

## **GSAW 2023 Tutorial C:**

### Software Defined Networking Leveraging Cloud Processing for Ground Satellite Operations

#### **Overview:**

Software Defined Networks (SDN) allow networks to be run in a more flexible and cost-efficient manner, e.g., by increasing network resource utilization and by decreasing operational costs. Network Function Virtualization (NFV) allows even further flexibility by migrating network functions from dedicated hardware to virtual machines running on commodity hardware, Virtual Network Functions (VNF). Network operators find VNFs appealing to ground system operators since they can be migrated and flexibly adapted to current demands. New satellites services can be added to an operation system in hours not weeks.

This technology is well known and extensively utilized by the telecommunications and IT industry; however, it is not well integrated into the satellite ground industry. Advances in virtualization capabilities specific to satellite ground operations and ongoing improvements in cloud processing technology, both in power and bandwidth capability have created the perfect storm allowing ground operations to adopt SDN technology in many key areas. The newly achieved flexibility opens a set of key questions concerning i) reliability, ii) service orchestration iii) function placement, and iv) performance.

This workshop will cover the basics of SDN and how it can be effectively integrated into a satellite ground operation.

- I. SDN/NFV architectures, applications, and updated use cases
- II. Typical domains within the proposed SDN/NFV satellite ground architecture
- III. Examples of how the architecture adapts to mission unique requirements of both commercial and military endeavors
- IV. How to operate virtualized network functions in a reliable manner including redundancy and load balancing
- V. How VNFs can provide performance figures required for satellite network operation
- VI. How service chains can be virtualized and automated in a satellite ground operation
- VII. Review of example service chains for use in operation systems today.
- VIII. What VNFs are available for satellite ground networks and how they be utilized to optimize the satellite ground network subjected to different design criteria
- IX. What is SDN/NFV-based service orchestration and how it can be incorporated into the satellite ground network
- X. What is multi-domain service orchestration and how to take advantage of it in a ground satellite operation
- XI. SDN/NFV-based network deployment and management for a ground satellite operation
- XII. How to add a RF monitoring service to the flexible satellite ground network architecture presented.
- XIII. How to add a network monitoring service to the flexible satellite ground network architecture presented.
- XIV. Satellite Ground and the role of Operational Support Systems (OSS) and Mission Planning for service demands
- XV. Other topics as time permits with an emphasis on virtualized networks and further discussion on industry standards and common methods to deploy network functions.

**Instructor:** Frank Sandoval, Kratos Space

#### **Biography:**

**Frank Sandoval** is a technology and product developer with Kratos who has a strong background in

the telecommunications industry. He has many years of experience with all aspects of the software development lifecycle, including roles from developer, architect, to Sr Director levels. Frank's interests and abilities have led him to focus on system design, collaborative development, and new product development. Currently, Frank is leading efforts to develop standardization of interfaces and open-source development.

**Description of Intended Students and Prerequisites:**

Attendees should have a general knowledge of satellite ground operations.

**What can Attendees Expect to Learn:**

Software Defined Networking as applied to the satellite ground networking. How to enable cloud processing to gain the most benefit.