

4K TV is Here!

4K TV has been making waves recently with great images from the exciting games of the Football World Cup in Brazil this summer. Spanish operator Hispasat, as with most major satellite operators, has been heavily involved in the dissemination of 4K technology, pioneering the first full-time 4K channel in North America earlier this year. This article by Hispasat's engineering team outlines the technical and commercial challenges that will bring full adoption of 4K TV a reality.

by Jorge Rodriguez, Aurora Mourelle and Inés Sanz

The satellite industry has been heavily promoting 4K TV or what is also called Ultra HD (UHD) as one of the key drivers for the broadcast industry for the coming years. However, several questions still need resolution not only from the technical but also from the commercial and strategic point of view in order for 4K TV to reach its full potential.

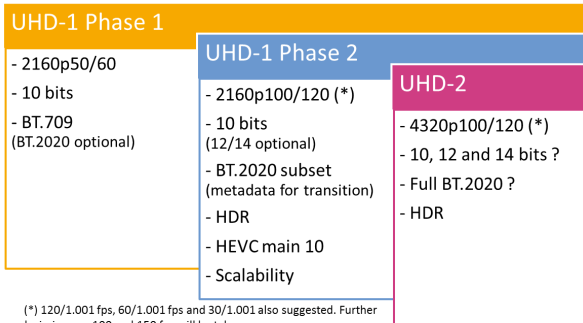
This article describes the challenges that broadcast industry is facing for 4K TV to become a reality. In particular, key technologies such as the development of the new HEVC encoding and the new satellite transmission techniques will be presented along with other critical aspects for 4K quality assurance, such as frame rate, bit depth and color gamut. To support the analysis, this article presents field trials that Hispasat, together with a consortium of companies and with the collaboration of European projects H2B2VS and UHD4U, are carrying out for achieving an exciting milestone: the first HEVC 4K

transmission with a bitrate below 20 Mbps, under the umbrella of the HISPASAT 4K TV channel, which

is currently being broadcasted in Europe, North America and in the near future in South America.

Major UHD Developments

Ultra High Definition (UHD) is, without doubt, the next big step in TV and a significant amount



This diagram summarizes the phased approach to Ultra HD development by the DVB community. [1]

of work is being devoted to defining the requirements and developing the technology that will make UHTV at home become reality. Most players throughout the value chain, from content producers to display manufacturers and encoders/decoders manufacturers have presented their latest products at the most important international shows such as IBC and NAB, with network operators showing demos and setting up the first test channels in all network types.

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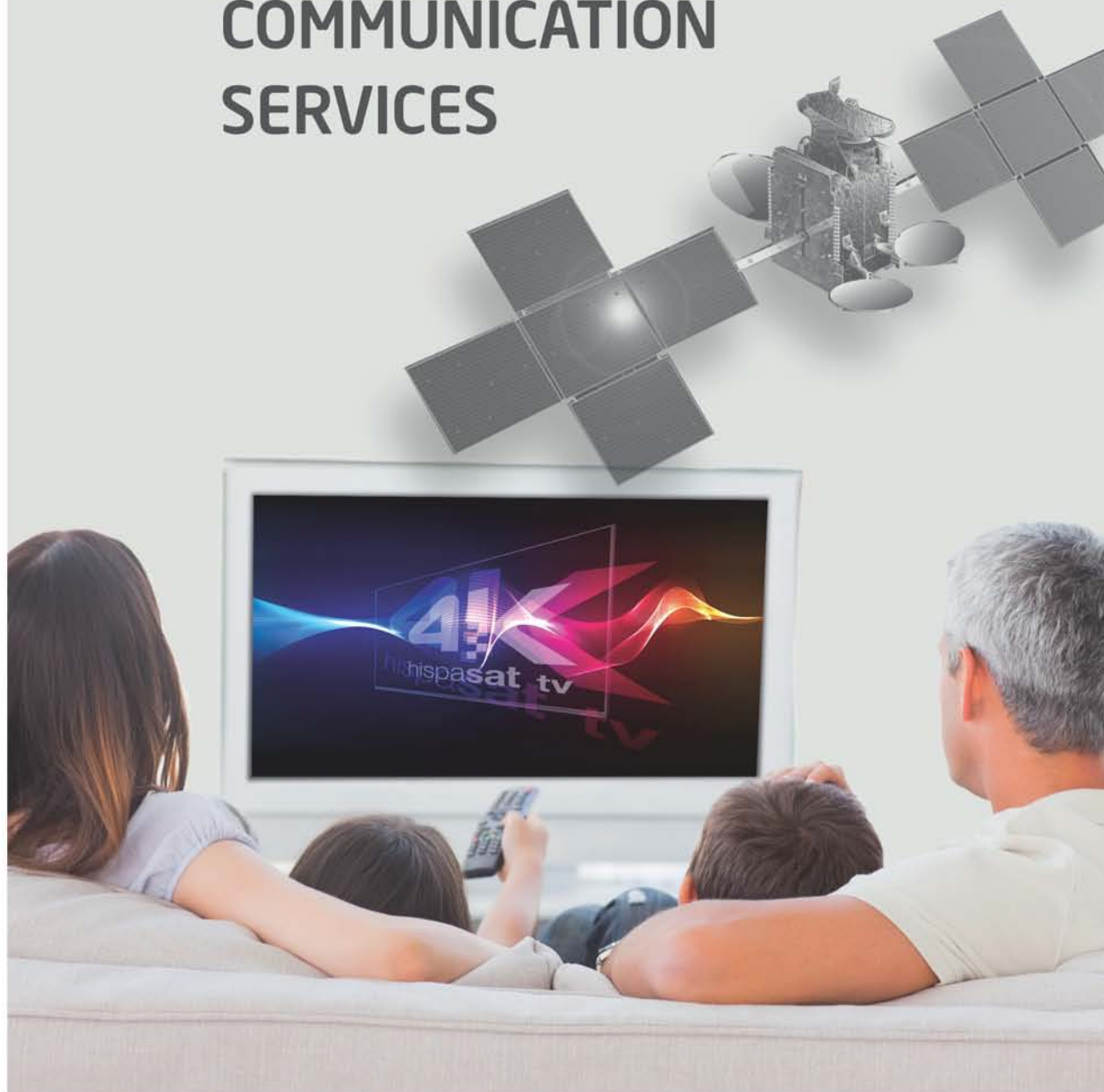
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4K TV is Here!



