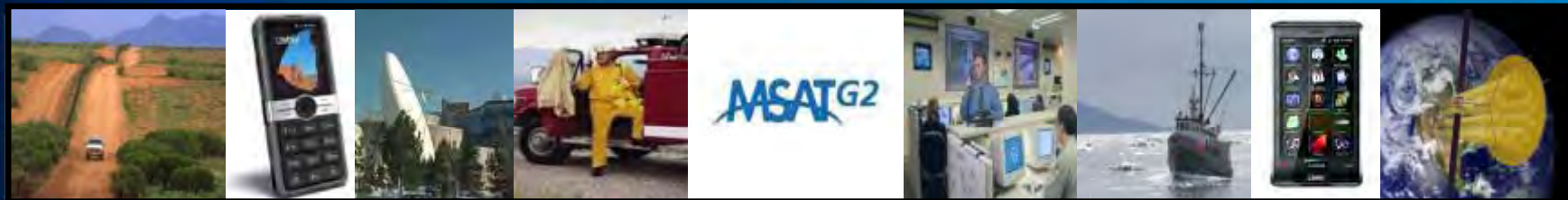




MSS Technology: Applications and Capabilities for Communications Interoperability

March 4, 2010

Valerie Draper, Channel Manager
valerie.draper@skyterra.com



SkyTerra Confidential

Satellite Orbits

- ▶ Geostationary Earth Orbit (GEO) MSAT 1 & MSAT 2
 - Orbit matches identical speed of the rotation of the earth.
 - Over the Equator (approx. 35,000 Kilometers / 22,000 miles)
 - SkyTerra has a regional 2 satellite constellation

- ▶ Medium Earth Orbit (MEO)
 - Typical Orbit Approx. (10,000 Kilometers / 6,000 miles)
 - Not as common as GEOs & LEOs
 - Navigation & Observing Satellites

- ▶ Low Earth Orbit (LEO)
 - Orbit is not equatorial (1,200 Kilometers / 300 miles)
 - Typically 48 to 66 global satellite constellation
 - Iridium & Globalstar

Satellite Orbits

▶ Geostationary Earth Orbit (GEO)

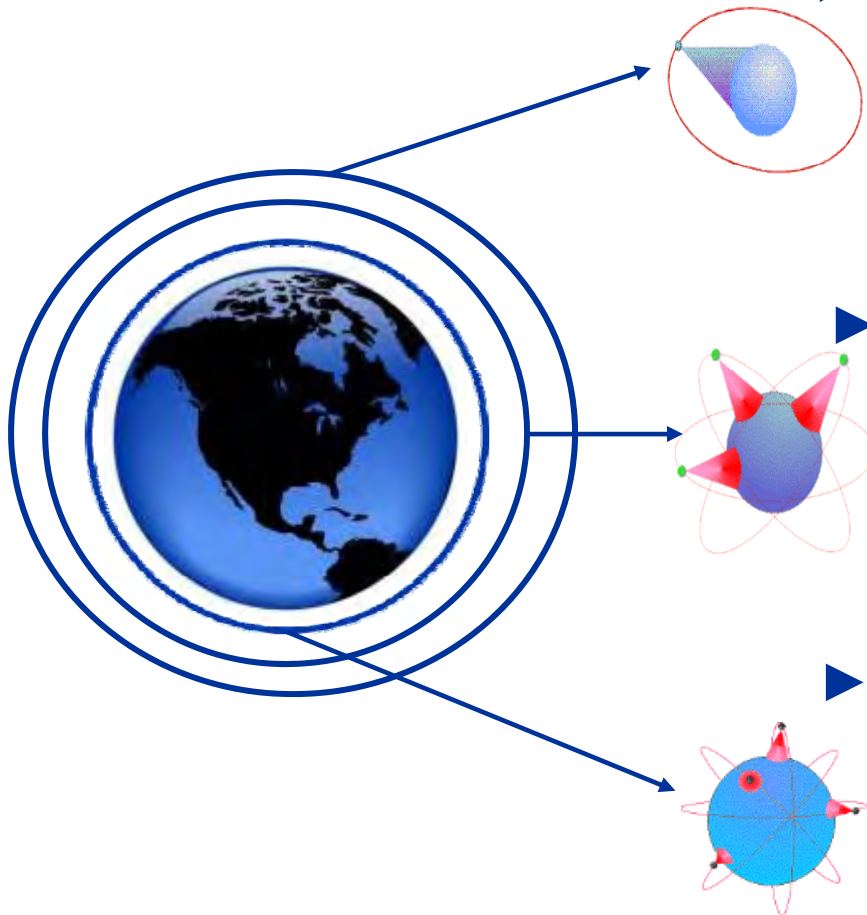
- Distance: 35,000 km / 24,000 miles
- Line of Sight: 24 hrs
- Merits: Covers 42% earth's surface / Constant View
- Demerits: Larger round trip delay / Expensive equipment due to weak

▶ Medium Earth Orbit (MEO)

- Distance: 10,000 km / 6,000 miles
- Line of Sight: 2 to 4 hrs
- Merits: Moderate launch costs / Small roundtrip delays
- Demerits: Round trip delay / Greater path loss

▶ Low Earth Orbit (LEO)

- Distance: 100 to 1,200 km / 300 miles
- Line of Sight: 15 min
- Merits: Lower launch costs/ Very short roundtrip delays / Small path loss
- Demerits: Short Satellite life / Encounters radiation belts / Short line of sight



Satellite Orbits

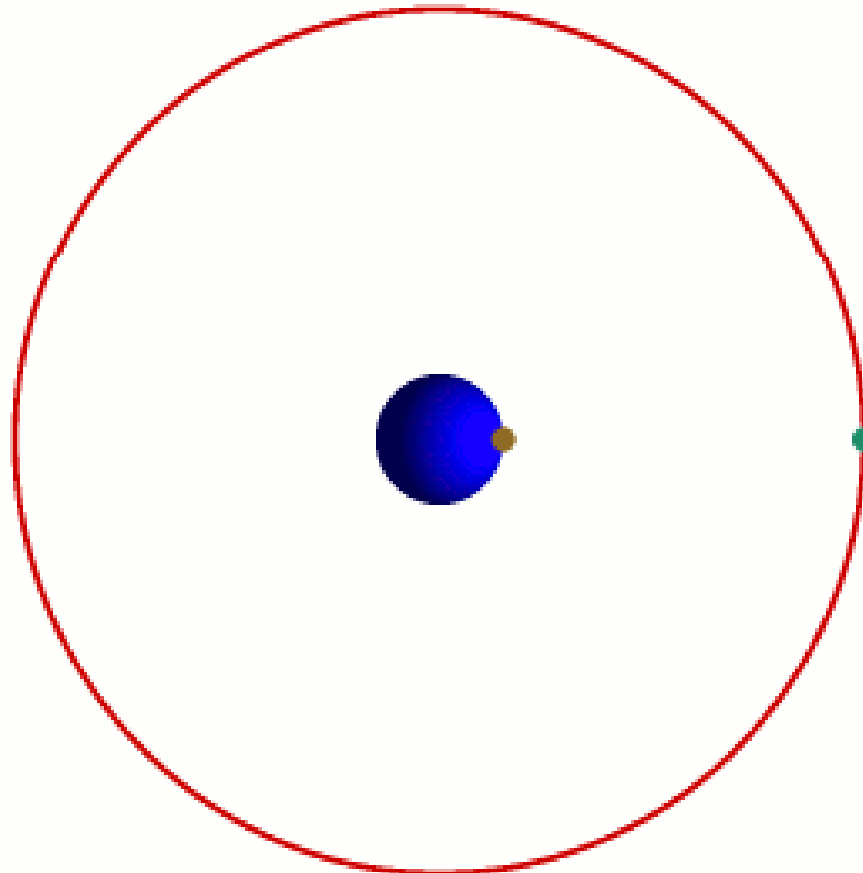
- ▶ Geostationary Earth Orbit (GEO) MSAT 1 & MSAT 2



