Foundational 5G Testbed for Next G/6G Framework Refinement and Implementation

Private Wireless Networks for Enterprise/Government

Dr. Rajeev Gopal
VP Advanced Systems, DISD
Hughes Network Systems, LLC

HUGHES
An EchoStar Company

Powering a
Connected Future

Leveraging 5G Testbed for Next G Evolution

Empirical Data-based Feedback

- **5G Standalone (SA) networks**
  - Edge cloud, automated management, and comprehensive security
  - 5G virtualization with increased flexibility, interoperability, and performance
- **Private 5G SA testbed for government and enterprise customers**
  - Prioritize security and resiliency
  - Empirically define and validate use cases and implementation approaches
  - Efficiencies with artificial intelligence (AI), and machine learning (ML)
  - Edge and centralized instances within a distributed cloud architecture
- **Leverage software agility and local management**
  - Information collection and processing (learning) closer to the tactical edge
- **Facilitate experimentation with Next G in remote locations worldwide**
  - Resilient broadband SATCOM connectivity (range extension)
  - Low-earth-orbit (LEO) and Geosynchronous (GEO) satellite links

Benefits
- Open
- Flexible
- Performance
- Edge Cloud

Challenges
- Macro Heritage
- Security
- Management
- Range Extension

Hughes - Pioneering SATCOM Heritage

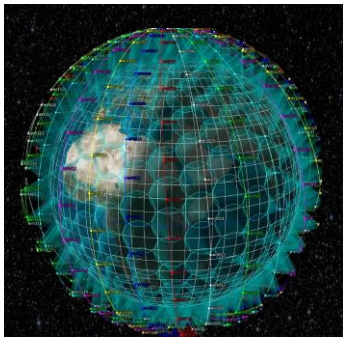
GEO/LEO Constellations and Managed Services

HUGHES
An EchoStar Company

- Mid-size US based company (DC area, $2B/year)
- GEO – High Throughput Satellites (HTS) and service
- LEO - OneWeb ground network – 4G/5G based
  - Thule, Greenland polar service (AFRL)
- USSF Protected Tactical Enterprise Service (PTES)
- 5G Standalone for flightline modernization
  - US Naval Air Station Whidbey Island (NASWI)
- Industry standards – DVB-S2/S2X, GMR-1, 4G/5G
- 6 Ka-band satellites/payloads
  - JUPITER – HTS (100s Gbps)
  - SPACEWAY – Onboard Layer 2 processing
- 50+ Gateways
  - > 500 Gbps of Capacity

OneWeb LEO Polar Orbit

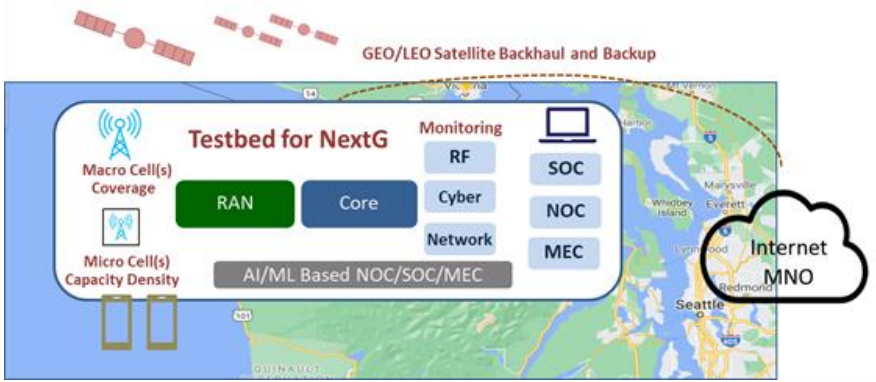
DEUCSI program
Thule, Greenland



Ka-band HTS
JUPITER Satellite
Systems

5G Testbed with Management and Security

AI/ML Based Operations Automation



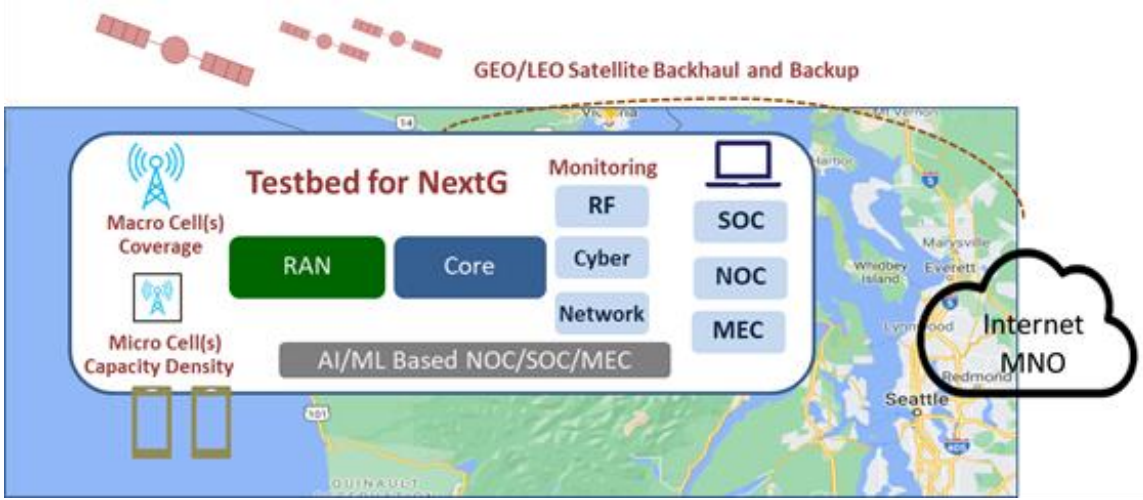
- **Three key Next G Alliance priorities**
  - Security/resiliency; distributed cloud and communication; and AI-native network
- **Empirical approach for key Next G challenges**
  - Define frameworks and solidify practical solutions
  - Utilize slicing and edge/centralized cloud instances
- **AI capabilities embedded in management software**
  - Automated network (NOC) operations
  - Automated security (SOC) operations
- **Automation for wireless and cloud technologies**
  - Network robustness, performance, and efficiencies
  - Diverse traffic types, ultra-dense deployment topologies
  - Challenging spectrum situations