Our cover story this month is on 4K TV and the challenges it faces for global adoption. Coincidentally, this month, 4K TV has made a great leap forward with the broadcast of the exciting FIFA World Football Championship finals in 4K or what is also known as Ultra HD, which is four times the resolution of standard HD.

Viewers in the football-mad country of Brazil will get to see the final three matches of the World Cup in Ultra HD courtesy of Globosat's SporTV channel which is available through many pay TV providers including Telefonica and NET.

Globosat teamed up with suppliers Broadcom and Elemental to create a system using HEVC, a new compression standard that supports 4K. This involves use of Elemental Live video encoders, satellite uplink signal receiving systems provided by Globosat, and Broadcom's video decoder system-on-a-chip supporting HEVC compression, 10-bit color and 60 frames per second.

The BBC reportedly will be retransmitting the 4K feed for a test involving delivery on an IP network and through its digital terrestrial TV service.

Things are definitely looking up for 4K TV.



Virgil Labrador

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4K TV ...From page 1

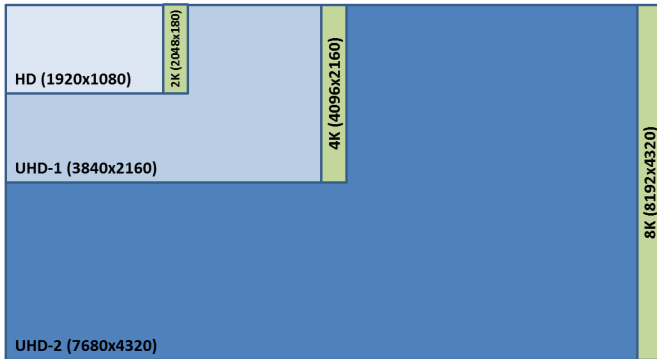


Figure 2: UHDTV and Cinema resolutions

UHDTV has been defined in two profiles by the International Telecommunications Union (ITU): UHD-1 (sometimes also referred to as 4K) with a resolution of 3840x2160 pixels, and UHD-2 (also known as Super-Hi Vision or 8K), with a resolution of 7680x4320 pixels. But UHD is not only about an increase in image spatial resolution; high frame rate (HFR), high dynamic range (HDR), wider color gamut or increased bit depth have to be redefined for a real “wow effect” that will push consumers into a mass adoption of UHDTV. The ongoing discussions within the industry have revealed significant differences in the approach that is considered appropriate for the roll-out of this new technology, and standardization bodies are working to ensure a common framework that satisfies all parties.

One of the key concerns for UHDTV to be considered as commercially attractive is the bandwidth required for its transmission. The standardization in 2013 of HEVC (High Efficiency Video Coding) makes it possible to deliver the same content at half the bit rate than that required when using MPEG-4, and has set an ideal scenario for UHDTV deployment. Furthermore, along with HEVC, improvements in DVB-S2 satellite broadcasting standard are also being developed and will make broadcasting of UHDTV more feasible. Other optimizations are also being studied, specially looking into defining a flexible solution that provides backward compatibility between phases and also compatibility among the different end-user equipment capabilities. In this sense, a scalable profile of HEVC is being standardized and the potential use of hybrid broadcast-broadband approaches is also under study.

The next sections are organized as follows: first, we present the basic concepts behind the main parameters referred to when speaking about UHDTV. The goal is to provide the reader with a clear picture of the key concepts in UHDTV from a user point of view. Once the basics have been explained, the technological challenges and solutions for a successful deployment of UHDTV such as HEVC or DVB-S2 extensions are described. Finally, the tests and trials set up by Hispasat together with a consortium of companies in

Europe will be described together with the conclusions derived from them.

The Basic Parameters

The need for parameters that go beyond those of HDTV to achieve an enhanced viewing experience such as the one aimed with UHDTV was introduced by ITU in recommendation BT.2020 - "Parameter values for ultra-high definition television systems for production and international programme exchange" ^[2] published in August 2012. This recommendation defines, besides the pixel count, different frame rates, bit depth and colorimetry than for HDTV, and recognizes the possibility of introducing a new transfer function for improved dynamic range.

I. Resolution

As already mentioned, two resolutions are included in UHDTV ITU recommendation: **UHD-1**: 3840x2160 pixels and **UHD-2**: 7680x4320 pixels.

Sometimes the cinema naming 4K and 8K is incorrectly used to reference the above resolutions, but there is a slight difference in the horizontal pixel count as shown in Figure 2.

The increase in spatial resolution means that users will benefit from a wider field of view of up to 100° for UHD-2, whilst for HDTV it is of only 30°.

