

Commercial SATCOM: Next 5 Years

Resilient Networking for Defense Applications

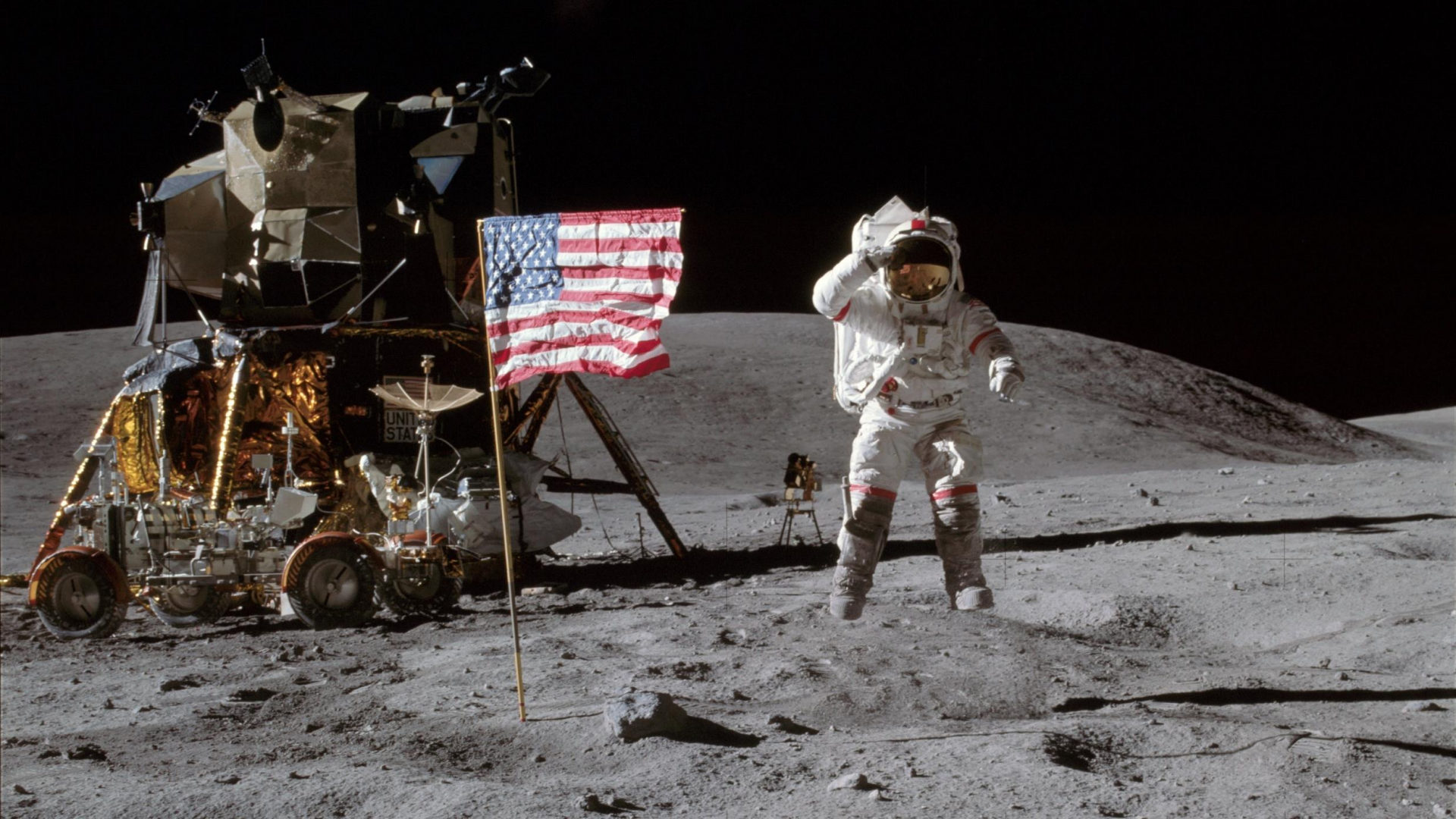
Dr. Rajeev Gopal
VP Advanced Systems, DISD
Hughes Network Systems, LLC

