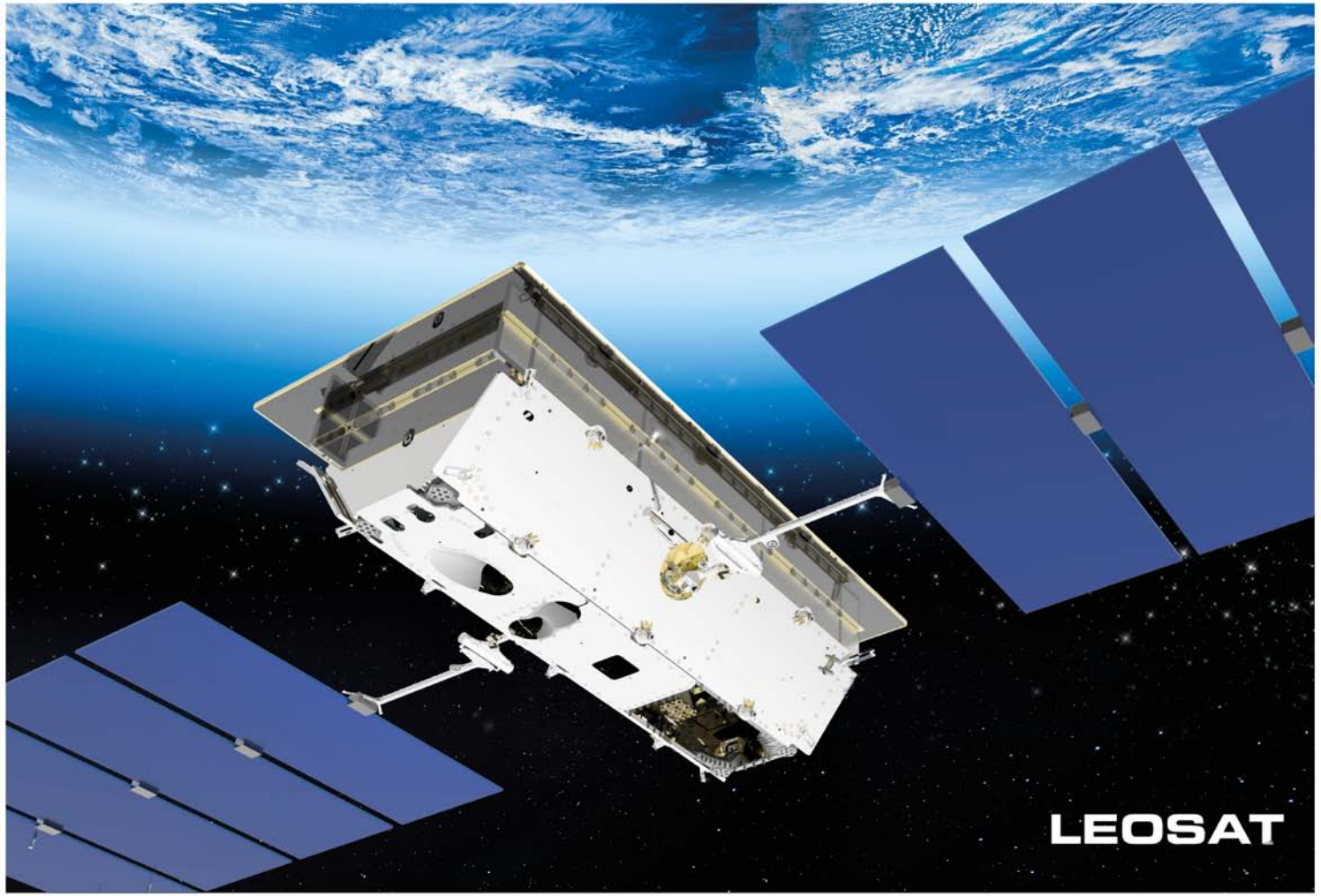
Optical Networks In The Sky

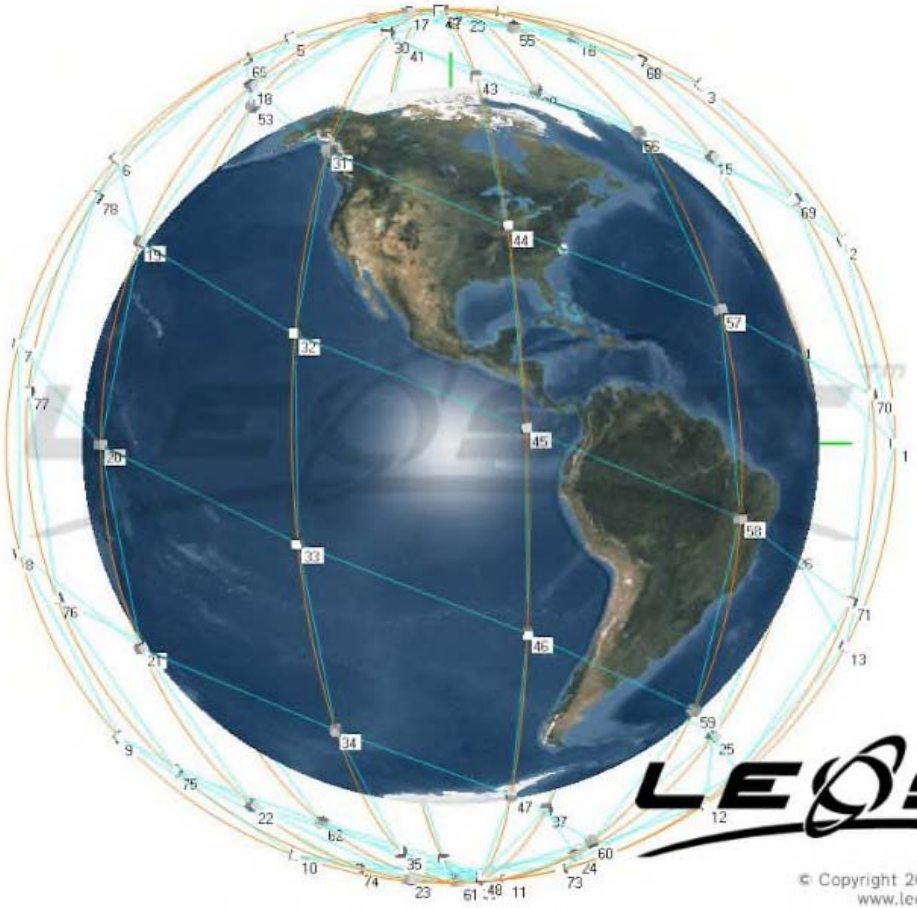


John Schuster – SVP of Engineering

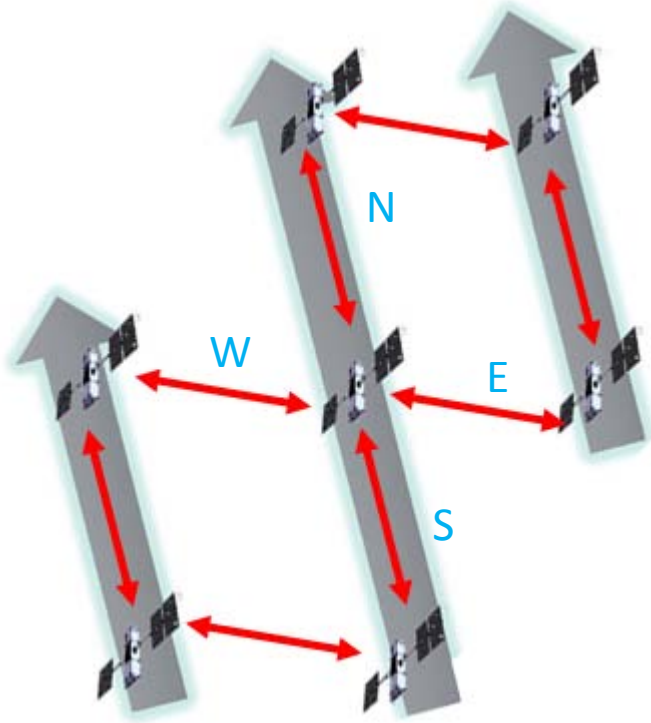
LeoSat's Plan

- Goal
  - The lowest latency, most secure, gigabit bandwidth data network providing connectivity anywhere on Earth
- Feature Set
  - Point-to-Point or Point-to-Multi-Point without touching the ground
    - Security
    - Performance - lowest latency possible
    - Fiber-like full-duplex connectivity and high bandwidth
- Target Markets
    - Enterprise
    - Government – Non-Military
    - Government – Military
    - Cellular Backhaul
    - Maritime
    - Oil & Gas
    - Media
    - Arctic Connectivity

