hoc networks / adaptation to high latency	- Synchronization across LEO, GEO and out to Cislunar - Implementation plans Comm & Nav - Integration across agencies to include timing standard - Adopt Open Source, Blockchain, and Zero Trust methodologies - Ensure continuous authority to operate (C-OTA) via continuous patching	- Synchronization between spacecraft and systems - CONFERs advancing ISO 24330 (2022) and AIAA S-155, S-157, and S-158 - USSF IEEE standards - Explore Licensing agreements - Accessing and using data - Expand use of Prototypes in response to demand signal
Testbeds & Proving Grounds to Build Confidence & Trust	- Reference ComSatCom TB&PG - TB&PG awareness, coordination, and partnering recommended - Develop a bank of authoritative sources of truth (ASOTs) - Engage UARCs, FFRDCs, DoD & Civil Digital Engineering teams - Do we need a champion? - Recognize acquisition leads' vision for multiple test ranges - ISAM State of Play Appendix 9 lists 50 TB&PGs - Commercial test beds for weather – resurrect CRADA engagements	- Digital engineering ecosystem SimCislunar - Explore more in 3GPP and WIFI on the moon - Lunanet/Lunar Comm Relay and Nav Systems (LCRNS) test set - Who would use these – primes or startups? Cost considerations as well as IP – marketing initiative as well as protocols/procedures/interoperability - Establish governance model (benchmark use of Space ISAC) - Make Space Digital Ecosystem and Integration (SpaceDEN classified testbed to perform live simulations available to small commercial companies	- Apply Edge Node TB&PG for ISAM AI for RPO/OOS - Mission Extension Vehicle (MEV) Space logistics / docking / RPO / refueling (ATK as well as SDL) - NRL space robotics lab - AFRL space robotics lab - Who would use these – primes or startups? Cost considerations as well as IP - National ISAM Strategy and implementation plan raises point on use of TB&PG
Business Cases for Sustainable Services and Solutions	- Focus on national level capabilities - fund fewer widgets to close the C2 business case - SDA published OTC standard recommended by industry (Consultative Committee for Space Data Systems (CCSDS), others) - Standards are key to affordability, integration, interoperability – look at aspects to focus on toward interoperability - NRO Commercial Systems Program Office (CSPO) strategic commercial enhancements program engages/supports range of business cases	- Start tracking protocols, methodologies - Timing and ranging - Establish common semantic ontology among agencies - Leverage NASA Moon to Mars strategy - Expand commercialization of non-earth imagery - Demand for commercial in cislunar, but no real business case for experimental capabilities to date - Use CORDS to track and manage space debris - NRO CSPO strategic commercial enhancements program	- End user license agreements for commercial reconnaissance - Must anchor delivery in operational requirement - MDA/NRO/other mission owners who have requirements must document operational capability - Establish policy for improved behavior/responsible use (NSC) - Currently may not be a business case or a vision and strategy for experimental ISAM – who leads/drives? - Gen Purdy – 'assured access to space' ideated on a space mobility command – anchor tenant relationship needed? - Leverage NASA Consortium for Space Mobility and ISAM Capabilities (COSMIC)

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Conclusions EXAMPLE INPUTS

Attendee input to 3x3 matrix informing Enterprise Integration going forward

	Ground Networks for Space Communications	LEO and Cislunar Space Domain Awareness	Space Logistics / On-orbit Servicing for National Missions
Interdependencies Across Space Systems	- Integration of space network entities present new challenges to the implementation of conventional routing protocols, resource management, and mobility management - Impacting the integrity of communications is the frequent handoff between satellites and air/ground networks and routing and link security	- Supply chain interdependencies across numerous sectors (transportation, critical manufacturing, energy) must be more visible and coordinated to reduce sourcing/logistics/security concerns	- Coordinate plans and schedules for on-orbit development across the interagency and with commercial
Testbeds & Proving Grounds to Build Confidence & Trust	- Develop TB&PG with high fidelity, operationally relevant environment for mission management, C2 testing, bidirectional space to ground communications, anomaly resolution, and anomaly scenario development	- Distribute results of testbeds to users beyond those investing in testbeds – for example, users who are looking to demonstrate similar capabilities or in tangential sectors	- Enhance the orbital simulation environment via in-orbit simulation robots benefitting from digital twin capabilities, which act as a proxy for the space environment and enable testing in the virtual world
Business Cases for Sustainable Services and Solutions	— Environmental, Social, Governance (ESG) concepts for ground networks must go beyond controlling orbital debris risk, and actively avoiding collisions to include redundancy and the capability of removing spacecraft from orbit	- Develop novel technologies to increase spacecraft endurance	- Establish the value chain