II. HFR - High Frame Rate

The increase in temporal resolution is critical for a truly enhanced viewing experience. At the current 25/30 fps, motion demanding sequences such as sports produce blur and strobe effects with the consequent bad quality of experience. In fact, in HD content tests show that a very significant increase in perceived video quality is achieved when changing from 50fps to 100fps. Several tests have been performed by different entities to identify the optimal frame



Fig. 3: Higher Frame rate in Motion Sequences



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- **European Beam** with four transponders 54 MHz each covering the territory of Western and Central Europe, the Middle East and Northern Africa;
 - **Southern Beam** with 8 transponders 54 MHz each covering Africa to the South of Sahara;
- Southern and European beams are cross-strapped.
- **Steerable Beam** with up to three transponders 72 MHz each to be pointed over African or Asian continent upon the customer request.

Steerable Beam and Northern Beam are cross-connected.

OPPORTUNITIES FOR INTERNATIONAL MARKET



rate for UHDTV for avoiding these effects and it is still under discussion. Recommendation BT.2020 defines the following values: **120, 60, 60/1.001, 50, 30, 30/1.001, 25, 24, 24/1.001**

However, some issues have been raised regarding the potential interference problems due to 50Hz lighting and multiples of 50fps have been suggested. The present convention is that 100/120 fps should be targeted for full UHDTV, though in a first implementation phase technological constraints will limit this value to 50/60fps.

III. HDR - High Dynamic Range

Increasing dynamic range means that details are better displayed in low-contrast conditions (either low or high lighting conditions).

Current displays are increasing their maximum brightness and so a wider contrast range could be exploited. The impact of this parameter in subjective quality assessment tests is particularly revealing and considered as key for a truly improved quality of experience, not only for UHDTV but also for improving HDTV.

Higher dynamic ranges are not standardized and would require a new electro-optical transfer function. Though not defined in BT.2020, it is recognized as a possible future improvement.

IV. Wider Color Gamut

BT.2020 extends significantly the color space respect to the recommendation for HDTV (BT.709 [3]) resulting in an improved color resolution and visual perception. Current displays exceed the bounds defined by BT.709 color gamut, but full compliance with BT.2020 is far from being achieved. The common understanding within the industry is that full compliance is not required in the short term, but extended features are desirable. Hence, the possibility of introducing color metadata to be transmitted along with the content has been identified as a very interesting solution. As described in DVB commercial requirements for UHDTV [1], this would allow for a smooth transition amongst different display capabilities.

V. Bit Depth

An increase from the current 8 bits/sample to 10/12 bits/sample has been agreed as a necessary requirement for avoiding banding effects in UHDTV.

Efficiency Improvements

I. HEVC – High Efficiency Video Coding

Transmission bit rate is one of the biggest challenges for UHDTV deployment due to the big amount of information that this format requires. Current video coding technology (H.264 – MPEG-4) provides good efficiency for HDTV broadcasting (between 6-10Mbps average), but UHDTV

would require, using MPEG-4, up to 40 Mbps making it very difficult to generate good business models for 4K massive deployment.

However, the recently standardized H.265 achieves an average gain of up to 50% compared to H.264 for the same video thanks to the incorporation

and optimization of different coding tools. The system permits the implementation of an UHDTV 4K channel in an average bit rate of 20Mbps. Since the standard publication (January 2013) HEVC has produced an important impact in the market with several manufacturers launching HEVC products.

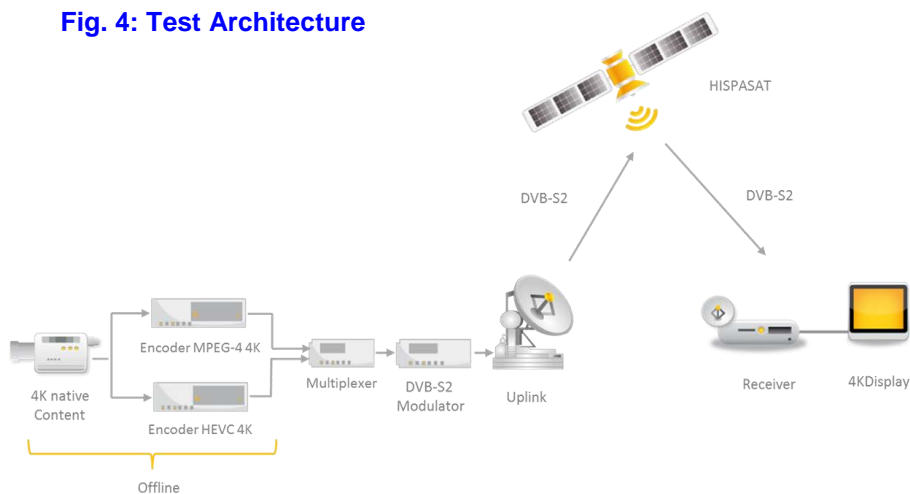
Further HEVC profiles including scalability are now under discussion in standardization groups.

II. DVB-S2 Extensions

Since Q1 2013, DVB-S2 group is working in an evolution of the standard to improve its efficiency. Publication of this new version is expected by Q3 2014 and will include new features such as:

New ModCodS: higher order modulations of 64, 128 and 256 APSK will be introduced, as well as new modulation-coding configurations. This will result in a higher FEC granularity which provides more flexibility to operators and service providers for selecting the most appropriate MOD-COD.

Fig. 4: Test Architecture





Hispasat's Chief Commercial Officer Ignacio Sanchis (center) at the press conference at the NAB 2014 launching the first full-time 4K channel for the Americas dubbed "Hispasat 4K TV channel." Inset is the channel presented on a live satellite feed at the Hispasat booth.



Sharper Roll-off: The roll-off factor is reduced from 20% (DVB-S2) to a maximum of 5%, improving transmission efficiency (bits/Hz).

