

# Communications Satellite Program Office (PMW-146)



## Leveraging Commercial Off-the-Shelf Solutions for Architecting the MUOS Ground System

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**CLASSIFICATION (U)**  
Classified by: PMW-146

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# Introduction/Agenda

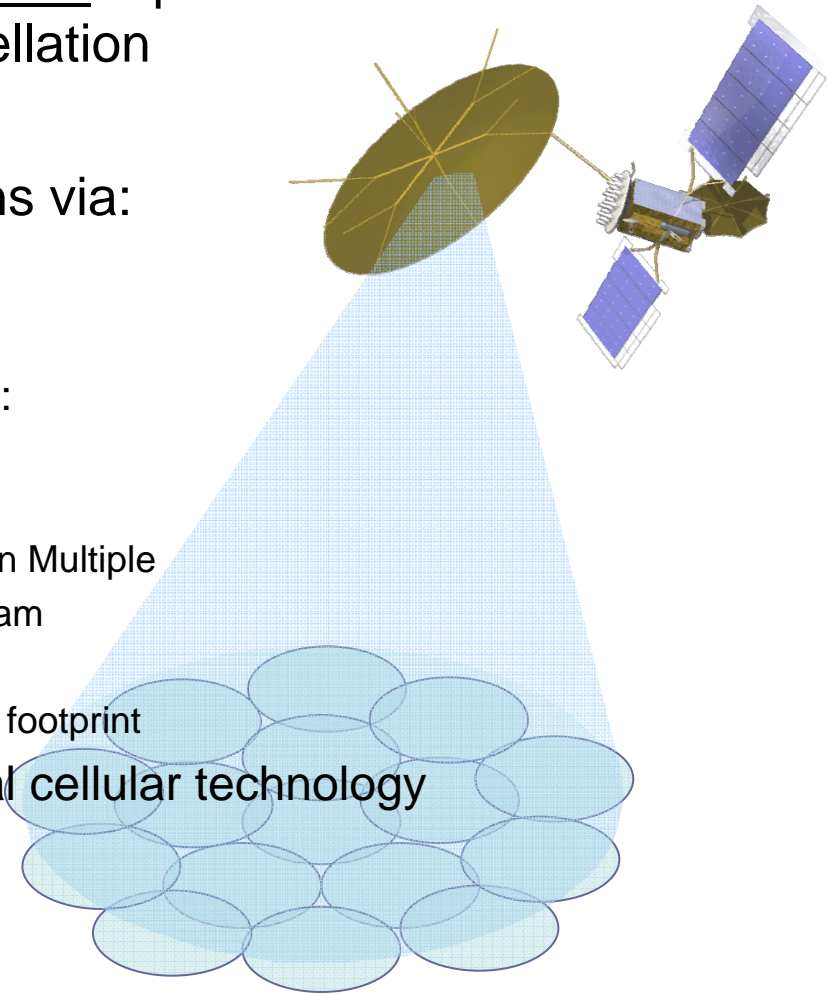
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- MUOS System Introduction
- Spectrum Usage
- Ground Segment Architecture
- Physical Architecture
- Service Architecture
- Leveraging COTS Packages
- Rollout Schedule
- Summary



# What is MUOS?

- Next Generation communications system replacement for the current UHF Follow On (UFO) Constellation
- Global voice and data communications via:
  - Four (4) satellite constellation
    - Coverage to  $\pm 65^\circ$  latitude
    - Simple “Bent Pipe” operation includes:
      - MUOS payload
        - » 16 “beam” segmented footprint
        - » Up to 4 Wideband Code Division Multiple Access (WCDMA) carriers per beam
      - Legacy payload (UFO F-11 Heritage)
        - » Single beam horizon-to-horizon footprint
  - Ground System leverages commercial cellular technology





# MUOS Key Features

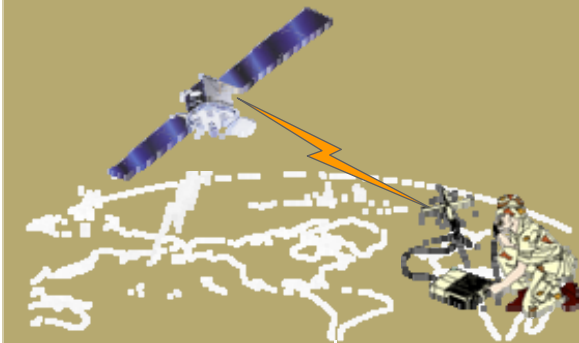
- Focus on usability
  - Minimized planning operations
    - Priority/Preemptive operation arbitrates in real-time
  - Simply power/dial & communicate
  - Connect to personal computer and go
  - “it just works”
  - Seamless global mobility
- Global group communications
  - Connect any set of users, regardless of location
- User-to-User, User-to-DISN/PSTN
- Voice, “circuit” data, “packet” data
  - Data rates to 384 Kbps
- “Network Centric” architecture
  - Future upgradeable
    - The “works” are on the ground





