

# ***Ground System Architectures Workshop***

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

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

***Workshop Summary***

***Chris Wallisch,  
The Aerospace Corporation***

***February 29, 2024***

# Ground Systems Architectures Workshop

Keynote Summary : Dr. Bryan Tipton, Chief of Architecture and Engineering, HQ USAF

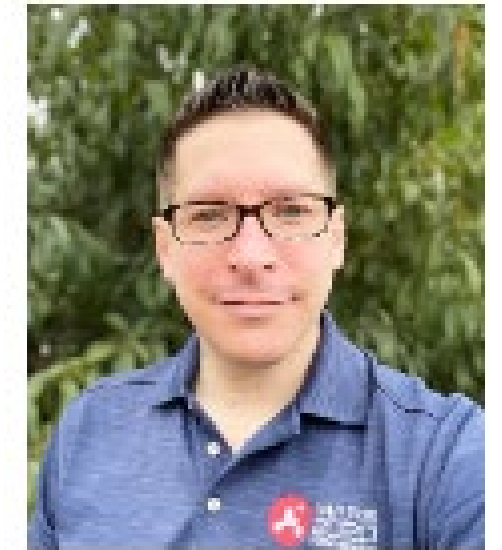
- Highlighted the transition towards a unified, efficient **BATTLE NETWORK** via technical architecture and program alignment, ensuring resilient decision-making
- Advocated for a ruthless focus on operational outcomes, violent execution of priorities, and extreme teaming for **System Integration**
- Three (3) Principles:
  - **Find the value in the Integration**
  - **Propose an Architecture** “A complex system has evolved from a simple system that worked” The inverse: “A complex system **designed from scratch** never works and cannot be made to work. You have to start over, **beginning with a working simple system**” John Gall
  - **Over Communicate** ... Advertising mentality ... don't assume a black box connection to external agencies, talk to them and understand their needs



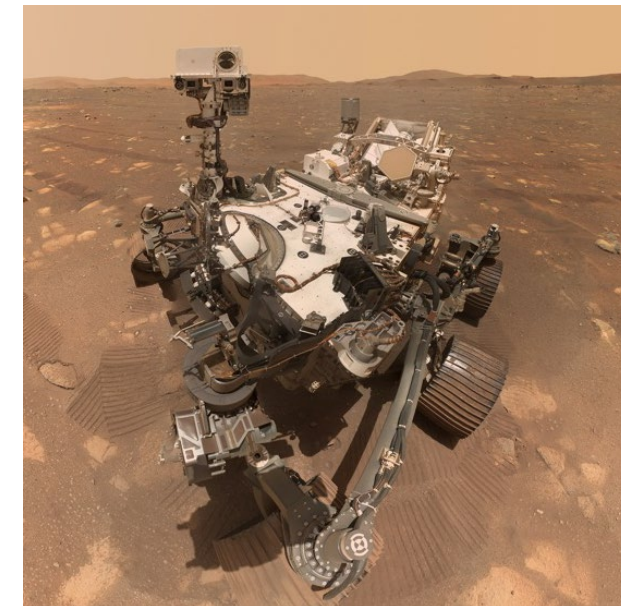
# Ground Systems Architectures Workshop

Keynote Summary : Guy Pyrzak, Mars 2020 Mission Lead, NASA JPL

- Highlighted groundbreaking Mars robotic missions, showcasing the Perseverance rover and Ingenuity helicopter's innovative deployment and operations.
- Emphasized Mars sample collection through advanced systems for significant geological analysis back on Earth
- Showcased Ingenuity's historic first powered extraterrestrial flight, setting new standards in space aviation.
- Highlighted the mission's extensive contributions to understanding Mars' climate, geology, and potential for past life, advancing planetary science.



