AsiaSat

Reaching Further, Bringing You Closer

HTS

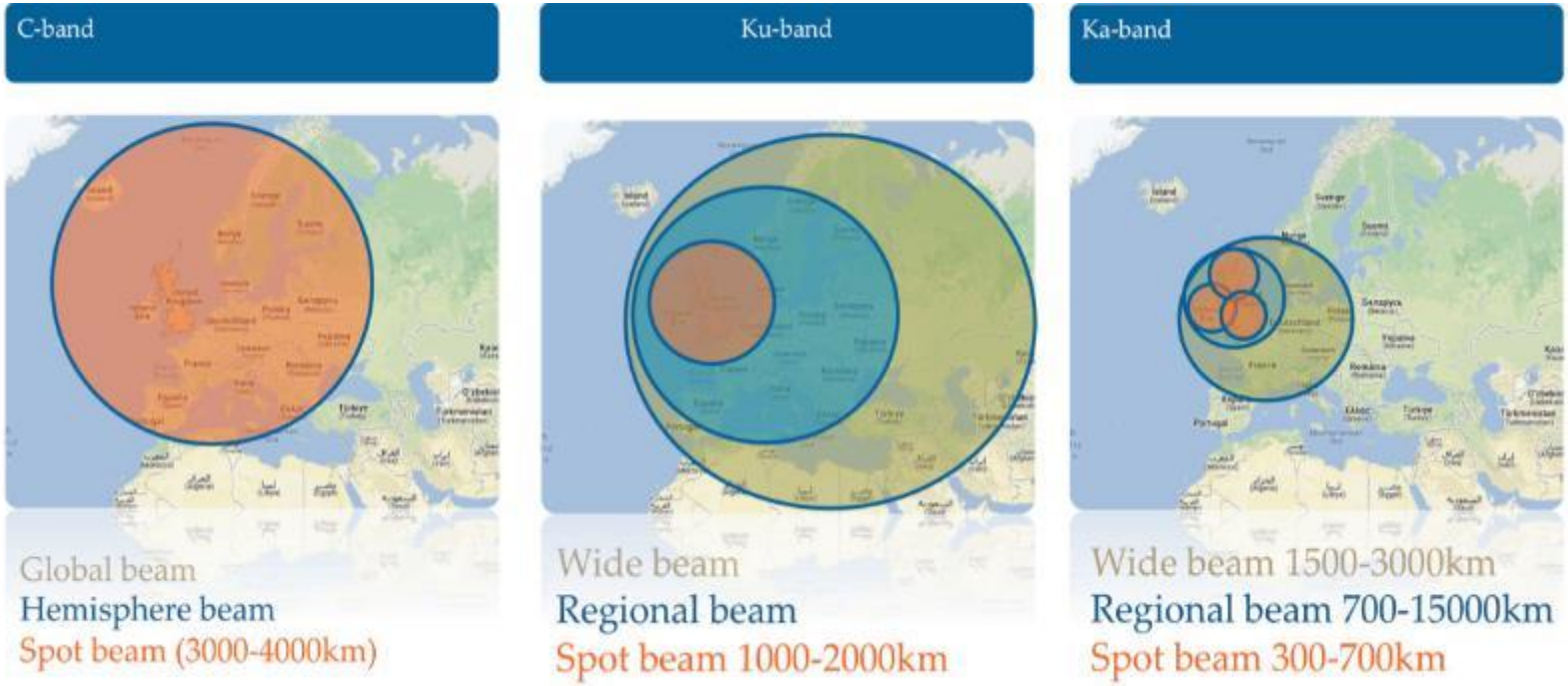
Fred Ho

Director, Technical Operations

Sep 2015

What is a High Throughput Satellite (HTS)?

- Provide 20 more times of total throughout than a traditional FSS satellite in a same amount of allocated bandwidth
- Extensively leverage the frequency re-use technique to increase the throughput
- Deploy multiple narrowly focused spot beams



FSS vs. HTS

Traditional FSS Satellite

- Throughput 2-6 Gbps
- Single global beam to a few large regional beams
- Frequency only reuse on different regional beams
- Optimized for broadcast, VSAT applications