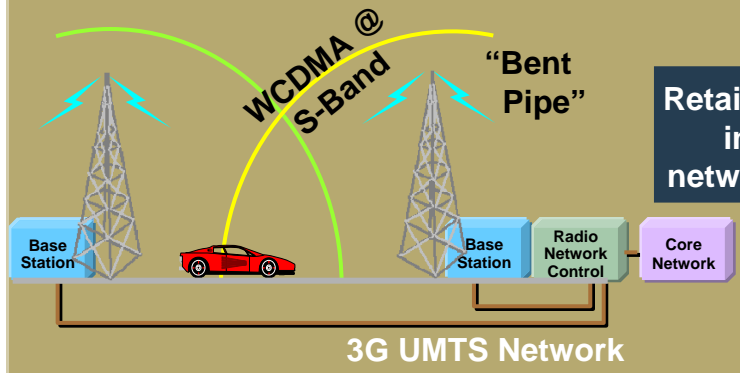
# MUOS Architecture Maximizes Use of 3G and Legacy UHF

Legacy UHF System and Frequency



Retains DoD UHF investment

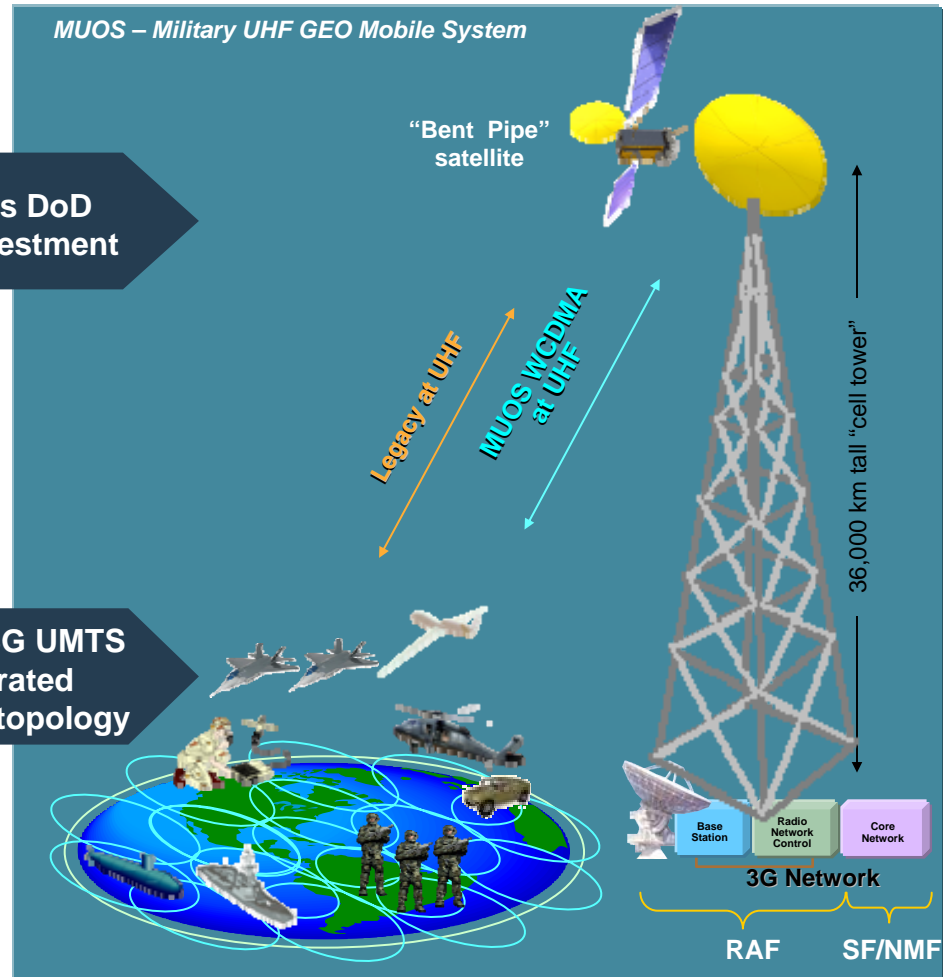
3G Commercial Terrestrial



3G Universal Mobile Telecommunication System (UMTS) Network

Retains 3G UMTS integrated network topology

MUOS – Military UHF GEO Mobile System