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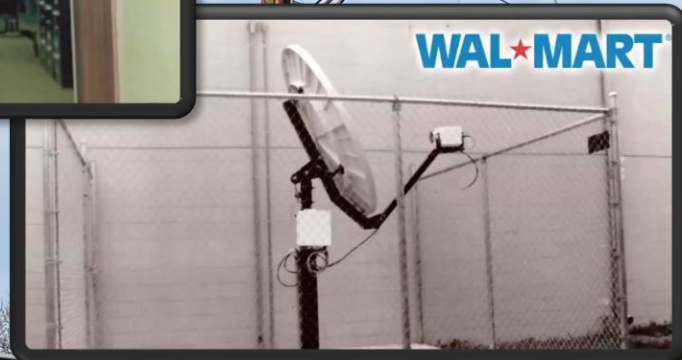
HUGHES
An EchoStar Company

Powering a
Connected Future



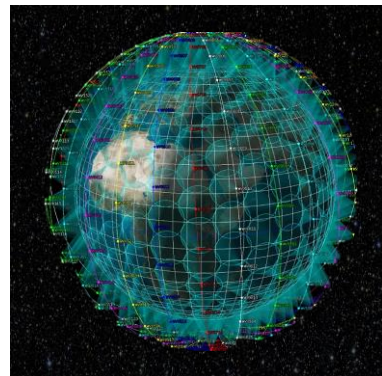


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Hughes – Today

- Global footprint
- Four decades of SATCOM design experience
- 300+ patents driving innovation
- OneWeb LEO ground network
- Largest network with 1.5+ million VSATs
- 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
- Consumer, Enterprise, Government



OneWeb LEO -
Polar Orbit
Early Service 2021

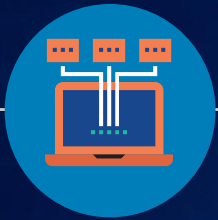
Ka-band HTS
JUPITER Satellite
Systems



How to Increase SATCOM Efficiency and Resiliency

Leverage Existing and Future Space and Terrestrial Hardware

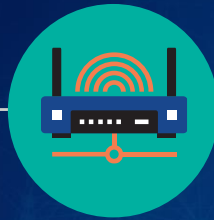
Management System



Element Manager
Network Manager

**Service/business
Manager of Managers**

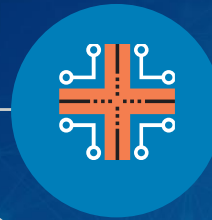
Terminal/Modem



DoD WIN-T, NMT, GMT,
EBEM, PTW Commercial
Antennas: fixed,
tracking, ESA

**Automated
Network/Satellite
Selection**

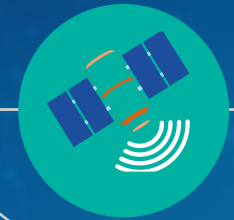
Gateway



DoD teleports,
commercial teleports,
managed service
gateways

Software Based Solutions

Space



Commercial LEO
Commercial HTS,
WGS, DoD protected
satellites, ISR

Consolidate and Simplify Enterprise SATCOM

Improve Readiness with Secure Data Analytics and Rapid Decision Making

- Software-centric approach
- Secure architecture
- IA-Pre, CMMc, CUI, Classified
- Cross domain solutions
- Standards-based
- Edge/cloud for flexibility
- AI/ML based decision making
- Secure technology and operations

SATCOM Enterprise

Terminal



**Automated Selection of
Satellite, Frequency,
Service Provider**

*Terminal Management
Agent (TMA)*

Multi-Orbit Space

Multiple frequencies, Multiple Orbits
(LEO/MEO/GEO)

Flexible Terminals

Multi-band, multi-waveform terminals
capable of multi-path operations

Flexible Networking

A network of networks to support
responsive and agile operations

Flexible Management

Global SA/COP, supports agile
planning and restoral access across all
enterprise compliant systems