Variable Coding and Modulation (VCM): This technology is optional in DVB-S2 and will be mandatory in DVB-S2x, allowing for the modcod to change on a frame-to-frame basis and making it possible to introduce criteria for quality of service differentiation within a single multiplex.

Channel bonding: This system makes it possible to transmit a single transport stream within several carriers, optimizing service multiplexing avoiding the need for padding. This is especially interesting for UHD transmission, given the higher channel bitrate required.

The efficiency of DVB-S2x respect to DVB-S2 depends on the type of service and, though it may reach 30-40% (professional services, contribution and VSAT), for the Direct-To-Home (DTH) scenario no significant gain at physical layer level is expected (< 10%). However, the combination

of these new technologies provides very interesting functionalities for its introduction together with HEVC in new STBs.

HISPASAT 4K TV Trials

In parallel to the development of key technologies for the deployment of UHDTV, such as HEVC and DVB-S2 extensions, during the last months it has been possible to see a great number of tests and trials of technology as well as demonstrators in the most important trade shows and conferences within the sector. One of the most important are those lead by NHK in the last IBCs demonstrating the performance of the SHV (Super High Vision) format. Also remarkable are the demo channels by Eutelsat (Quad HD format), SES (UHDTV with HEVC since April 2013) and the trials lead by Abertis Telecom during the MWC2013 in which an UHDTV channel was transmitted over a DVB-T2

multiplex.

Since Q2 2013, a group of companies lead by Hispasat performed different UHDTV trials and tests. Different technologies, equipment and configurations at key elements of the value chain were tested (coding, transmission, reception and display). Part of these tests fall within the scope of two European projects in which Hispasat is involved: UltraHD-4U (Catrene) and H2B2VS (Celtic +).

I. Test Objectives

The main goal of the trials was to define the optimum configuration for broadcasting high quality UHD content over satellite in the most efficient way.

II. Test Architecture

The demonstrator architecture included the following elements:

Content: The service has a 4K loop of content available.

Most of the sequences are static camera captures to avoid visual discomfort in

big UHDTV displays due to the HDMI frame rate limitation.

Coding: Content was encoded using two main coding candidates for 4K broadcasting: MPEG-4 and HEVC.

Transmission: Different DVB-S/S2 configurations were tested.

Satellite: Single 36MHz transponder operated at saturation simulating DTH conditions. Tests were performed over European coverage (using Hispasat 1E), Pan-American coverage (using Hispasat 1C) and North America coverage of AMZ-3.

Receiver: Since 4K receivers were no available in the market. A PC with a DVB-S/S2 demodulator card was used as receiver. Content was reproduced using VLC player compatible with 4K .

4K display: Different 4K screen models were tested (55", 65" and 85") with different display manufacturers (LG, Sony, Samsung and Philips).

III. Test Results Summary

After three months of tests, different conclusions about UHD transmission have been reached.

Coding

As already mentioned, during the test campaign different coding configurations were been tested.

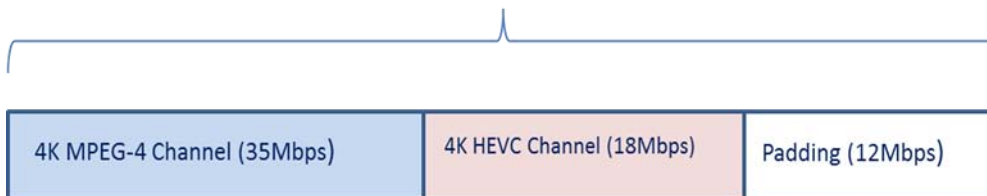
For MPEG-4 option, bitrates ranged from 30Mbps to 65Mbps. The conclusion was that increasing bitrate above 35Mbps there was not perceivable improvement from a user point of view.

For HEVC bitrate ranged from 15Mbps to 25Mbps. 18Mbps was selected as the optimum value in this case.

4K Video Parameters

Regarding the image parameters, besides coding bitrate, the following configurations were selected:

DVB-S2 TS 30Msps (65Mbps)



Bit depth: 8 bits were chosen due to the fact that current displays, with some exceptions in the professional market,

are only compatible with this option.

Frame rate: For similar reasons, 25/30 fps was selected as frame rate value, since it is the highest frame rate compatible with current displays due to HDMI 1.4 restrictions.

The main conclusion of the tests with these two parameters is that this configuration significantly limits the possibilities for high quality UHD content transmission. 25fps frame rate is not compatible with wide and fast camera movements and, in some cases, the 8 bits for bit depth produces banding effects in certain images. Unfortunately, no more configurations could be tested because of the lack of equipment compatible with more advanced profiles.

DVB-S2 Transmission Parameters

For transmission parameters, the main objective was to simulate as closely as possible the typical DTH platform operating conditions. Therefore, a DVB-S2 carrier occupying a full 36MHz transponder in the typical MODCOD configuration for this type of service was selected – 8PSK 3/4. Fig 8 shows the final transport stream configuration.

4K Displays Compatibility

One of the most relevant aspects of the test campaign were the service compatibility tests with different 4K displays. It was found that the most limiting factor was the HDMI interface. The current implementation of HDMI (1.4) limits the maximum frame rate to 25/30 fps. However, it was also found that for the displays launched during 2013, manufacturers introduced options for motion compensations that made it possible to improve the movement perception for 25/30 fps signals. However, it is not recommended to rely in these mechanisms for commercial deployment due to the lack of standardization.

The launch of 4K displays compatible with the new HDMI 2.0 during 2014 has been announced. This new standard makes it possible to reach frame rates up to 50/60fps.