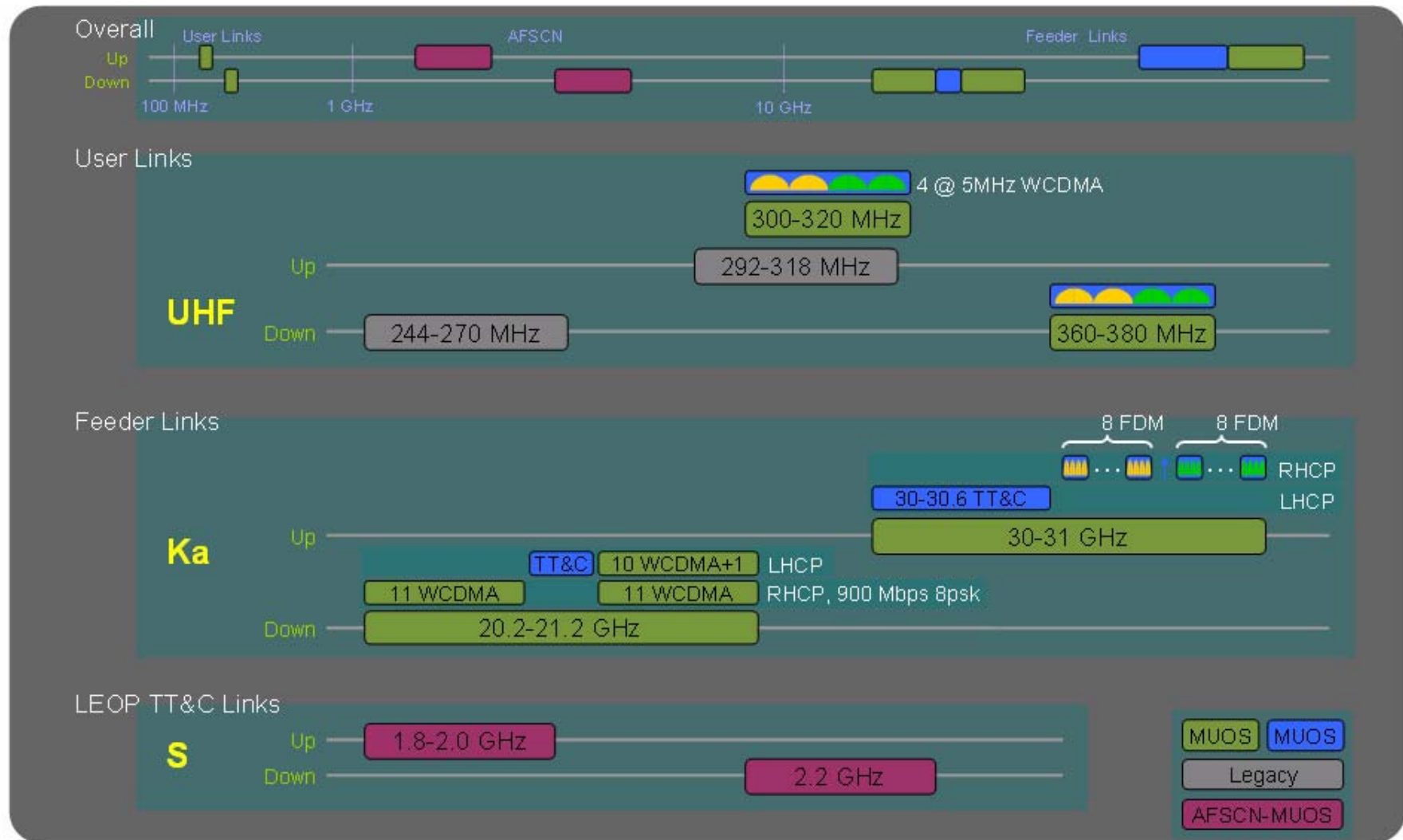


**Smooth transition and low system integration risk**



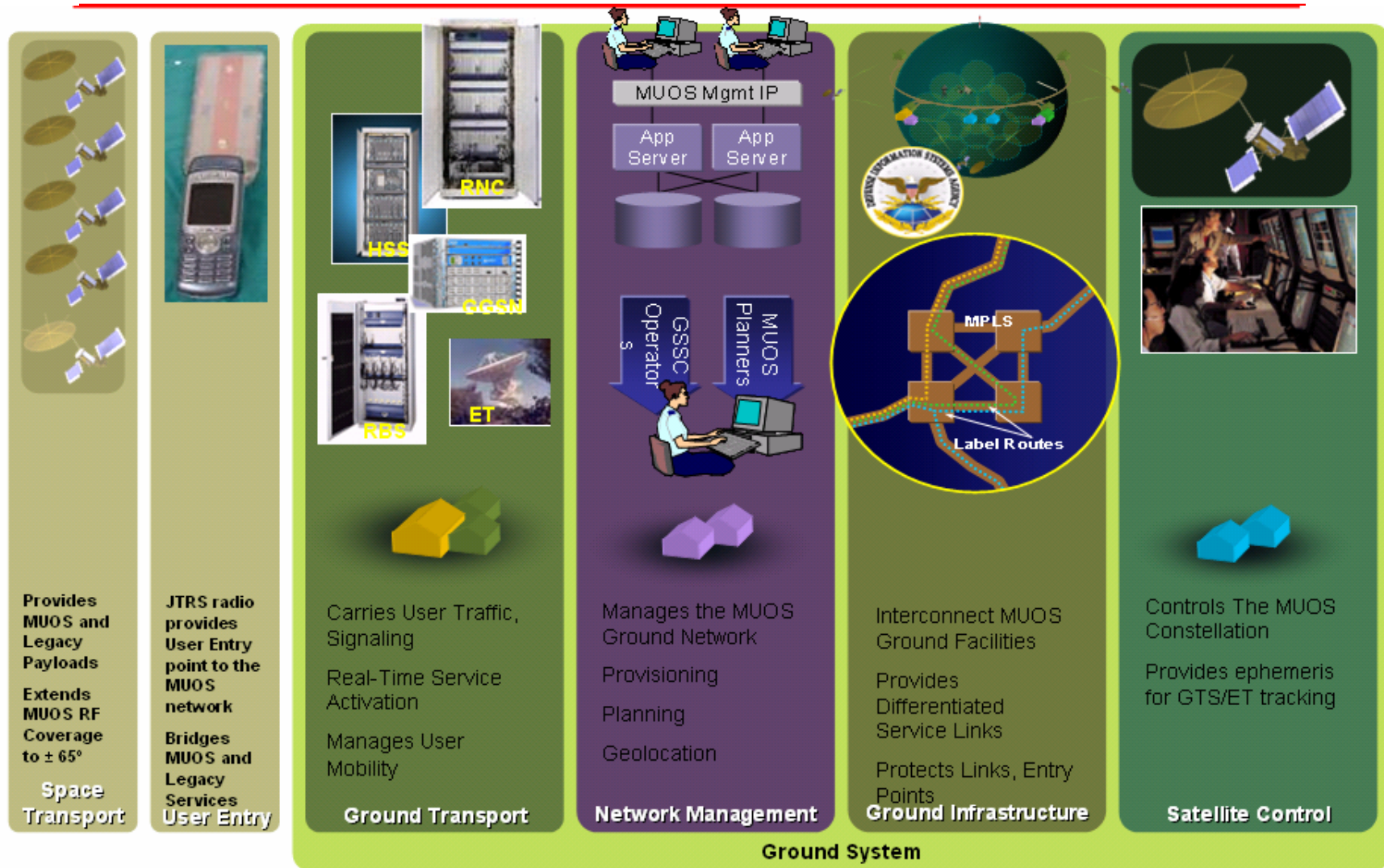


# MUOS Frequency Allocation/Usage



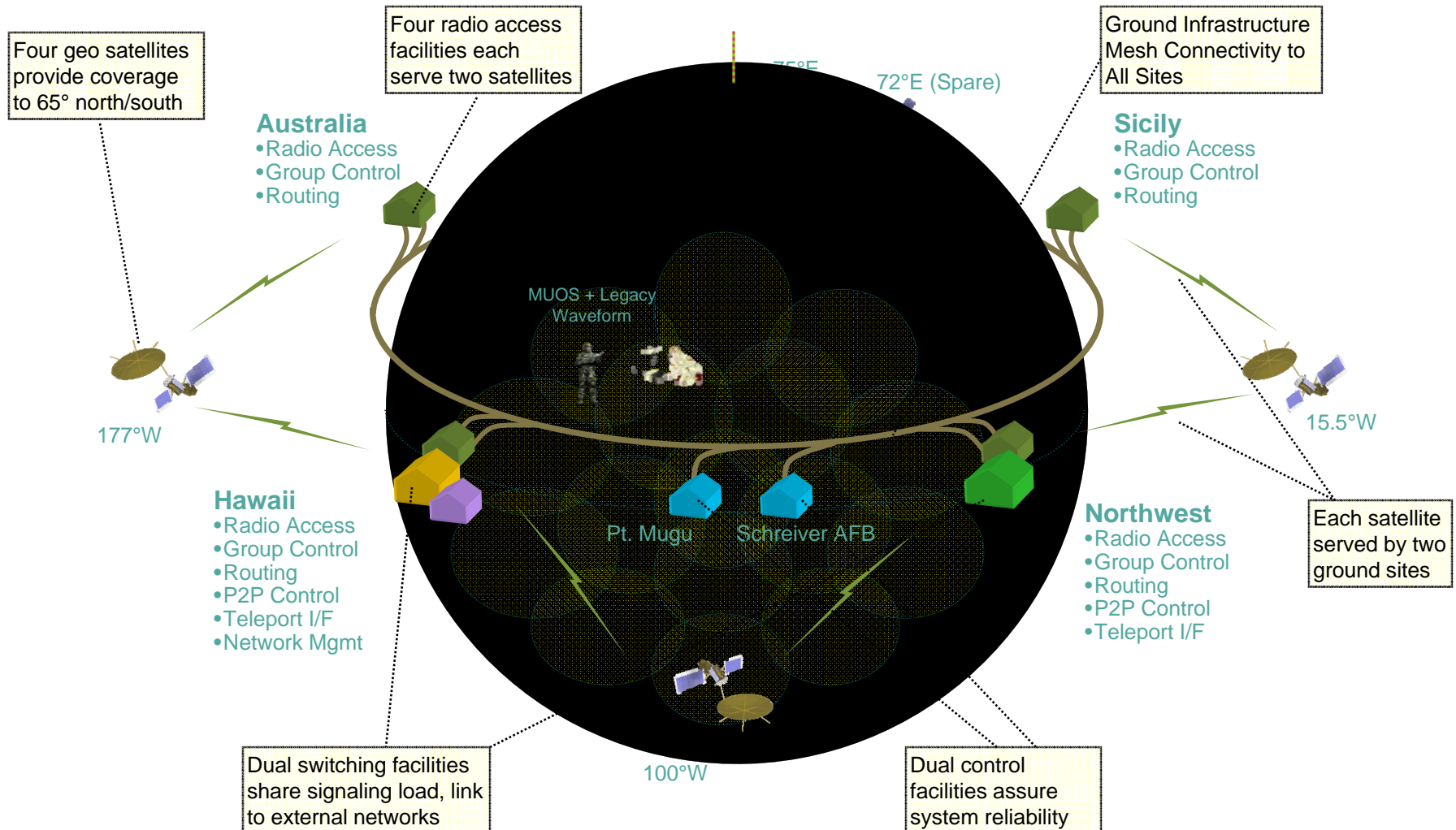


# MUOS System Segment Architecture





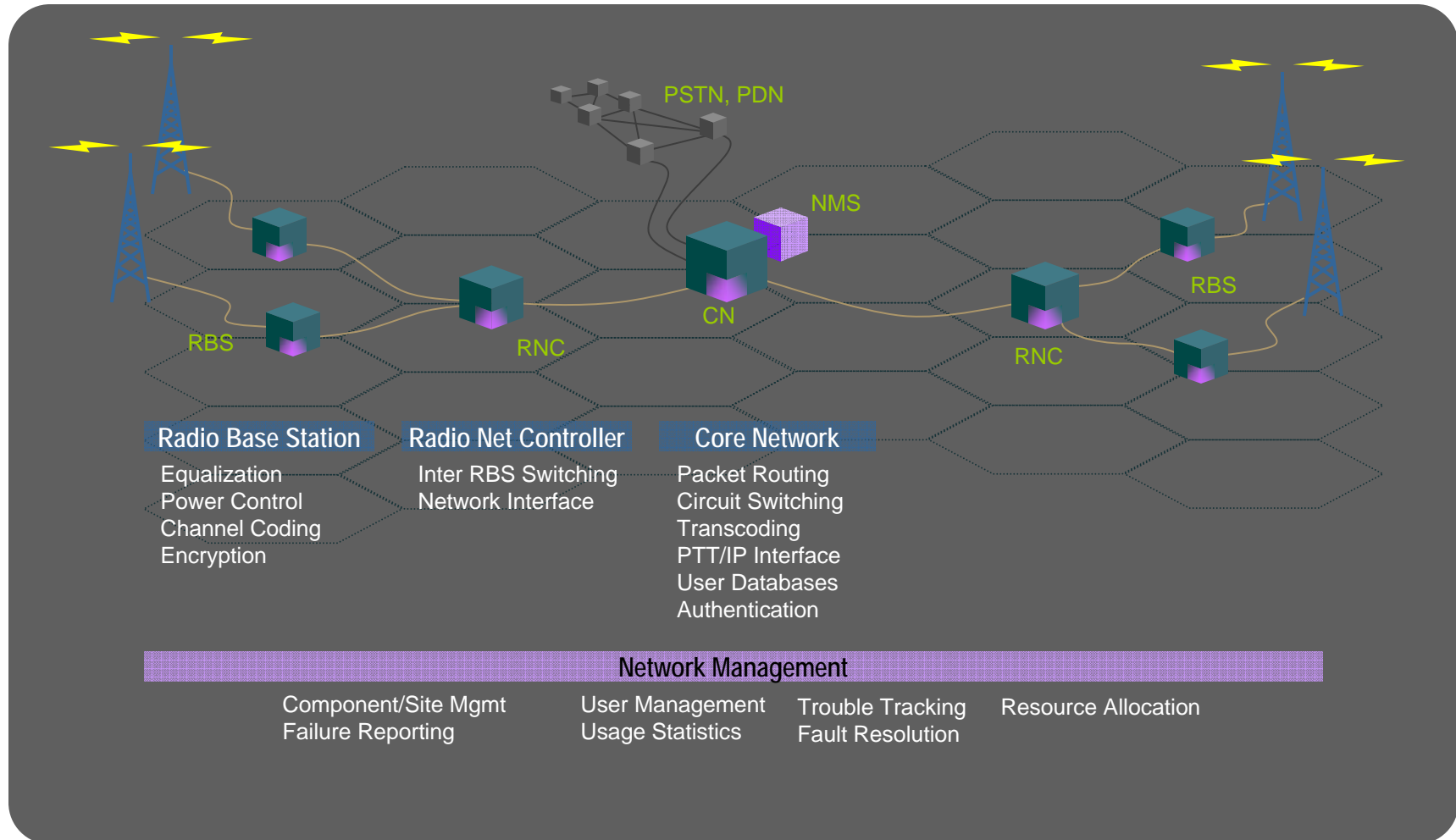
# Orthographic MUOS System View





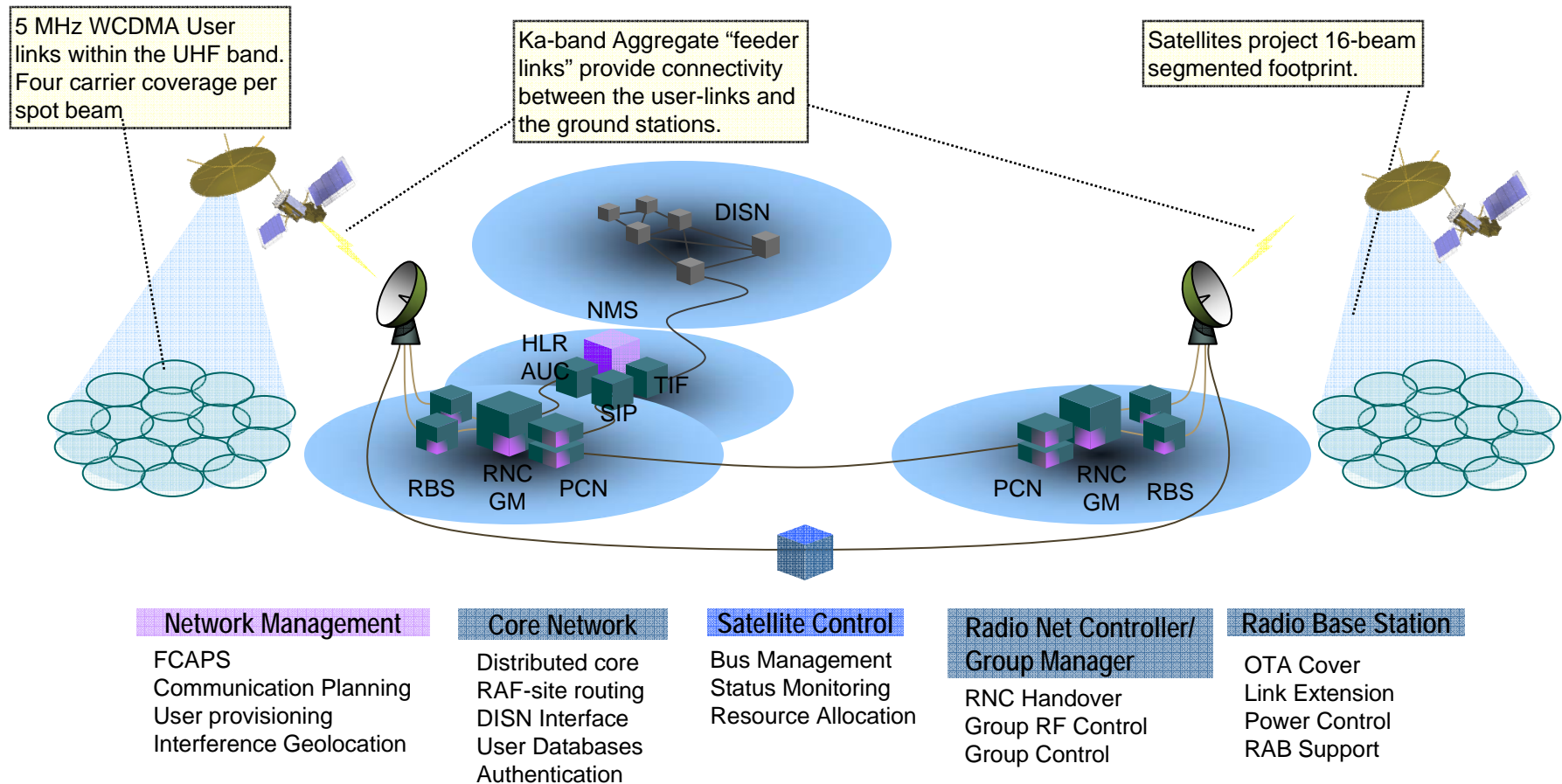