Management System



**Integrated
Situational
Awareness and
Mission
Management**

*Enterprise
Management &
Control (EM&C)*

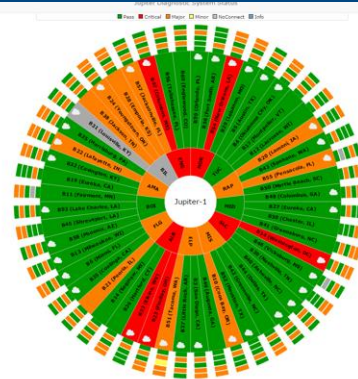
Commercial AI/ML Technologies for EM&C

Rapid Deployment of Flexible Rule-based and Machine Learning Models

- AI/ML in production use
- Smart diagnostics for equipment
- Analytics for interference problems
- Analytics for situational awareness
- Automatic SLA compliance
- Automated installation assessment

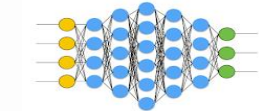
Leveraging commercial AI/ML heritage for US DoD programs – extending to data and control planes

Network Wheel of Health



AI/ML Applicability in Terminals and EM&C

Network Analytics - Network Dashboard

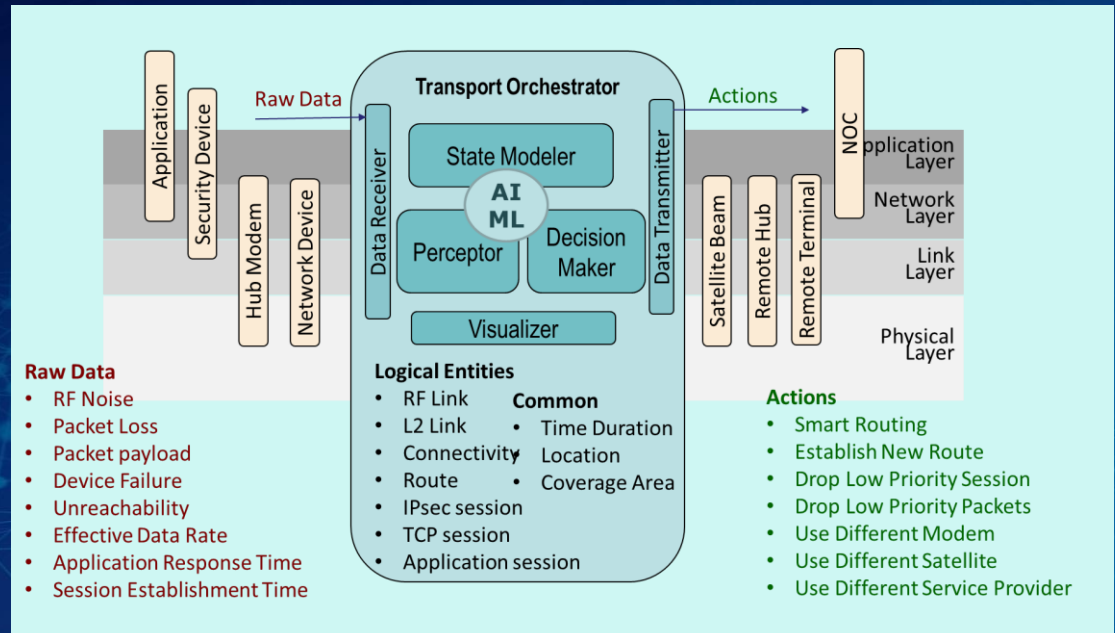


Model Training Terminal Installation

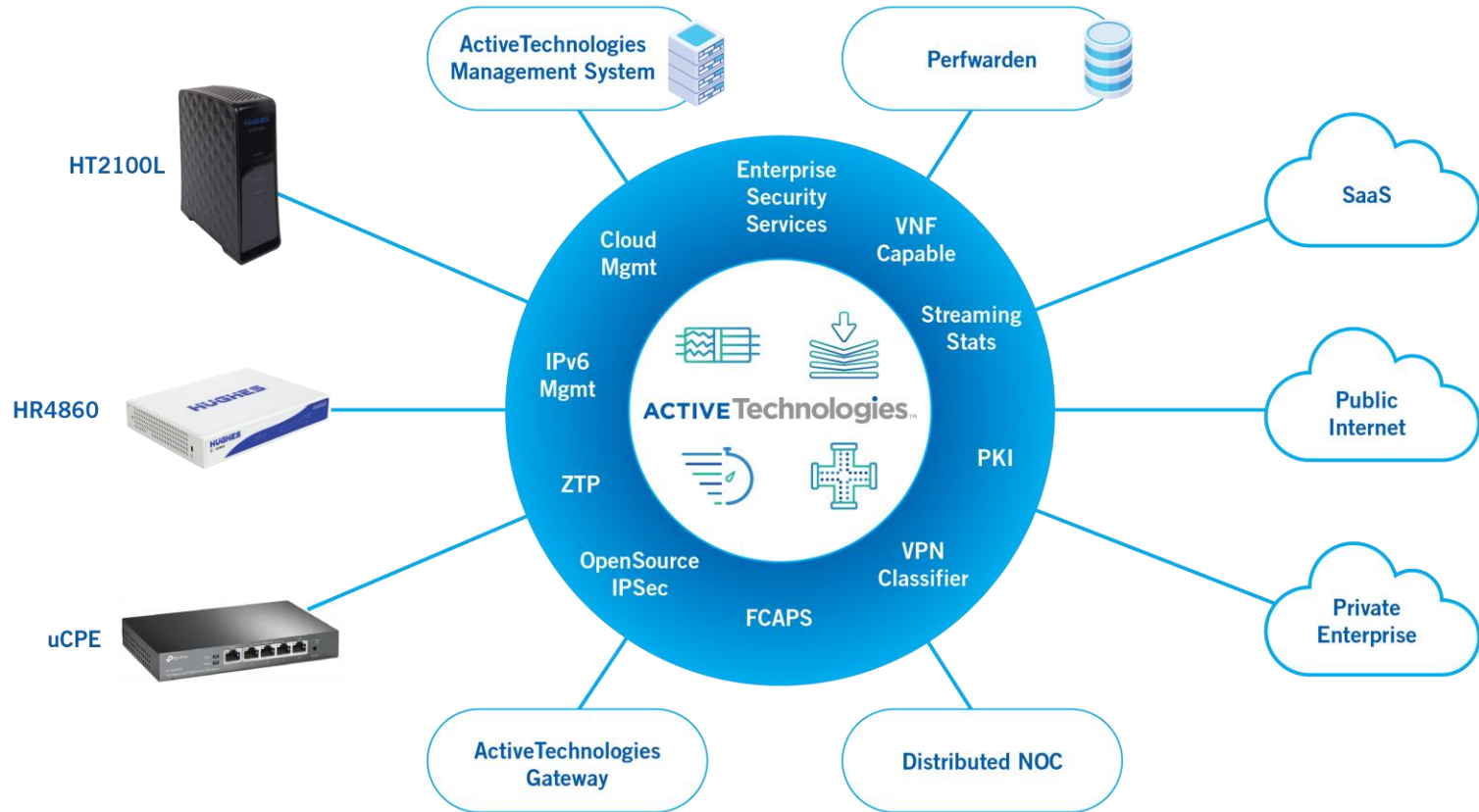
Flexible Automation with AI/ML Techniques

Software-based Technology for SA/Planning and Terminal Automation

- Cross layer decision making
- Model for domain simulation
- Rules based AI heuristics
- Machine learning (labeled, unlabeled)
- Management, control, and data planes
- Edge and cloud computing
- Global policy/local execution