Within the UltraHD-4U and H2B2VS European projects, further tests will be performed and enhanced features introduced into the demo channel.

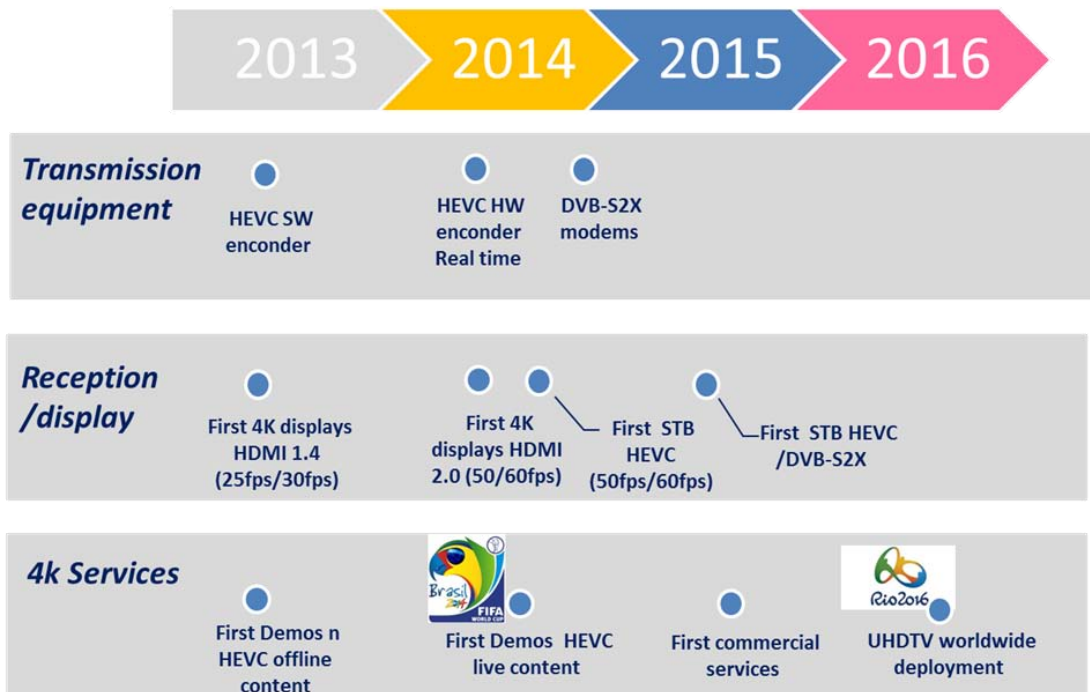
Also, the use of hybrid architectures and scalable profiles of HEVC when available will be conducted within the scope of these projects.

Road Map to the Future

Taking into account the analysis presented in this article, it is possible to provide a roadmap forecast for UHD service deployment. This forecast is mainly based on three key aspects:

First, the development of transmission equipment compatible with the new 4K systems. It is important to highlight the important technological step that will be achieved with the launch of HEVC real time encoders. The first prototypes are expected in 2014.

UHD TV Road Map



Also, the reception and display markets have already started to take off in 2013 with the launch of 4K displays. The consolidation of 4K displays compatible with HDMI 2.0 launched this year provides an optimal quality at least during the first deployment phases.

Finally, other non-technological factors are expected to influence UHDTV deployment: sport events such as World Cup 2014 and 2016 Olympic Games will surely increase users' interest and will push a renewal of the TV base.

After 2016 we find a lot of uncertainty. Probably there will be many technological changes, including for example HDR or higher frame rates improving quality of experience.

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- [1] DVB CM-UHDTV Group, "Commercial requirements for UHD-1 Phase 1", November 2013.
- [2] Recommendation ITU-R BT.2020, "Parameter values for ultra-high definition television systems for production and international program exchange", August 2012.

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The Satellite Ground Communication Segment

by Bruce Elbert

The satellite ground communication segment has been undergoing many changes in the last few years. To shed light on the latest technical developments in this important segment of the satellite industry, we provide excerpts from the forthcoming updated and revised edition of book, *The Satellite Ground Communication Segment and Earth Station Handbook*, Second Edition, by renowned industry consultant Bruce Elbert. Follows are excerpts from the second chapter entitled “*Earth Station Design Philosophy*”:

The previous chapter provided a historical perspective for the ground segment, laying out how earth stations were created and evolved into higher forms. As a radio communication facility, an earth station receives and, in many cases, transmits a properly formatted signal on a reliable and affordable basis. The first earth stations were designed as major facilities that could house the necessary electronic equipment. Like the radio telescopes and tropospheric scatter sites discussed in Chapter 1, these earth stations were impressive in their scale. They bear some resemblance to major earth stations in modern networks used as uplinks, concentration points, and network management centers. Subscriber terminals, on the other hand, must have fewer components and be simple to operate and maintain. A single-function design philosophy was pioneered with C-band backyard dish receivers and the first VSATs drawn from the consumer electronics and telecommunications equipment businesses.

