

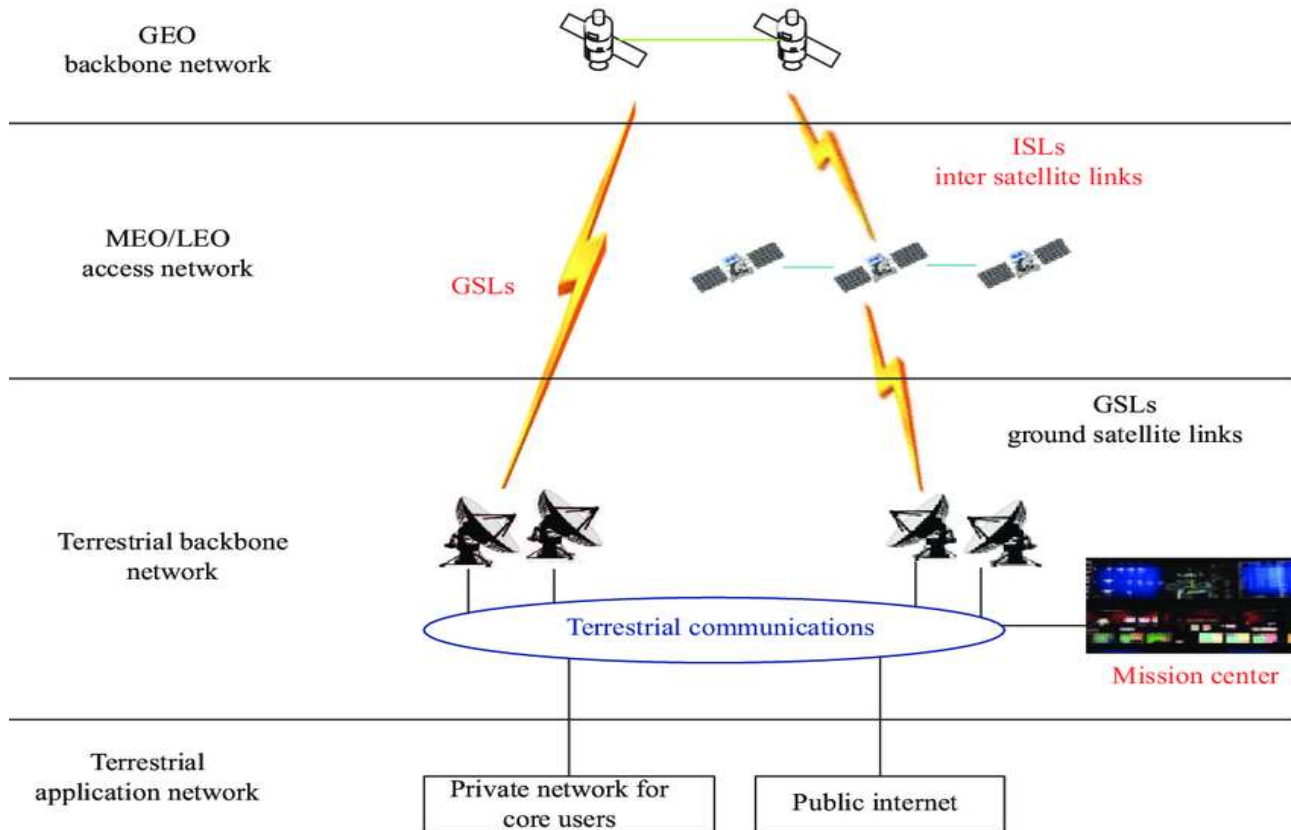


SATCOM & ANTENNA TECHNOLOGIES DIVISION

Ground Network in Hybrid Space Architecture

RK SINGH
Managing Director

Hybrid network



Hybrid network

- Space-air-ground integrated network is a prominent architecture for the future wireless communication system.
- Under a hybrid approach, data transmission can be initiated through a network at geosynchronous orbit (GEO), then jump onto a satcom network at medium-Earth orbit (MEO) or low-Earth orbit (LEO).
- Potentially back up the orbital satcom chain – until the data transmission reaches the receiver.
- The HAS (Hybrid Space Architecture) aims to demonstrate a network architecture that leverages both commercial and government space assets across diverse orbits to provide secure, assured, and low-latency data communications anywhere on and off Earth.

CPI SAT's Orbital Systems LEO products



6.1m



3.0m



2.8m

5.0AE3BP-5.0m and 5.0AE3BP-6.1m

Elevation-over-azimuth with tilt axis positioner with 5.0m, or 6.1m reflector for lower maximum wind locations or operation under a radome - includes built in ACU

3.0AE3BP-3.0m, 3.0AE3BP-3.7m, 3.0AE3BP-2.8m

Elevation-over-azimuth positioner with 3.0m and 3.7m versions - includes built in ACU. Optional three-axis version for Ka band.

