Prospects for use of the Ka-band by satellite communication systems

Almaty, Kazakhstan, 5 - 7 September 2012

Konstantin Lanin

Agenda

- About Hughes
- About Ka-Band
- Considerations of Ka-Band
- Hughes experience

EchoStar and HUGHES

Focus On Video

Focus On Data

Combination creates a worldwide leader in satellite delivered video and broadband services

Joint Focus On Multi-Mode Satellite Services & Enabling Technologies

$2.7B revenues 2011

World's Leading Provider of Broadband Satellite Services and Technology

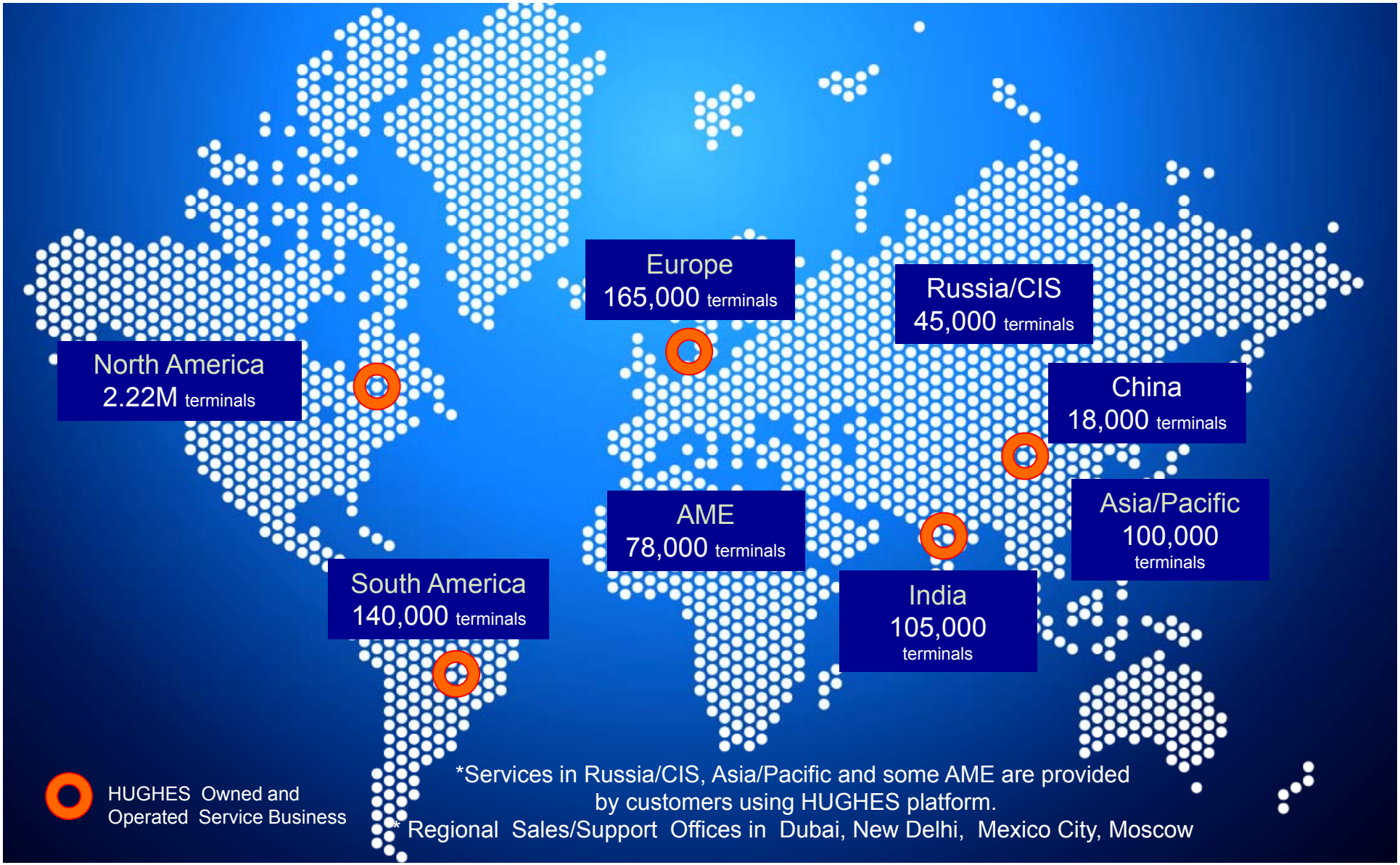
- Consumer/SMB

- Enterprise

- Government

- Mobile Satellite

More than 2.8 Million Terminals Shipped Worldwide to Customers in Over 100 Countries: >50% Market Share (COMSYS Report)



Why Ka-Band?

Service Business Drivers
- Increasing subscribers
- Increasing performance

Ka-Band is an enabler to achieve
- More satellite capacity
- Capacity optimized for broadband
- Lower cost per bit

Ka-band benefits:
- More Orbital slots available
- High power, assignable beams
- High Capacity: over 100Gbps

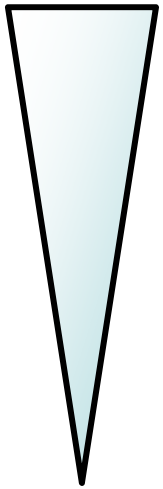
Ka-band issues:
- Small Beams
- Rain Fade

Ka-Band: Key Characteristics

V-band	50–to–75 GHz
Ka-band	26.5–to–40 GHz
K-band	18–to–26.5 GHz
Ku-band	12–to–18 GHz
X-band	8–to–12 GHz
C-band	4–to–8 GHz

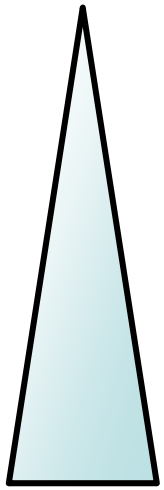
Higher Pointing Accuracy

Focus of Antenna



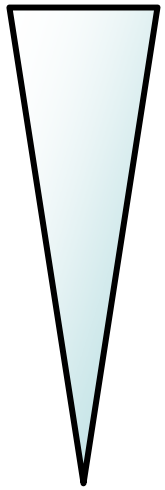
Smaller Antennas

Size of Antenna



Rain Fade

Impact of Rain



Rain Fade Mitigation

Technologies Have Been Developed To Compensate For Rain Fade

Forward Channel 

Adaptive Coding
Adaptive Modulation
Uplink Power Control
RFT Diversity
Geographical NOC Redundancy