Network Topology and Information Formats

Communications satellites combine with earth stations to create networks, serving end users with a variety of content and applications. Designing earth stations involves a thorough understanding of network principles in general and as applied in the current context. Figure 2.1 provides a general view of a network based on its geographical arrangement, referred to as the topology. Understanding the origins and destinations of all communications is

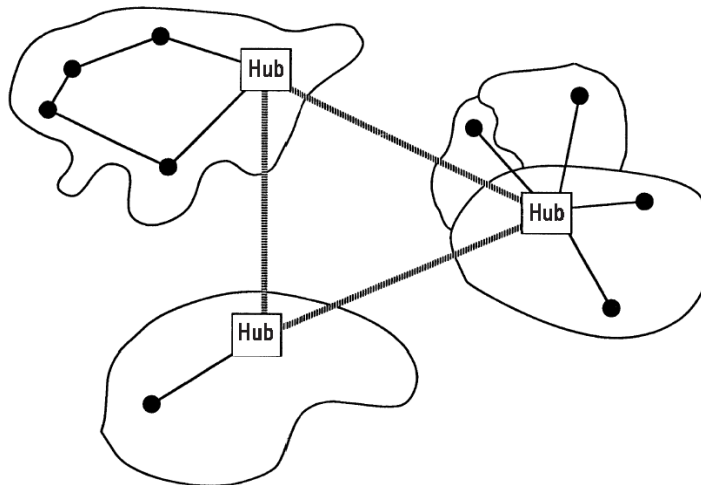


Figure 2.1 A generic network topology featuring hubs, backbone links and sub-networks.

key to being able to overlay an effective network—one that can be implemented and managed. There are a total of five regions to be served and it has been determined that from one to four destination nodes will serve well (indicated by the solid dots connected by branch lines). These could be in local communities or at office parks. At a higher level of this topology we have three telecommunications hubs that aggregate demand from the regions. The hubs are in turn interconnected by backhaul circuits (called trunks in traditional telecommunications systems). Branch lines and backhaul circuits can either be provided by terrestrial links or by the various types of satellite link connectivities to be discussed shortly.

Figure 2.2 provides an example of a terrestrial network with three primary locations that are interconnected by T1 (1.544 Mbps) backhaul circuits. The

latter are offered from telecommunications companies with regional and national infrastructures (LEC for local exchange carrier and IXC for interexchange carrier). The individual channels of communications are obtained by subdividing the T1 channels into their constituent DS0 channels of 64 kbps each. While this type of network is considered old and perhaps obsolete in advanced nations, it nevertheless shows a real-world example of how topology works in the network domain.

The way that earth stations employ a communication satellite is termed the connectivity. Point-to-point connectivity provides a full duplex path between two earth stations using the satellite as a repeater in the middle. As shown in Figure 2.3, we need two paths through the satellite repeater—this is called multiple access. The link can be established on a preassigned (permanent) basis or it can be estab-

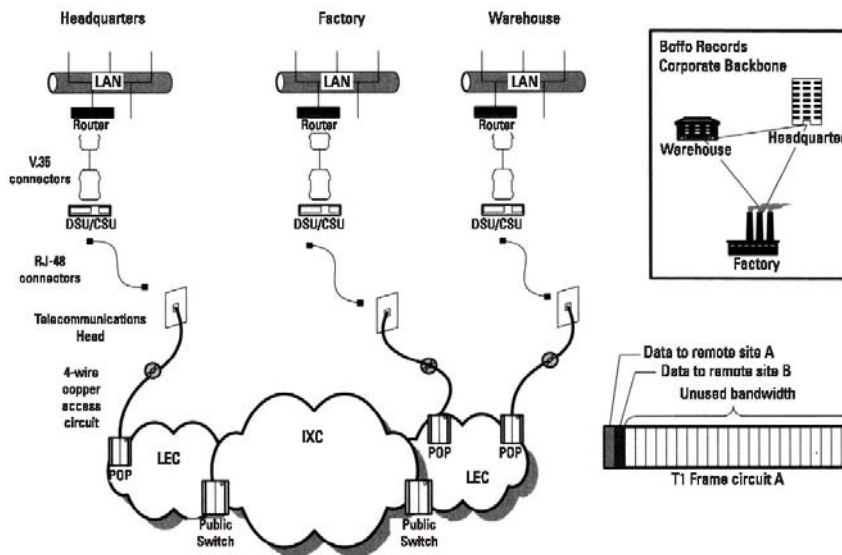


Figure 2.2 An example of a terrestrial network topology to provide classical T1 links to various locations of an enterprise.

lished on demand in response to a short term need. Preassigned links act as backhaul circuits or trunks, while demand-assigned links are used to make a telephone call or other on-demand transmission requirement. In the world of the Internet, on-demand links provide connections for access to websites or to deliver files. The delivery of content in the form of video and audio streams to many locations is the purpose of the point-to-multipoint connectivity. This is also called “broadcast” because the same information is received by all of the sites within the beam on the right. Point-to-multipoint connectivity is how direct broadcast satellites are used to serve a region with millions of home dish antennas. Only one earth station uplink path to the satellite is needed.

Figure 2.5 presents the type of connectivity most commonly found in two-way data communications via satellite. There is one primary uplink, called the hub, from which information is transmitted to all of the remote

antennas. In this case, the remote antennas can also originate data which they transmit on a different channel from the hub. We see that the individual transmissions from the remote sites are in the form of packets or bursts of information, and the link bandwidth is actually timeshared. The hub receives the packets sequentially from the remote sites. Figures 2.3 and 2.5 provide

because the same information is received by all of the sites within the beam on the right. Point-to-multipoint connectivity is how direct broadcast satellites are used to serve a region with millions of home dish antennas. Only one earth station uplink path to the satellite is needed.

