

Low Earth Orbit (LEO) HTS Market Surveys - Discussion Guide

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April 2014

- **Introduction**



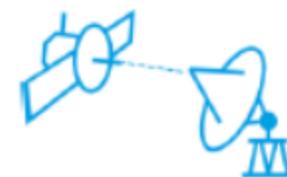
- **System Description**

- Architecture & Capabilities
- LEO Advantages



- **Feedback & Discussion**

- Market Potential
- Design Suggestions

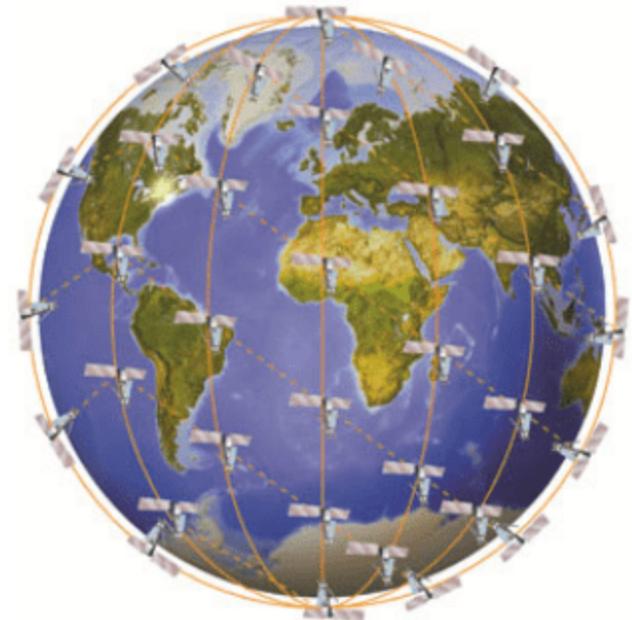


- **About NSR**



NSR is working on behalf of a client planning to deploy a constellation of Low Earth Orbit (LEO) high throughput satellites (HTS)

- **NSR was hired to conduct a set of market surveys and industry discussions related to the potential for a LEO-HTS broadband constellation.**
- Presentation meant to be used as a guide for an open discussion with the following goals:
 - **Potential:** Evaluate market potential for our client to serve service providers and end users
 - **Market Feedback:** Help our client to incorporate market feedback into business plan
 - **Design:** Allow potential users to influence on system design based on their specific needs
 - **Unmet Needs:** Identify needs not well served by current satellite solutions and network architectures



System Description

Global, Full-Mesh LEO-HTS Constellation

The LEO-HTS constellation will have the following main capabilities:

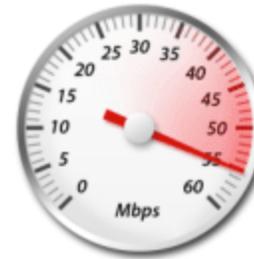
- **70 LEO High Throughput Satellites (HTS)**
 - Hybrid Ka-Ku band Payload
 - Over 400 Gbps of global aggregate capacity
 - Orbits at approx. 400 miles above the earth.

End Users to benefit from:



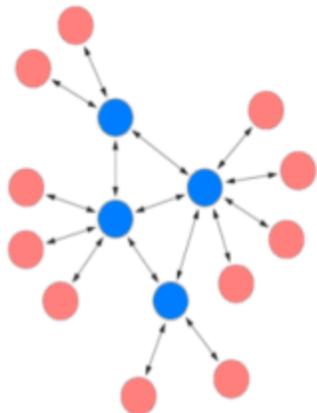
True Global Coverage

- 100% earth coverage
- Equal speed capability at any location



Low Latency, High Throughput Performance

- 600 Mbps to 1.2 Gbps per beam
- 50 millisecc. (round trip)



