



Asia-Pacific Satellite Communications Council · ISSN 1226-8844



APSCC

NEWSLETTER

Satellite Ground Segment Business

Interview with
John Higginbotham
CEO, Integral Systems

07

JULY 2009

Trends in Satellite Broadband Systems

Dave Rehbehn, Senior Director, Hughes Network Systems

Consumer and business appetite for complex applications has transformed broadband from a "nice to have" to an absolute necessity. And satellite plays no small role in meeting the need for broadband services, particularly in remote and hard-to-serve areas. Figure 1 illustrates the latest market data, (Northern Sky Research, May 2009) showing over 2.5 million broadband satellite terminals in service globally, with a forecasted 12.5% CAGR.

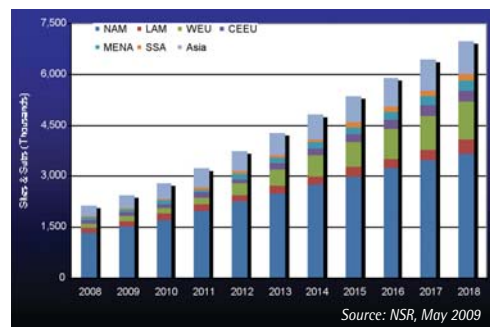
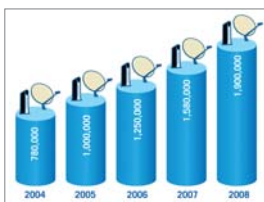


Figure 1. Broadband Satellite Market Size

As further evidence of the demand, Figure 2 shows the cumulative shipments of broadband satellite terminals from Hughes during the last 5 years, with over 1.9 million units shipped to more than 100 countries at the end of 2008. Growth is across a wide range of market segments and applications, including high-speed Internet services for consumers and SMEs (Small to Medium Enterprise); distance learning and video conferencing; Mobility services; cellular/Wimax trunking; as well as increasing deployments of small private networks. Perhaps most strikingly, since 2004 Hughes has shipped well over one million satellite

Figure 2. Hughes Cumulative Shipment of Broadband Satellite Terminals



broadband terminals (including over 300,000 terminals in 2008 alone), testifying to the growing value of satellite broadband in the marketplace.

Further, the success of Hughes in developing its own service businesses in North America, Europe, India and Brazil underscores the strength of broadband satellite as the primary solution in rural and remote areas. Despite the challenging economic times in the first quarter of 2009, Hughes achieved an all-time high of 53,000 gross subscriber additions, bringing the total number of North America HughesNet consumer subscribers to over 450,000.

Critical to maintaining this kind of market growth is the ability to continually develop and enhance satellite broadband technology and systems to meet market demand. This article examines the key market drivers and presents recent product innovations focused on these requirements.

Getting the Most out of Satellite Broadband

Ever-increasing demand for Internet connectivity is the strongest driver for satellite broadband. According to the International Telecommunications Union (ITU), the number of Internet users worldwide has increased over threefold from 390 million to over 1.5 billion since 2000. Not all of these users are situated in urban areas, which enjoy high-quality terrestrial connections. But there is still a significant "broadband divide":

in North America alone, analysts estimate that 10 to 11 million households and over 3.5 million small businesses don't have access to terrestrial broadband services. Even urban and suburban areas that are otherwise covered by fiber, DSL, or cable have pockets that contain no landline broadband access.

Turning to the developing world, the availability of landline broadband becomes even more challenging, and it is unlikely that terrestrial technologies can provide cost-effective coverage in the near or mid-term future. Whether it is DSL, cable or fiber, or terrestrial cellular or wireless broadband, capital cost rises as distances increase and subscriber density decreases, making it impossible to justify large investments in low density rural and in many ex-urban areas. Even larger cell wireless solutions such as WiMax are cost-constrained to urban and close-in areas, thereby leaving those in rural and hard-to-reach areas without options for terrestrial broadband. This low-density market is where satellite technology is ideally suited to provide cost-effective broadband connectivity.

Quality, performance and cost differentiate one service provider from another. Hughes further differentiates itself by being both a service provider and broadband technology/ product developer, which gives us the unique ability to rapidly bring new features and services to market enabled by new system platforms and capabilities. As illustrated in Figure 3, Hughes is focused on a two-pronged development strategy. The first part is to focus on the reduction of the "total cost of ownership", including both one-time equipment costs and recurring or operational costs. The second part of this strategy is to focus on achieving higher performance to end users.