2.4AE3BP-2.4m, 2.4AE3BP-2.8m and 2.4AE3BP-3.0m

Elevation-over-azimuth positioners for 2.4m, 2.8m, and 3.0m applications - includes built in ACU

1.8AEHT-1.5m and 1.8AEHT-1.8m

Elevation-over-azimuth positioners for 1.5m and 1.8m applications - includes built in ACU



5.0m



3.7m



2.4m



1.8m

LEO Tracking terminal markets

There are really three LEO markets

- **Earth Resources Satellite**
 - Imagery and sensor applications
 - S and X-Band originally but other frequency bands as well
 - CPI Orbital Systems excels at smaller apertures with larger antennas now coming
- **Classified / Scientific**
 - Special purpose antennas
- **Evolving LEO constellations**
 - Lots of these coming, O3B (which is MEO), OneWeb, and Spacelink ...
 - Market driven by price
 - Performance is almost insignificant
 - Represented by “CubeSats” and other low-cost spacecraft



Orbital Systems 7.3 Meter LEO Antenna



Malibu GDA CDL Antenna

Earth resources satellite market

Our Orbital Systems antennas are significant in this market

- Satellites are mostly LEO
 - Weather and other imagery
 - Earth sensor missions
 - Government, scientific, and increasing civil missions
- Frequency bands are often standard
 - S/X-Band are the most common with some L-Band
 - Increasingly requiring Ka-Band for higher data rates
- The market is evolving
 - First systems were inexpensive RO antennas
 - Most of the market is moving to higher performance antenna system



Orbital Systems 7.3 Meter LEO Antenna

Classified / scientific LEO market

Increasingly, government and scientific missions want LEO support

- Heightened interest to add to previously GEO systems
 - Various applications, RX, TX
 - More launches, thus more interest
 - Government, non-commercial users
- Frequency bands are varied
 - Many are typical satcom
 - Other frequencies can be “special”
- The classified market is not driven by cost
 - Mostly a question of meeting performance requirements
- International government market appears robust
 - Allied governments are interested in monitoring space faring nations’ progress



18 Meter and larger antennas often desired

Emerging Big LEO market

Big LEO constellations will have hundreds or thousands of satellites

- Many future LEO constellations are launching and planned
 - Most Big LEO constellations are for internet service
 - Include optical and RADAR imagery and Earth Observation constellations
- Frequency bands are moving higher
 - OneWeb is Ku to users, Ka to gateways
 - Most planned systems are Ka-band
 - Many companies have filed for Q/V-Band as well
- This market is **incredibly cost-sensitive**
 - Satellite constellations are **expensive**, individual satellites are **cheap**
 - The system model is really “direct-to-user”
 - With thousands or more User Terminals the model is similar to GEO VSATs
 - Gateway terminals are not very large and many are redundant single-thread designs
 - User terminals are “A VSAT that tracks a LEO” and Gateways are very low cost



Spacelink Phased Array User Terminal

HTS VHTS Gateway antennas match system needs

HTS VHTS Ka Q V-Band Gateways

- **5.5 to 13.2 Meter HTS VHTS Gateways antennas**
 - CPI's 13.2 Meter Gateway antennas provide the highest EIRP
 - EIRP is usually the driver in Gateway selection
- **Maximum system efficiency**
 - High performance antenna optics
 - Reduces feed loss and maximizes efficiency
 - Hub-mounted HPAs minimize uplink loss
- **Now with combined Ka, Q, V-Band**
 - Full HTS and VHTS support
 - Lowest total system cost



CPI 9.2 Meter Ka/Q/V-Band Gateway Antenna

16.4 / 18.3, 20 Meter Turning Head – Lunar/Deep Space



15.0 Meter Full Motion - LEO / MEO Launch Support



Related Tracking terminal market

CDL ground to UAVs

- **Military UAVs**
 - Malibu is a major player in this market
 - Operate as CDL terminals for line-of-sight operation
 - Initially Ku-Band, now including S-Band and C-Band
- **Commercial UAVs**
 - Mostly international government
 - Various frequencies
 - Cost-sensitive applications
- **Antenna slew rates similar to LEOs**
 - Depends upon distance to UAV
 - Can be 10 Degrees/Second or more
 - Can use GPS command track or Autotrack



L3Harris UGDT using Malibu GDA Antenna

SATELLITE COMMUNICATIONS FOR EARLY WARNING, CLIMATE CHANGE & NATURAL DISASTERS

- **Automated & resilient, instant information solution**

For areas where it can be difficult to frequently deploy manpower

- **Complete, low power, cost-effective, easy to install**

A solution in response to small, medium and large threats & risks

- **Guaranteed data delivery for any number of users**

Handshake protocols between satellite messaging terminals & monitoring terminals

- **Path diversity for redundancy & resilience**

Ensuring continuity & back-up through use of diverse solutions that avoid total reliance on vulnerable terrestrial networks



0.6m

1m

1.25m

1.4m



1.8m



2.4m

Thank You



Photo courtesy of L3Harris Technologies