High Throughput Satellite

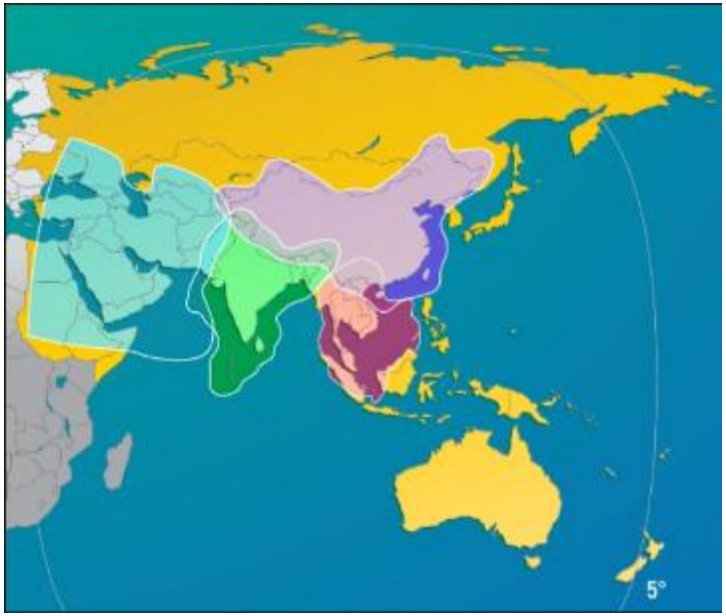
- High Throughput ≈100Gbps
- Multiple narrowly focused spot beams; several tens
- Frequency highly reuse on spot beams; like cellular network: microcell and picocell
- Optimized for data applications; internet service, backhaul (non-real time transmission)

Coverage (FSS vs. HTS)

FSS

Several large beams

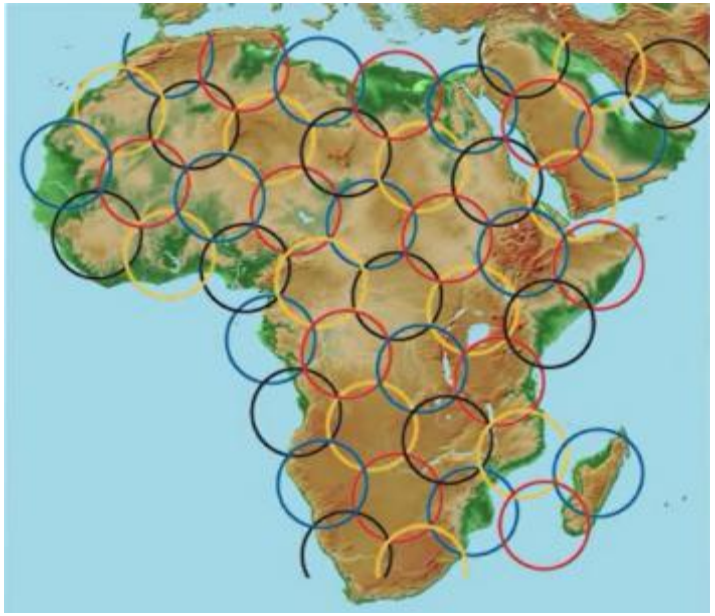
Frequency re-use on different regional beams



HTS

Multiple very small & focused spot beams

Extensively reuse frequency in different spot beams to increase the throughput



HTS Network Architectures

Star

Require a Central Hub (Gateway)

All user beams traffic go to the Central Hub first, then route to the destined user beam

