



Session 3: NGSO Constellations

3a: One Web

3b: O3B

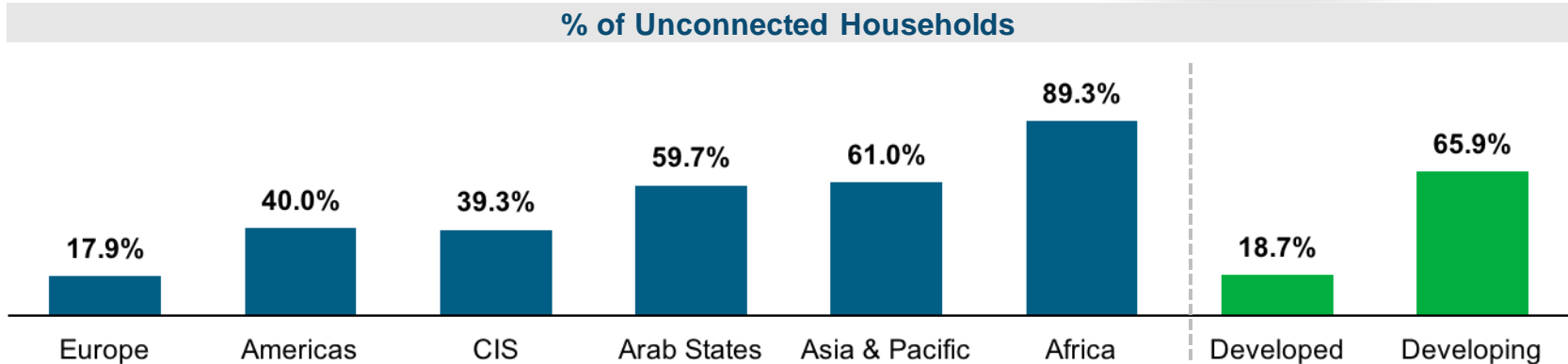
3c: Starlink – SpaceX



Session 3a: One Web

Majority of the World Does Not Have Access to the Internet

- The ITU ¹ estimates over **4 billion people** without internet access globally
- 55 million people lack access to advanced broadband in the U.S. alone
- OneWeb's market entry objectives align with public initiatives and international governments' goals



Source: ITU - ICT Facts & Figures, 2015; FCC 2015 Broadband Progress Report.

(1) International Telecommunication Union, an agency for information and communication technologies within the United Nations (UN).

OneWeb is Expanding Global Connectivity



Technology at a Glance

Lowest Latency
< 50 milliseconds

Highest Throughput
400 Mbps Down/Beam
100 Mbps Up/Beam

Smallest High-Performance User Terminals
30cm – 65cm

System Capacity
8 Tbps

Premium Spectrum
Ku- and Ka-band Rights

Multiple Local Access Options
Wi-Fi, LTE, Ethernet, etc.

Global Constellation
648 LEO satellites (Initial)
882 LEO satellites (Full)

Lowest Satellite Cost
around 600K \$ / satellite

Low Earth Orbit (LEO) System Offers Lowest Latency

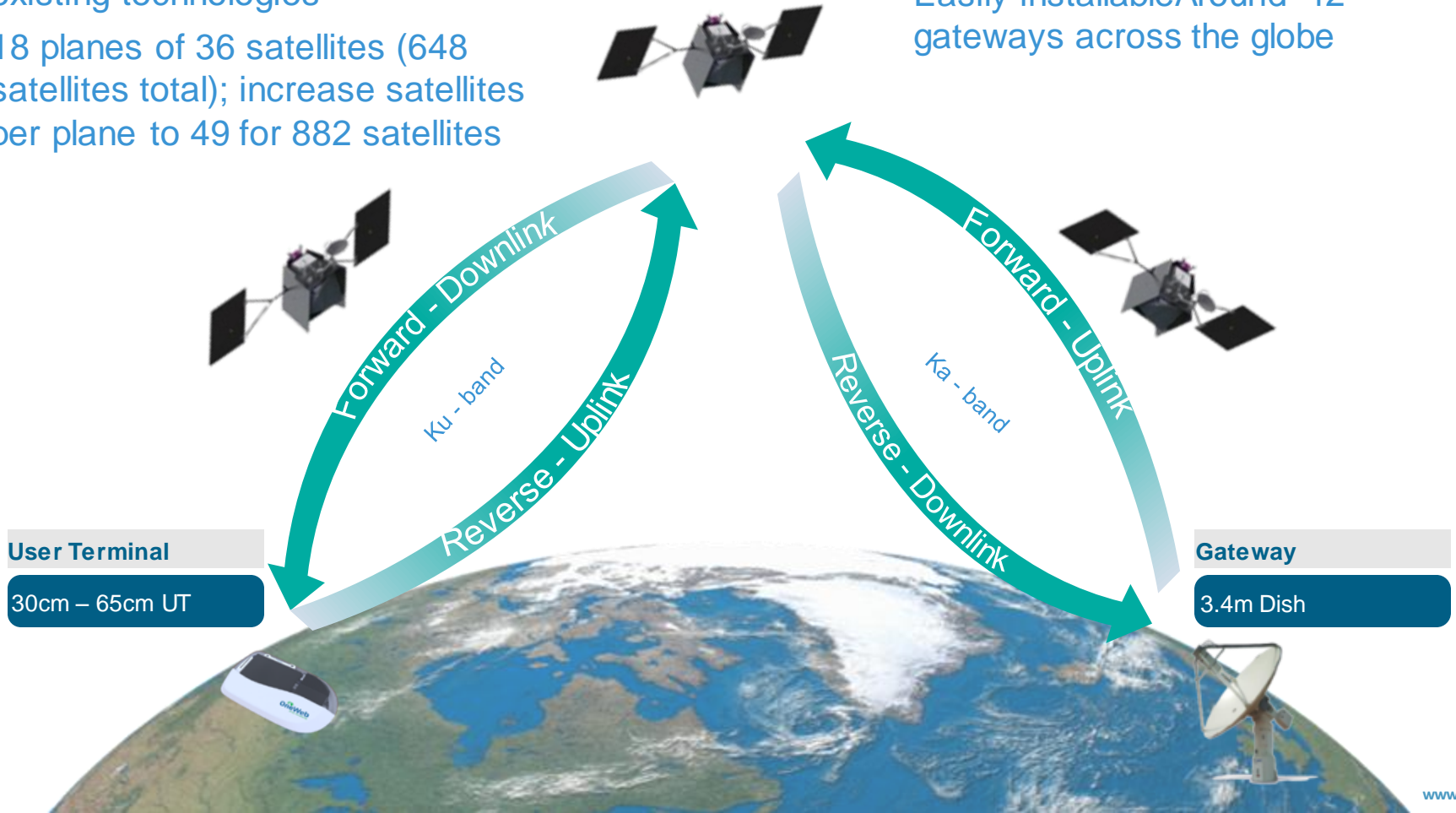


Constellation

- Innovative beam technology
- Small, inexpensive satellites using existing technologies
- 18 planes of 36 satellites (648 satellites total); increase satellites per plane to 49 for 882 satellites