Mesh Network Topology

- Anywhere to anywhere high speed IP connectivity
- Supports all user needs

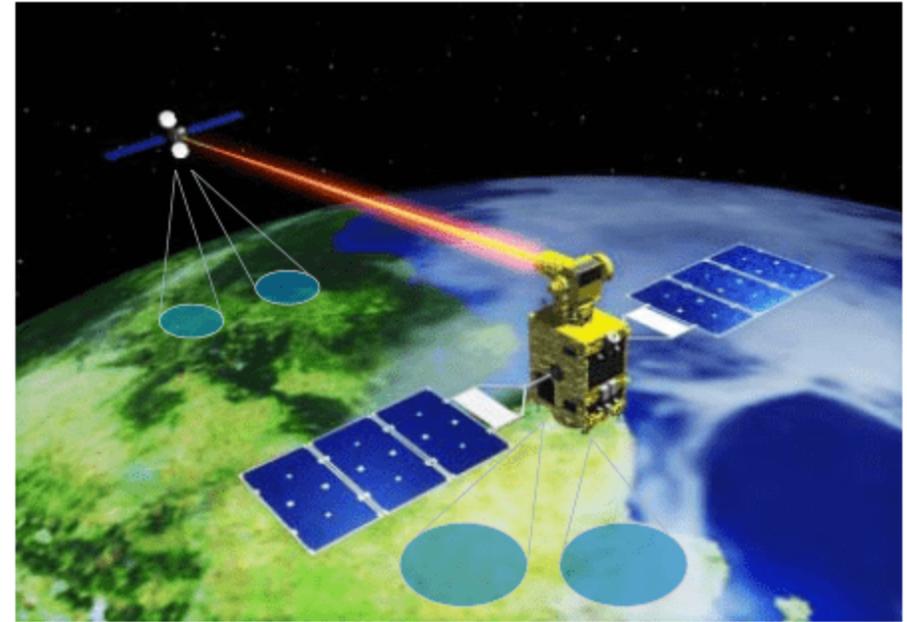


Standards-based Open IP Architecture

- Empowered Service Ecosystem.

Each LEO-HTS Satellite will have:

- **Ku-band and Ka-band spot beams**
 - 7 Gbps of Ka-Ku capacity each satellite
 - 1.2 Gbps Ka-band beams
 - 600 Mbps Ku-band beams
- **Inter-Satellite Links (ISL's)**
 - Five (5) choices of network paths for data transmission off the satellite.
- **On-Board IP Routing**
 - On-board full scale routing capability with real time intelligent routing.



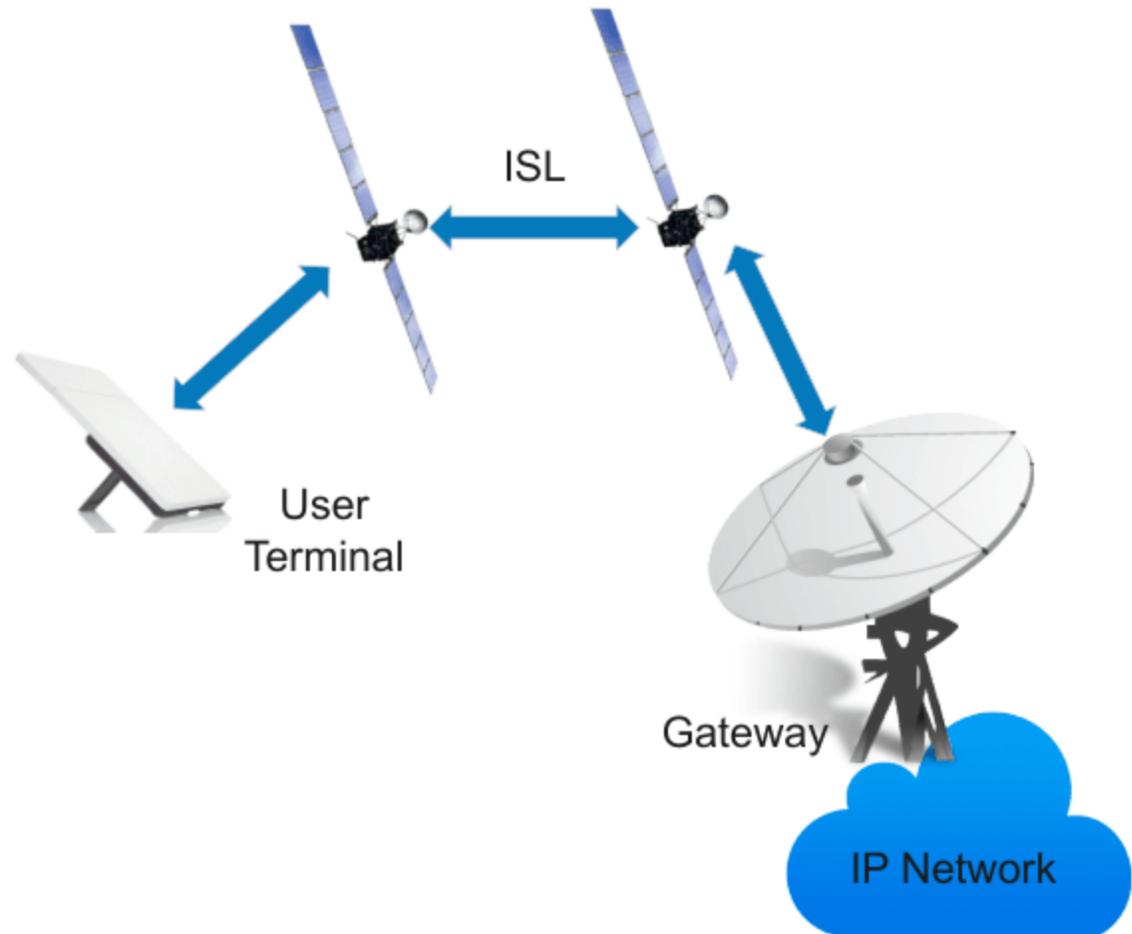
Gateways & User Terminals:

- Gateways will be strategically located for the cost of bulk bandwidth, lease costs and best weather.
- Each satellite has routed access to any gateway without going to ground.
- Any client station can be a gateway.