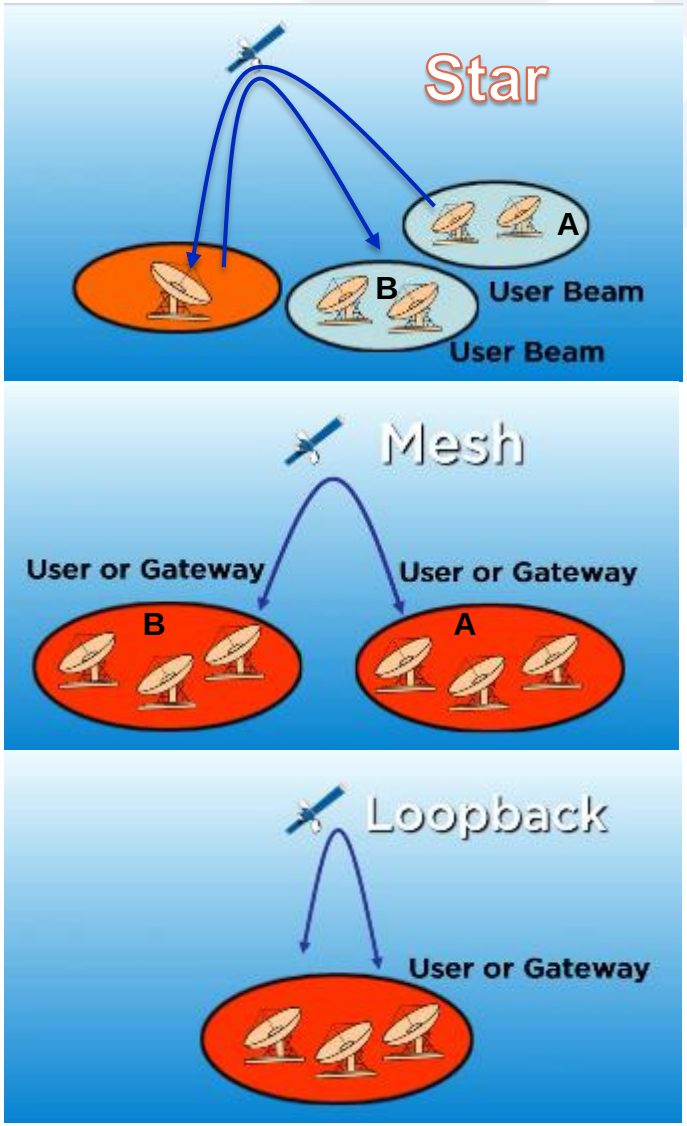
Mesh

HTS network supports open network architecture

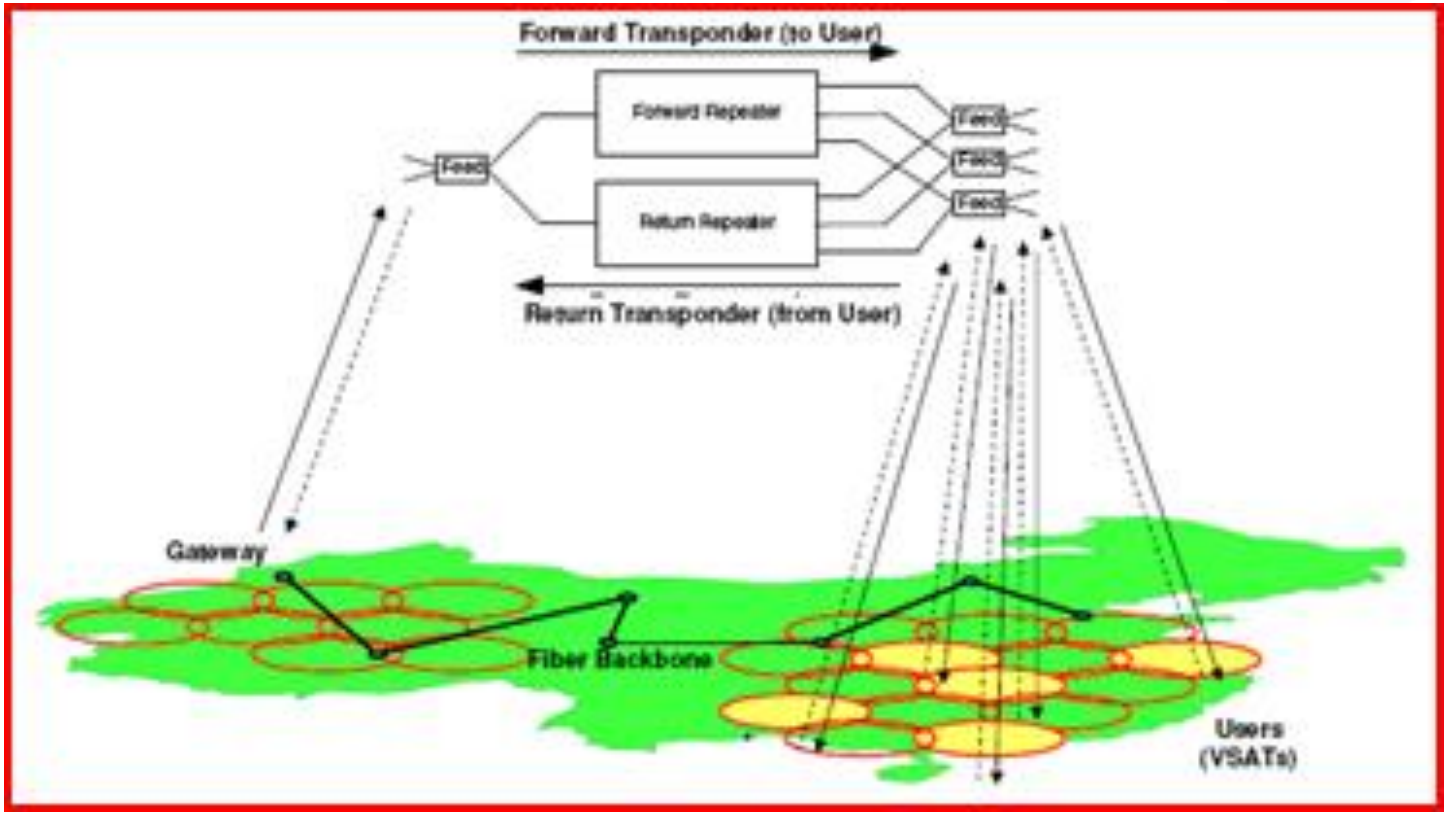
User beam can connect to other user spot beam without via the central hub