Ground

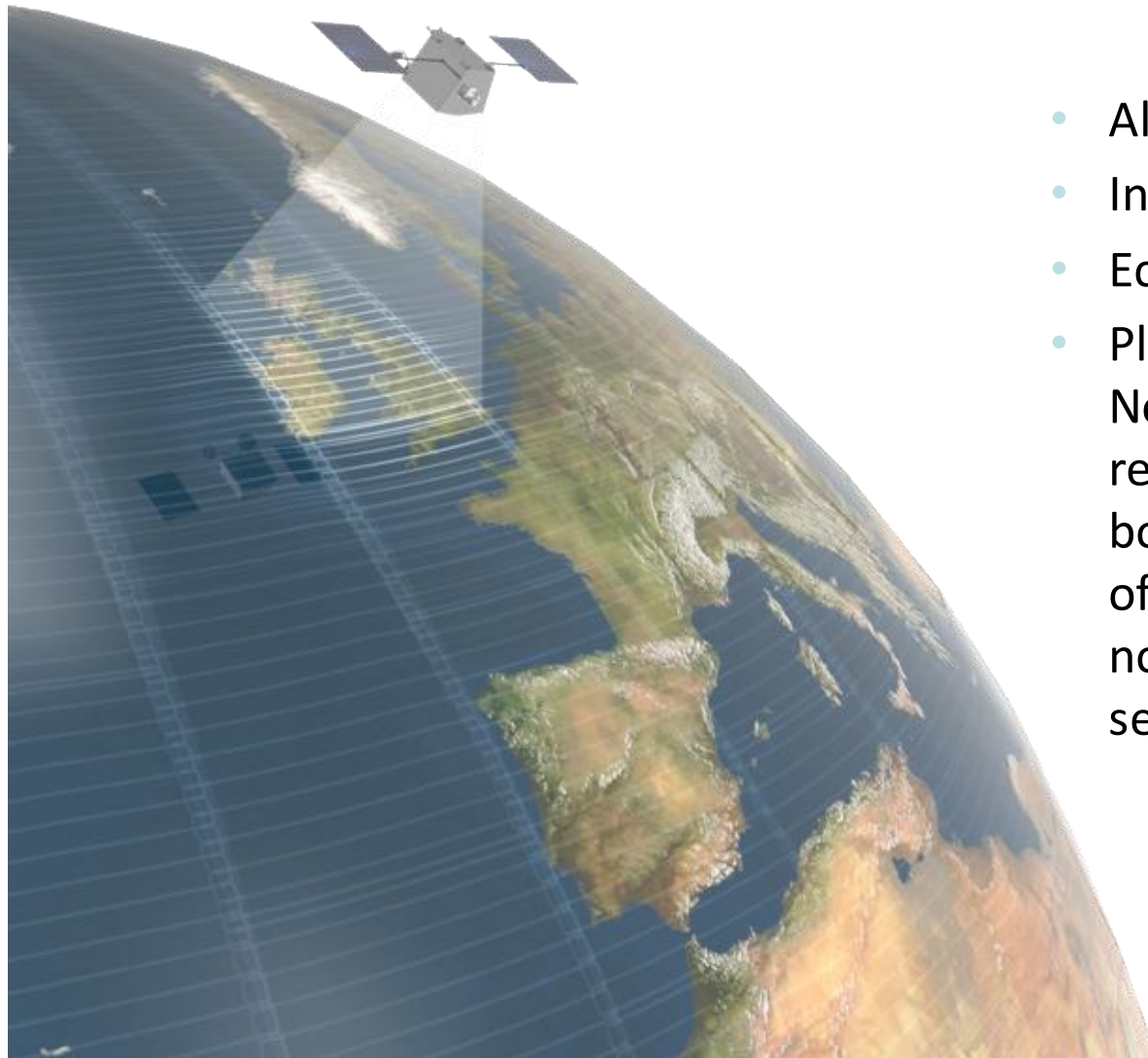
- Affordable, compact, multi-user access terminals
- Easily installable Around 42 gateways across the globe



Orbital Characteristics

The satellites in the constellation have the following parameters:

- Altitude: 1,200 km
- Inclination 87.9 degrees
- Eccentricity: 0 (circular orbit)
- Plane Spacing: 10.15 degrees -
Note 10.15 not 10.0 degrees to
reduce spatial gap between
boundaries adjacent orbit planes
of ascending and descending
nodes – referred to as “the
seam”.



Network Of Operating Centers and Equipment for Global Coverage

Key Components of the OneWeb System

System Engineering and Program Management

Communication Ground Segment (CGS)

- Satellite Network Portals (SNPs) and associated Satellite Access Points (SAPs)
- OneWeb Points of Presence (PoPs)
- Global Network Operations Center (GNOC)