While important, the cost of the equipment is only one component to the "total cost of ownership" (TCO) in providing satellite broadband services; other important factors include transmission and operational costs. Hughes has brought to market key developments to address each of these cost elements.

Key Developments to Improve TCO, Performance and Quality

The price of space segment is a major cost component of a satellite broadband system, and consequently anything that can increase IP throughput over the satellite will substantially reduce its cost. Spectral efficiency, while important, is but one element of overall IP throughput. Interestingly, end users report better general performance when efficiency improves.

Hughes produces a wide range of products based on a common set of core technologies and capabilities to achieve high IP throughput:

DVB-S2/ACM - Hughes first brought to market VSATs supporting the DVB-S2 standard using Adaptive Coding and Modulation (DVB-S2/ACM) in 2007. To date Hughes has shipped over 700,000 DVB-S2/ACM-compliant terminals. Typically our service provider clients who have implemented ACM for the forward channel realize approximately 50-60% improvement on throughput of the forward channel.

Adaptive Inbound Selection (AIS) - Just as we are able to dynamically change the forward link, it is also possible to dynamically change the return channel link. Hughes introduced the AIS feature, which includes dynamic coding, so that the return link is always optimized for the link conditions. Typical implementations of AIS result in about 20% improvement on the throughput of the return link.

Header Compression - By compressing 40 bytes of IP and TCP/UDP/RTP header data into 8-12 byte amounts, overall system efficiency is improved. Particularly when the traffic is small, as is the case with VoIP packets, this approach yields significant savings in bandwidth consumption and increases overall IP system throughput.

Payload Compression - Hughes has integrated packet payload compression into our TCP spoofing



Figure 3. Hughes Cost-of-Ownership Strategy

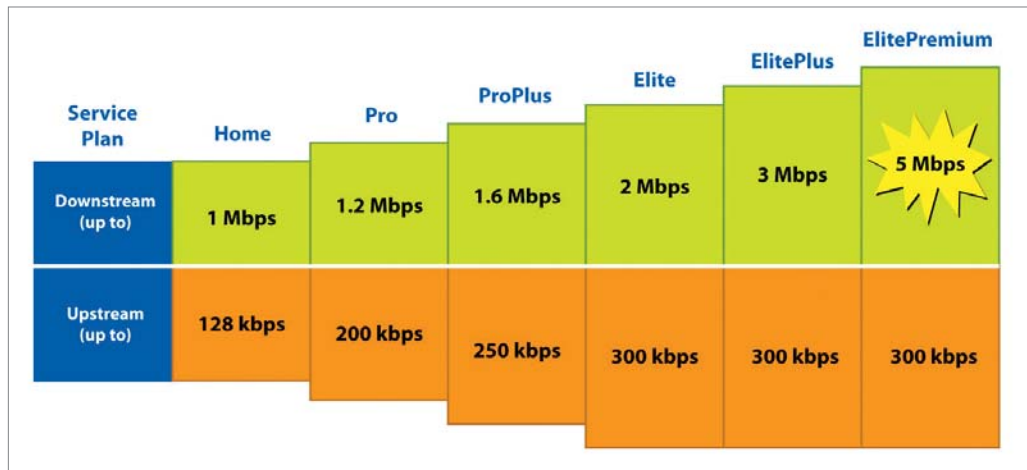


Figure 4. HughesNet Internet Service Plans

software, particularly with Web traffic where much data is highly compressible. The "YK" algorithm used by Hughes provides almost double the compressibility over other algorithms evaluated including the "GZip" algorithm. As a result, 12:1 compression for compressible payload data can be achieved, resulting in both faster performance and lower transmission cost.

TurboPage - Hughes has designed algorithms to prefetch HTTP objects and cache them in remote routers in advance of the user's browser requesting these objects — a key differentiator. This technology allows the user to experience extremely fast "paint" times for Web downloads, while significantly reducing the amount of traffic over the return channel, because the object "gets" are not transmitted.

Return Channel Efficiency - Beyond spectral efficiency (bits/hertz) and the ability to compress and optimize IP traffic, a key element of throughput on the return channel is the efficiency of the return channel. Using a variable burst length architecture along with a number of other technology innovations, the Hughes approach results in a return channel having efficiencies up to 89%, meaning less return channel capacity is required to support more terminals.