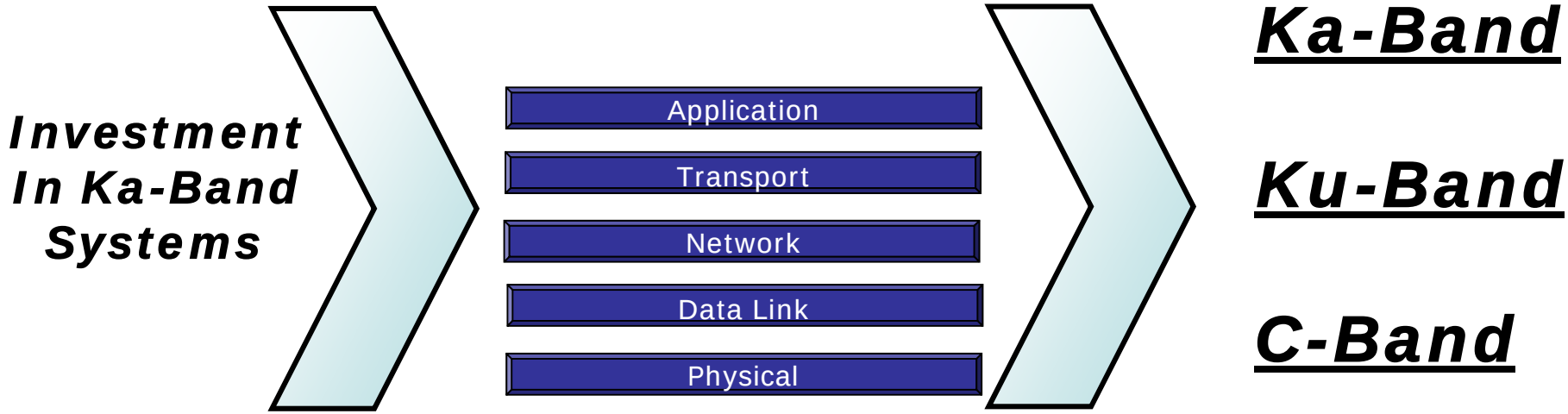
Return Channel 

LDPC Coding
Adaptive FEC Coding
Adaptive Inroute Selection
Uplink Power Control

For High Fade Regions We Can Improve Availability Using Larger Antenna

By the way… 10 years ago: "*Ku band will never work in* …"

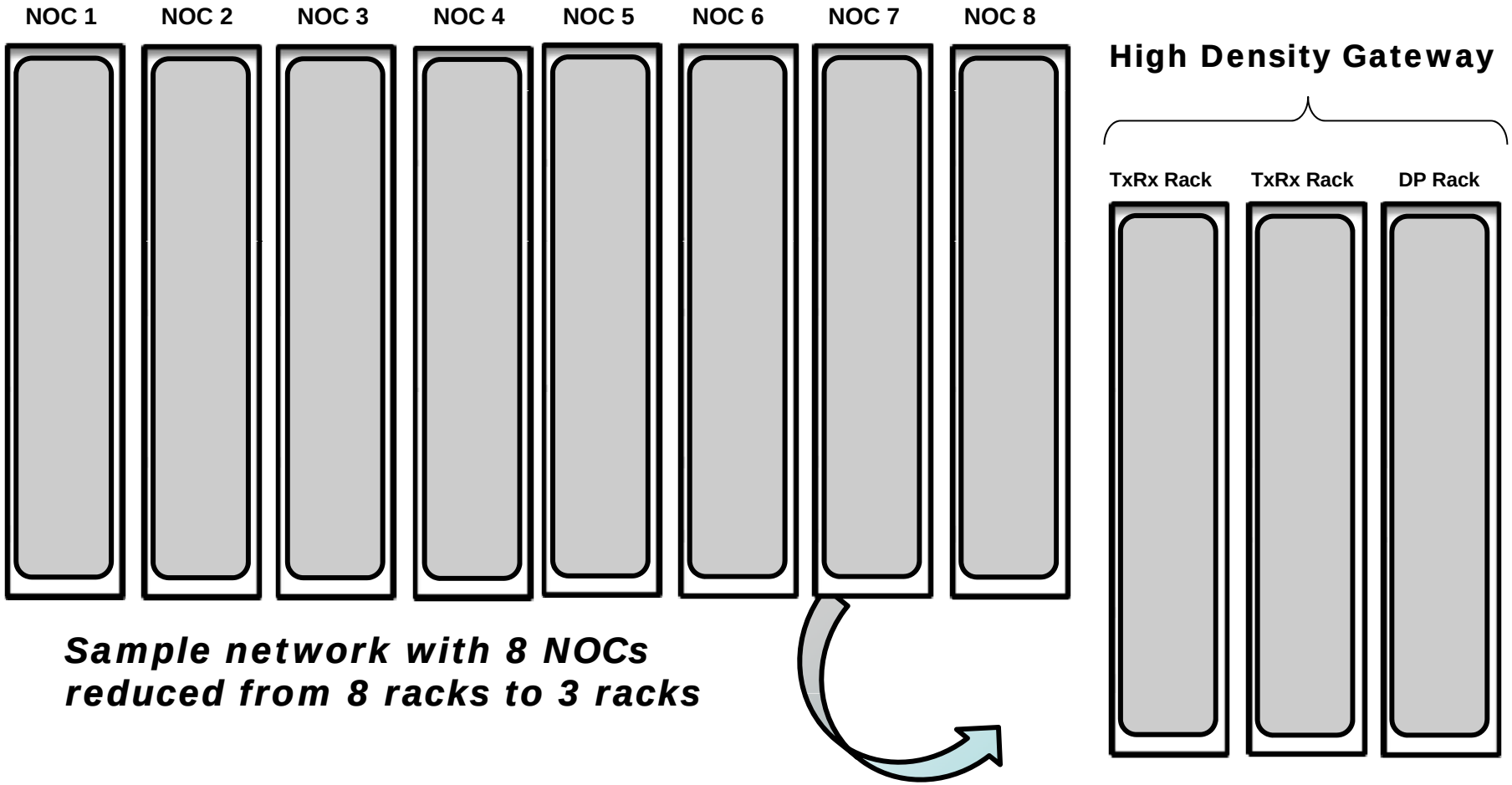
Ka-Band Technology Development Benefits "Legacy" Systems



Common Core Technology Used for All VSAT Systems

HN High Density Gateway

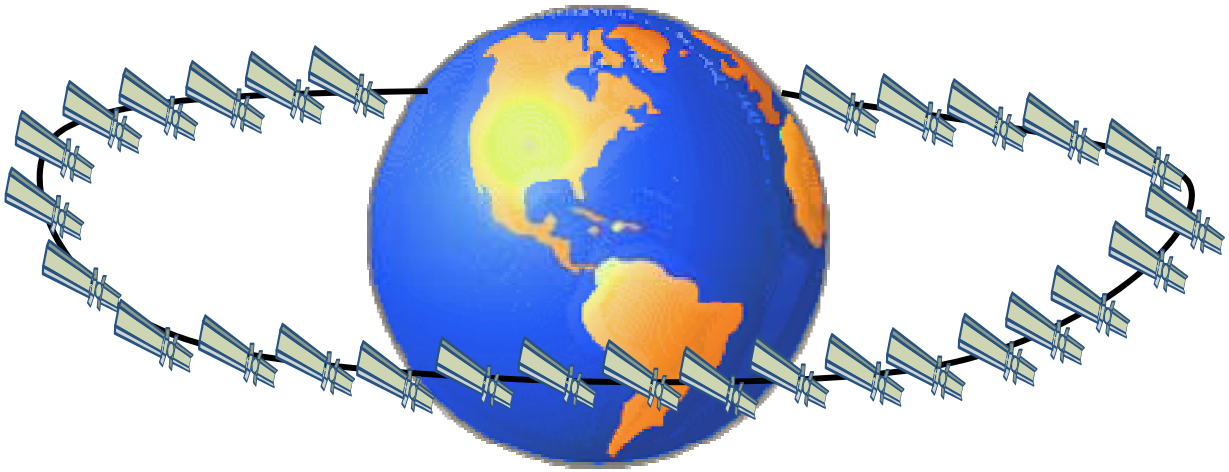
Enables significant reduction in rack space and power for multiple beam networks