User Terminal Segment

- User Terminals providing access to the OneWeb network

Corporate Segment

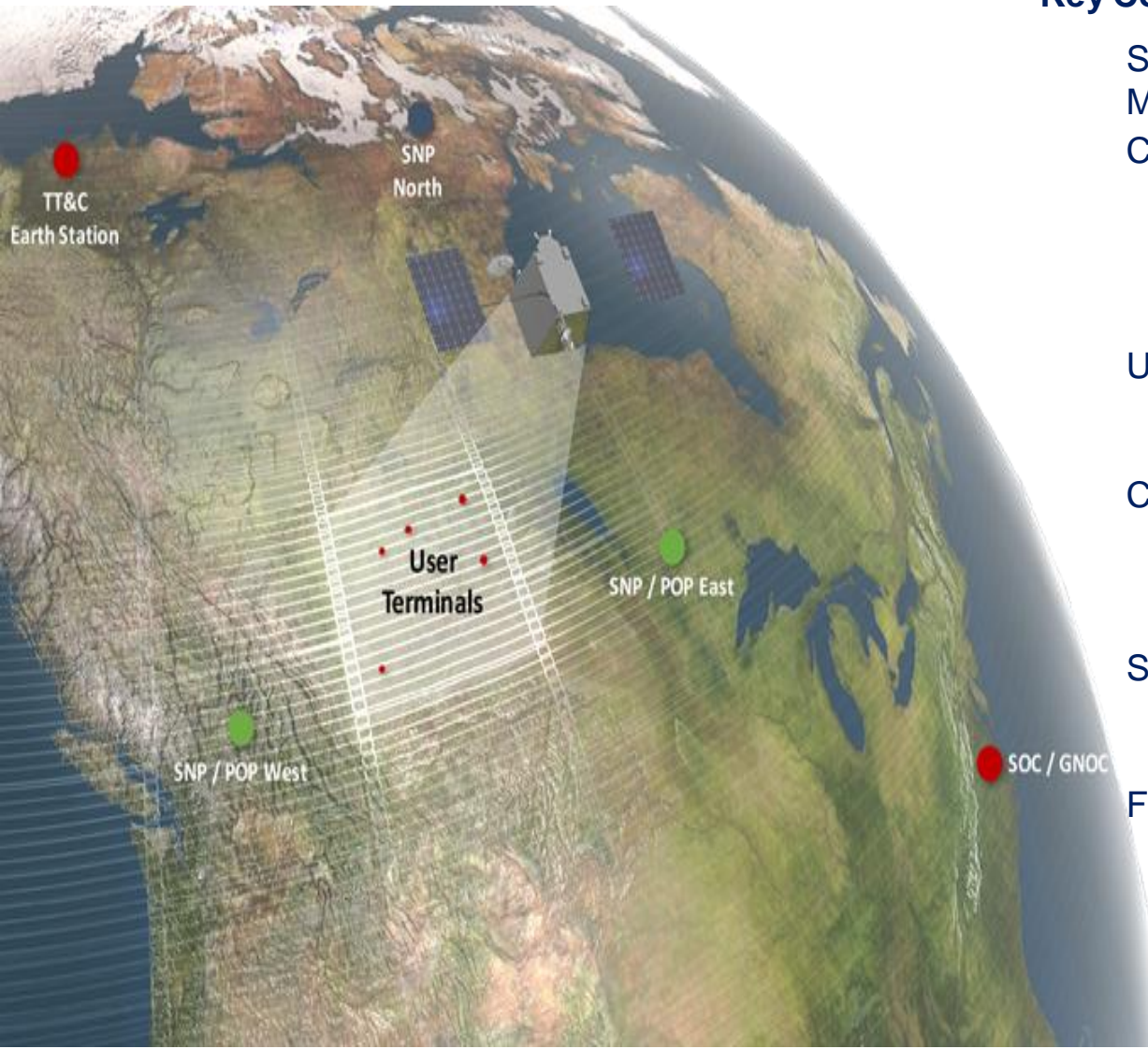
- Customer Support Center (CSC)
- Billing and Operation Support Systems (B/OSS)

Space Segment

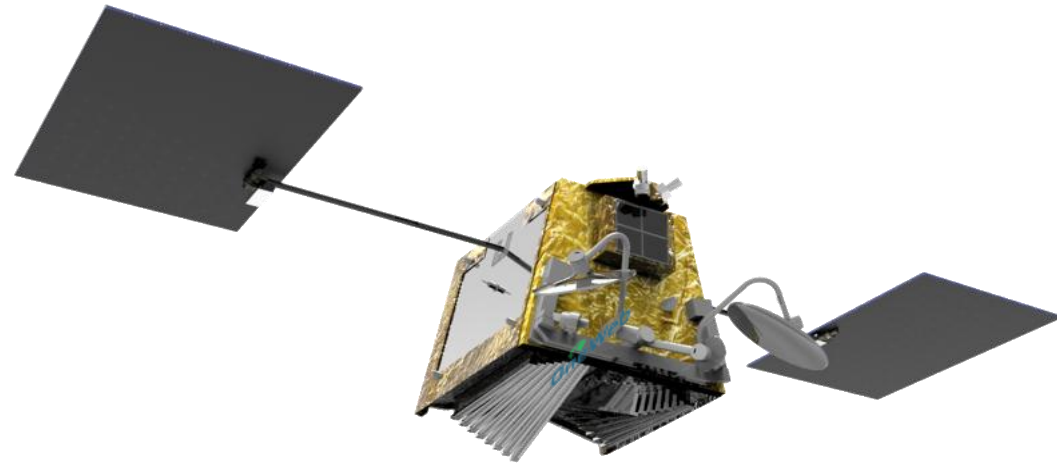
- LEO Satellite Constellation
- Launch Capability

Fleet Management Segment (FMS)