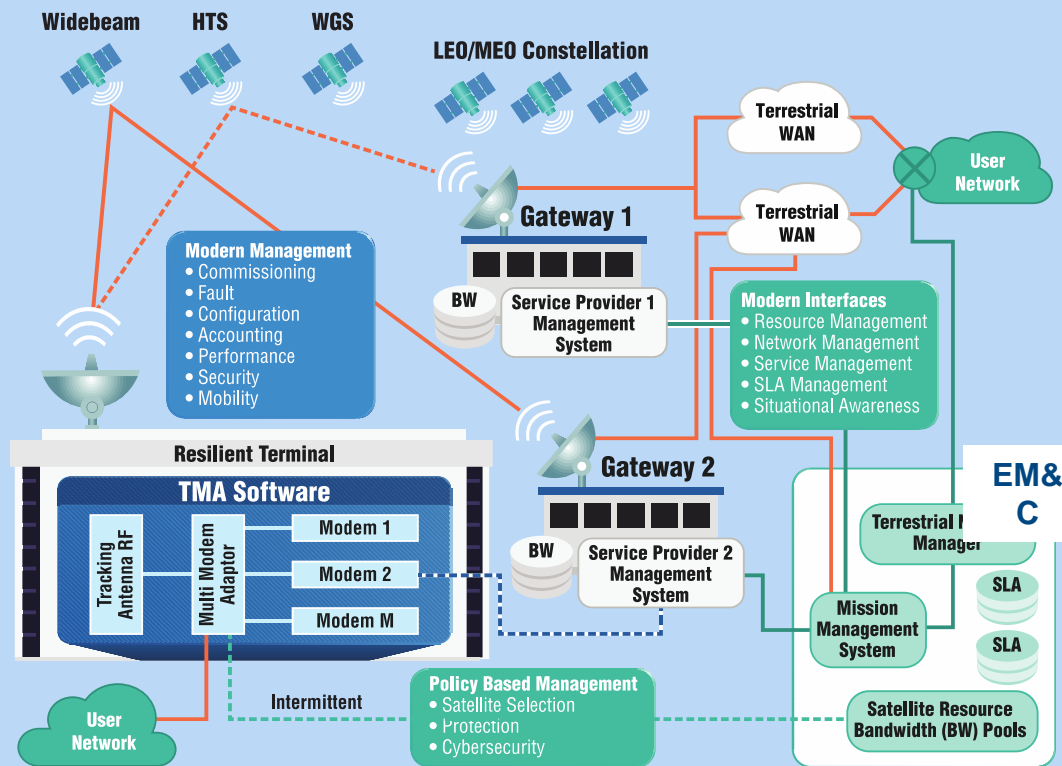
Hughes ActiveTechnologies™



Implementing Flexible Terminal with TMA Software

Flexible Terminal Interface (FTI) for Standard for EM&C-Terminal

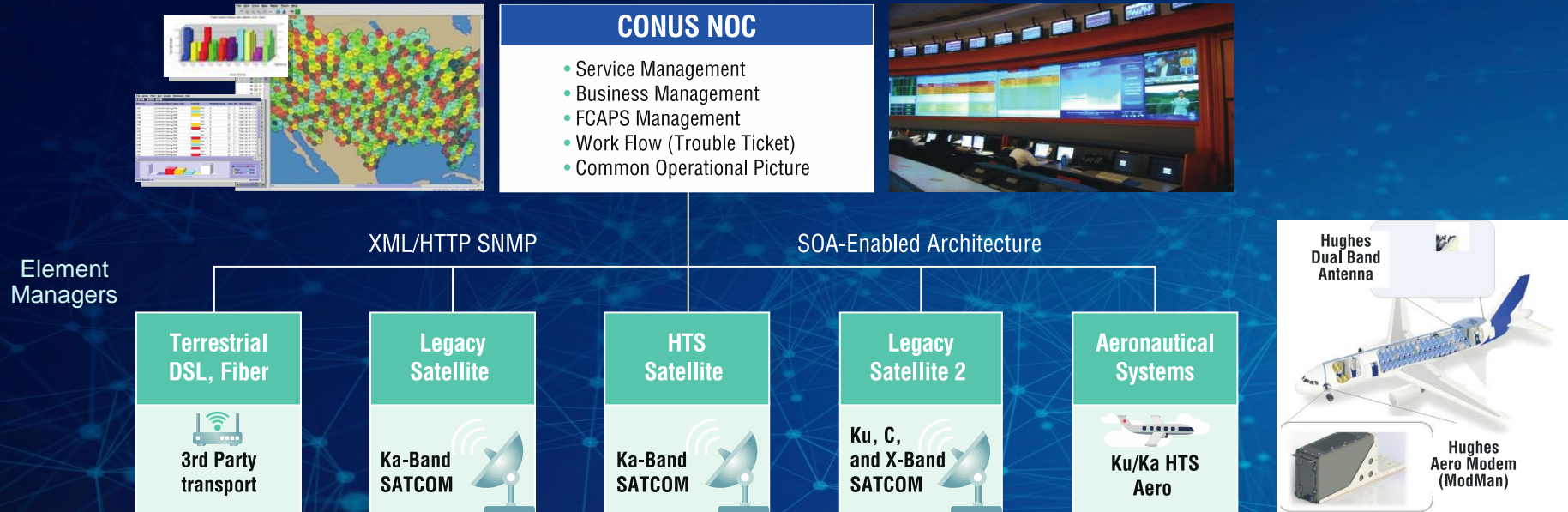
- Terminal Management Agent (TMA) for automation with AI rules engine
- Terminal can have discrete modems or software defined radios
- Automatically selects the most “appropriate” transport path
- Implements PACE plans from EM&C
- Provides situational awareness data to EM&C
- TMA and EM&C enhance resiliency and efficiency



Heritage - Commercial Management Architectures

Hughes EM&C Solutions for Largest SATCOM Network (> 1.5 Million Terminals)

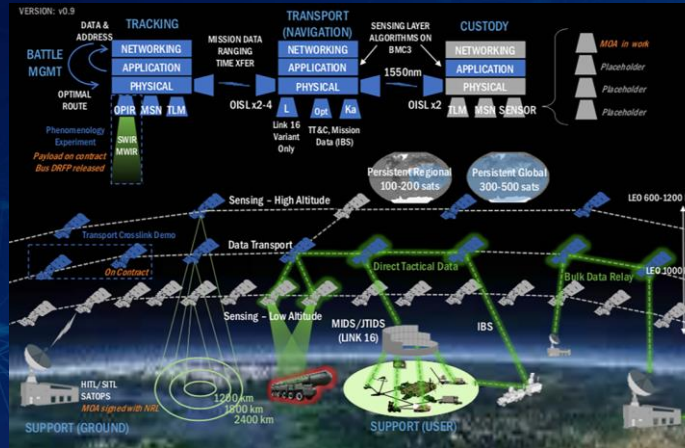
Manager of Managers



Enterprise Management & Control

Manager-of-Managers: Common Operational Picture and PACE Plans

- Situational Awareness
- Mission Planning
- Service Broker
- Service Orchestration
- Bandwidth Pool Manager
- Integrated Data Management
- Enterprise Management



- COTS software components
- Public/private cloud architecture
- Agile/DevSecOps - rapid deployment
- Standards-based FTI interfaces
- Cyber/RF security
- Interoperability - Unified Data Library
- AI/ML based automation

Key Take-Aways

Industry and Government Collaboration for Leveraging Mature Technologies

HTS Capacity
Density



5G

LEO
Coverage



Cloud
Scalability



AI/ML
Automation



Efficiency
Resiliency



- Significant commercial investments
- GEO and LEO HTS satellites and 5G
- Multiple waveforms in decision space
- AI/ML already in production
- AI Expert system approach (coded rules)
- Data from network operations for ML
- Rapid government/industry adoption of cloud
- Agile development with DevSecOps