Figure 2.5 presents the type of connec-

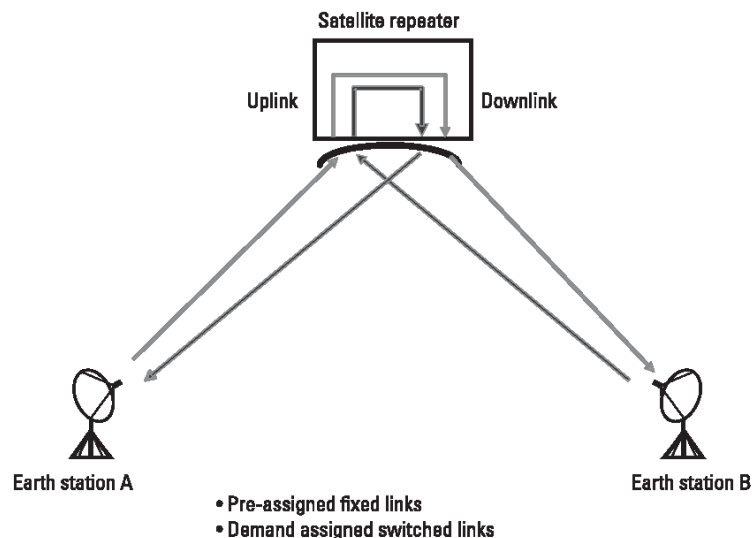


Figure 2.3 Point-to-point connectivity over a satellite between two earth stations. The link could be pre-assigned for a dedicated connection, or demand assigned to address a requirement of limited time duration.

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tivity most commonly found in two-way data communications via satellite. There is one primary uplink, called the hub, from which information is transmitted to all of the remote antennas. In this case, the remote antennas can also originate data which they transmit on a different channel from the hub. We see that the individual transmissions from the remote sites are in the form of packets or bursts of information, and the link bandwidth is actually timeshared. The hub receives the packets sequentially from the remote sites.

Figures 2.3 and 2.5 provide the basis of the two fundamental satellite network topologies—the star and the mesh. A star is formed in the manner of the multipoint “interactive” connectivity, with the hub earth station at the center and the remote terminals connected by the satellite links. For two-way (duplex) transmission, the forward link (also called

the outbound channel) emanates from the hub to all remotes on a single wide-band channel. Within that channel can be found the individual subchannels of information addressed to individual remotes. These subchannels are in the

form of packets of information using the Internet Protocol or other data format. The return link (also called the inbound channel) emanates from each individual remote terminal, as depicted for Figure 2.5. . Most of the communi-

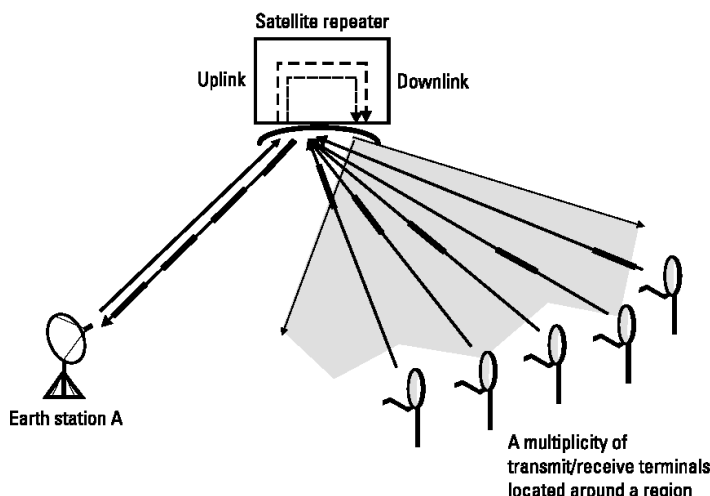


Figure 2.5 Multipoint “Interactive” connectivity that employs a broadcast forward link and many return links from the remote locations. The forward link is continuous in nature and contains data for individual locations, while the return links are time shared to conserve bandwidth.



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cation is between hub and remote, which is on a single hop basis. Communication between a pair of remotes must be via a double-hop that includes the hub. The mesh network topology depicts how each remote site, termed a peer node, can communicate directly with any other node without the transmission passing through a hub station. Avoiding a double hop means that the time delay is reduced, as is the quantity of bandwidth required for the end-to-end data transfer.

The connections can be preassigned to provide backhaul circuits or established on demand. In the case of the latter, there must be a control point that recognizes when a remote requires service, where the desired connection is to terminate (i.e., at which remote), and to instruct both terminals as to the bandwidth to be used. When the transmission need is through, the control recovers the bandwidth to be used for other connections. Operation of a demand-assigned network is much like

that of the telephone network, applying to both the star and mesh topologies.

Putting these elements together, we obtain the architecture of a satellite network. Three segments are included: the space segment, composed of communications satellites (intersatellite links are suggested but not often provided), the ground segment of user terminals (installed at fixed locations and on moving platforms like vehicles, aircraft, and ships), and the large fixed ground stations that control and manage the overall operation. Within the last segment we find the TT&C earth

stations of the satellite operator, gateway stations used to interconnect the user terminals with terrestrial networks like the telephone network and the Internet, and hub stations that operate remote terminals and likewise provide terrestrial network access.



The second edition of the *The Satellite Ground Communication Segment and Earth Station Handbook* is now available at www.artechhouse.com or at www.amazon.com.



Bruce Elbert has over 30 years of experience in satellite communications and is the President of Application Technology Strategy, L.L.C., which assists satellite operators, network providers and users in the public and private sectors. He is an author and educator in these fields, having produced seven books and conducted technical and business training around the world. During 25 years with Hughes Electronics, he directed major technical projects and led business activities in the U.S. and overseas. web : www.applicationstrategy.com/ email: bruce@applicationstrategy.com

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Finding and Fixing Application Performance Problems with WAN Emulators

by DC Palter

Satellite users know better than anyone that latency and packet loss can have as big, if not bigger, impact on application performance than link bandwidth. Applications that aren't specifically tested and optimized to run over a satellite network are unlikely to work well.