- Satellite Operations Center (SOC)
- TT&C Earth Stations



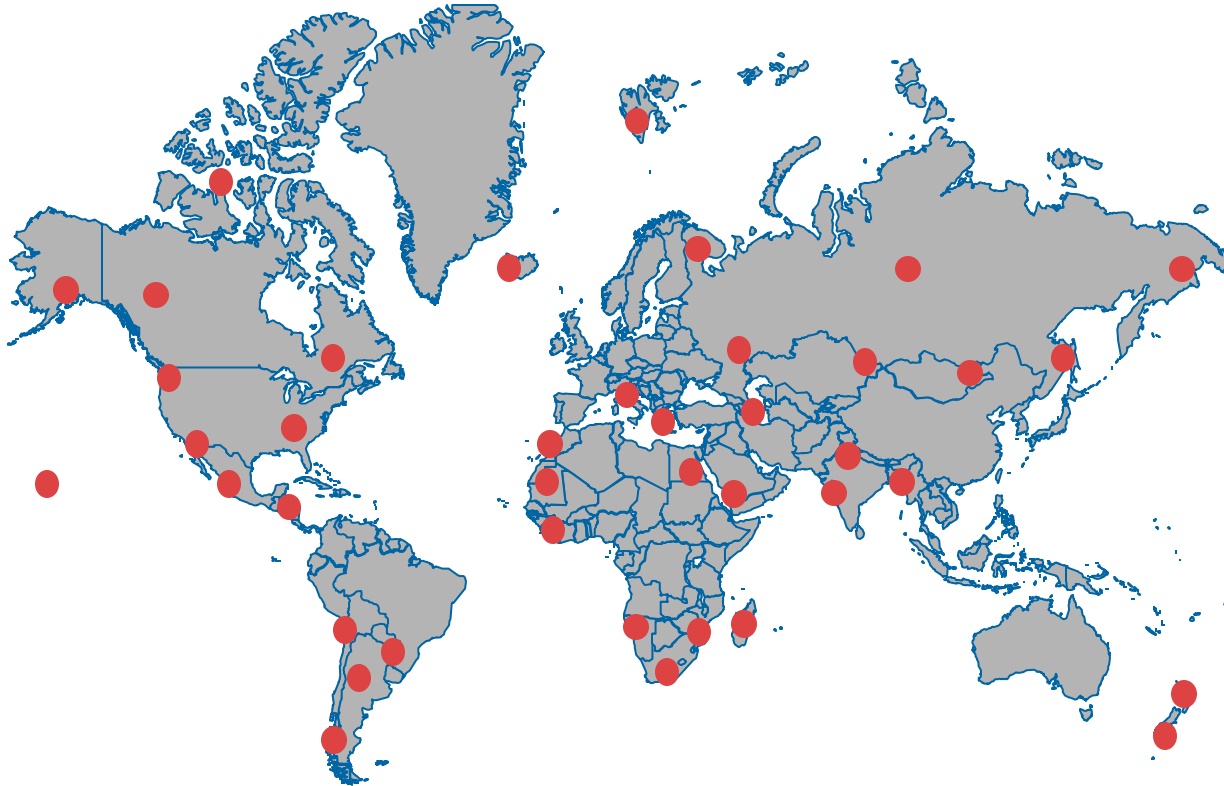
- Small, low mass satellites with modular design
- Produced in new manufacturing facility for high-rate and low-cost production
- Leverages existing and proven technology
- Unique modular design
- Strong industry participation
 - Over 150 RFPs already released with +85% supplier response rates



All Major Systems Designed

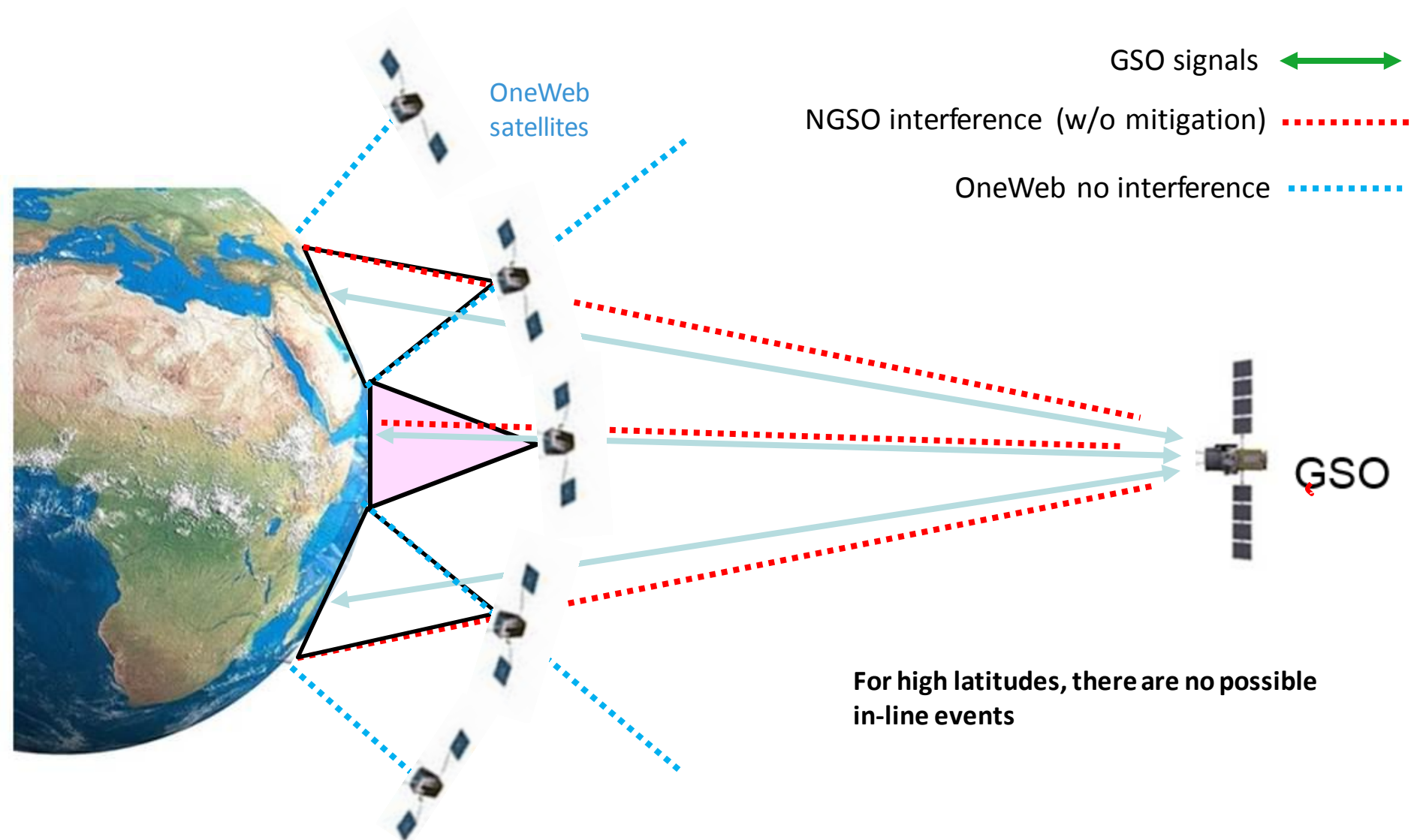
- Electric Propulsion
- Thermal Control
- Electrical Power
- Avionics and TT&C
- User Antenna
- Gateway Antenna
- Mechanical Systems
- Guidance, Navigation and Control