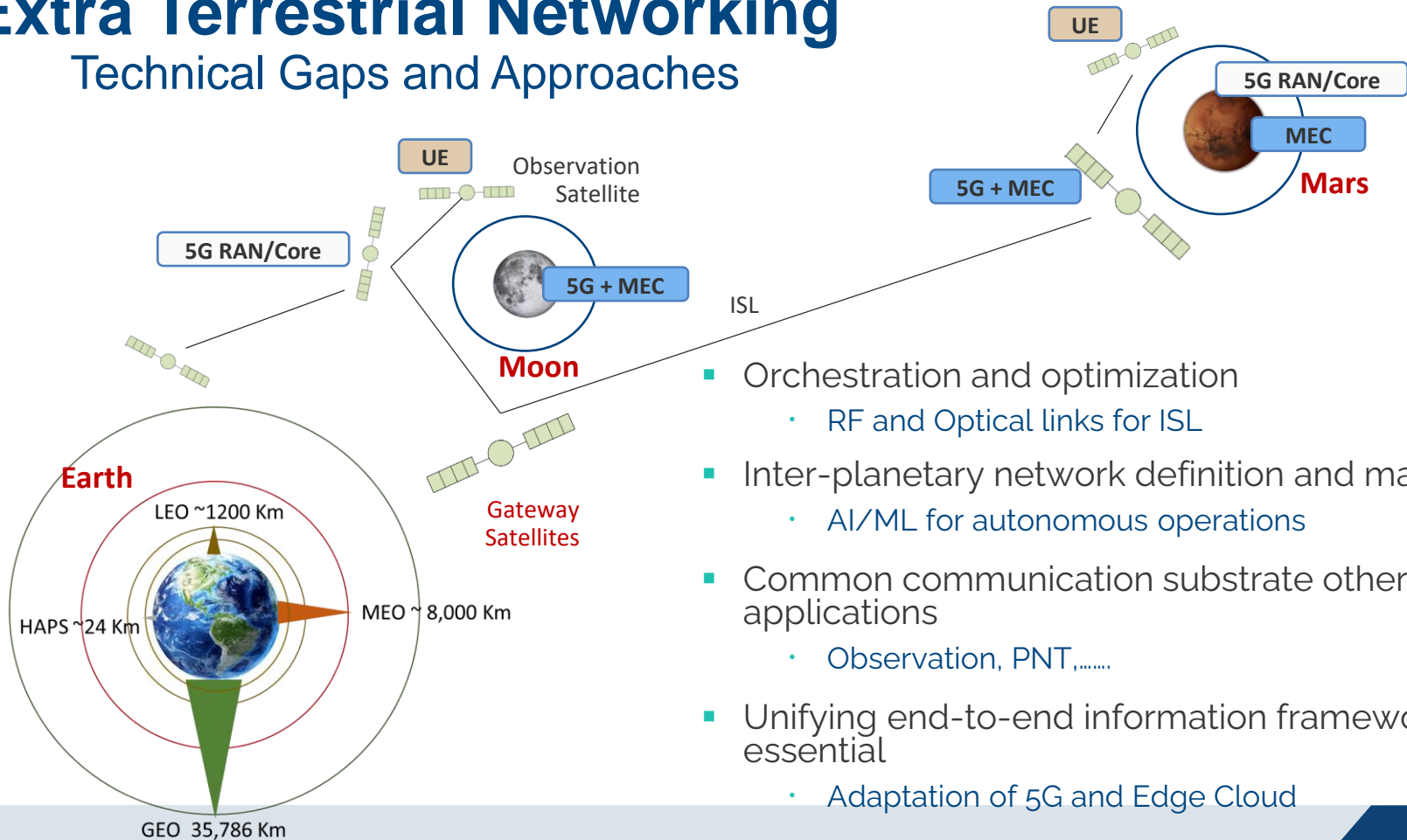


- September 2021 Demo
- OneWeb LEO
- Jupiter HTS GEO
- Active Technologies



Extra Terrestrial Networking

Technical Gaps and Approaches



- Orchestration and optimization
 - RF and Optical links for ISL
- Inter-planetary network definition and management
 - AI/ML for autonomous operations
- Common communication substrate other applications
 - Observation, PNT,
- Unifying end-to-end information framework essential
 - Adaptation of 5G and Edge Cloud

Thank You.

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