Satellite appears stationary in the sky over the equator

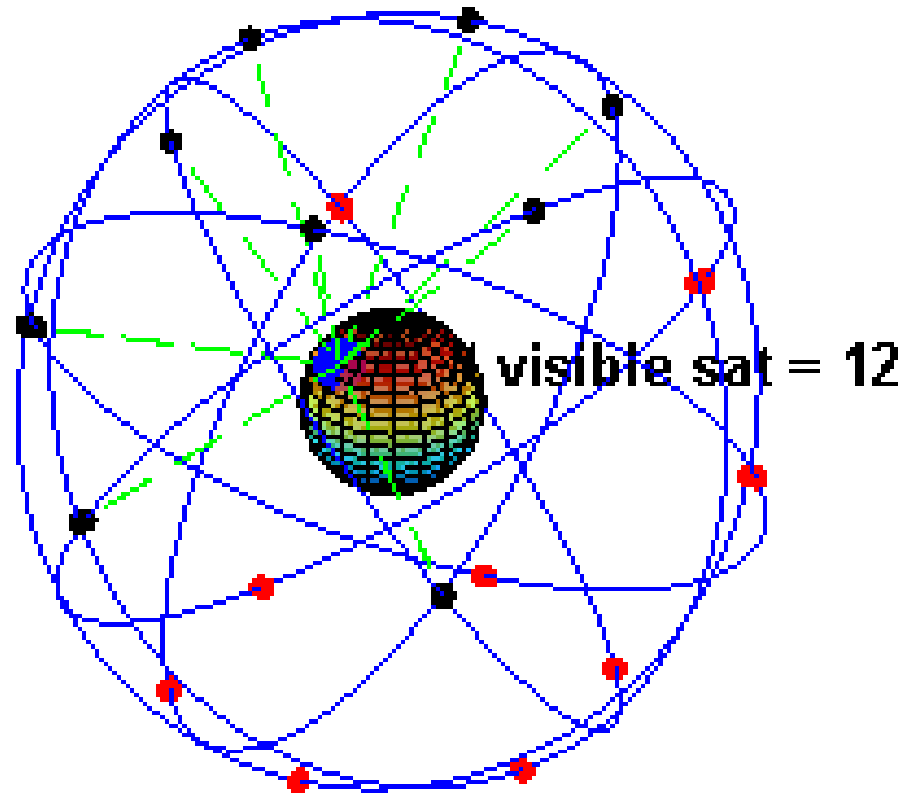
Satellite Orbits

- ▶ Geostationary Earth Orbit (GEO)



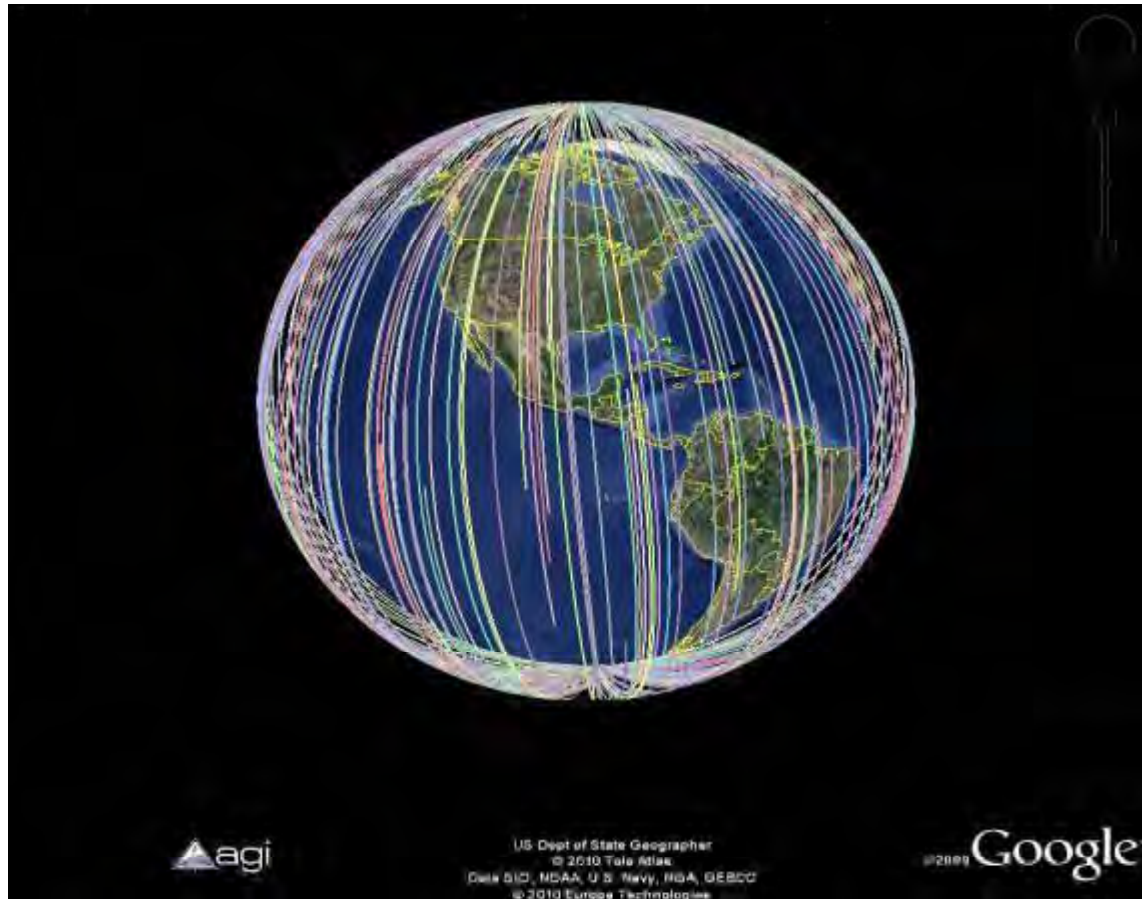
Satellite Orbits

- ▶ Medium Earth Orbit (MEO)
 - Primarily used for GPS
 - 24 satellites in constellation



Satellite Orbits

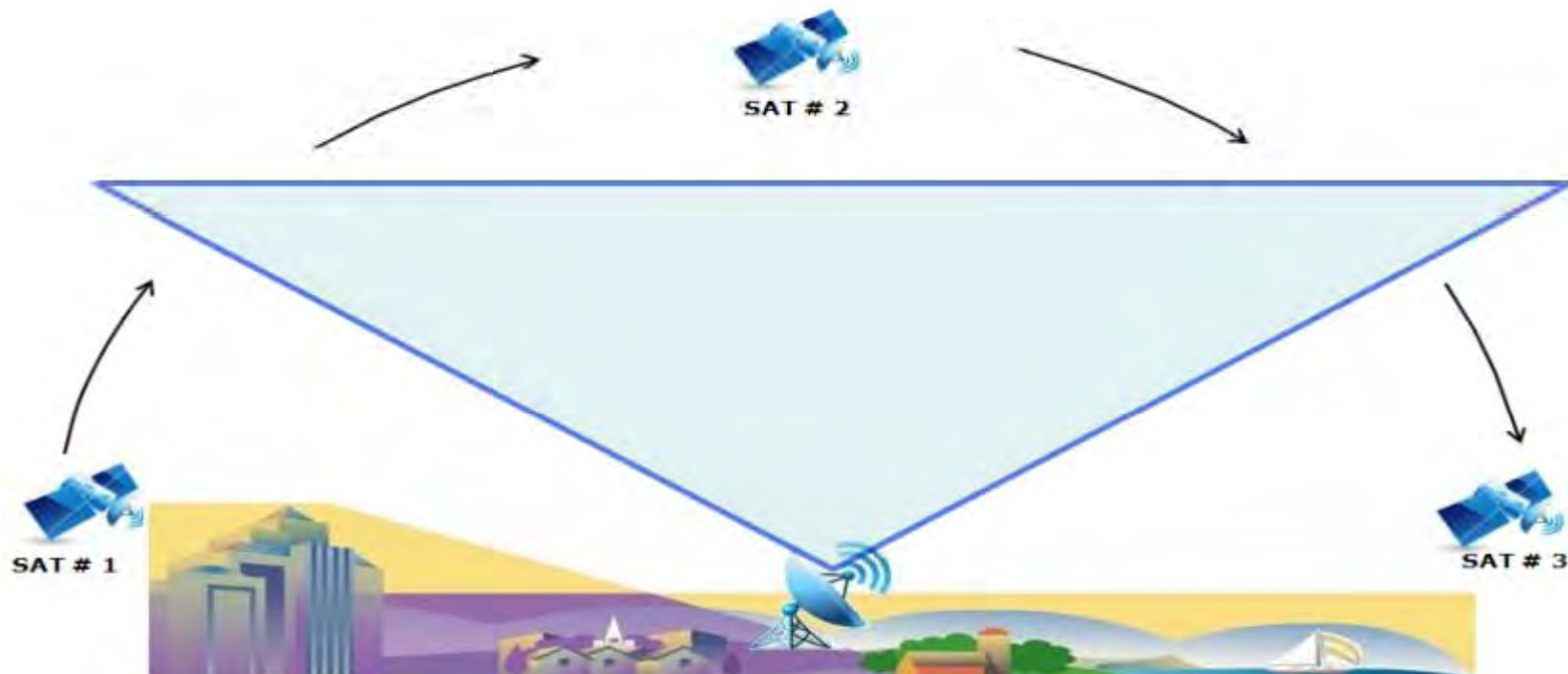
- ▶ Low Earth Orbit (LEO)
 - Iridium constellation