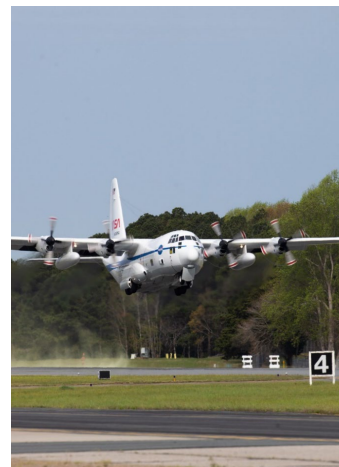
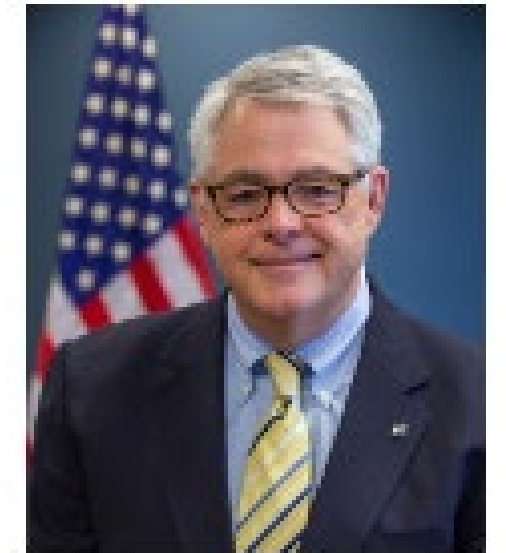
## Mars 2020 Mission and its Ground System



# Ground Systems Architectures Workshop

Keynote Summary : David Pierce, Director NASA Wallops Flight Facility

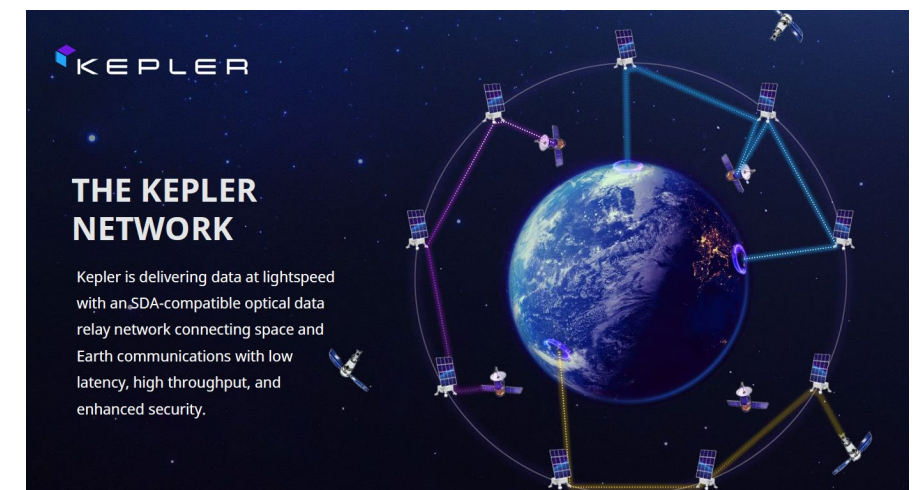
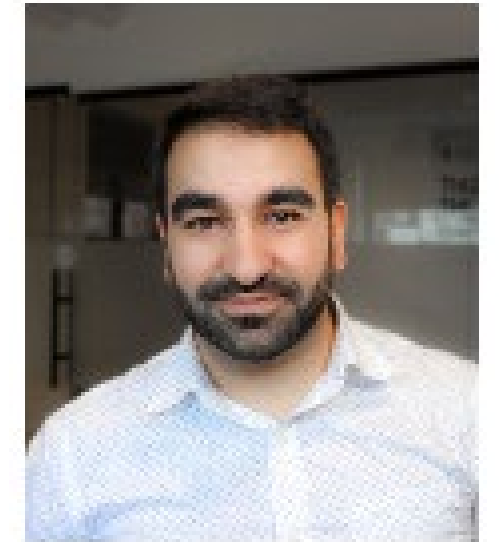
- Showcased Wallops Flight Facility's role in offering cost-effective, flexible suborbital and orbital launch services, enhancing U.S. space capabilities from Earth to the Moon.
- Emphasized its support for diverse missions, including those for NASA, DoD, and commercial entities, highlighting its extensive service offerings.
- Detailed the facility's upgrades in telemetry and command systems, showcasing improvements in mission efficiency and support through technological advancements.
- Outlined future plans for incorporating commercial services, aiming to bolster secure and dependable space communications in line with emerging mission requirements.