Sample network with 8 NOCs reduced from 8 racks to 3 racks

Orbital Positions Available

ITU requires minimum 2 degree spacing in orbital arc

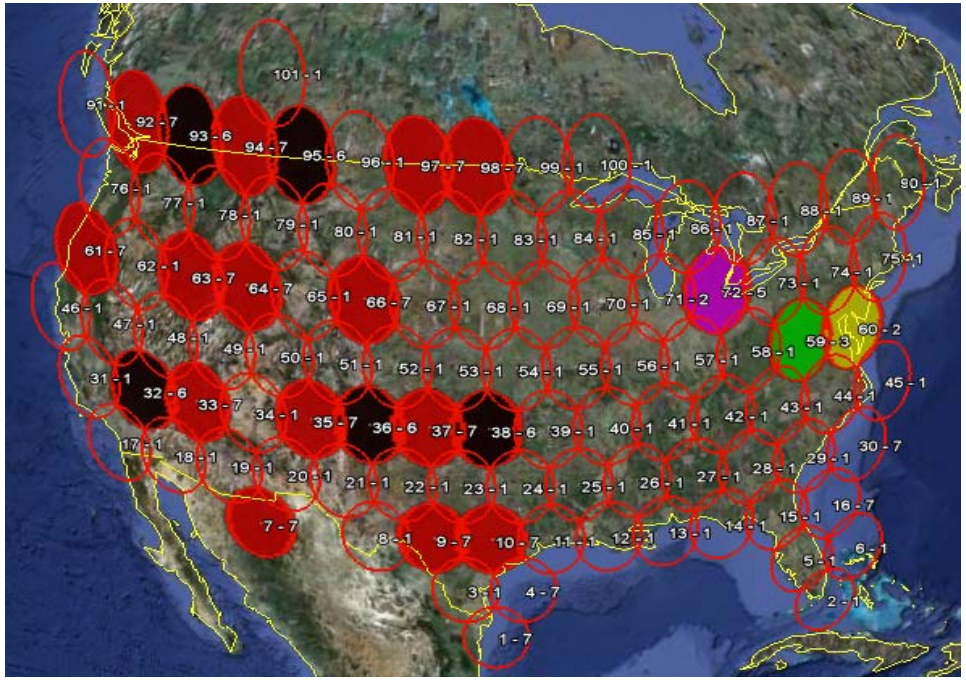


There are virtually no available Ku-band “slots”