Satellite Orbits

► Low Earth Orbit (LEO)

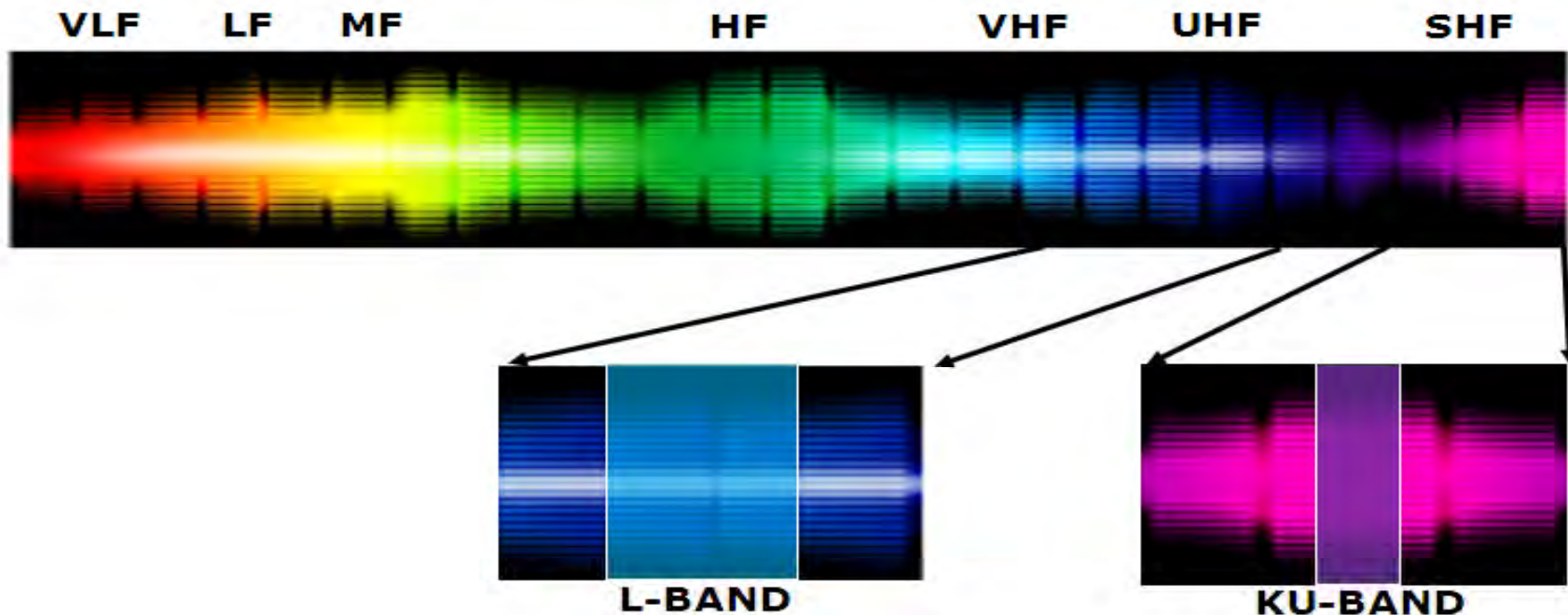
- Typically 48 to 66 global satellite constellation
- Handoffs from satellite to satellite every 15 to 20 min
- Smaller antenna
- Iridium and Globalstar





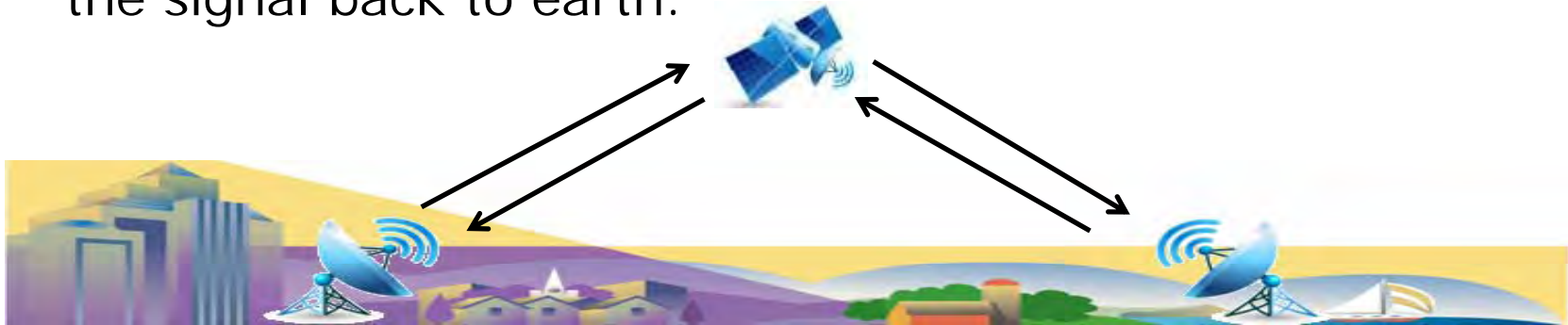
Frequency Allocation

- ▶ VLF 3 KHz – 30 KHz: Very Low Frequency, maritime mobile navigational frequency
- ▶ LF 30 KHz – 300 KHz: Low Frequency, maritime mobile navigational frequency
- ▶ MF 300 KHz – 3 MHz: Medium Frequency, am radio
- ▶ HF 3 MHz – 30 MHz: High Frequency, shortwave broadcast
- ▶ VHF 30 MHz – 300 MHz: Very High Frequency, fm radio, TV, air traffic control
- ▶ UHF: 300 MHz – 3 GHz: TV, cell phones, trunked radio (800 MHz), L Band
- ▶ SHF: 3 GHz – 30 GHz: C, X, Ka, Ku bands