# Ground Systems Architectures Workshop

Keynote Summary : Mina Mitry, CEO/Co-Founder Kepler Communications

- We learned how Kepler Communications is revolutionizing the space industry with rapid deployment, showcasing a leap from concept to orbit in just nine months, highlighting agility and innovation.
- Breaking new ground in space communications, addressing current limitations by introducing a robust, low-latency optical network, and enhancing connectivity across space missions.
- Demonstrating significant advancements with the deployment of Pathfinder satellites, setting the stage for a global, real-time Earth observation data relay service.
- Setting new standards for space infrastructure, emphasizing open, secure, and scalable solutions, preparing for the future of space economy and connectivity.





# Ground Systems Architectures Workshop

## Highlights from Plenary Sessions – Sessions 2 and 3

- **Observations on Leveraging “New Space” by Traditional Space Users** **Session 2 “New Paradigms”**
  - Delved into the contrasts and **synergies between traditional space sectors and the emerging “New Space” domain**, outlining the benefits, challenges, and necessary strategies for legacy space users to adapt and thrive within this evolving landscape.
- **Innovations and Technological Advances in Support of Cost-sustainability of NOAA’s Future Ground/Flight System Architectures**
  - Focused on **transforming NESDIS Ground Enterprise into a unified, efficient, and sustainable architecture**, highlighting a shift towards a service-based, cloud-oriented model to handle increasing data volumes and sources efficiently and cost-effectively
- **Large Earth Observation New Space Ecosystem Ground Segment**
  - Provided an **in-depth analysis of the evolving ground segment infrastructure in the context of the large Earth observation new space ecosystem**, highlighting the transition towards more automated, interoperable, and cost-effective solutions to enhance mission management and data processing capabilities
- **Towards Ground Segment as a Service (GSaaS)** **Session 3: Ground as a Service**
  - Outlined **EUMETSAT’s strategic shift towards a Ground Segment as a Service (GSaaS) model**, highlighting the operational, cost, and efficiency benefits, as well as the challenges and solutions involved in transitioning from traditional ground segment systems
- **Exploring Ground Segment as a Service (GSaaS) as a Commercial Alternative to Traditional Distributed Architectures**
  - **Presented an evaluation of the transition to Ground Segment as a Service (GSaaS), advocating for a consolidated architecture to improve reliability, lower costs, and enhance response times,**
- **Monitoring Satellite Health & Safety of GEO Satellite with a Machine Learning Application**
  - Detailed a **machine learning solution for monitoring the health and safety of GEO satellites**, emphasizing the application’s adaptability across different orbital types and its deployment in operational environments, notably in the GOES-R ground system, enhancing telemetry data analysis and anomaly detection.

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## Highlights from Plenary Sessions – Sessions 5 and 6

- **Large Scale Flight Dynamics - Navigating Complex Scenarios with Simple Patterns** **Session 5: Scalable Solutions**
  - The presentation introduced the **transition of large-scale flight dynamics to cloud-based solutions using the Meridian Cloud Workbench**, highlighting the necessity for modernization to handle the increase in satellite deployments and the complexities of STM
- **EUMETSAT ML Framework System and AI/ML Applications**
  - Outlined the **development and implementation of EUMETSAT's ML Framework**, highlighting its strategic alignment with AI/ML roadmap objectives, and showcasing its application across various operational scenarios to enhance data analysis, system monitoring, and decision-making processes.
- **Lessons Learned in Responding to Increasingly Complex Earth Science Missions**
  - Covered the **intricate challenges and solutions encountered in the NISAR mission**, emphasizing the critical role of IT support in managing the mission's complex technology and infrastructure requirements, **showcasing collaboration between NASA/JPL and ISRO**.
- **Ground and Space Development Security and Operations for Reconfigurable Edge Platforms** **Session 6: Cyber Considerations**
  - Presented a comprehensive **strategy for transitioning towards dynamic and distributed space cloud architectures**, emphasizing the enhancement of ground and space operations through DevSecOps for reconfigurable edge platforms
- **The State of CryptoLib: The Open-Source Satellite Cryptography Library**
  - Discussed the **development and application of CryptoLib**, an open-source library for satellite communication security, highlighting its compliance with CCSDS standards and integration with various systems to ensure secure space communication.
- **Moonlight Defender – Purple Teaming in Space**
  - Presented an examination of the Moonlight Defender exercise, **illustrating the innovative approach of purple teaming in space cybersecurity**.