# Ground System Heritage – Terrestrial UMTS





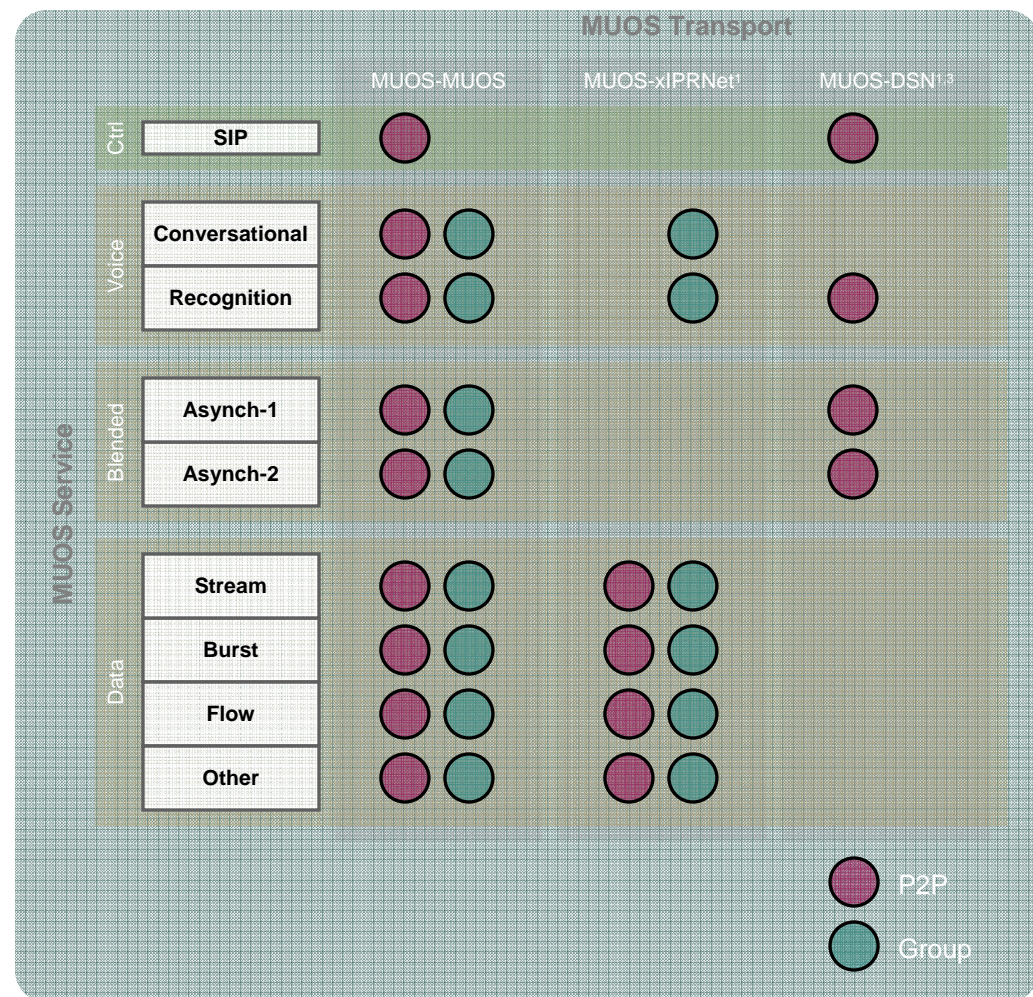
# Ground Segment Heritage – Extended for MUOS





# End-User Service-Oriented Architecture

- MUOS provides
  - Point-to-Point
    - \*arranged\* and initiated on-demand
  - Group
    - pre-arranged, initiated on-demand