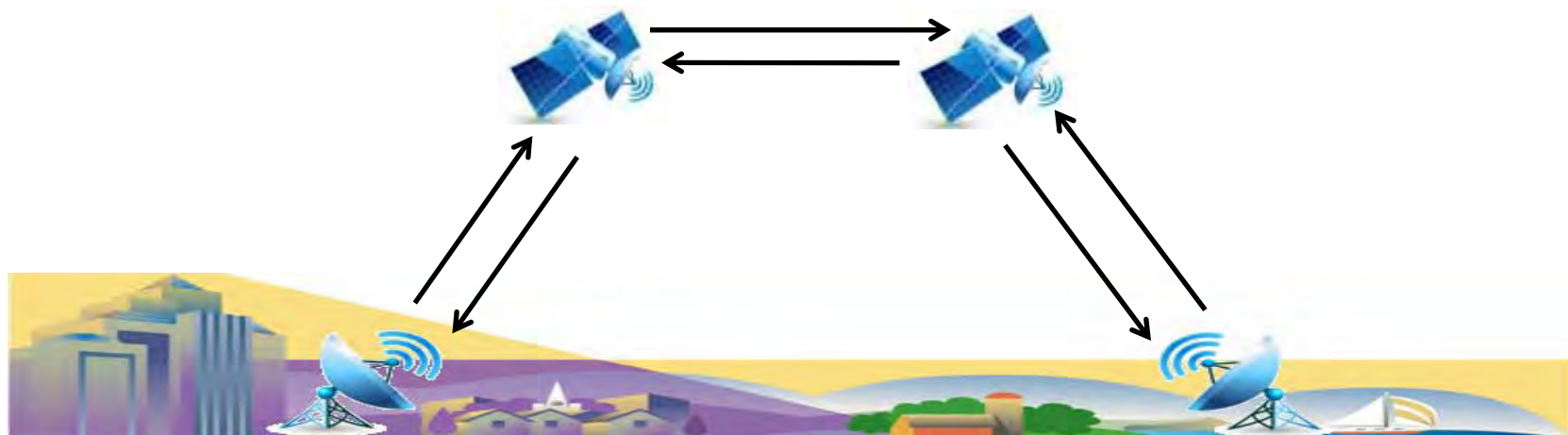


Bent Pipe (MSAT) vs. On Board Routing

- ▶ Bent Pipe routing: the satellites acts like a mirror, reflecting the signal back to earth.



- ▶ On Board Routing (satellite to satellite): the satellite sends the signal from satellite to satellite and then down to earth.



Propagation Issues

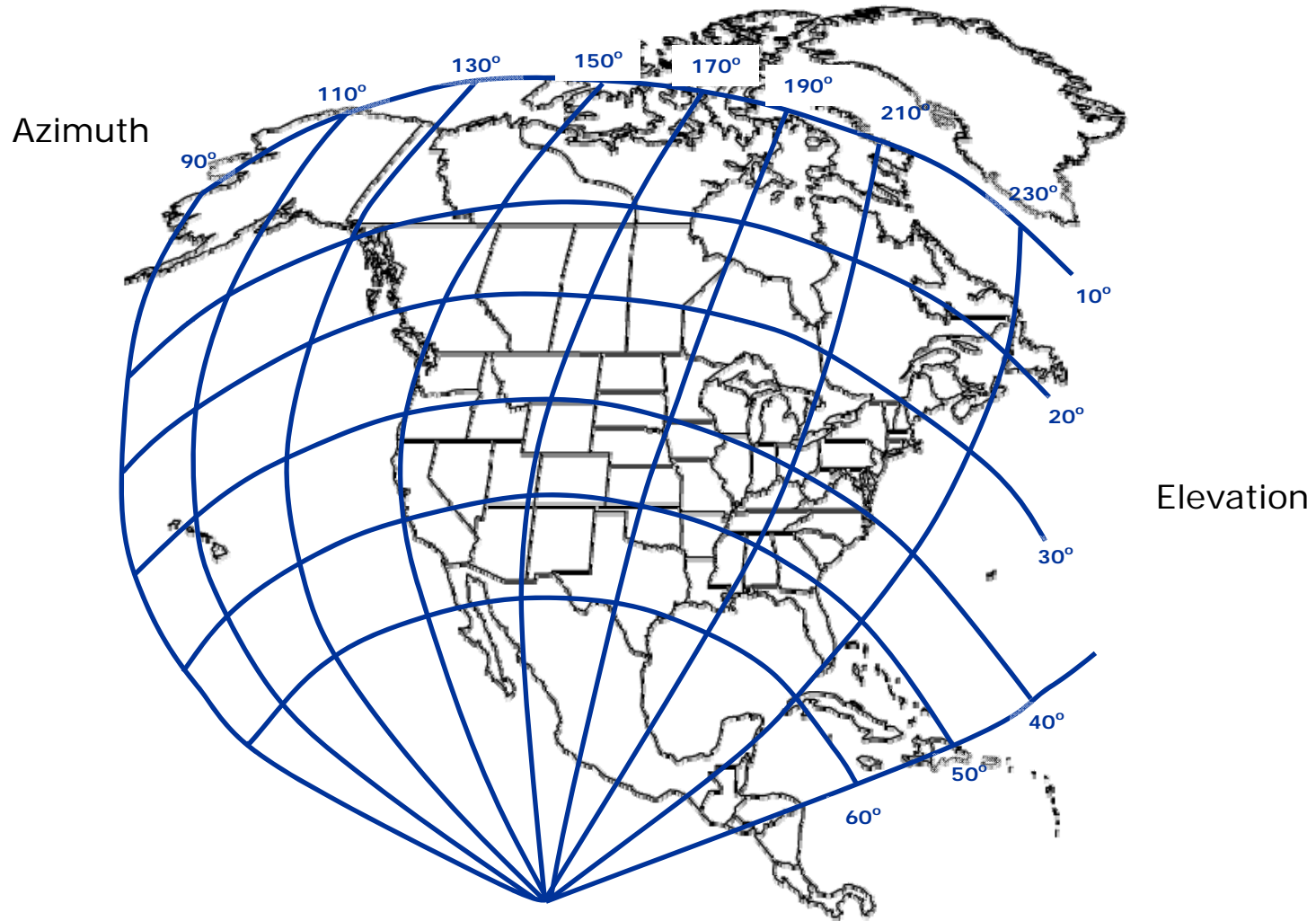


**Rain attenuation
(Uplink Power Control)**



**Shadowing, Terrain and
Vegetation**

Azimuth and Elevation



Traditional MSS Markets

▶ Government

- Public Safety
- Emergency Management
- Transportation
- Education
- Healthcare
- Maritime

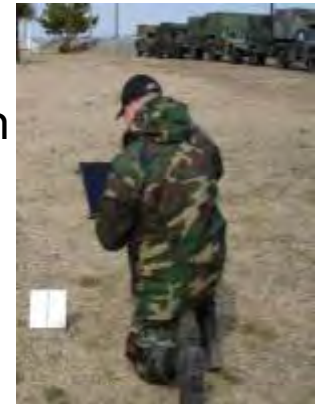
▶ Enterprise

- Oil and Gas
- Media and Entertainment
- Transportation
- Telecommunications
- Utilities
- Maritime









Mobile Satellite Services (MSS)

- ▶ Key services to customers anytime, anywhere
- ▶ Telecom and broadband services critical to industry, homeland security and Department of Defense
- ▶ Remote data telemetry monitors US infrastructure
 - Utilities –oil/gas/water pipelines, electrical distribution
 - Trains/trucks – location/status monitoring
- ▶ Voice and data connectivity
 - First Responder connectivity
 - Repair/maintenance of dams, bridges
 - Fiber restoration
- ▶ Maritime/Aeronautical communication
 - Lifeline for ships/planes/trucking/railroad
 - Emergency communications
 - Tracking dangerous shipments



MSS Service Providers for North America

	Inmarsat	Globalstar	Iridium	SkyTerra (Future)	TerreStar	SkyTerra (Current)
Coverage	Global	Americas, Europe, Australia, Asia except some parts of Middle East, Northern Africa	Full global & polar	Americas	USA and Canada	Americas
System	11 GEO satellites (3rd I-4 2008) Contract to build Alphasat I-XL. Option for two additional satellites.	48 LEO satellites plus 3 in-orbit spares. Contract to Thales Alenia for 48 replacement satellites launching starting 2010	66 LEO satellites with inter-satellite links, plus 9 in-orbit spares Iridium next generation satellites under planning; launches to begin in 2013	2 GEO sats	Planned 2 GEO sats MSS/ATC 2010	Planned 2 GEO sat MSS/ATC 2010/2011
Spectrum	L-band (1.5-1.6 GHz)	L-band, S-band	L-band	L-band (1.5-1.6 GHz)	2 GHz	L-band
Devices						