User Terminal to Gateway

Client terminals, satellites and gateways are fully meshed both physically and logically.

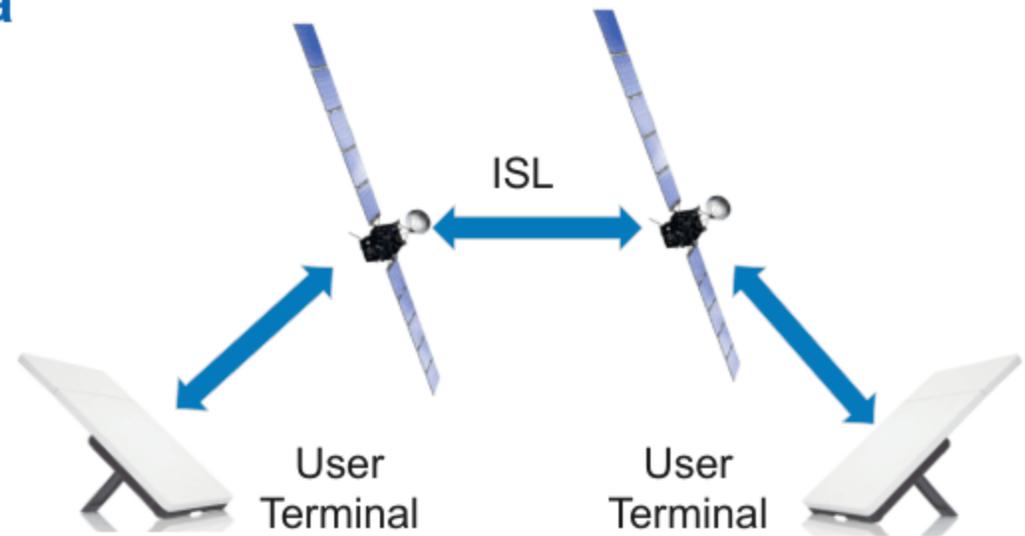
- **Each satellite has the ability to route data to the gateway most advantageous to the data being sent based on a rules engine.**
 - Sovereignty issues can be respected where required.
- **Load balancing is inherent in the network**
 - Least cost routing on a whole new level.
 - User terminals can also become gateways to terrestrial IP networks



User Terminal to User Terminal

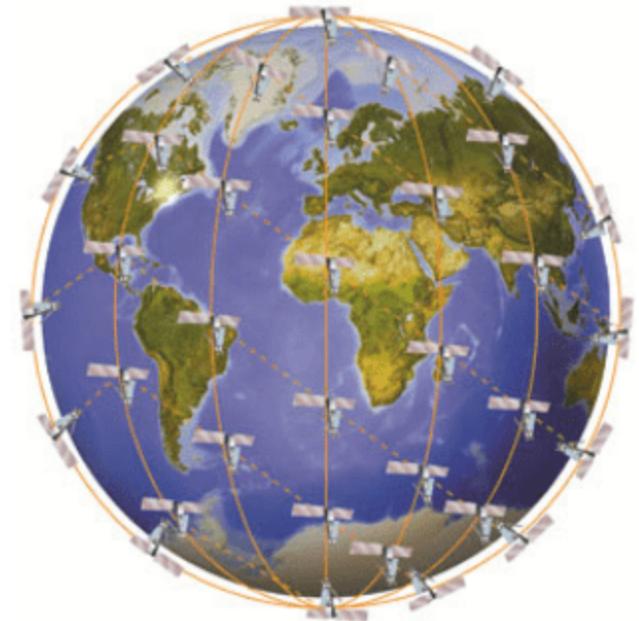
Client station to client station data is sent through the satellites only

- Never needs to go through a gateway.
- **User terminals will support a wide range of uses and network topologies:**
 - **Any network topology:**
 - High-speed point-to-point, point-to-multipoint, partial and full mesh
 - **Flat 40 cm square flat panel antenna will handle beams required to maintain a continuous connection to the satellites as they move overhead**
 - No moving parts (maintenance free)
 - **Privacy:** Secured, private IP links with encryption