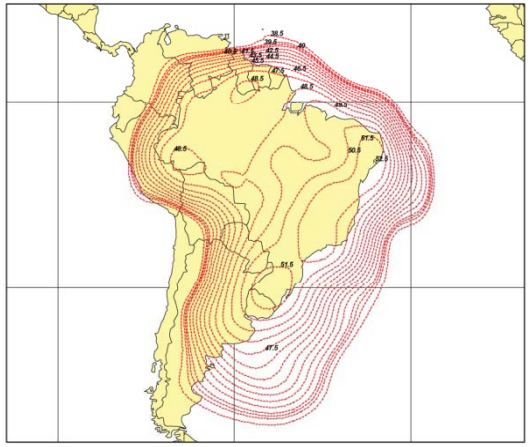
But Ka-band orbital slots are available

Extensive Frequency Reuse

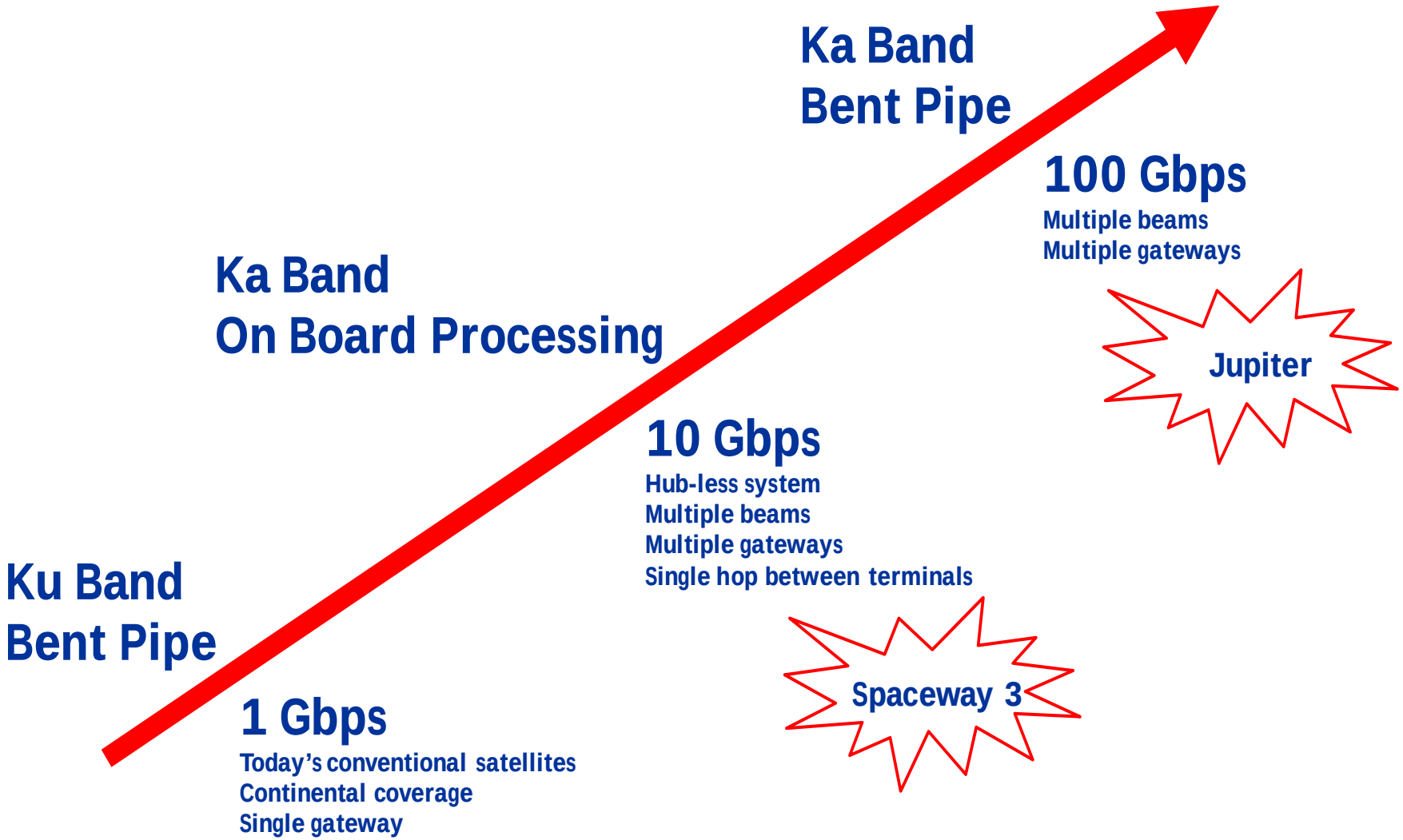
Hughes SPACEWAY® 3 Beam Pattern



Conventional satellites use large beams



Evolution of Internet Via Satellite



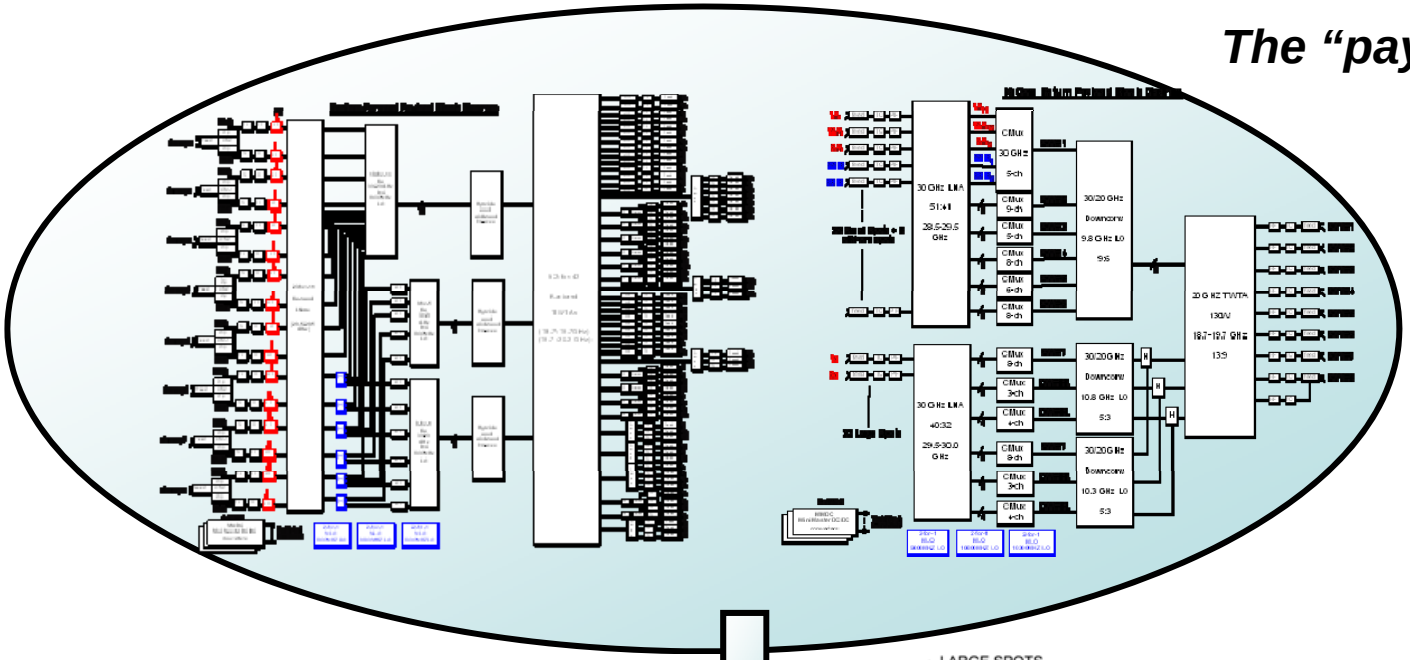
Ka-Band Technology Trends

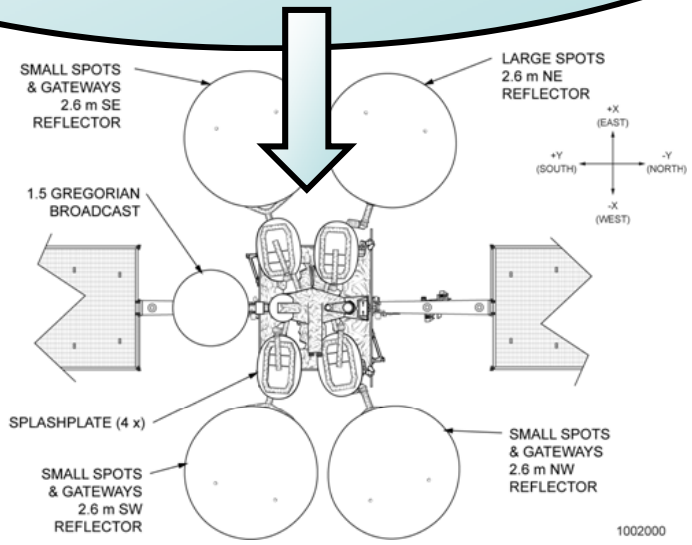
		2010	2012-2013	2015+
Satellite	Mass (Kgms)	5000-6000	6000-6500	8000+
	Power (K watts)	10-15	15-18	20-25
	Capacity	10 Gbps	100 Gbps	150+? Gbps
Gateways	Capacity	1 Gbps	6-7 Gbps	10+ Gbps
VSATs	Modem (Mbps)	100 Mbps	200-400 Mbps	400-700 Mbps
	Spectral Efficiency	8PSK (2 bits/HZ)	16APSK (4 bits/HZ)	32APSK (5 bits/HZ)
	Baseband VLSI Technology	10M gates	20M Gates	40M Gates