Testbed Differentiators

- End-to-end Management
- UE Simulator
- RF, Cyber, and Network Sensing
- Integrated LEO/GEO for Range Extension
- DevSecOps Development Pipeline

5G Standalone Testbed Architecture

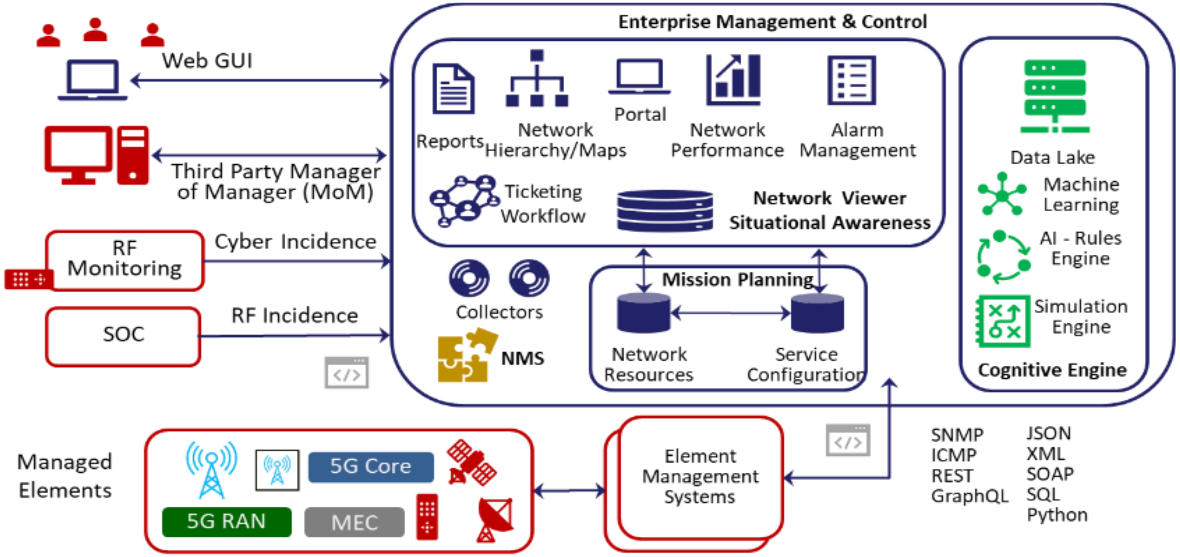
Local Management and Comprehensive Security

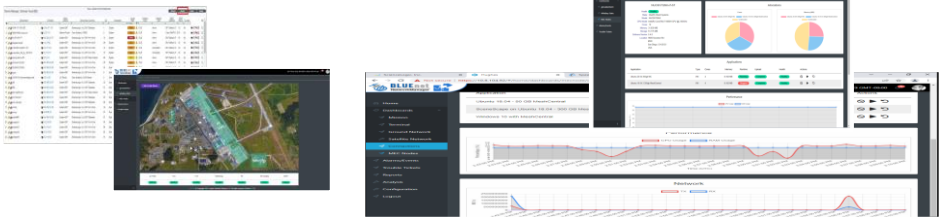


- **Redundant data network**
  - Firewalls, routers, switches
  - Layer 3 subnets
  - Layer 2 VPNs
  - Separation of planes
  - Management, control and user
- **NOC as manager-of-managers**
  - Fault, accounting, performance aggregation
  - Links to RAN/Core/MEC EMSs
- **Independent SOC function**
  - Monitoring
  - Scanning
  - Compliance
- **AI/ML for NOC/SOC**

Network Operations Center (NOC)

Reuse of Management Software (Heritage: Largest SATCOM Operations)