These and numerous other developments have helped Hughes successfully deliver a cost-effective

platform that provides the required quality and performance for broadband services in rural and underserved areas. Figure 4 illustrates the HughesNet service offerings available to consumer and SME subscribers in North America; these kinds of services can be offered by any operator in the world using the Hughes platforms.

Using VSAT for Mobility Services

Internet users expect high quality, affordable broadband services at their homes — and not surprisingly anticipate the same when they travel — whether by land, ocean, and even by air. While mobile satellite services at lower satellite frequencies (L-band in particular) have been available for some time, these services are typically limited to throughputs below 500 kbps and can be costly. Satellite broadband using higher frequency services such as Ku-band offers the promise of affordable, mobile broadband services, but the very nature of these higher frequency services presents a significant challenge.

Some of these challenges and how the technology solutions were implemented on the advanced Hughes HX platform are summarized as follows;

Changing Transmission Path - The primary challenge is in the satellite broadband system's ability to dynamically adapt to changing link conditions as the terminal moves, maintaining high availability while not wasting

satellite capacity. Use of DVB-S2/ACM enables continuous adjustment of the forward channel to compensate for movement of the remote terminal. Hughes uses similar technology to dynamically vary the link on the return channel as well.

Frequent Blockage - The challenge is to quickly recover links after obstructions block them; e.g. tunnels, trees, or part of a ship/plane. The HX System maintains a "persistent IP session" during brief periods of link outages so that the end user's IP session is not lost while the satellite link is absent. For the terminal itself, Hughes has implemented an advanced "flywheel" mechanism so that recovery of the channel is immediate once the obstruction is cleared.

Doppler Compensation - Another challenge for services to mobile vehicles is Doppler compensation. Transmission equipment must account for instantaneous change in movements (e.g., a truck taking a sharp turn), and enhancements to Hughes demodulators compensate for the frequency shifts of these high-speed movements.

Recent Hughes Product Introductions

Beyond high-speed Internet access, connectivity requirements for SCPC replacement and cellular/WiMax trunking place additional demands on product designs. These applications require the ability to transport a large number of packets per second and to support low jitter, constant bit rate bandwidth links using dynamic bandwidth assignment. In response, Hughes recently introduced its latest generation HX200 broadband satellite router.

Taking advantage of higher processing power and significant enhancements to TCP spoofing software, the HX200 satellite router supports nearly double the throughput performance of the HX100 unit, thereby enabling a more cost-effective solution for high-capacity links.

When supporting latency-sensitive applications such

as voice or videoconferencing, there was a clear market need for single-hop connectivity. In response, Hughes recently introduced mesh capability within the HX System.

As illustrated in Figure 5, an important innovation was to implement the HX hub TDMA demodulator technology in the HX260 mesh satellite router. By doing this essentially enables these remotes to operate as "mini hubs." Employing an integrated multichannel TDMA demodulator means any HX260 can communicate via a single satellite hop to one or more other HX260's in a defined group.

Furthering the "minihub" analogy, the HX mesh system can also deploy "star in star" topologies, for easy setup of one or more small (star) private networks. Applications needing this kind of connectivity include cellular backhaul where a BSC needs to connect single hop to a small number of BTS stations (as illustrated in Figure 6).