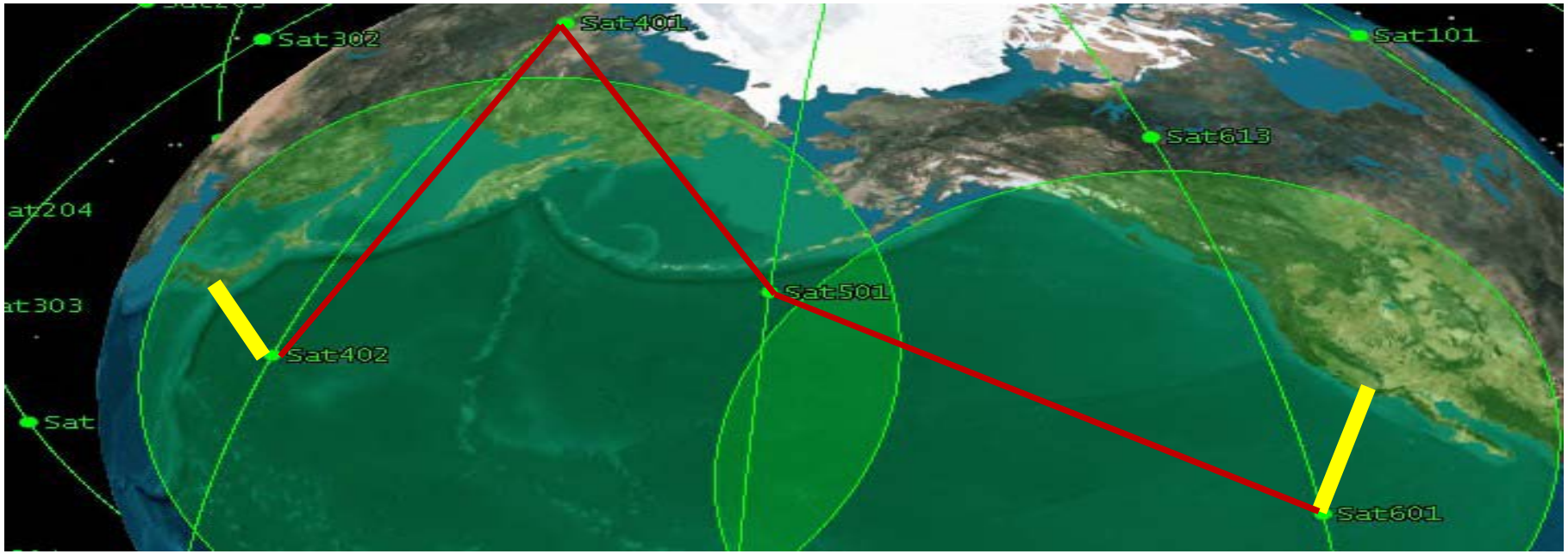
The LeoSat Constellation



- 84 satellites
- 6 orbital planes
  - 14 satellites per plane
- Polar Orbit at 1,400 km altitude
- 24+ Ka-band spot beams per satellite
- Four ~20+ Gbps optical inter-satellite links (OISL)