Source: Hughes

Ka-Band Enable More Capacity

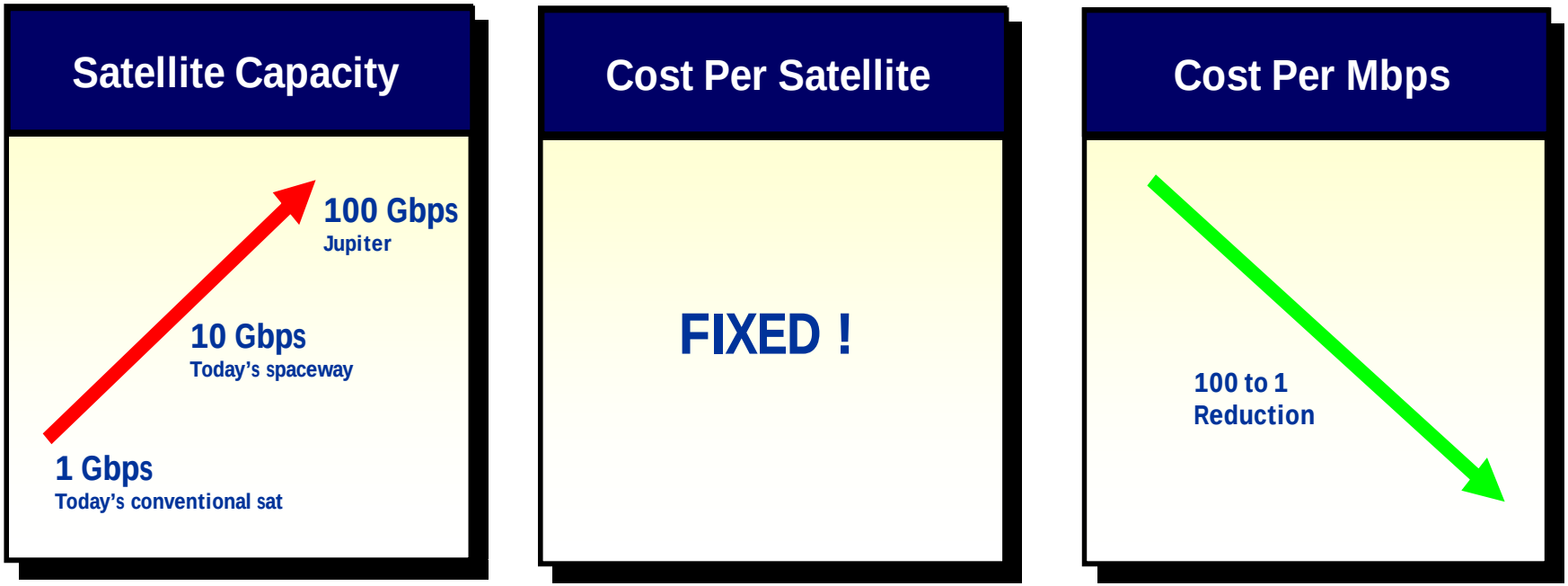
The "payload" of the satellite





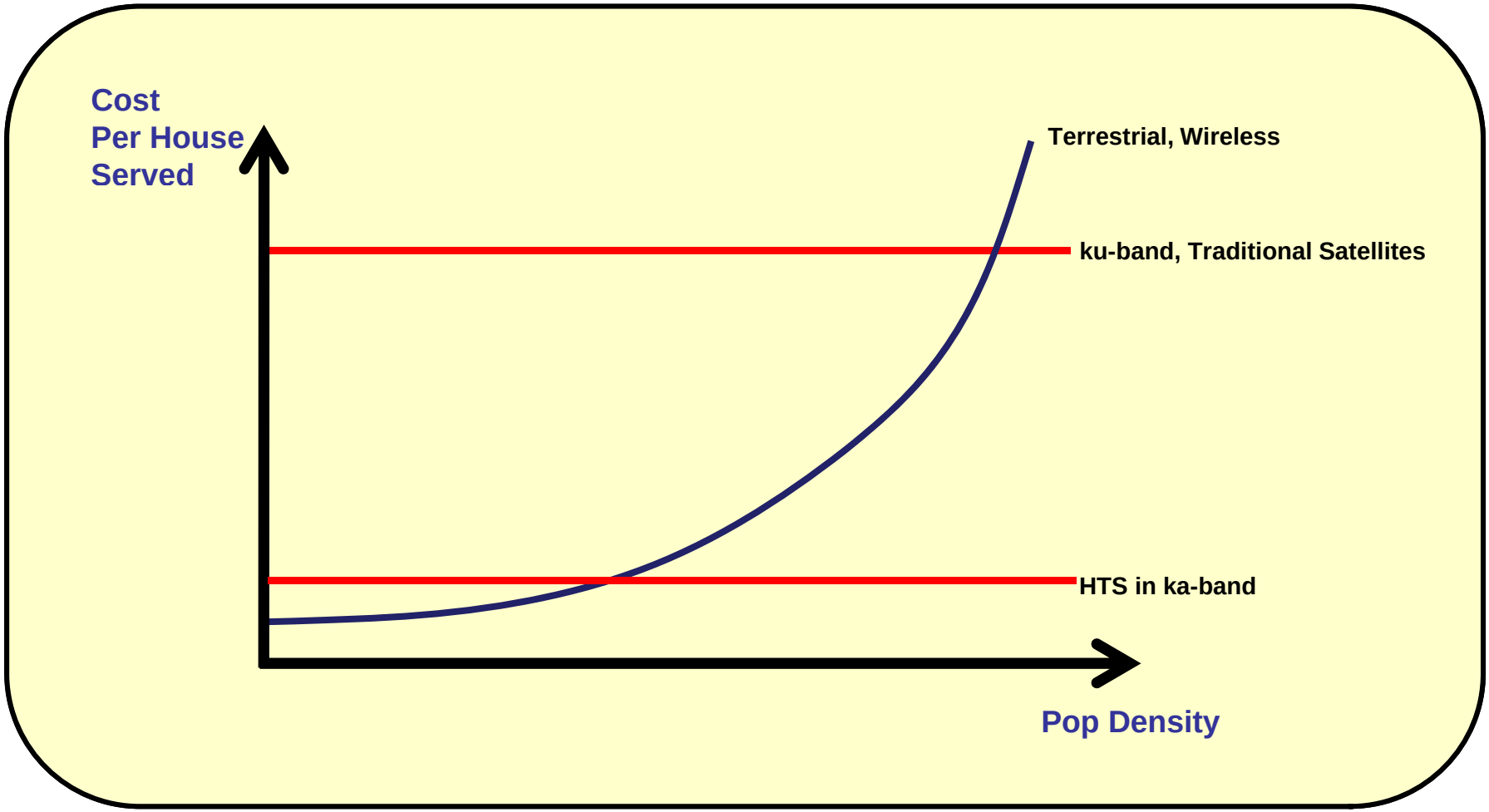
Ka-band transponders are lower mass than Ku-band for given amount of capacity