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## Highlights from Plenary Sessions – Sessions 7 and 8

- **3GPP/5G Based Lunar Surface Communications** [Session 7: Communication Solutions](#)
  - Covered the **advancements in 3GPP/5G technologies for lunar surface communications**. It discusses the potential to enhance lunar mission communications through improved range, reliability, and data aggregation capabilities, aligning with NASA's M2Mars strategy.
- **A Technical Overview of the Mission Onboarding Process Managed by the Mission Engagement Working Group**
  - Provided insights into the **MEWG's role in streamlining mission onboarding processes for the Near Space Network**, enhancing communication, and fostering collaboration between aerospace entities and government agencies.
- **Commercial Antenna Security: Risks Real and Imagined with Using Commercial Antenna Systems**
  - Evaluated the **security implications of integrating commercial antenna systems into critical space programs**, weighing the perceived versus actual risks and offering strategic mitigations to ensure the secure operation of space-to-ground communications
- **Supporting Agile Space Operations with a Cloud-Based Solution** [Session 8: Agile/Dev/SecOps](#)
  - Presented a **cloud-based solution for agile space operations emphasizing flexibility, scalability, and modularity** for dynamic mission needs, simplifying preparation, enhancing security, and improving microservice deployment for increased efficiency and adaptability.
- **DevSecOps Approach to Multi-Mission Operations**
  - Introduced a **DevSecOps strategy for streamlined multi-mission operations**, integrating specialized tools, common solutions, and shared IT to lower costs and risks while boosting security.
- **Return Link Service Test Bed: Demonstrator Platform and Web Applications for New SAR Galileo Services**
  - Outlined the **development and application of the Return Link Service (RLS) Test Bed for enhancing Search and Rescue (SAR) operations through the Galileo satellite system.**



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## Highlights from Plenary Sessions – Sessions 9 and 10



- **Comparative Evaluation of Anomaly Detection Solutions on Satellite Telemetry** **Session 9: Intelligent Systems**
  - Discussed the **evaluation of machine learning-based anomaly detection solutions in satellite telemetry**, emphasizing the development and results of the MALTA evaluation framework.
- **Look Houston...No Hands!**
  - Explored the **challenges and opportunities in implementing autonomous systems for satellite operations**.
- **Next-Gen Space Safeguards: ML-Based Protocol Anomaly Detection for Securing Space-to-Ground Data Links**
  - Focused on **leveraging machine learning for anomaly detection in space-to-ground data links**. It highlighted the evolution of threat landscapes and the application of various machine learning techniques to ensure the security and integrity of communication protocols critical to mission success
- **An Agile, MBSE Approach to Data Definition** **Session 10: Digital and Data Technologies**
  - Showcased **Sandia National Laboratories' successful use of an Agile Model-Based Systems Engineering (MBSE) approach for managing and defining data specifications in a complex ground system re-architecture project**.
- **Utilizing CSRM for NASA Mission Ground Segment Design**
  - Focused on the **application of the CubeSat System Reference Model (CSRM) in the design of NASA's mission ground segments**.
- **Monitoring Satellite Pattern-of-Life Changes with Passive Radio Frequency Data**
  - The presentation illustrated the use of **machine learning techniques to detect anomalies in satellite behavior**, enhancing space situational awareness and operational security.



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## Highlights from Plenary Sessions – Sessions 12 and 13



- **Tactical Surveillance Reconnaissance & Tracking (TacSRT) Snapshot** **Session 12: Partnerships and Collaborations**
  - Outlined the TacSRT pilot's mission to **demonstrate the U.S. Space Force's capability to rapidly deliver unclassified commercial space-based sensing and analytics capabilities** to Combatant Commands through Space Components.
- **Hiding in Plain Sight: Achieving Secure and Resilient Space to Ground Communications**
  - The presentation emphasized the **creation of a distributed architecture combining government and commercial ground stations, employing modern routing, encryption,** and active monitoring to safeguard against vulnerabilities and malicious activities.
- **Optimizing Ground Systems: An Operator's Perspective**
  - Addressed the **challenges in current satellite operation workflows and proposed enhancements through automation and advanced technologies.**
  