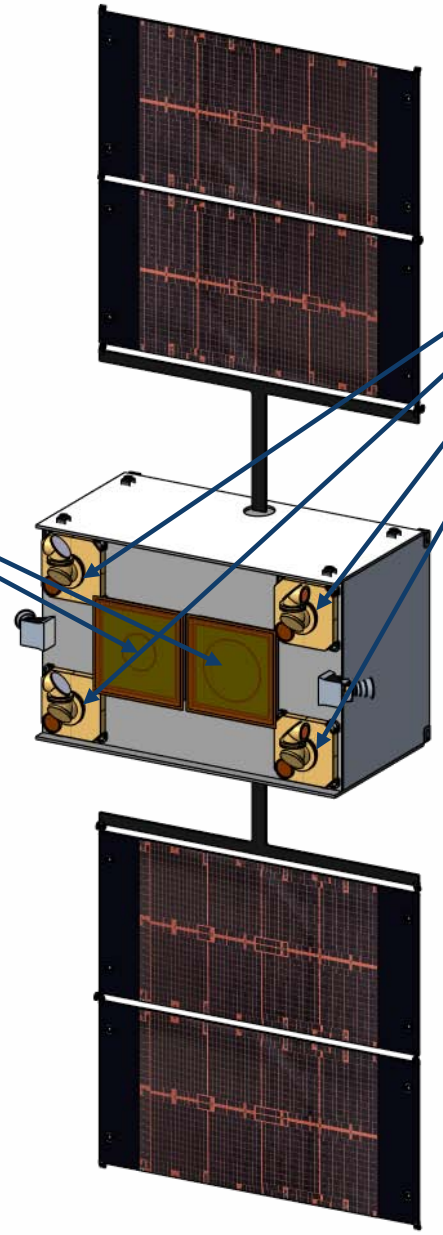


End-to-End Earth Station Connectivity: RF + OISLs



- A customer's data enters the mesh typology network via one satellite's Ka-band spot beams
- It is routed through the satellite mesh typology via the OISLs
- The data is returned to the Earth via the last satellite's Ka-band spot beams
- **The customer's data only touches the ground at the customer's ground terminals**
- **FASTER and more SECURE than fiber**

A LeoSat Satellite – Artist's Concept



4 OISL Terminals
- N & S: in-plane
- E & W: adjacent planes

Tx and Rx
Phased Arrays

Direction of
orbital motion

Optical Inter-Satellite Links (OISLs)

Why Lasercom

- Very SWaP (size, weight, and power) efficient for a given data rate
  - Apertures of ~7 – 10 cm in diameter
  - At 5,500km = ~55m spot size
- No RF spectrum/no interference
- Very high data rates supported
  - >10 Gbps
- Lasercom in space is easier than on the ground
  - No weather
  - No scintillation
  - Our satellites are moving, but the motion is highly predictable

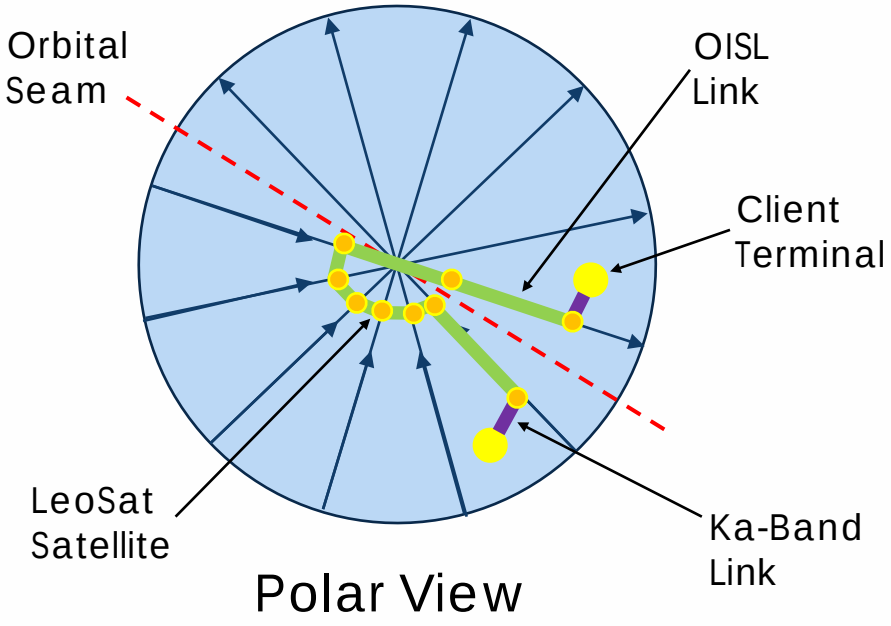
Challenges

- Operations with sun in the field of view
- Internal mechanical/optical alignment over constantly changing solar exposure
- Satellite platform deflection due to solar/thermal loading
  - Alignment between terminals
  - Can be compensated/predicted over time and data gathering
- Radiation darkening of fiber in amplifiers
- Mechanical pointing and tracking system lifetime with 24/7 operations
- Optics contamination
  - Direction of travel facing optical system