Indicative Satellite Network Portal Locations

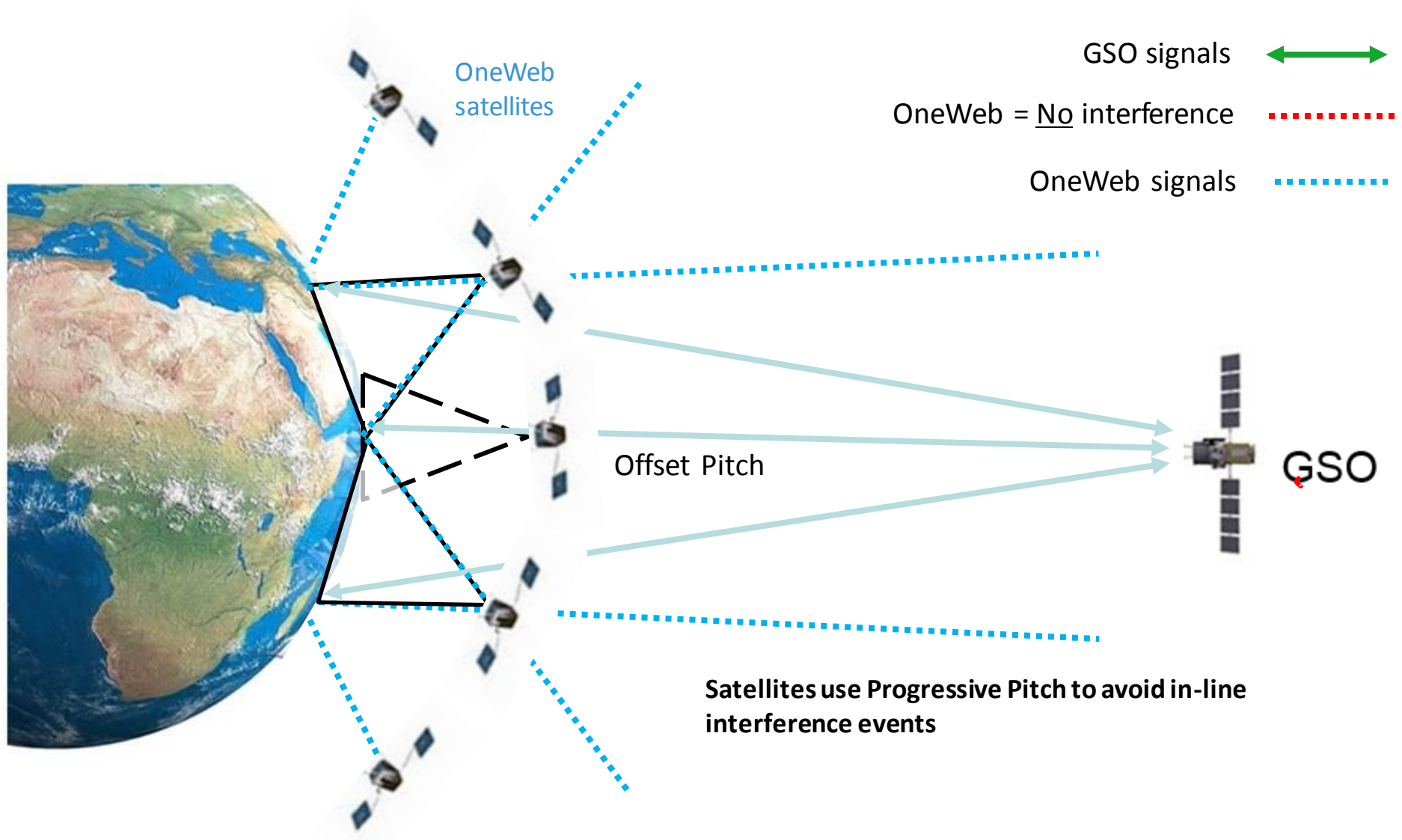


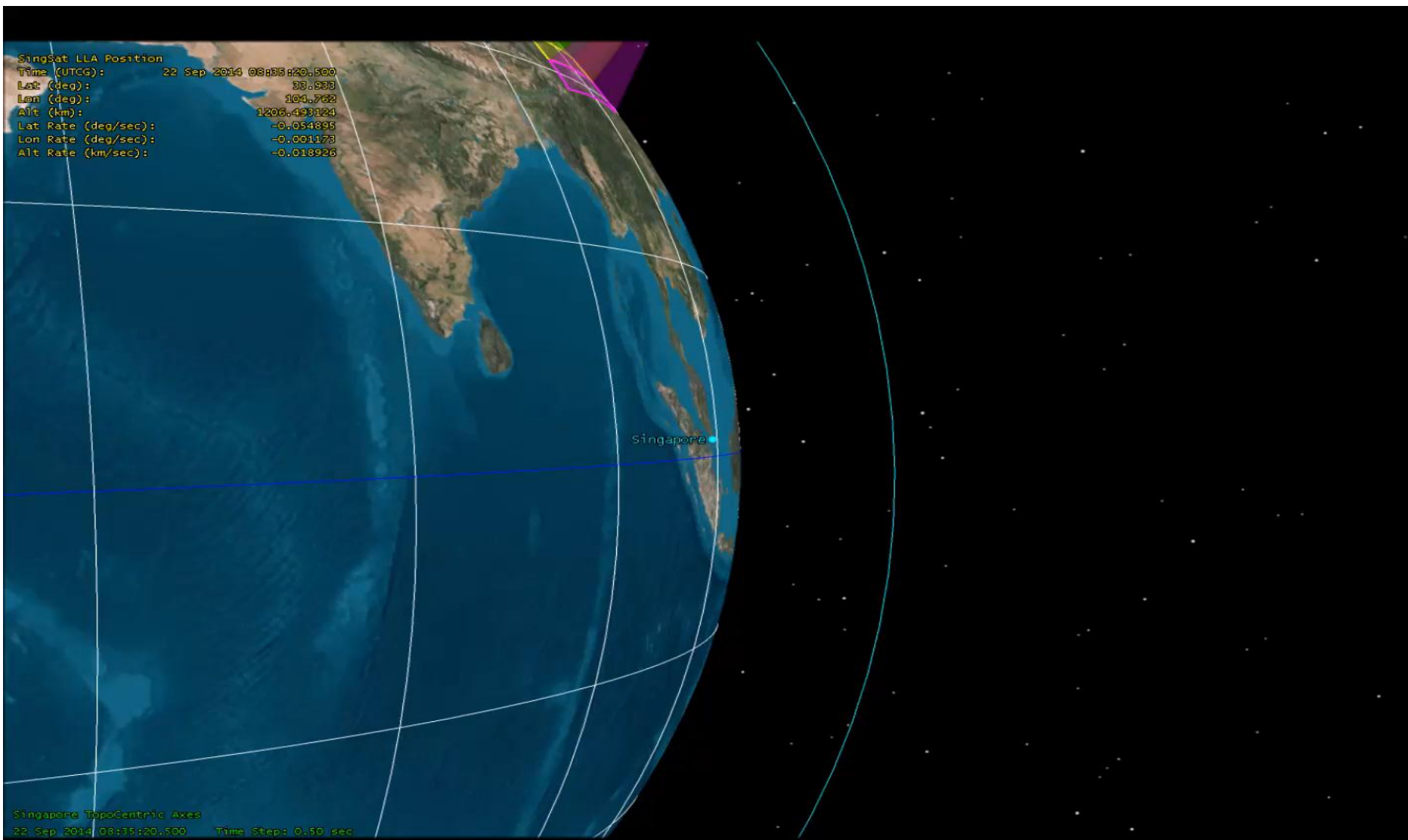
- The initial deployment plan has up to 42 Satellite Network Portals (SNPs), which provide coverage for OneWeb's operational area
- Site locations to be synchronized with regulatory considerations
- Leverage Hughes ground system design expertise