  - Connectionless
    - Initiated on-demand
- User services include voice, packet data, asynch data
- MUOS reaches external DISN through the entire service set
- Service access arbitrated by priority in real-time
  - Aggregate load management assures service availability for priority users





# Ground Design Leverages COTS Packages

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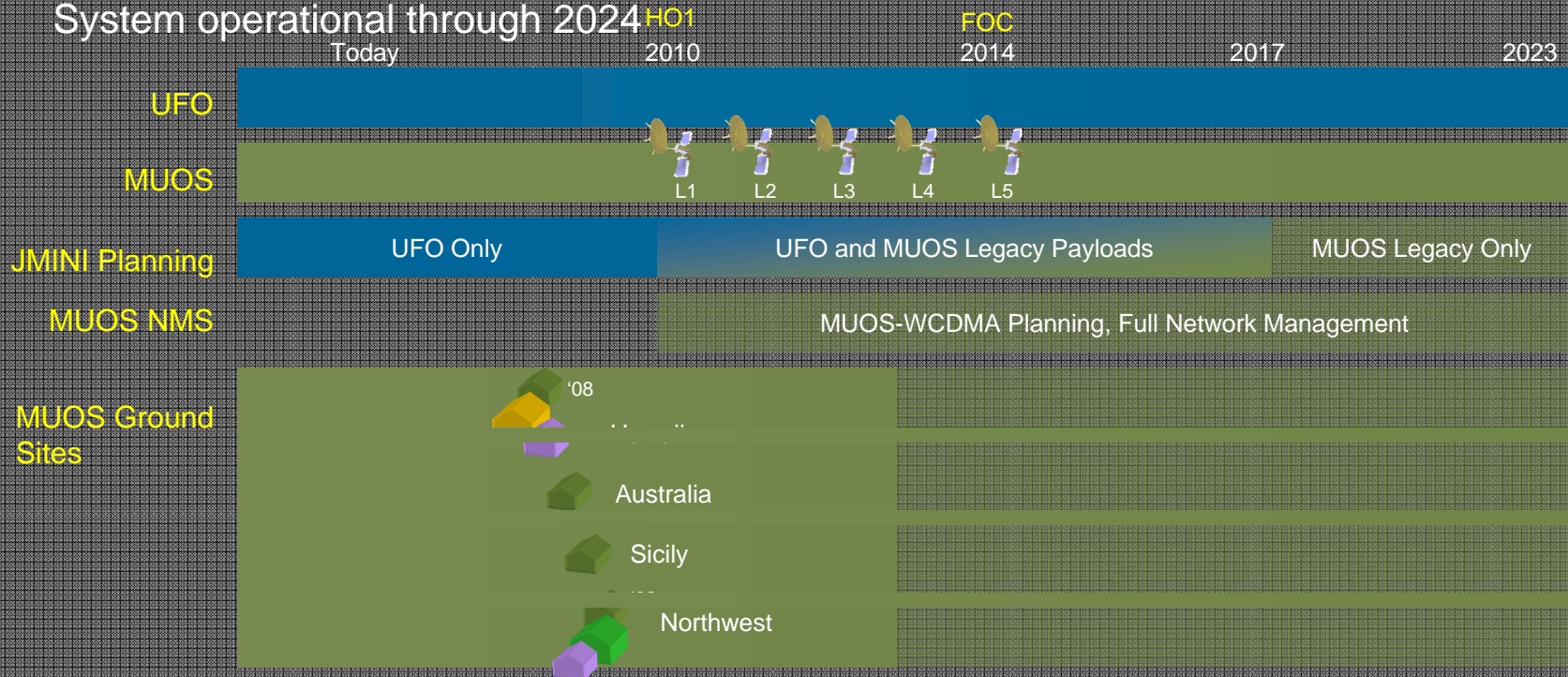
- MUOS-modified COTS approach of 3<sup>rd</sup> Generation WCDMA for UMTS
  - Ericsson: 3G Terrestrial UMTS Radio Access Network and IP Core switch
  - InterDigital: Wideband CDMA common air interface
  - Saved program a minimum of \$600M and at least a year over new development
- Network Management strategy integrates COTS communication products for Fault, Configuration, Accounting, Performance, and Security Management (FCAPS):
- Satellite Control TT&C provided by Harris' OS/COMET
- Unique vendor agreements in place for training, subject matter experts, and ongoing hardware/software services support
  - Close working relationships established