Loopback

Gateways and users are at the same spot beam. They can communicate back & forth



Typical HTS Network Connectivity

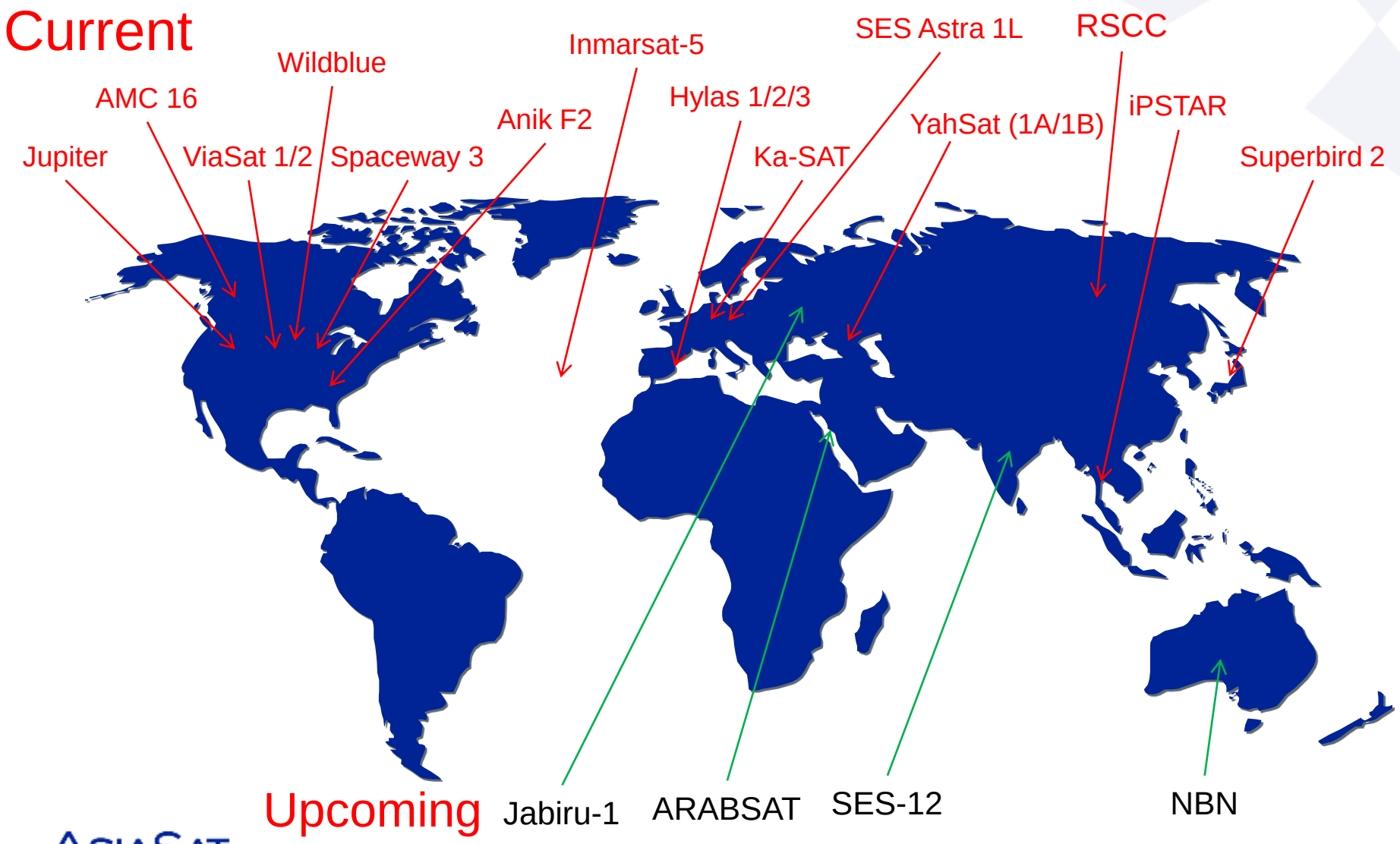


- High capacity designs are fixed configuration supporting star networks
- Each Gateway needs access to the Internet fiber backbone
- A subset of spot beams is served by a single Gateway as an isolated network

Typical HTS Architect

- Majority of current HTS technology is based on a forward and return link type of design
  - Does not support a direct remote to remote communication
  - All have to go through a gateway for processing
  - Capacity per spot is fixed by design
  - It is a simple sum of all the spot capacities
- Newer generation of HTS satellites starts to incorporate front end (uplink) frequency band flexibility but still limited by the downlink configuration
- There is no true high throughput satellite where capacity can be deployed anywhere and anytime to meet demand changes

Current and Upcoming Ka-Band GEO Satellites



Satellite Technologies Required for HTS

- Increased propulsion and structural capabilities to handle very large payloads and support electric orbit raising
- Modernize the spacecraft control electronics to handle enhanced on-board hardware capabilities and capacity
- Significantly improvement in satellite pointing capability
  - Better than 0.03 degrees requires the use of use of new propulsion and control systems
- Increased end-of-life power capability to 25 kW overall
  - Flexible Solar Array system
  - High thermal capabilities
- Increased antenna and payload capabilities
  - Digital Signal Processing
  - Multiple spot beams and Integrated Antenna Feeds
  - Increased Front End RF performance
  - Increased EIRP and RF Power distribution flexibility
  - Flexible beam shapes and bandwidth allocations per spot