Using Novel Techniques to Protect GSO



Using Novel Techniques to Protect GSO





- Development and manufacturing strategy leverages existing industry expertise and common engineering technology
- Compact user terminals
- Speeds of over 50 Mbps
- Includes WiFi / LTE / 3G / 2G
- Multiple manufacturing options with low cost of production
 - RFPs issued to manufacturers
- Flat-phased array antennas that do not require aiming and can be easily installed
- Leverage Qualcomm wireless connectivity expertise and patents

Prototype User Terminals Under Development



Mobile Applications



Enterprise Applications



Small Cell Applications

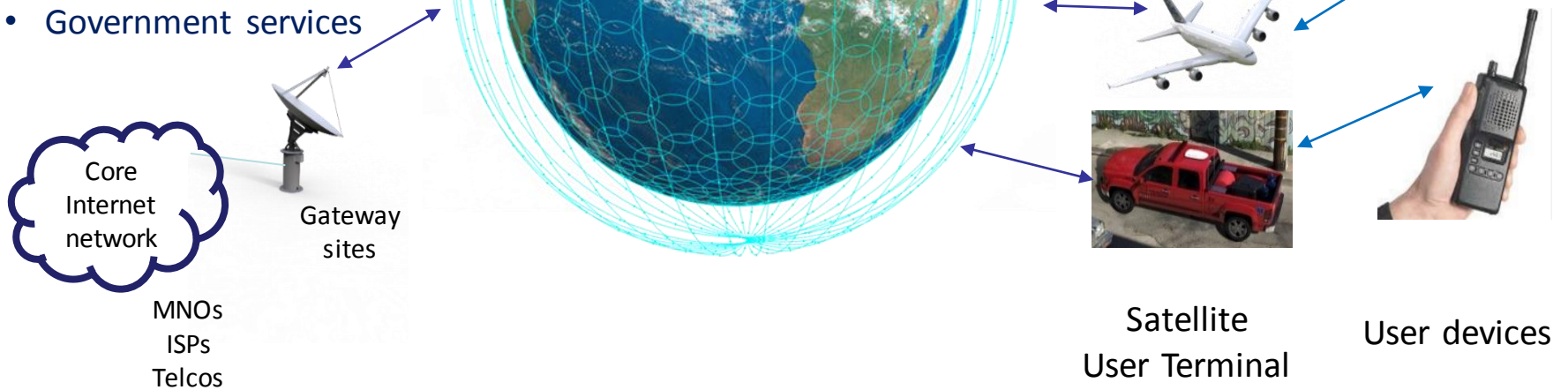


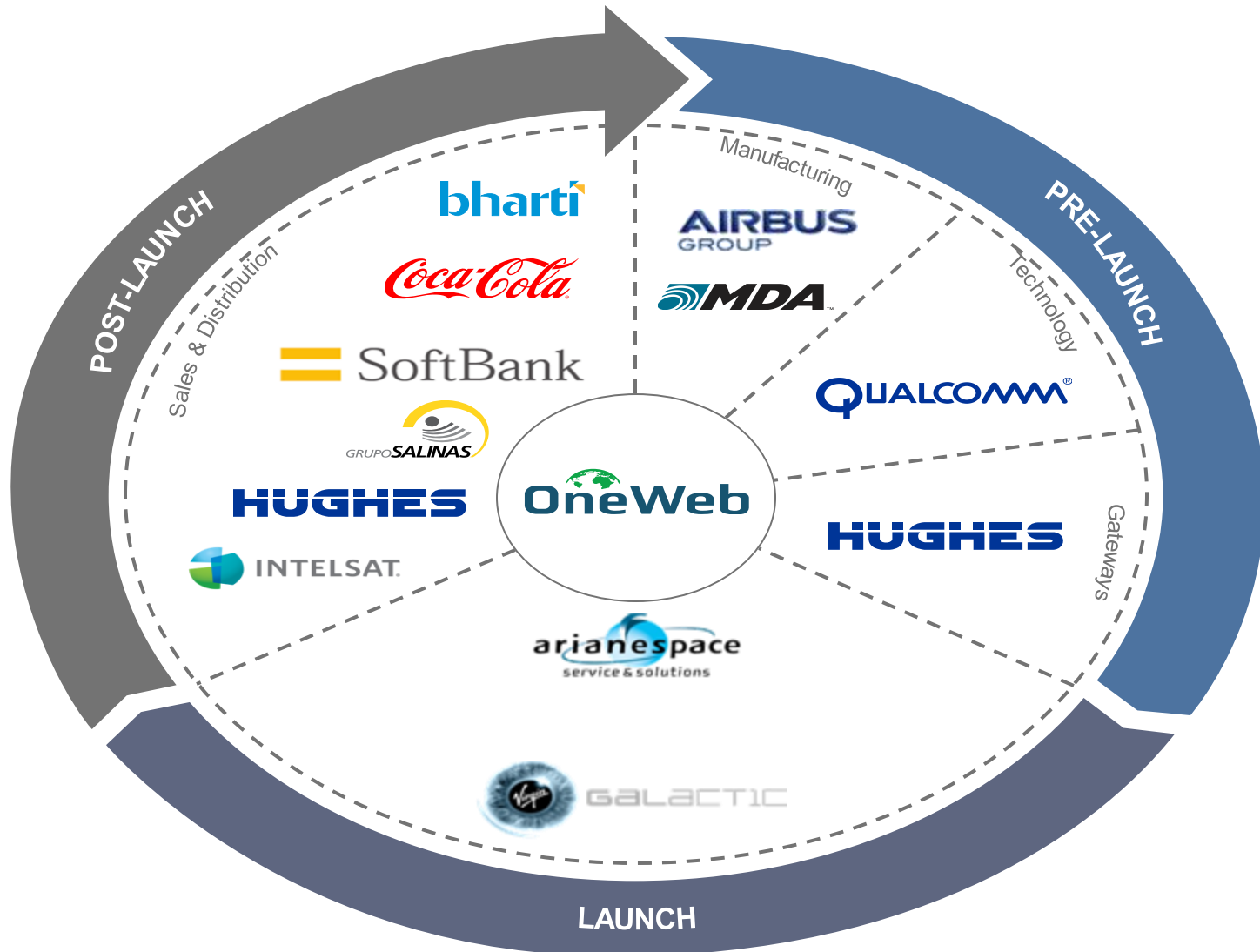
Cellular Backhaul Applications

One Web Constellation Overview

NGSO constellations provide global seamless, ubiquitous and low latency connectivity:

- Satellite Broadband
- Passenger Broadband
- Emergency Services
- Disaster Relief
- Backhaul cellular
- 3G/LTE/5G expansion
- Enterprise connectivity
- Communities/Schools
- Hospitals/Health
- Government services







Session 3b: O3B

Innovation in Satellite Technology opening New Horizons in Africa



The fiber has landed.....

Yes, Fiber has arrived to Asia

All of them redefining and changing the telecommunications Landscape of the Continent

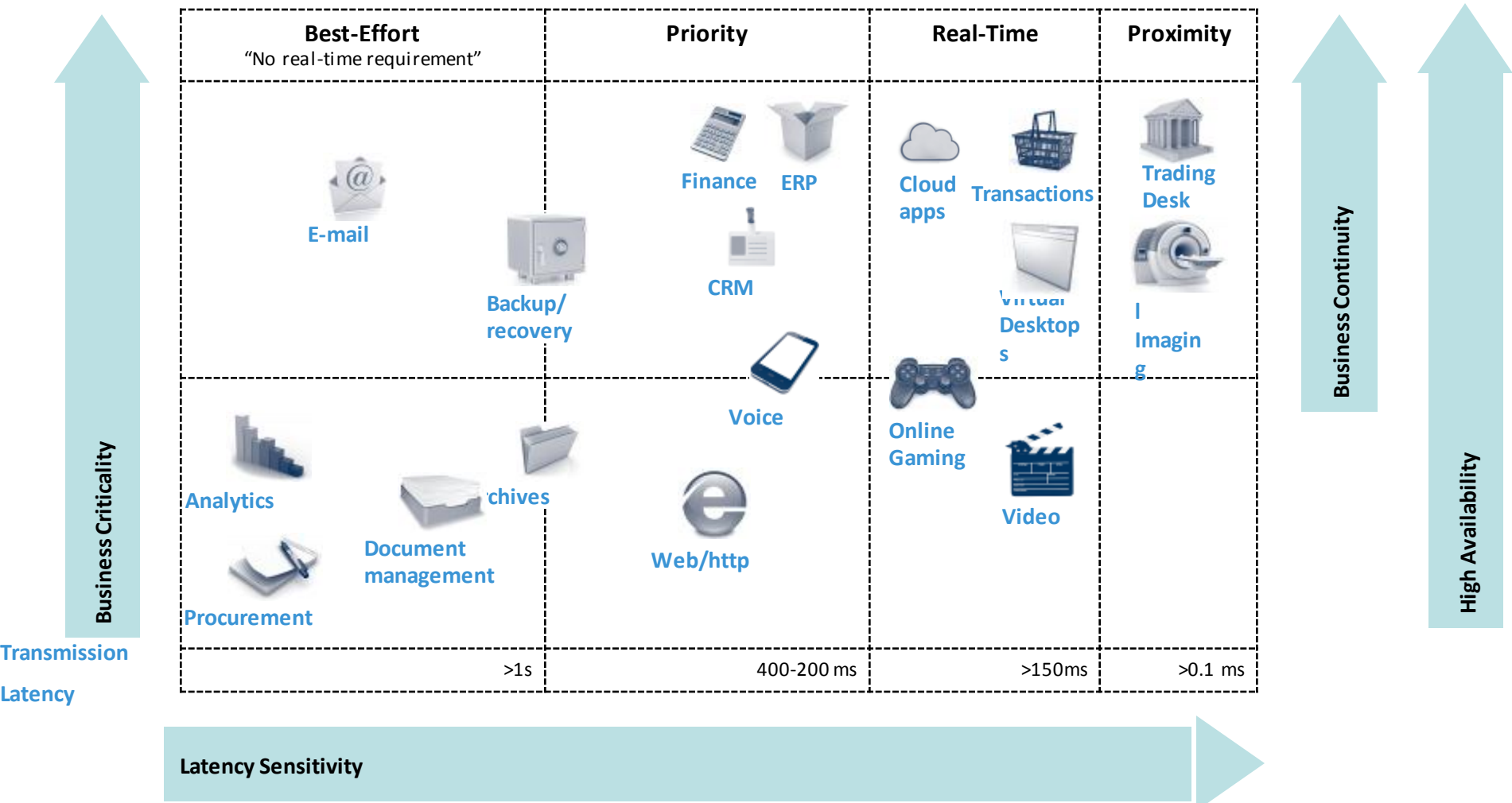


A few selected changes.

- Significant Increase in data traffic.
For example, many Asian countries are doubling their bandwidth consumption every year, and the same is expected to happen gradually in other countries
- Increased Internet Penetration: enabled by lower prices, better user experience, but in urban areas mainly
- A big growing demand for inland connectivity – Suburban and Rural areas not covered by fiber
- New applications enabled by the low latency of fiber.

let's see how fiber affects user experience.....

Latency defines what applications can be implemented



But Fiber is not the solution to everything

- For now, fiber reaches effectively only the main coastal urban localities
Inland fiber is very difficult to deploy and maintain
- Fact: Fiber has less availability than Satellite. And when the fiber goes down, it really goes down, often for long periods until repaired.
- Telecommunications and Business Critical Applications require a reliable and affordable backup and alternative source of connectivity

Geostationary Satellite, the traditional Satellite Solution can no longer provide the required connectivity standard, in which low prices and low latency are required (together with high reliability)

A new technology is required.....Mid Earth Orbit Positioned Satellites.