# MUOS System Deployment Schedule

- MUOS Ground System sites deployed through 2009
- First MUOS satellite launch 2010
- Smooth system transition supported by dual MUOS-Legacy operation
- JMINI management of UFO and MUOS legacy payload usage
- MUOS system complete 2014
- System operational through 2024





# Summary

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- MUOS extends terrestrial cellular technology via geosynchronous “Last Mile”
- Robust network architecture reliably delivers service to  $\pm 65^\circ$  latitude at all longitudes
- IP Core network services aligned with DoD future “Net Centric” direction (IPv4 and IPv6)
- Service delivery to multiple radio platforms, including handheld
  - Voice and packet data, to 384 Kbps
- Architecture focused on usability... “it just works”
  - Reduced planning requirements
- Significant service capacity improvements over legacy system
- Future upgrades enabled; commercial trend makes MUOS Ground System largely application-agnostic
- Ground System contractor (General Dynamics) recently completed successful Critical Design Review



# Backup - Acronyms

3G	Third Generation	GSSC	Global SATCOM Support Center	PDN	Packet Data Network
3GPP	Third Generation Partnership Project	HLR	Home Location Register	PMW	Program Management Warfare
8PSK	Octal phase shift keying	I/F	Interface	PMW-146	Communications Satellite Programs Office
AFSCN	Air Force Satellite Control Network	IP	Internet Protocol	PSTN	Public Switched Telephone Network
AuC	Authentication Center (Security Keys)	JMINI	Joint UHF MILSATCOM Network Integrated	RAB	Radio Access Bearer
CDMA	Code Division Multiple Access	JTRS	Joint Tactical Radio System	RAF	Radio Access Facility/Remote Access Facility
CN	Core Network	Ka, Ka-band	Radio Frequency band from 20 to 40 GHz	RBS	Radio Base Station
COTS	Commercial Off-the-Shelf	Kbps	Kilobits per second	RF	Radio Frequency
DISN	Defense Information Systems Network	LEOP	Launch and Early Operations	RHCP	Right Hand Circular Polarization
DoD	Department of Defense	LHCP	Left Hand Circular Polarization	RNC	Radio Network Controller
DSN	Defense Switched Network	MHz	Megahertz	SF	Switching Facility
ET	Earth Terminal	MPLS	Multi protocol Label Switching	SIP	Session Initiation Protocol
FCAPS	Fault, Configuration, Accounting, Performance and Security	MUOS	Mobile User Objective System	SIPRNET	Secret Internet Protocol Router Network
FDM	Frequency division multiplexed	NMF	Network Management Facility	TT&C	Telemetry Tracking & Commanding
GHz	Gigahertz	NMS	Network Management Segment	UFO	UHF Follow-On
GM	Group Manager	OTA	Over the Air	UHF	Ultra High Frequency
GSSC	Global SATCOM Support Center	P2P	Point to Point	UMTS	Universal Mobile Telecommunication System
				WCDMA	Wideband Code Division Multiple Access