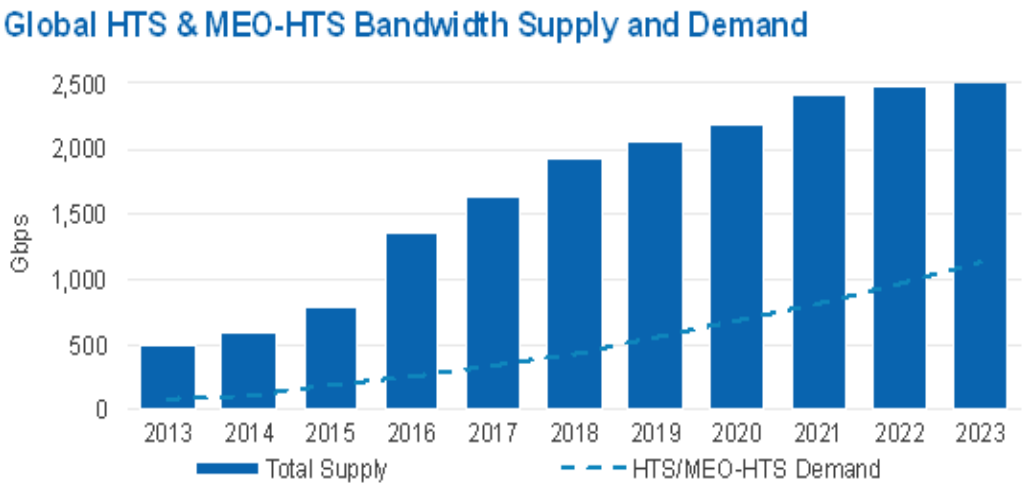
Current Ka-Band HTS Market Summary

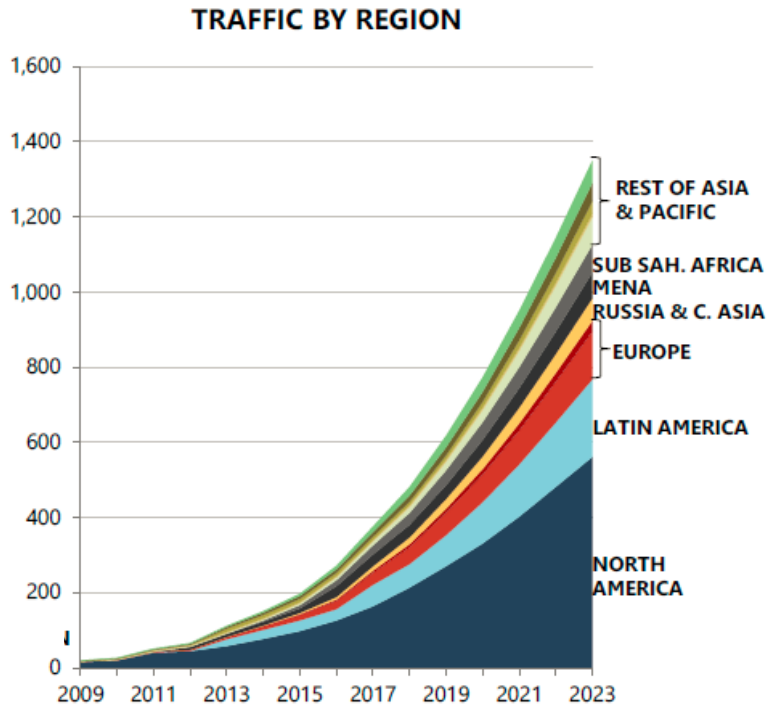
- Ka-Band in Europe (EU) and North America are developing quickly with multiple operators and satellites being deployed
  - Obtaining landing rights for Ka HTS in different countries is a challenge
- Ka-band cost-per-bit is significantly cheaper than that of C- and Ku-bands from a straight mathematics if all capacity are fully utilized
- Significant benefit of Ka HTS is in offering broadband mobile connectivity over land, sea or air that conventional FSS satellites are more limited
- Satellite operators are all planning to start Ka-band in Asia
  - Initial step of claiming orbital slots is apparent as shown in the ITU filings
  - 422 Ka-Band filings within the 55E to 130E orbital arc (75 degrees) over 143 locations (as of March, 2015)
- Although satellite technologies are maturing, they are not all fully ready at commercially viable economics.

Demand Forecast on HTS Payload (GBPS)

Euroconsult (Sep, 2014) and NSR report (Oct, 2014)

- Demand Forecast from Euroconsult and NSR both predict increase demand of HTS capacity, especially in North America
- NSR research shows supply significantly outstrip demand
- Clear indication of market turbulence in the near future