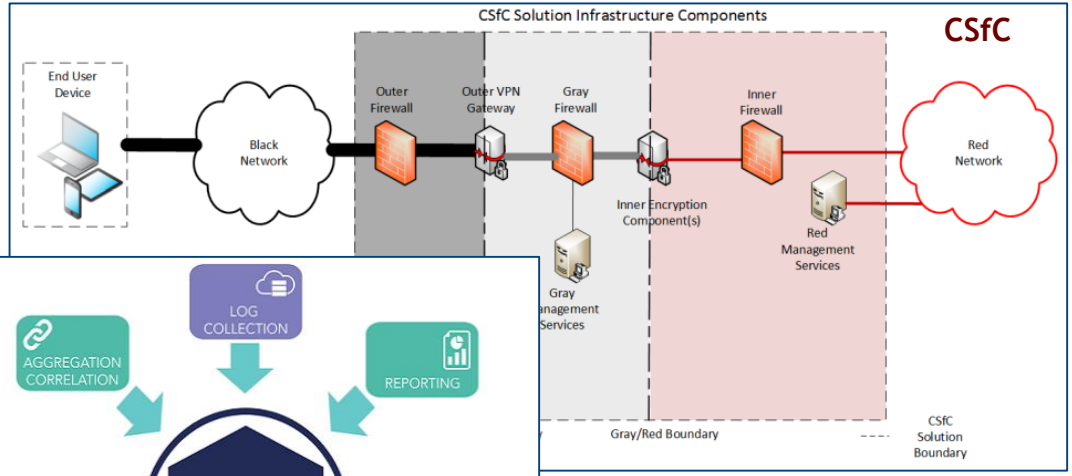


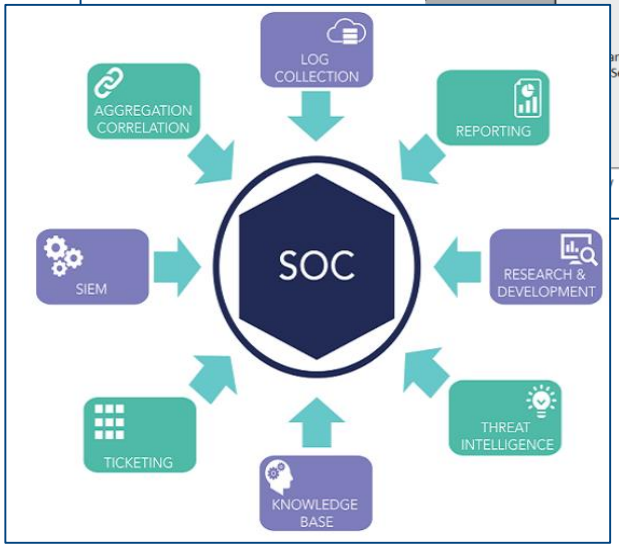


- Manager of Managers
  - Multiple EMSs
  - GUI integration for EMS
- Network viewer
  - Web GUI
- Data lake
  - Fault, performance, and accounting data
  - Data mining
  - Machine Learning (ML)
  - Diagnostics, trending
- Mission planning
  - AI Rules-Engine based
- Standards-based interfaces
  - EMS, Elements

Purpose Built Security Layers

Off-the-shelf Commercial Components for SOC

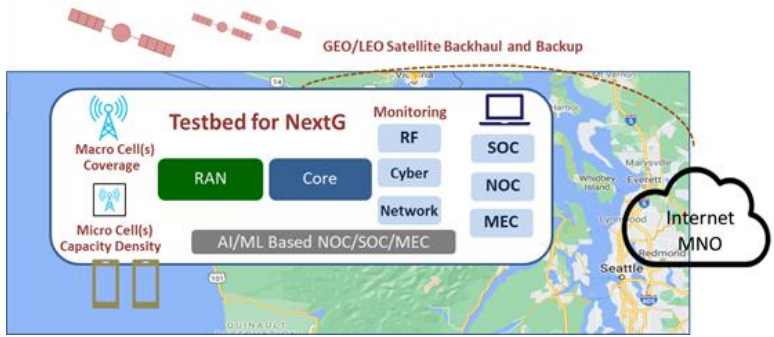




- Commercial Solutions for Classified (CSfC)
- Zero Trust Architecture (ZTA)
- Encryption and authentication
- Continuous Monitoring
  - Scan and security incident event monitoring
- Security at each layer of the OSI Model
- Security features
  - Addressing data at rest and data in transit
  - Identity services - multi-factor Authentication
  - Key Management
- Role Based Access Controls (RBAC)

Key Takeaways / Next Steps

- Private networks with comprehensive security and management
  - CSfC, ZTA, local NOC/SOC
  - End-to-end wireless network with local cloud (MEC)
- AI/ML based automation
  - AI rules engine for executable expert knowledge
  - Data lake for data-based learning (ML)
- 6G requirements and implementation approach
  - Private network applications (use cases)
  - Role of network slicing for private (small) networks
  - Security controls specificity
    - Confidentiality, Availability, Integrity
  - Orchestration templates for peripheral components
  - Management and security models and templates



Thank You.

Dr. Rajeev Gopal
VP Advanced Systems, DISD

rajeev.gopal@hughes.com

Hughes Network Systems, LLC
11717 Exploration Lane Germantown
MD 20876