Mobile Satellite Radio

- ▶ Main components:
 - L-Band Antenna System
 - Transceiver Unit (TU)
 - Dual Service Handset
- ▶ Services:
 - Telephony voice
 - Push-to-Talk (PTT)
 - Push-to-Track service (GPS)
- ▶ Dial up 4800bps data
 - Text and email type applications



Mobile Satellite Services

▶ Two-Way Radio (PTT) Service

- Only Satellite PTT provider
- User initiated talk groups, in real time
- Up to 10,000 users in a Talk Group
- Point-to-Multi-Point Communication
- Point-to-Point Communication (Private Mode)
- Nation Wide Coverage



▶ Telephony

- Real-time, full-duplex voice communication
- Direct dialing for all calls, including international
- North American dialing plan
- Fixed and Mobile Voice



▶ Data

- Dial-up
- Packet

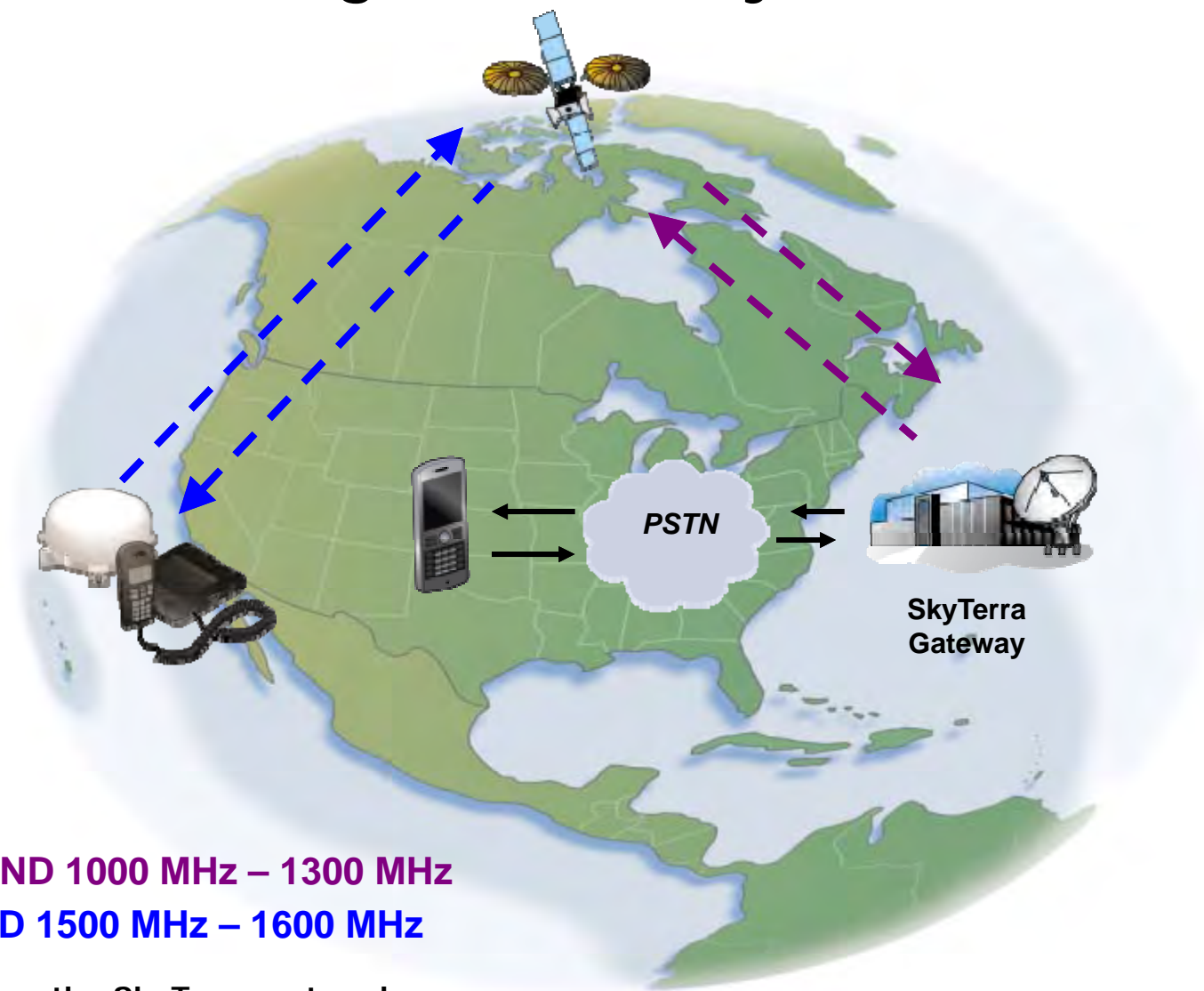


MSS Telephone Service

- ▶ Real-time, full-duplex digital voice communication
- ▶ Direct dialing for all calls, including international
- ▶ GETS compatible
- ▶ Key features and benefits:
 - Interconnection to PSTN
 - North American dialing plan
 - Call management features
 - Call Waiting
 - Call Forward
 - Call Barring
 - Conference Calling
 - Voice Mail