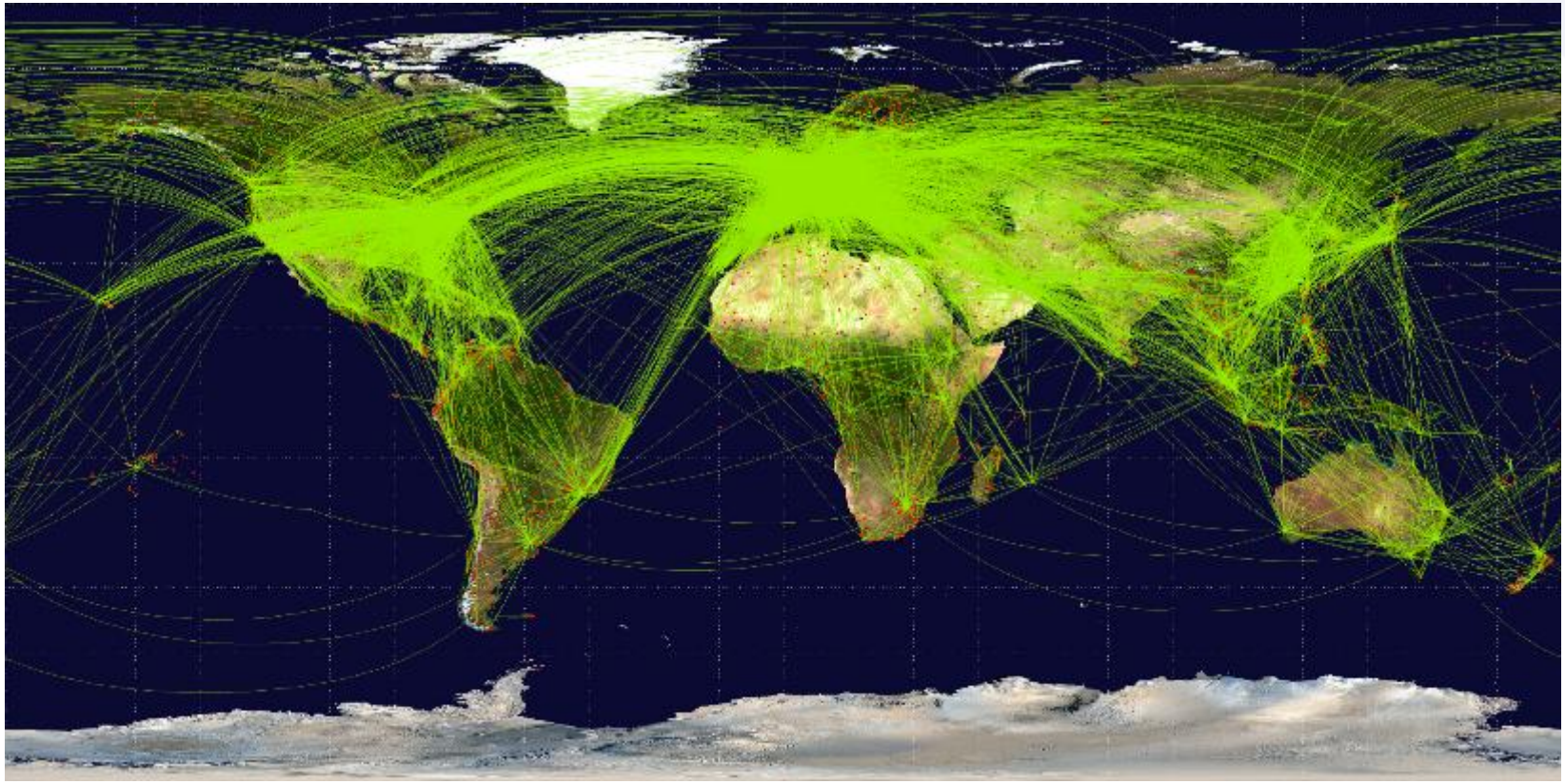




Airline Routes (2009)