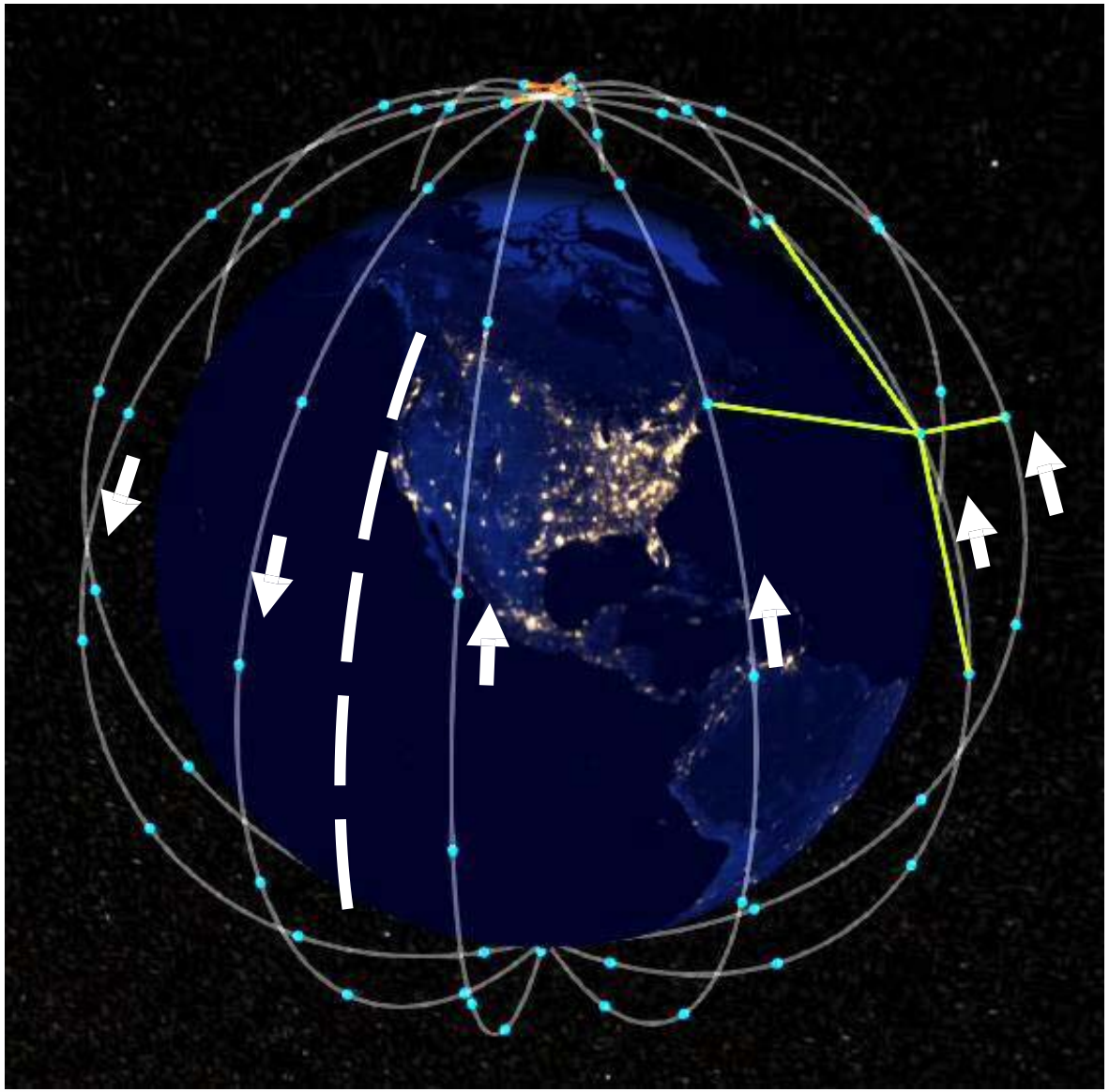
Cross Seam Communications

At the Seam, satellites moving in opposite N/S directions

- Links constantly dropping and re-acquiring
- High angular tracking rates
- If not crossed, must be routed "around" – increases latency



Polar View



Opportunities?

1. Combining/Mining pointing and tracking data
   - Each LeoSat spacecraft has 4 OISL terminals
   - Each terminal is constantly monitoring its line of sight
     - Microradian resolution at kHz sampling rates
   - Can we combine the pointing and tracking data across terminals and satellites to reduce acquisition time across the seam?
   - What else can be mined from that data?
     - Exceptionally high resolution Position, Navigation and Tracking (PNT) applications?

2. Use the LeoSat constellation to downlink data from EO satellites
   - EO satellites could upload their data to LeoSat using RF Ka-band or OISLs
   - Real-time downlinking of data from/to anywhere in the world

Thank You