- **Evolving Telemetry Storage with Search and Time-Series** **Session 13: Data Centric Architectures**
  - **Explored advanced telemetry storage solutions to meet growing data demands in space missions.**
- **Prototype USSF Enterprise Satellite Operations**
  - Outlined the **progress and future plans for the Prototype USSF Enterprise Satellite Operations,** emphasizing the transition from traditional satellite operations to a more integrated, cloud-based approach.
- **Interoperability Without Standards: An Architecture for Handling Data in Any Format**
  - Introduced a flexible architecture designed to adapt to various data formats and communications, addressing the challenges posed by the multitude of existing standards



# Thank you to all our Keynote Speakers

Tuesday, February 27 – 8:00 AM PT



**Dr. Bryan Tipton**

Chief of Architecture and Engineering  
Department of the Air Force (DAF) Integrating Program Executive Officer  
(PEO) for Command, Control, Communications and Battle Management  
(C3BM), Assistant Secretary of the Air Force for Acquisition, Technology and  
Logistics, Headquarters U.S. Air Force  
([bio](#))

Tuesday, February 27 – 12:00 PM PT – Lunchtime



**Guy Pyrzak**

Mars 2020 Mission Lead  
NASA/Jet Propulsion Laboratory (JPL)  
California Institute of Technology  
([bio](#))

Wednesday, February 28 – 8:00 AM PT



**David Pierce**

Director  
NASA's Wallops Flight Facility (WFF)  
NASA's Goddard Space Flight Center  
([bio](#))

Thursday, February 29 – 8:00 AM PT



**Mina Mitry**

CEO/Co-Founder  
Kepler Communications Inc.  
([bio](#))

Thursday, February 29 – 1:30 PM PT – Classified Session



**Colonel Kalliroi Landry**

Chief, Support Cell (Ground, Launch, & User Equipment)  
Space Development Agency  
United States Space Force (USSF)  
([bio](#))

# And Panelists .....

## Panelists



**Kris Acosta**

Director of System of Systems Engineering and Net Assessment of the Space Systems Integration Office (SSIO)  
Space Systems Command (SSC)  
United States Space Force (USSF)  
([bio](#))



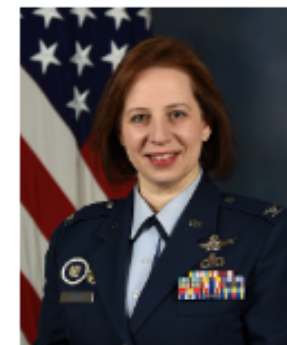
**Victor Grycenkov**

Deputy Director, JPSS  
National Oceanic and Atmospheric Administration (NOAA)  
([bio](#))



**Katarzyna Cichecka**

Head of the System and Applications Engineering Division  
European Space Agency (ESA)



**Colonel Kalliroi Landry**

Chief, Support Cell (Ground, Launch, & User Equipment)  
Space Development Agency  
United States Space Force (USSF)  
([bio](#))



**Wing Commander Richard Crouch**

United Kingdom Liaison Officer to the US Space Systems Command  
Space Capability Planning Group  
UK Space Command & UK Strategic Command  
([bio](#))



**Erwin Mercado**

President & CEO  
Swedish Space Corporation (SSC) Space US  
Head of Region, Americas  
([bio](#))

# And Technical Exhibitors .....

## GSAW 2024 Technical Exhibits

*(Scheduled to attend)*





## ***And Our Outstanding Poster Session Presenters.....***

**Reshaping Space Operations with AI:** Alessandro Benetton, CTO, AIKO

**Future of NOAA GEO Ground Station: A Multi-Mission Enterprise Solution in the Cloud:** Lili Alvarado-Ortiz, Pouyan Amirshahi

**Aspects of Safe Drone Operations for Wildfire Response:** Robert J Kerczewski

**Leaping into New Space using Standards:** The OMG Space Domain Task Force

**Applications of Large Language Models (LLMs) in Ground Stations:** Sean Colbath

**Next-Gen Space Safeguards: ML-Based Protocol Anomaly Detection for Securing Space-to-Ground Data Links:** Shannon Bull, William Stanton

**Research Areas in Ground Systems at USC's Center for Research in Space Technologies (CREST):**  
Andrea Belz, Alfiya Hussain





# *Looking Forward to GSAW 2025 ....*



**Thanks to everyone who attended and participated in GSAW!**

- Tutorials
- Working Groups
- Plenary Sessions
- Technical Exhibits
- Poster Sessions
- Keynote Speakers

**See You Next Year!!**