The LEO-HTS Constellation brings key advantages to end users:

- **Low Latency:** Low latency of less than 50ms RTT makes IP Data run:
 - 3 x faster than MEO satellites
 - 12 x faster than GEO Satellites
- **Power:** Being the satellites much closer to Earth, LEO satellites require:
 - Less than 1/30th the amount of radio amplification of the GEO's to meet the same link budget requirements
 - This lowers antenna and amplifier size
- **Availability:** The relative closeness of the satellite to the client provides a much improved environment for Ka band during rainy or cloudy weather.
 - Thus, maintaining a solid connection is much less challenging.



Feedback & Discussion

User segments and applications to benefit from LEO-HTS

Maritime



**Enterprise
VSAT**



Oil & Gas



**Video
Contribution**



**Backhaul
/Trunking**



**Network
Offload /
Restoration**



- **Applications served by satellites in your niche**
 - Data, video, voice, etc.
- **Hot Geographies in your Satcom Market**
 - On-shore/ off-shore
 - Global, Regional, Local, Hot Spot (e.g. Caribbean, Mediterranean)
- **Common Link Requirements**
 - Data rate, latency, availability, jitter, etc.
- **Bandwidth Growth**
 - Typical link data rates for satellite services
 - Projected growth: % Increase for Link Data Rates over time
- **Topology and Access technology**
 - SCPC Point to Point
 - Multipoint TDMA
- **Current VSAT Equipment used** (modems, fixed /stabilized antennas, etc.)

Current Satcom Environment

- **Environment: Fixed Satcom / Mobility**
 - Limitations imposed by current satellite systems
- **CAPEX-OPEX Economics**
 - Off-balance?
 - High CAPEX and/or OPEX inhibitor in current satcom systems?
- **Key need /s to be met by satcom to be successful in your user segment**

- Link Throughput
- Network Flexibility
- Cost per bit
- Link Availability
- Client Support



- Integration
- Value-added services
- Mobility
- Etc.

Value Proposition

What characteristics of the LEO-HTS System are perceived as potentially valuable and unique:

- **Low Latency**
 - How important is latency for your apps?
 - Application response thresholds / time-outs
- **Mesh Connectivity**
 - Could this drastically improve services?
 - Is “double hop” currently a constraint?
- **Dual Frequency Band**
 - Views / experience on Ka band vs Ku band
 - Preference for one or both?
- **Flexible Pricing**
 - Terminal \$ discourages migration?
 - How about terminal cost within MRC?



Global IP Inter-network
High Throughput – Low Latency
Small Terminals – Open

Opportunity to have first-hand input for system design and business plan to satisfy your needs

– Current system design may be changed for improvements or in response to user feedback during this study.

• Preference for Ka or Ku band?

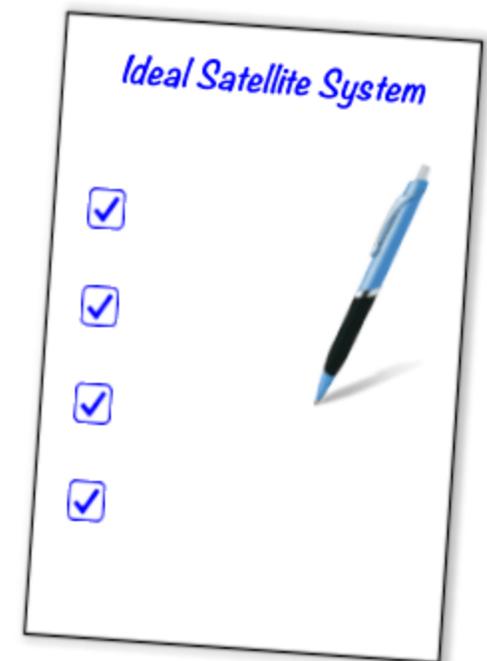
- Pros and Cons for each
- Equipment backward compatibility
- Propagation considerations

• OPEX-CAPEX Pricing

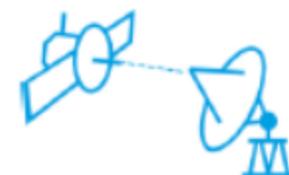
- CAPEX an inhibitor in current HTS systems?
- How about no CAPEX spend?
 - Cost of equipment amortized over life of the contract.

• Beam width versus bits/hertz

• Service Ecosystem



Final Thoughts or Suggestions?



About NSR



NSR is a Global Leader in Satellite Market Research and Consulting

Founded in 2000, NSR specializes in analysis of growth opportunities across the satellite industry

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