The Cost Impact



100 to 1 reduction in cost per Mbps

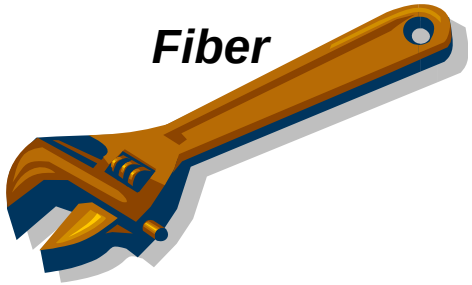
Cost Satellite x Terrestrial

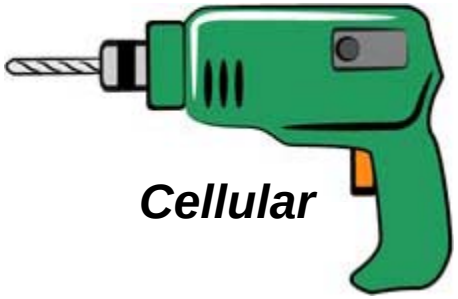


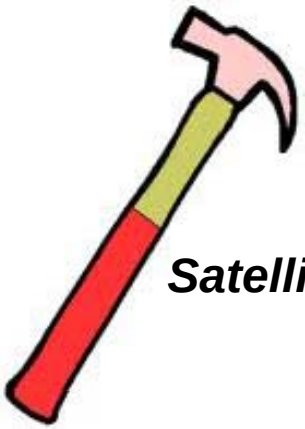
To Sum Up, Our View

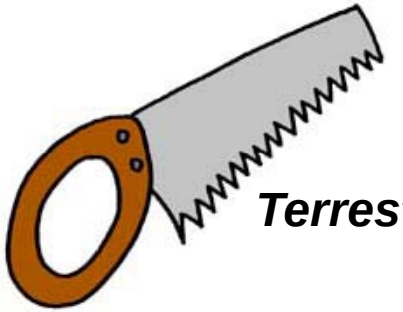
1. *Universal broadband coverage is not possible without satellite*

2. *Ka-Band HTS are a very important tool in the toolbox*

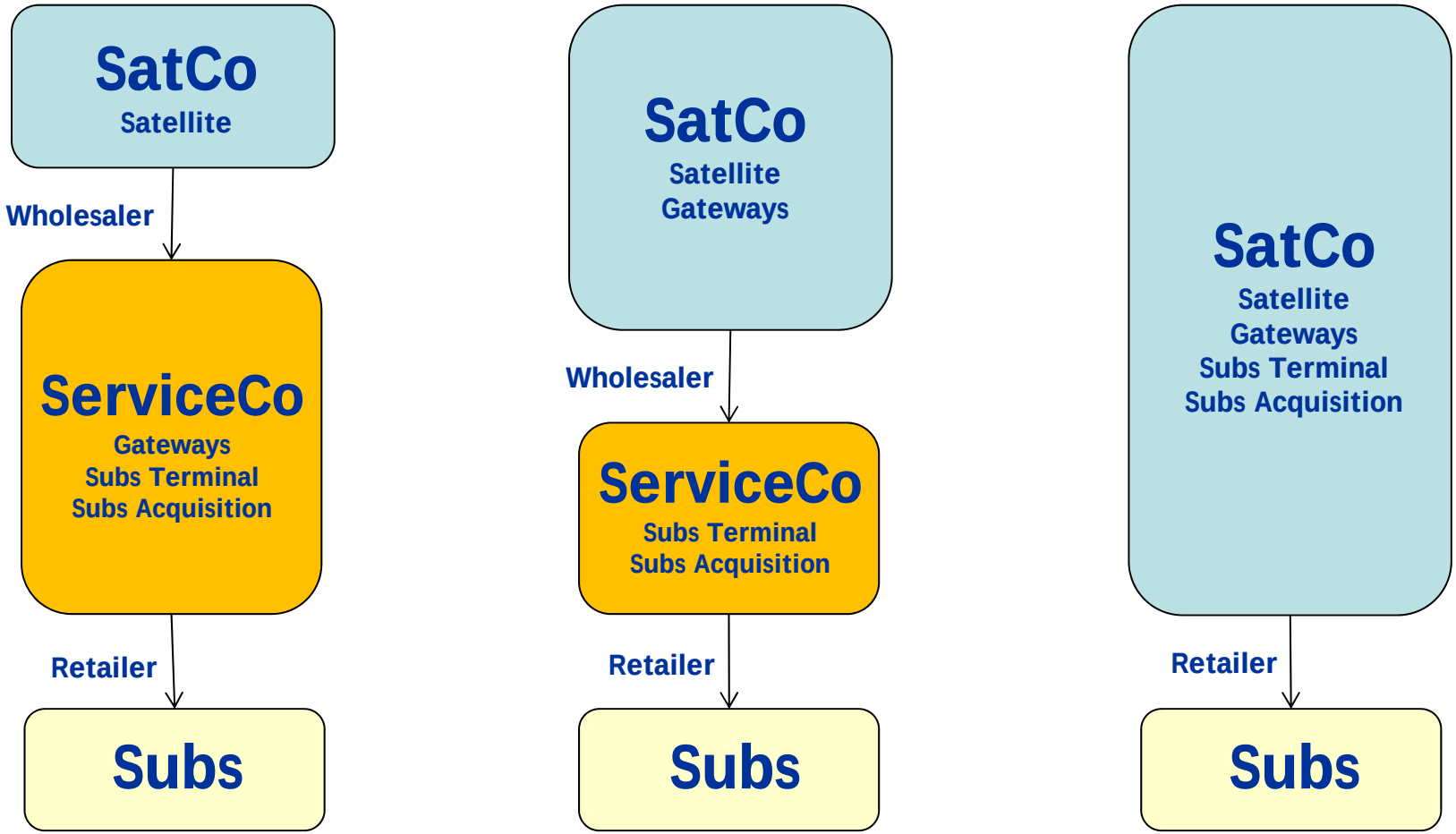








Examples of Biz Models



Also hybrid models based on geography

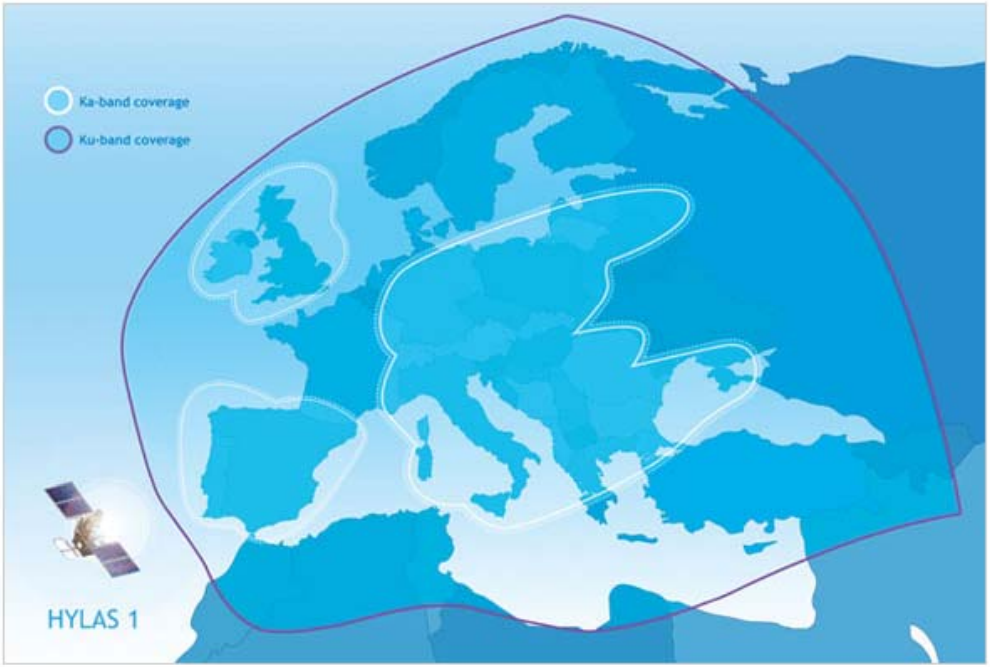
Systems and Services – Ka-Band Expansion Examples (2008-2012)

