



# ***Ground System Architectures Workshop***

## ***Stronger Together: Improving Interoperability for Users and Operations***

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## ***Bridging Together Ground and Space Capabilities for Users and Operators***

***Leads: Mr. Alvin Leung  
SSC/BCTI***

***Dr. Xinyu Wang  
The Aerospace Corporation***

A satellite in space with solar panels and a ground station antenna on Earth. The background is a teal gradient with a faint circular graphic on the right.

## *Session Goals*

- Develop near-term strategic action plan to bridging the gap bringing together ground and space capabilities for users and operators
- Working group attendees share their past experiences and thoughts through an interactive, guided whiteboarding and breakout session

A satellite in orbit with solar panels and a ground station antenna on the left. The background is a teal gradient with a faint circular graphic on the right.

# *Presenters/Panelists*

- Mr. Alvin Leung  
SSC/BCTI
- Dr. Xinyu Wang  
The Aerospace Corporation

A satellite in orbit with solar panels and a ground station with a large parabolic dish antenna.

# Key Points

## Discussions and highlights

- Interoperability:
  - *The WG acknowledges that the DoD has been building many **stove-piped systems** over years; very few of them permit interoperability across different systems. Many existing efforts to interoperate are “bottoms-up.”*
  - *The WG agrees that the enabling of interoperability between space and ground systems is critical for **optimal resource utilization** and avoids tremendous development and O&M costs*
  - *The WG believes that the interoperability challenges are mostly caused by **DoD policy and cybersecurity restrictions**, instead of technical feasibility*
  - *The **Flexible Network Interface (FNI) is an SSC attempt** to integrate various underlay network resources from different organizations together using an overlay network with the goal to provide common interfaces and network services to the users and missions. FNI has gone through several rounds of demonstrations.*
- On-demand Resource Provisioning of the Space and Ground Networks
  - *The WG discussed the current DoD practice of **static provisioning** with the signed Service Level Agreement (SLA) and the commercial cellular network service providers pay-as-you-use-it model*
  - *The WG discussed **enabling technologies**: orchestration of the users’ network management systems and the service providers’ network management systems to facility on-demand real-time resource provisioning*
  - *The WG is **unaware of any existing on-demand resource provisioning solutions across DoD**, and attributed this to existing culture and common practices*

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# Key Points

## *Discussions and highlights*

- Zero Trust Architecture (ZTA) for Space Systems
  - *The WG discussed the **DoD ZTA Strategy** published in October 2022 that specifies the ZTA functions and required timeline of deployment in DoD systems*
  - *The WG discussed the differences between the ground network systems and the space communication systems, particularly the threats and vulnerabilities, and agrees that **the ZTA for the space communications should be tailored** from the DoD ZTA Strategy which mainly focuses on ground systems*
  - *The WG informs the anticipated release date (**end of FY2023**) of the DoD ZTA Strategy **for Space Systems***
- Cloud Computing: Space-based vs. Ground-based
  - *The WG discussed the feasibility of the space-based cloud computing and agrees that*
    - (1) Space-based computing is valuable in a **contested environment** when space-to-ground links are not available
    - (2) **Cross-links** in space communications should be explored first before space-based computing
    - (3) Space-based computing can only handle **very limited computing demand** (such as a Software Defined Network controller) due to the power consumption constraints
  - *The WG discussed commercial industry's deployment of the space-based cloud computing and recommends **learning from commercial practices***

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# Conclusions

## Near Term Action Items

- Interoperability
  - *The WG recommends that interoperability across different DoD systems should be worked out **step-by-step** and with **multiple bi-lateral agreements**:*
    - Starting from a bi-lateral agreement between **two** organizations and then gradually expanding to other organizations
    - Support from the **decision makers** is critical
- On-Demand Resource Provisioning
  - *The WG recommends a deep dive of other **charge by-use models** especially across disparate networks (e.g. cell roaming)*
- Zero Trust Architecture (ZTA) for Space Systems
  - *Space Systems Command (SSC), in collaboration with the Aerospace (and other organizations), **plans to release a ZTA Strategy for Space Systems***
- Cloud Computing: Space-based vs. Ground-based
  - *The WG recommends the pros and cons study of the **cross-link communications vs. the space-based computing***
  - *The WG recommends starting space-based computing with **the light-weight functions**, such as the controller of the space-based SDN network*
  - *The WG recommends a deep dive of **current commercial industry space-based computing practices** for DoD use*