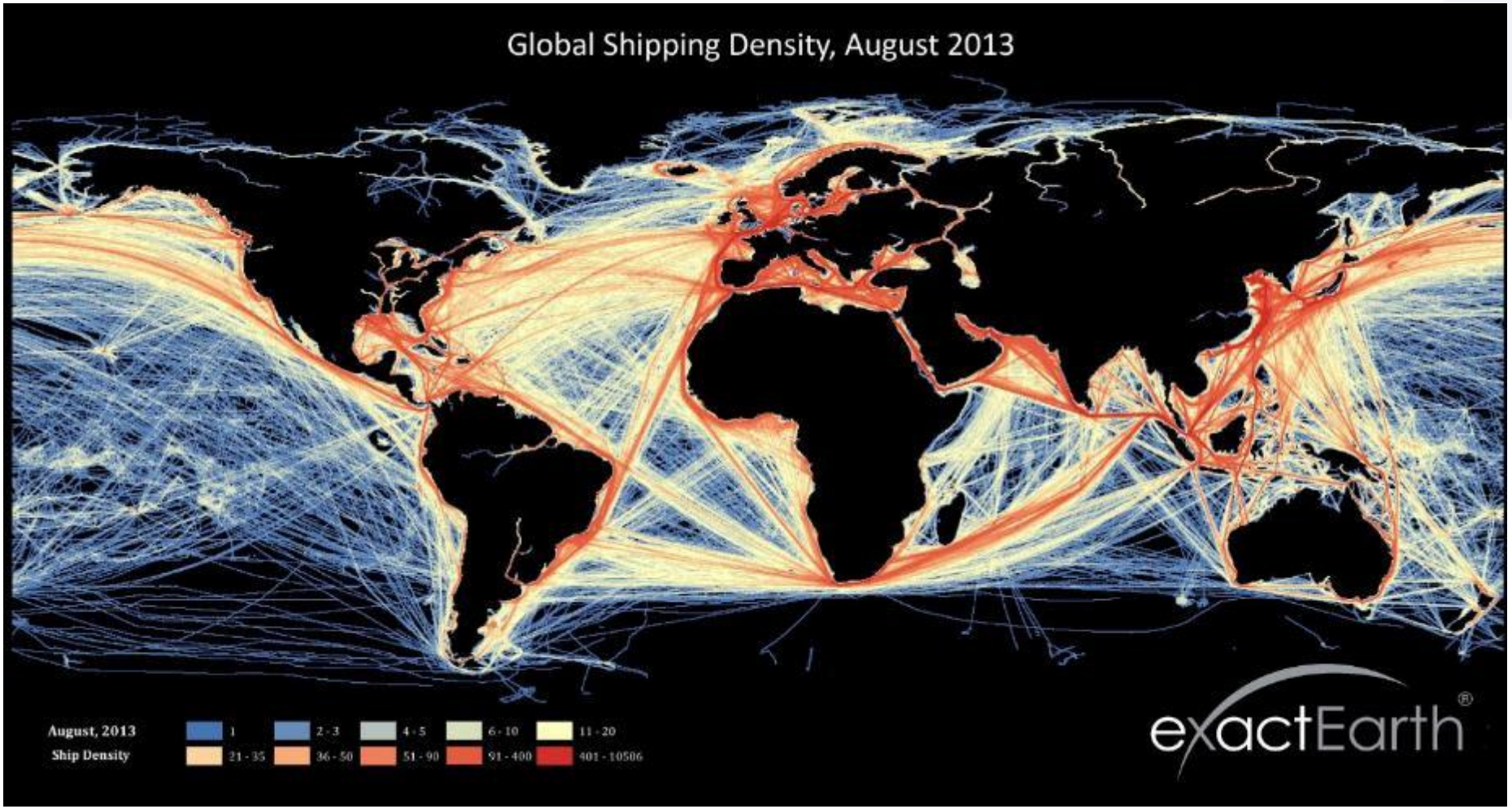
Asia has the same concentration of airline routes as in Europe