Figure 5. HX Mesh Architecture

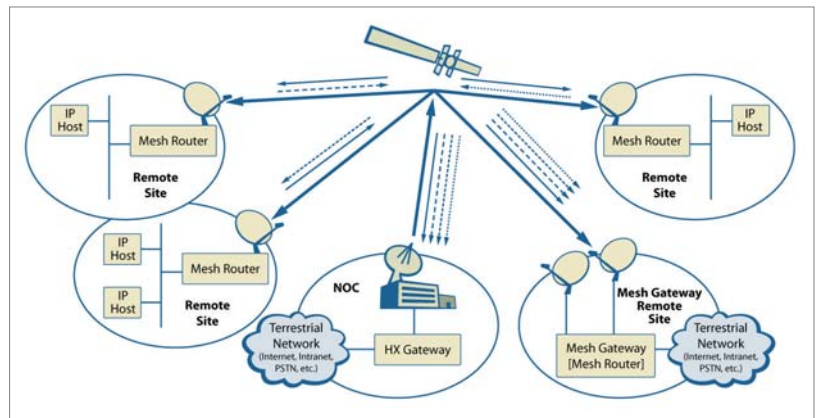


Figure 6. HX Mesh Enabling "Star in Star" Topology

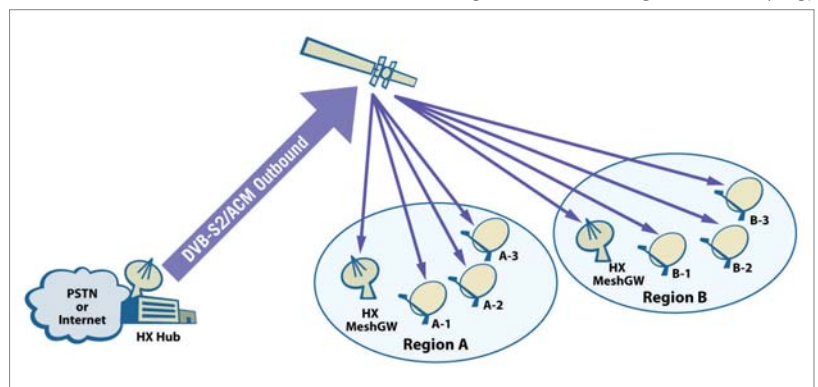




Figure 7.
HX GW with Multi-Satellite Support

When satellite capacity is limited, it is not uncommon for the available capacity to be in small portions (a few MHz), split over multiple transponders and even multiple satellites. As a result, customers have asked for hub systems that can support multi-transponder and multi-satellite operations. In response, the latest generation of Hughes HX Gateway stations (hub system) are prewired so that expansion of additional forward channels is achieved simply through the addition of an outroute expansion kit. Figure 7 shows the latest generation of HX GW supporting multi-satellite expansion.

Hughes also recently introduced the "Configurable Demodulator Subsystem" or CDS, recognizing that fewer demodulators at a hub are important elements in reducing service delivery cost. As illustrated in Figure 8, the CDS is contained within a one-rack unit chassis and is capable of simultaneously demodulating up to nine channels over 36 MHz of spectrum. These channels can be a combination of different symbol rates, and each channel supports adaptive coding for individual TDMA bursts. The result is a lower investment cost for an operator while simultaneously achieving higher operational efficiency because of the ability to use different symbol rates and adaptive coding.



Figure 8. Multichannel Demodulator

Looking Forward

With an extensive array of new technologies, including 10Gbps throughput, on-board switching and

routing, phased array antenna and spot beams, the Hughes Ka-band SPACEWAY® 3 satellite system launched into commercial service in April 2008 truly represents a generational step forward from conventional Ku band, bent-pipe satellite technology. Not only do the high performance SPACEWAY broadband routers operate with dynamic power control, but these systems have the capability to demodulate and process a 440 Mbps downlink from the satellite. They are some of the first in the industry to incorporate an advanced chip set technology especially designed for these high data rates.

As SPACEWAY 3 has leapt forward, it is clear that "next generation" satellites will have tenfold or more capacity increases, up to 100Gbps and more, due to extensive frequency reuse from many small spot beams. In addition, these systems will likely utilize much higher forward and return channel data rates. Further, it is clear that the bandwidth consumption per user is on an inexorable increase, driven by an appetite for more content, such as peer to peer applications and rich media downloads. This means that the ground systems of tomorrow need to support significantly wider channels, and with significant channel throughput increases to provide end users with the broadband performance they expect.

It means that all of us in this dynamic industry will continue to confront the challenges and experience the joy in pushing the technology and business envelope of satellite systems and services globally, bringing the many benefits of broadband to consumers, businesses and governments around the world. <

Dave Rehbehn is the Senior Director responsible for global marketing of Hughes broadband products and services. In this capacity Rehbehn develops Hughes market strategy, including product and service offerings, and is responsible for the strategic direction for the Hughes International sales force. Rehbehn has more than 20 years experience in the satellite arena including business development for the Hughes set-top box product family as well as the HughesNet™ Consumer internet service business. Before his current role in the International Division, Rehbehn was responsible for HughesNet corporate sales for the Southeast United States and worked closely with many of the US based Fortune 1000 companies to develop network solutions tailored to their needs.