Telephone – Signal Pathway

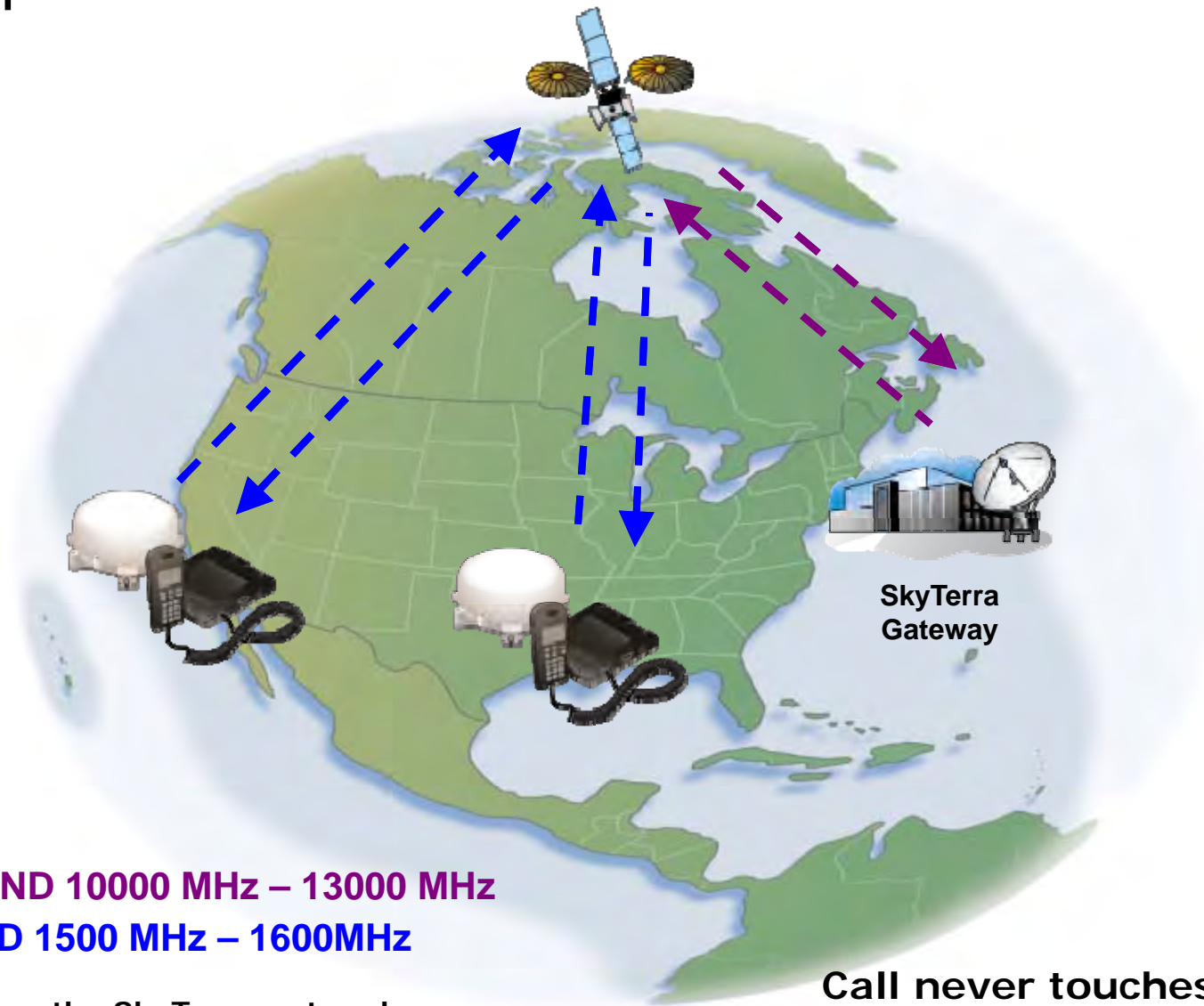


* KU BAND 1000 MHz – 1300 MHz

* L-BAND 1500 MHz – 1600 MHz

** Based on the SkyTerra network

Telephone – Sat Phone to Sat Phone



* KU BAND 10000 MHz – 13000 MHz

* L-BAND 1500 MHz – 1600MHz

** Based on the SkyTerra network

Call never touches the PSTN



Two-Way Radio (PTT)

- ▶ Two-Way, Push-to-Talk (PTT) Voice Service
 - Satellite based trunked digital radio
 - User initiated talk groups, in real time
- ▶ Key features and benefits:
 - Group oriented communication one-to-many
 - 15 Talk Groups per radio
 - One-to-one communication
 - Interoperability between groups
 - Interoperability with terrestrial two-way radio
 - Satellite protocols providing privacy
 - Priority interruption capability
 - GPS location ability
 - PSTN user access via Dial-In/Out capability
 - Continent wide coverage
 - Over the air reprogramming capability



Two-Way Radio – Signal Pathway



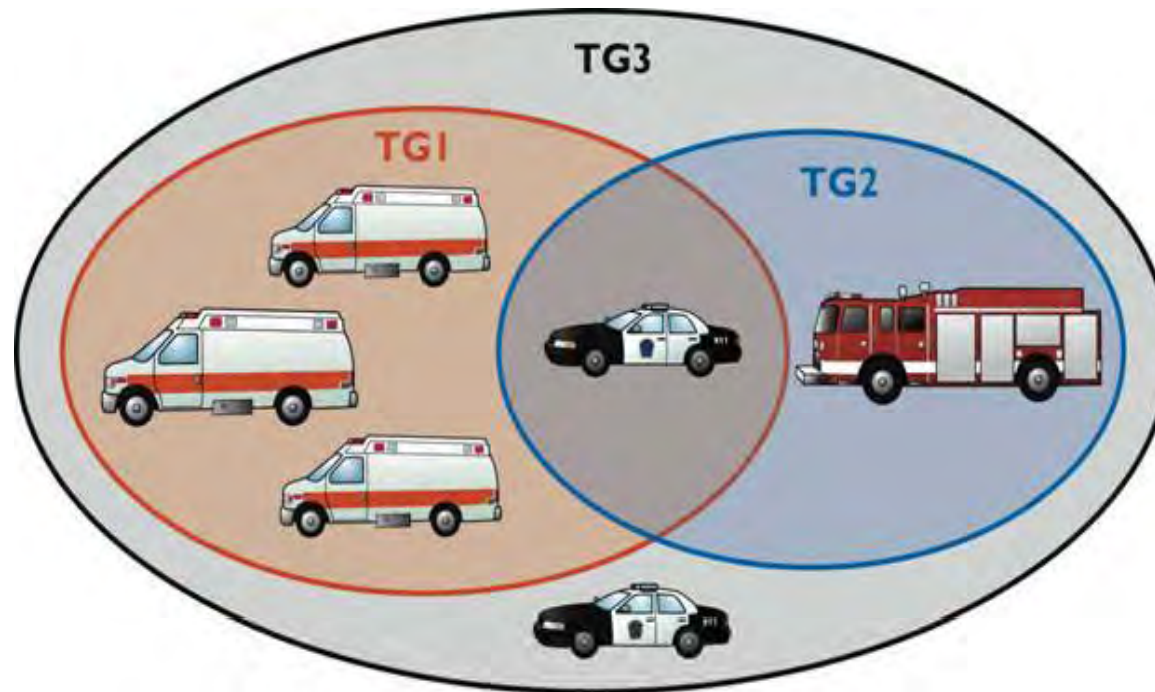
Call never touches the PSTN

KU BAND 1000 MHz – 1300 MHz
L-BAND 1500 MHz – 1600 MHz



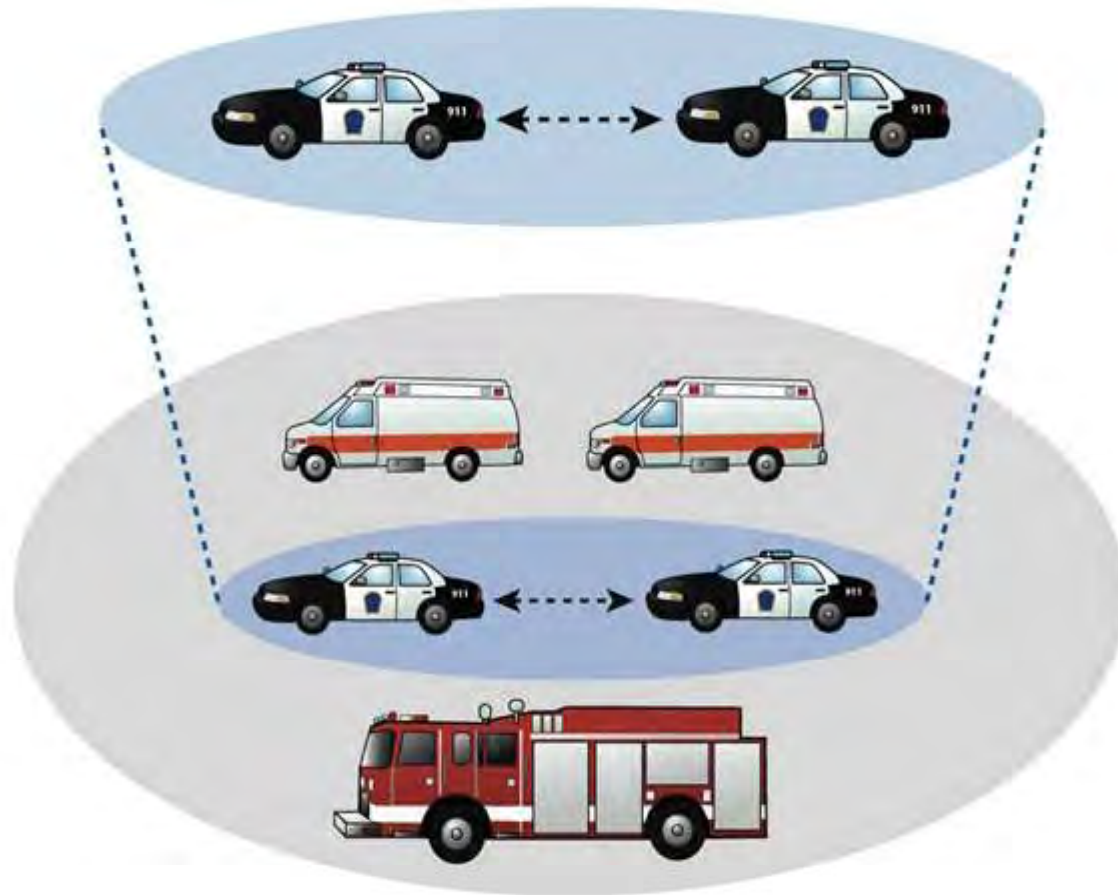
Talk Groups: Group Mode

- ▶ Group oriented communications solution
- ▶ Network resource friendly – small amount of network capacity can service large group of users
- ▶ Flexibility of configuration



Talk Groups: Private Mode

- ▶ One-to-one push-to-talk conversation
 - Allows direct connect based on 4 digit Directory Number



Satellite Mutual Aid Radio Talkgroup™



Nationwide SMART Talkgroups



J-SMART & SMART-T – Public Safety
Manager: DOJ Wireless Management Office



F-SMART - Fire Service
Manager: Charlottesville (VA) Fire Dept.