SPACEWAY® 3	North America
HYLAS 1	Europe
HYLAS 2	Europe, Africa, Middle East
YAHSAT	Africa, Middle East
JUPITER™	North America
T.B.D.	Hughes aggressively pursues other system opportunities

- Spot Beam + Frequency Reuse = More Capacity
- Multiple High Capacity Gateways
- Higher Performance VSATs
- Advanced Network Management and Control

Hylas 1 (Avanti) Ka-Band Spot Beam In Service 2011

- IPoS/ DVB-S2 ACM Compliant Solution
- Adaptive Inroute Selection (AIS)
- Extensive leverage of Ka-band experience (SPACEWAY 3)
- Smooth deployment using proven planning and system integration tools
- Full Range of service plans:
  - Consumer
  - SME/Enterprise
  - Government



Hylas 2 (Avanti) Ka-Band System

- Mid-2012 Launch
- Gateways and VSATs completed integration phase
- More powerful than Hylas-1
- Extended coverage across Europe, Middle East, and Africa
- HN high-density gateway

Yahsat Ka-Band System

- Mid-2012 Launch (Yahsat 1)
- Hughes Solution Fully IPoS Compliant (DVB-S2/ACM and AIS)
- Yahclick Service to Leverage Hughes Ka-band experience (SPACEWAY 3)
- Comprehensive
  - Ka-band Gateways
  - Network Control Center
  - Complete OSS/BSS Solution

yahsat الياه سات

Ka-Band : HN/HX Platforms

- High Performance
  - Up to 60 Mbps throughput
- High Efficiency
  - Adaptive LDPC coding on both transmit and receive
- Advanced Components
  - Digital modem technology at near theoretical performance
  - High-speed CMOS
  - VLSI
  - Gallium Arsenide (GaAs)
  - Silicon-Germanium (SiGe)
- Range of terminals scaled for Consumer/ SME/Enterprise

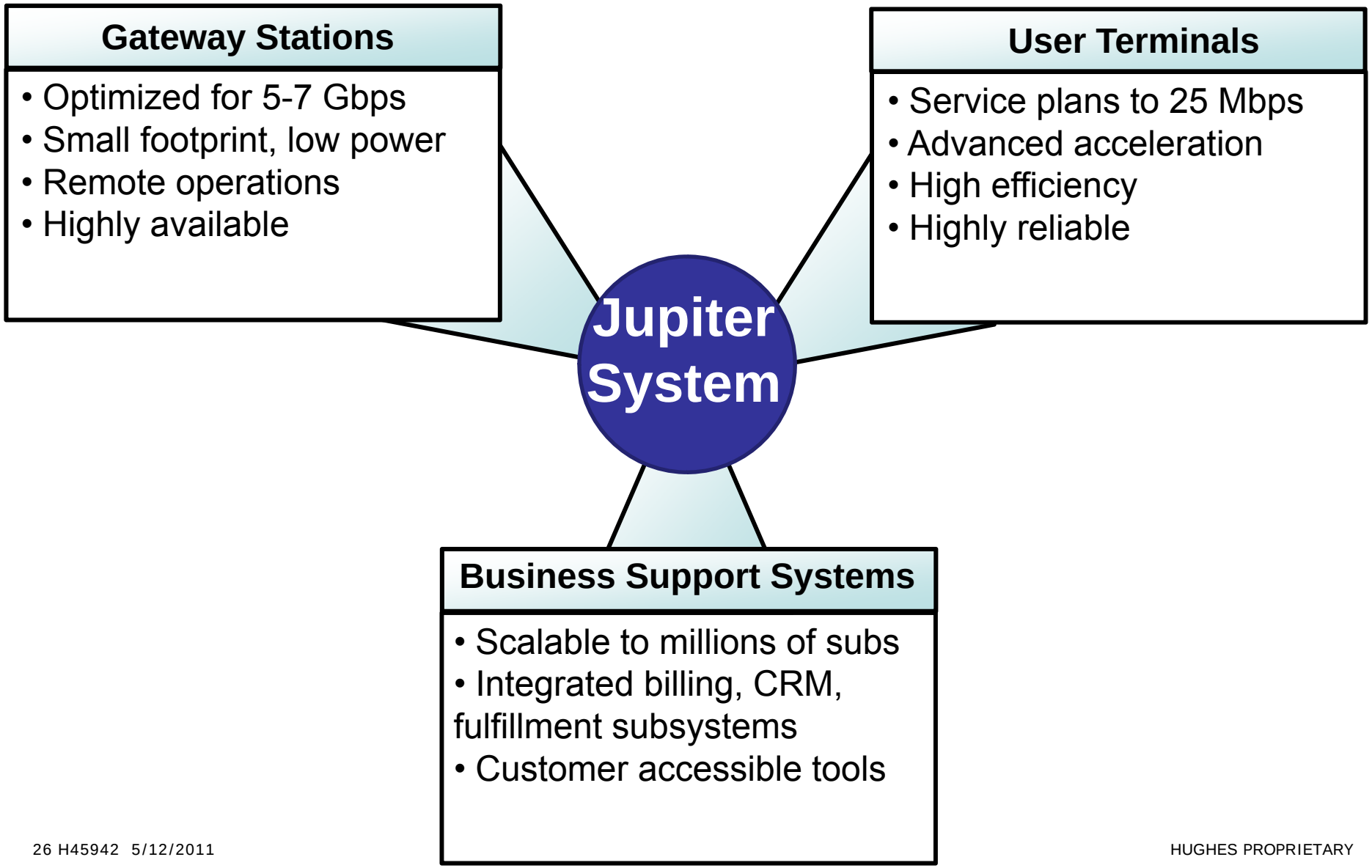
JUPITER™: Next Generation Ka-Band High-Throughput Technology

- Well in excess of 100+ Gbps capacity
- Launch mid-2012
- High capacity multi-Gbps gateway architecture
- Advanced Ka-band terminals
- Adaptive coding and modulation for both transmit and receive
- Throughput per terminal
  - Over 60Mbps
- Optimized for broadband access
- Enhanced QoS and Web acceleration
- Enhanced user experience