Introducing O3B and it's new generation Satellite Constellation



- O3B is building a next-generation satellite constellation: capable of offering customers connectivity which is better, faster and more affordable. In other words: **Fiber Quality and Pricing, with Satellite Reach and Reliability**
- Deploying next year 8 satellites operating in the bandwidth rich KA Band, and to be positioned in a Mid Earth Orbit (8000km height). Each satellite will provide multiple Gbps of bandwidth.

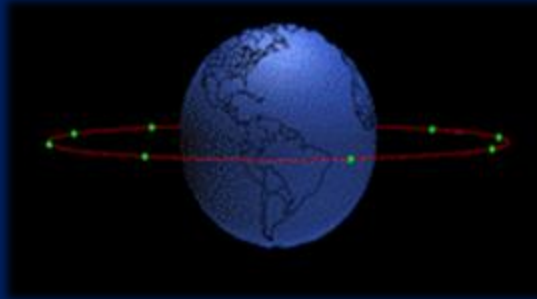
The MEO Advantage

GEO: 36000km altitude



- Round trip latency of ~600 ms
- Increased path loss of ~12dB as compared to MEO
- Covers single fixed region

MEO: 8100km altitude



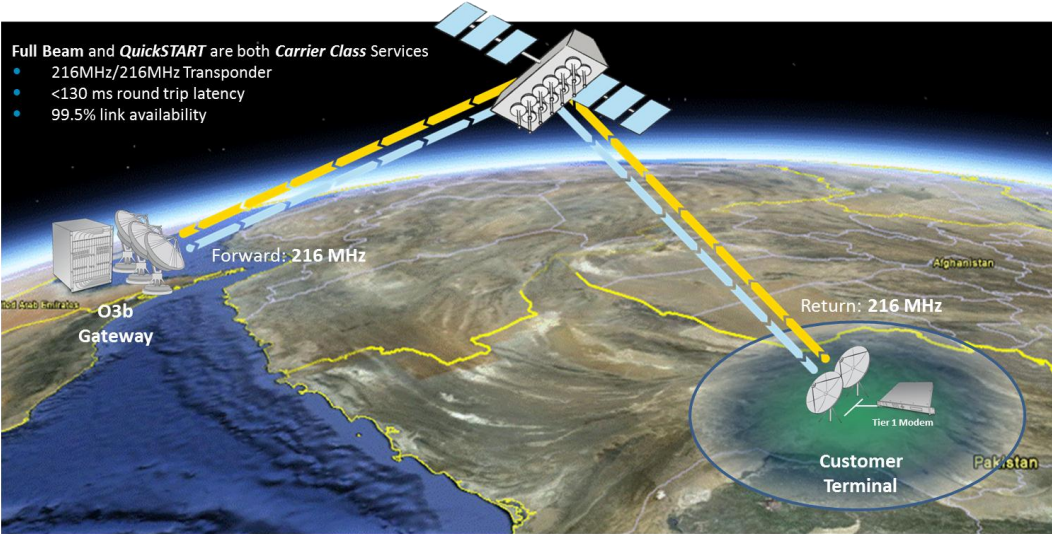
- Round trip latency of <130 ms
- More affordable bandwidth
- Global reach, anywhere in the world, +/- 45deg latitude
- Scalable capacity, just add more satellites

**MEO Enables
Fiber Like Latency
Connections via
Satellite**

How does it work.....

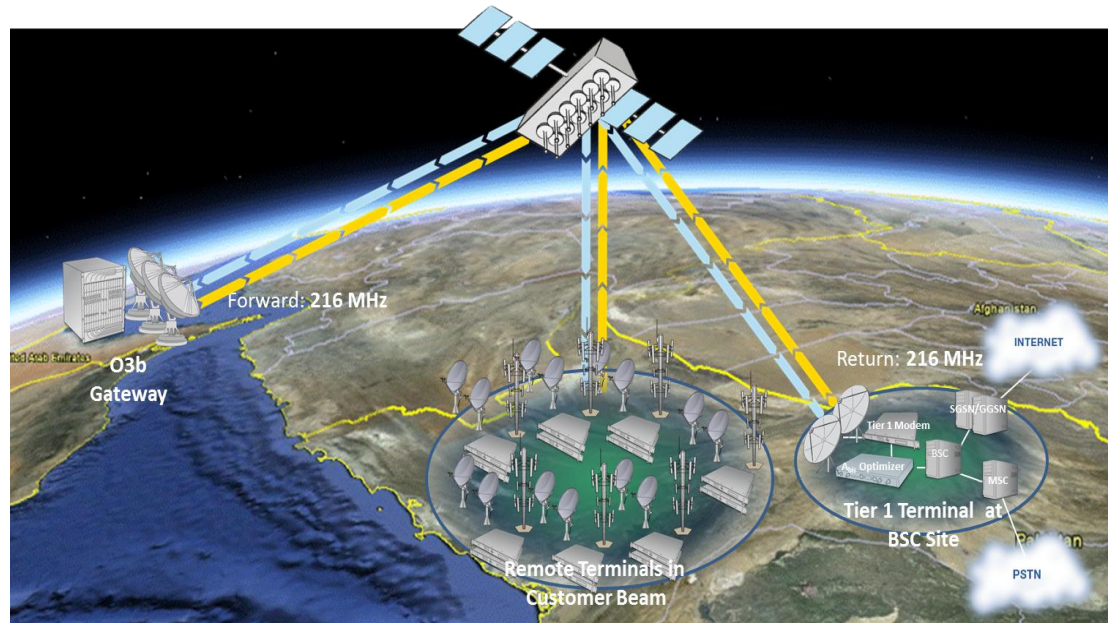
How Does it Work?

- Initial Constellation of 8 Satellites will provide continued and uninterrupted connectivity
- Only 5 satellites are required to provide service – Embedded System Redundancy
- Satellites have 12 transponders capable of providing about 1 Gbps of BW each.
- Initial BW for Africa: 10 Gbps
- Multiple Teleports around the globe, connected to the Internet Backbone



IP Trunking

Cellular Backhaul





KA Band provides ample Bandwidth for today's new connectivity standards



Low Latency allows for improved user experience and innovative applications



Best Priced Satellite Solution in the market. And cost is the key to everything.



Easily and Quickly deployable infrastructure



In Summary: the best compliment/alternative/backup to fiber connectivity



3b
Networks

Fiber Speed. Satellite Reach.



Session 3c: Starlink – SpaceX

slides to be added

Satellite

Beyond the reach of other technologies

**Next Session 4:
Satellite Integration in to 5G**