NPHST-1 / NPHST-2 – Public Health
Manager: KY Department for Public Health



I-SMART – Critical Infrastructure
Manager: Seattle Public Utilities



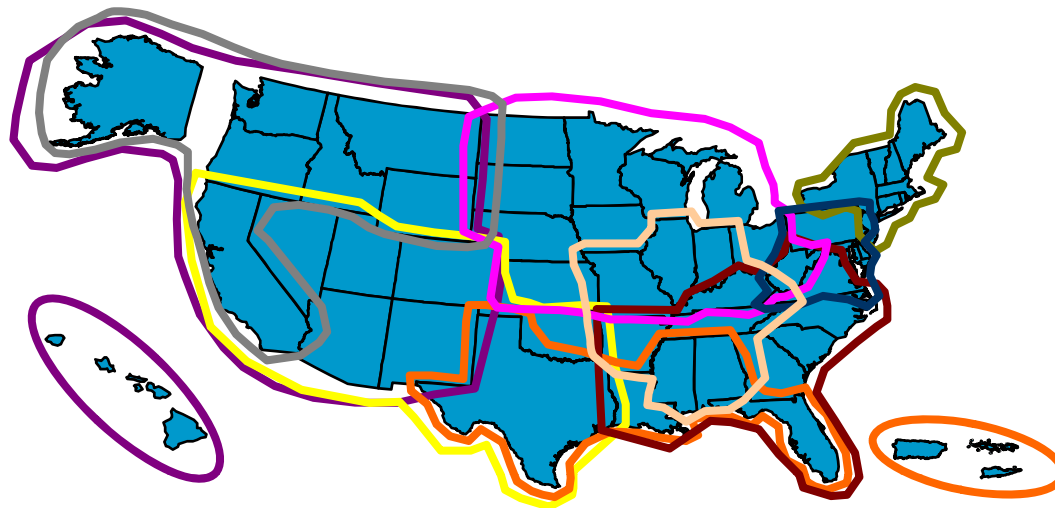
E-SMART – EMS
Manager: KY Dept. for Public Health



L-SMART - Law Enforcement
Manager: U.S. Marshals Service



Regional SMART™ Talkgroups



NESMART - CT, DE, MA, ME, NH, NY, NJ, PA, RI, and VT

Manager: Connecticut State Police



MWSMART - IA, IL, IN, KS, KY, MI, MN, MO, OH, ND, NE, SD, WI, and WV

Manager: IN Department of Homeland Security



M-SMART - DC, DE, MD, PA, VA, and WV

Manager: Allegany County (MD) Dept. of Public Safety and Homeland Security



SWSMART - AZ, CA, CO, NV, NM, OK, TX, and UT

Manager: Contra Costa County Fire Protection District



SESMART - AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, and WV

Manager: Fairfax County (VA) OEM/Public Safety Comm.