ECHOSTAR XVII Satellite with JUPITER Technology

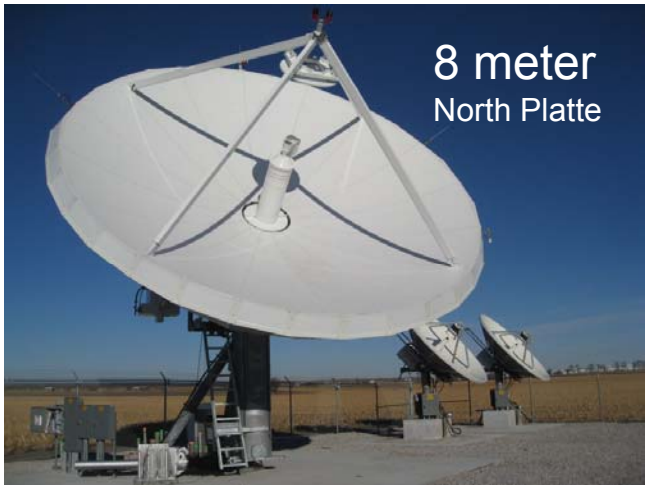
JUPITER System based on IPoS

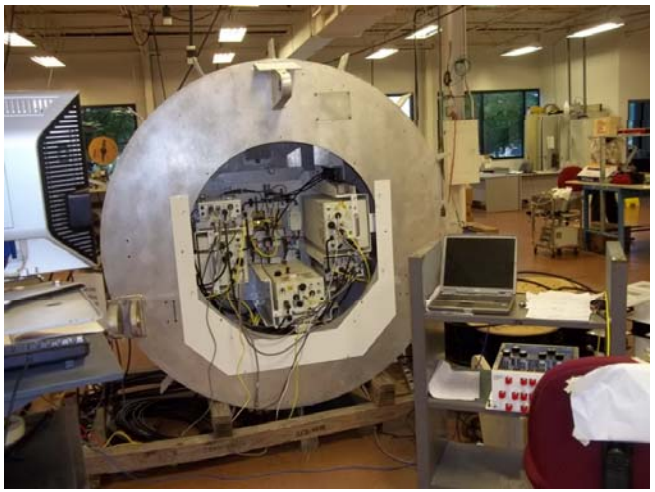
JUPITER High Throughput Technology Ground System Requirements



Jupiter Gateway RFT – 2012

- Antennas
  - 6 and 8 meter
  - Satellite tracking
- Transceiver subsystem
  - 3000 MHz Ka spectrum
  - 3 x 500 W Ka-band TWTAs
  - Electronics integrated in Hub
- High reliability and availability
  - Redundant design
  - Remote quality monitor
  - Uplink power control





Jupiter High Throughput Technology

JUPITER
HT1000 Broadband Satellite IDU

Small Footprint

Attractive Design

High Throughput
- Up to 15 Mbps TCP

Enhanced Web Acceleration
- Much faster than prior generation
- Hyper fast web page load

IPV6/IPV4
- Dual stack
- Simultaneous IPV4 and IPV6 support

Simple Installation
- Single IFL cable
- Advanced install process

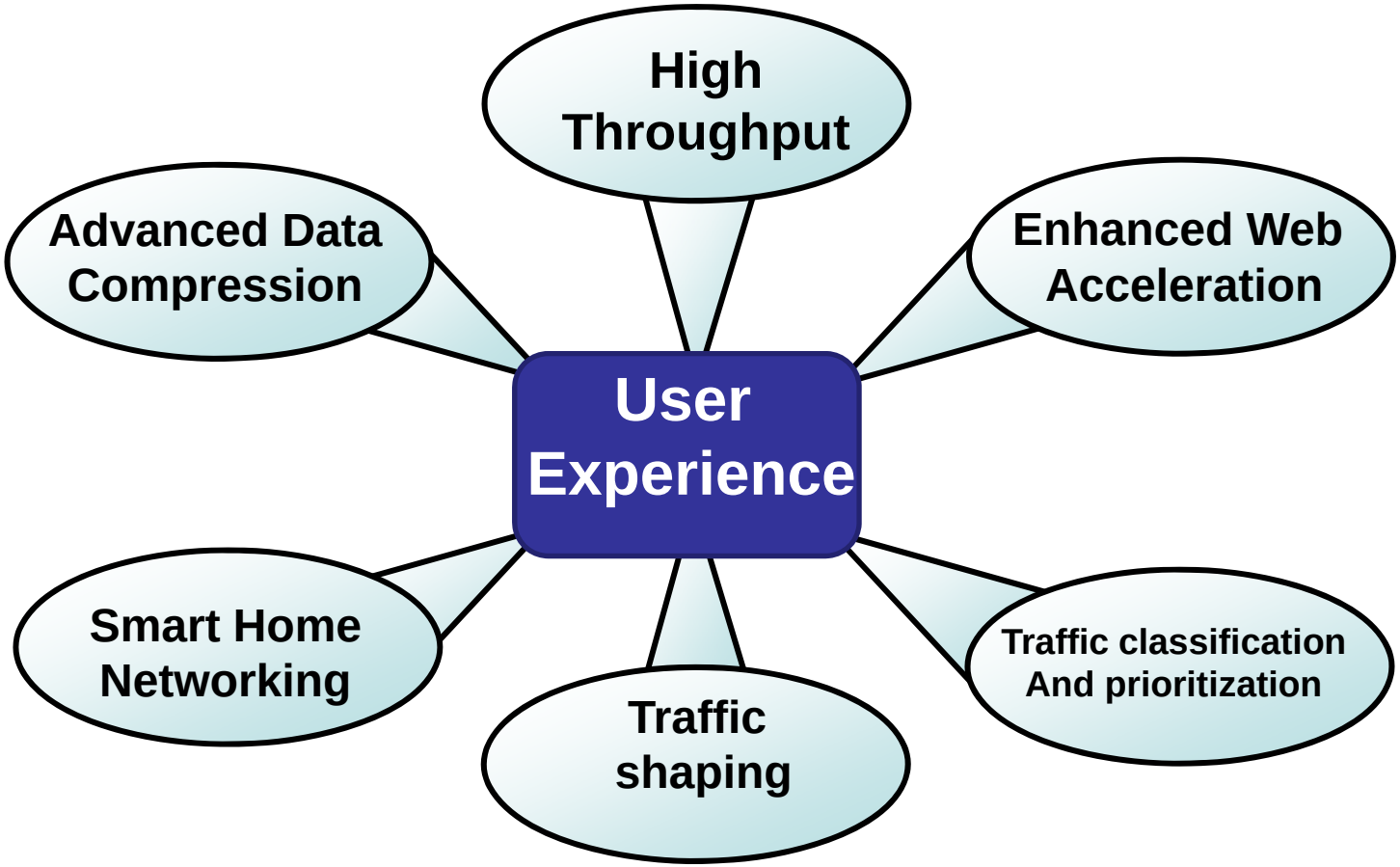
JUPITER
HT1000 Broadband Satellite ODU

Fully Integrated ⇨ ***High Reliability***

Single casting containing:
- BUC
- LNB
- Tria assembly

- New consumer-oriented design
- 74 cm antenna with optional 98 cm
- Extended Ka-band frequency range that operates with A, B, and NGSO bands
- Single Interfacility Link (IFL) cable

Enhanced User Experience – IP over Satellite Optimization



HughesNet Gen4
Satellite 'Home of the Future'