- over China, Japan and into South East Asia



Global Shipping Density

Asia has the same concentration of shipping routes as in Europe
- over China, Japan, India Ocean and into South East Asia



Emerging Market for HTS Applications

- Spot beam nature of HTS makes it ideal to address the following type of applications:
  - High concentration of traffic demand in small geographical areas: trunking
  - Applications that requires tracking antennas:
    - Maritime services
    - Aero services
    - High Speed Train services

- Challenges for the above applications to satellite operators are:
  - Customers turn-over is highly influenced by price and performance:
  - Similar disruptive examples in the market places are:
    - number portability in the mobile phone industry
    - least cost and packet routing for international long distance phone calls
  - This is expected to cause a significant price stability problem and race for new satellite technologies.

Is Asia Ready for HTS

- From Euroconsult report, Asia's demand for HTS shows a clear growth on 2023 but only approximately 200 Gbps
- Significant part of the demand is most likely generated from Australia
- Asia has a significant number of regional and national flag satellite operators that can generate regulatory road blocks.
- High population concentration and rapid GDP growth rate of Asian countries means higher rate of application and service obsolescence as shown in the mobile industry
- Current basic economics in Asia does not support a commercially sustainable HTS market unless:
  - Initiative is backed by government: Australia
  - Backed by anchor customer for application specific HTS: Aero services

Unique Asia Situation

- Many different countries in Asia should be treated as many different markets
- Most of Asian countries have small landmass
- Except India, Indonesia, Australia and China, a lot of countries with small land mass
- Population clustered at developed areas, usually with infrastructures in-placed or soon will be deployed.
- Lots of regulatory issues to resolve
- Least cost routing of traffic pattern: maritime service provider can reconfigure their fleet to a new satellite table every 4 hours
- NBNCo is designed for 25Mbps to home, but a typical urban area home in Asia is over 300Mbps (satellite construction time is long)

Competitors for HTS

- LEO network: Large scale LEO that is being developed and filed
- MEO: O3B for reduced latency
- Ground wireless: 4G and 5G

AsiaSat View

- Asia Market is ready and in need HTS capacity: who would not want faster and cheaper capacity
- Weather conditions in Asia still represent a significant challenge to Ka-Band: better understand of the Rain Fade model is required
- Satellite technologies are maturing and will be ready within the next few years for flexible HTS implementation
- Ground technologies are developing but still need improvements:
  - Open architecture for platform compatibility
  - Bandwidth flexibility: up to 500MHz carriers
  - Dynamic ground terminals to handle multiple communication protocols
- Market turbulence is expected within the next few years due to excess capacity when the technology hype is over (such as 3G and 4G)
- High mobility service providers have little loyalty and will be driven by cost per bit.
- Conclusion:
- To enter the HTS race will require the following:
  - Strong business case with anchor customer
  - Fast time to market deployment: cannot design, build and launch in 4 years.
  - Strong management of technology obsolescence risk

AsiaSat

Thank You

Reaching Further, Bringing You Closer