W-SMART - AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, and WY

Manager: California Emergency Management Agency



G-SMART - AL, FL, LA, MS, TX, PR, and VI

Manager: LA Governor's Office of Homeland Security and Emergency Preparedness



NWSMART - AK, CA, ID, MT, OR, WA, and WY

Manager: WA State Emergency Management Division



CUSEC-1 - AL, AR, IL, IN, KY, MS, MO, and TN

Manager: Central United States Earthquake Consortium

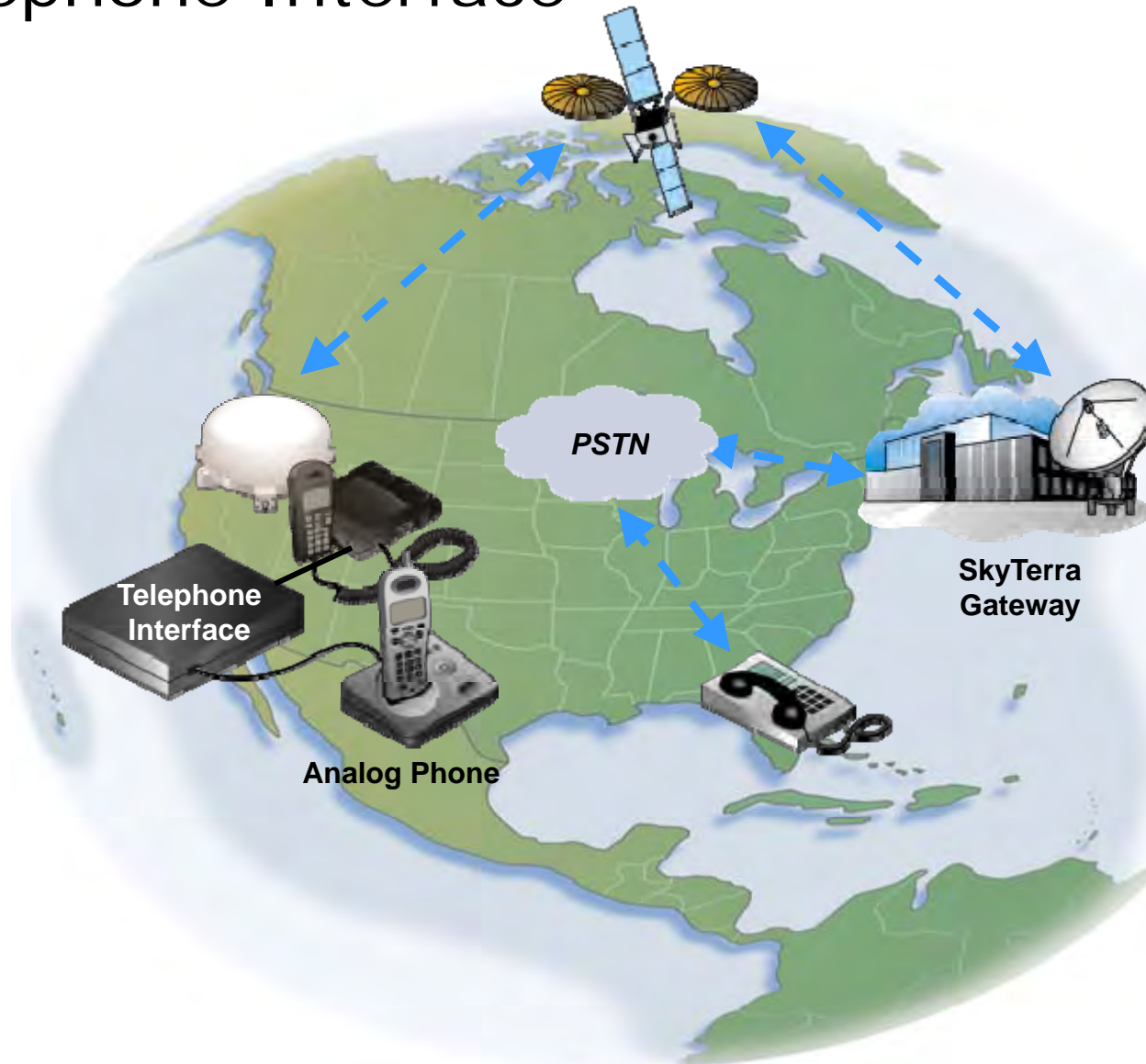


Interoperability Interfacing Capability

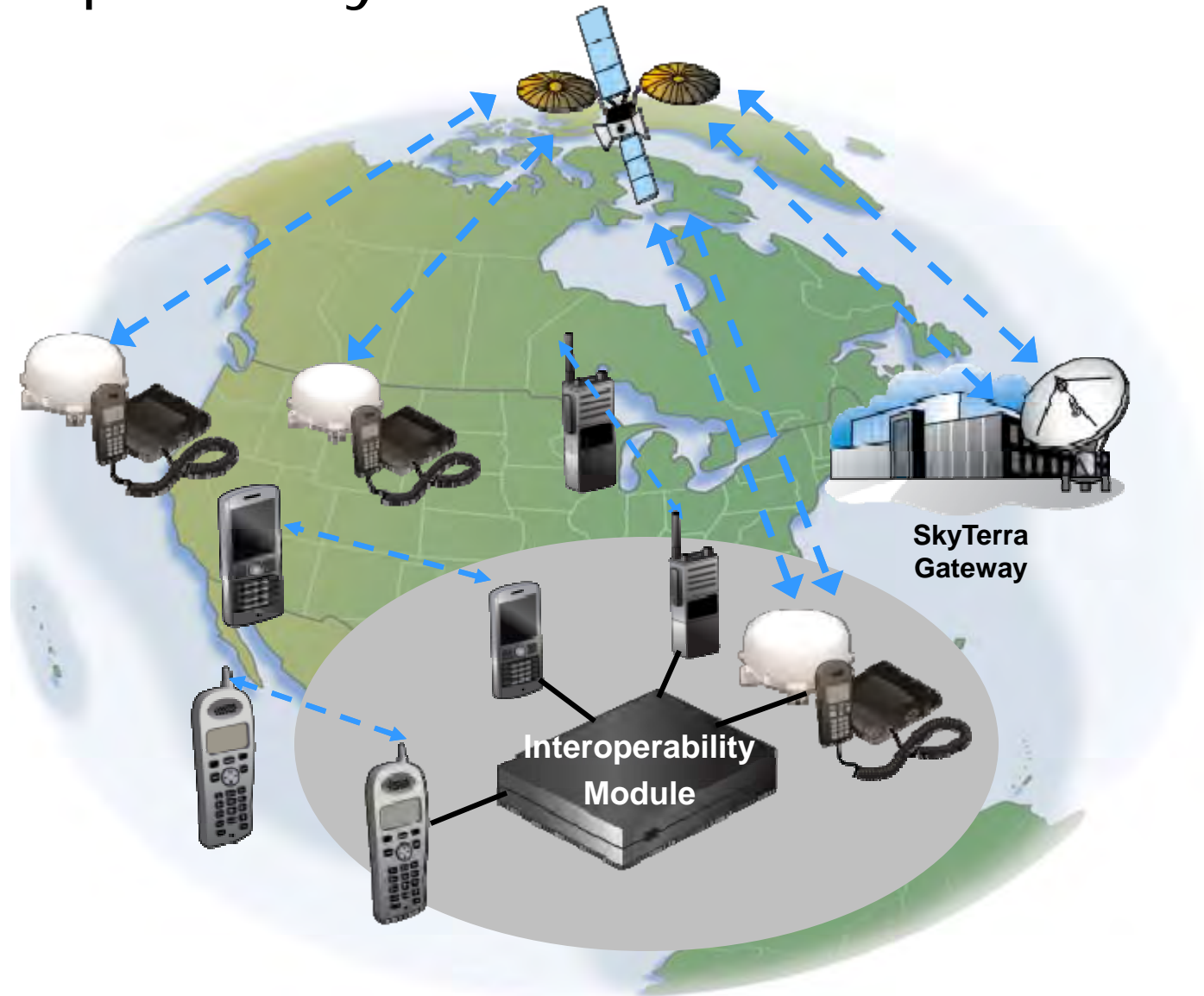
- ▶ Telephone Interface
 - Enabling use of conventional telephones with the satellite radio
 - PBX integration
- ▶ Interoperability Modules
 - Interconnecting disparate radio types
- ▶ Vehicle Repeaters
 - Extending capability by enabling use of handheld radio



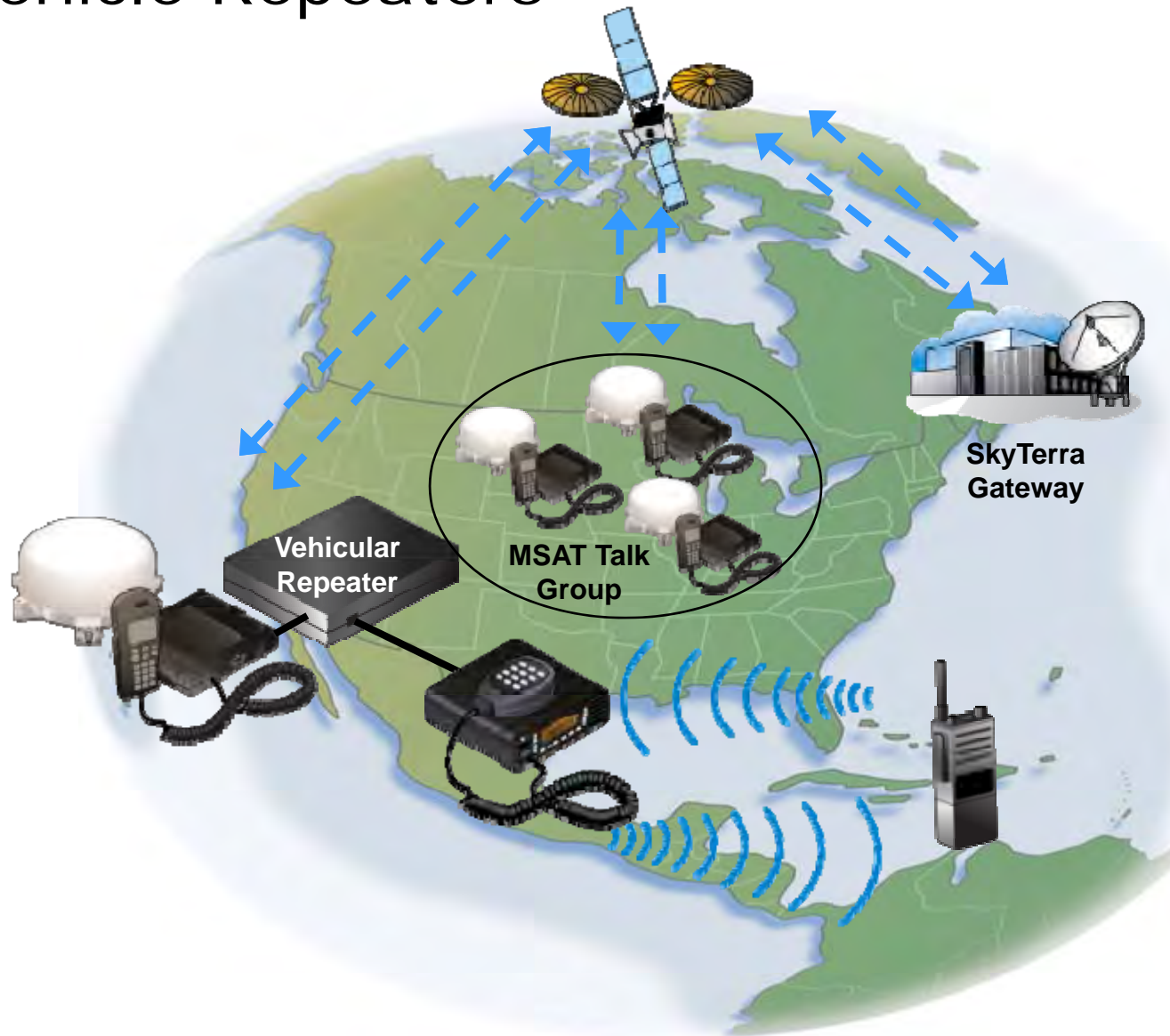
Telephone Interface



Interoperability Modules



Vehicle Repeaters



Questions?