Testing is therefore critical, but here, too, satellite users have unique challenges. Satellite time is expensive, conditions can vary dramatically from moment to moment, and what-if scenarios such as adding bandwidth are often impossible to validate beforehand.

Fortunately, there is a convenient and easy solution – applications can be tested using a WAN emulator to replicate the satellite-based IP network. Unlike satellite simulators, which are used to test the satellite communications hardware itself, WAN emulators are designed to test application performance.

Since applications nowadays run almost exclusively on standard IP-based clients and servers, a WAN emulator simply provides Ethernet ports to connect between client and server networks, much like a simple router, but makes all the traffic passing through it appear as if it had traveled over the satellite link. These same emulators are widely used to simulate terrestrial, internet, wireless, line-of-sight, and other types of IP networks, so the costs are reasonable

and start at around US\$ 2,000 for a device that can simulate links up to 100 Mbps.

The most basic WAN emulators can simulate the bandwidth, latency, jitter, and bit errors of the satellite link. More advanced models offer the ability to add background traffic to create realistic congestion, model complex loss conditions, take into account QoS on the network, simulate multiple links at the same time, cause packets to be fragmented, duplicated, or reordered, and replicate various other network impairments. Some emulators can even record the conditions from the real network as they change second-by-second and reproduce those changing conditions in the emulator.

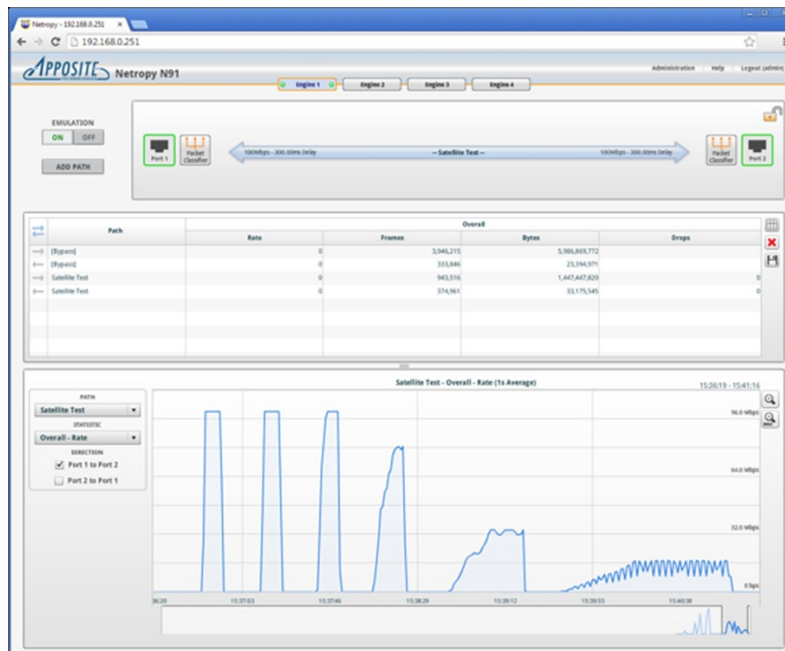


Figure 1: Netropy WAN Emulator screen.

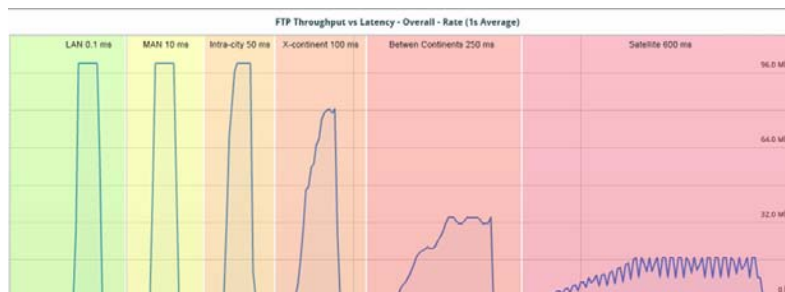


Figure 2: Graphs of test results.

Testing Application Performance

Configuring a test can be as simple as attaching a client device to one port of a WAN emulator and the server to a second port. Of course, instead of a single client and server, entire networks can be connected on either side. Once the link conditions are specified, it's as if the two devices are connected over a satellite. Then simply run the application and observe or measure the results.

Figure 1 shows the user interface of a Netropy WAN emulator from ApPOSITE Technologies. The throughput graph on the bottom half shows the results of a series of tests. While Figure 2 zooms in on the graphs.

This test shows the effect of latency on application

throughput. A 100 MB file was transferred between two Linux machines over different types of links with varying latencies from LAN to satellite. The bandwidth in cases was 100 Mbps. The table below summarizes the results.

Network	Round-trip Latency	Time to Transfer 100 MB File
LAN	0.1 ms	8.9 sec
MAN	10 ms	9.0 sec
Intra-city	50 ms	10.3 sec
Cross continent	100 ms	15.3 sec
Between continents	250 ms	36.5 sec
Satellite	600 ms	82.4 sec

This test shows the effect of latency on application throughput. A 100 MB file was transferred between two Linux machines over different types of links with varying latencies from LAN to satellite. The bandwidth in cases was 100 Mbps. The table below summarizes the results.

As expected, the transfer completes quickly over low latency links and takes almost ten times longer over the satellite link. If you've been involved with satellite communications, you've certainly seen a graph like this before.

What has changed is that you can now run your own tests within minutes for conditions and interest to you using your own applications. While general graphs like this published by vendors and academics are instructive, they don't tell you how your applications will perform over your network. Now it's easy to find out.

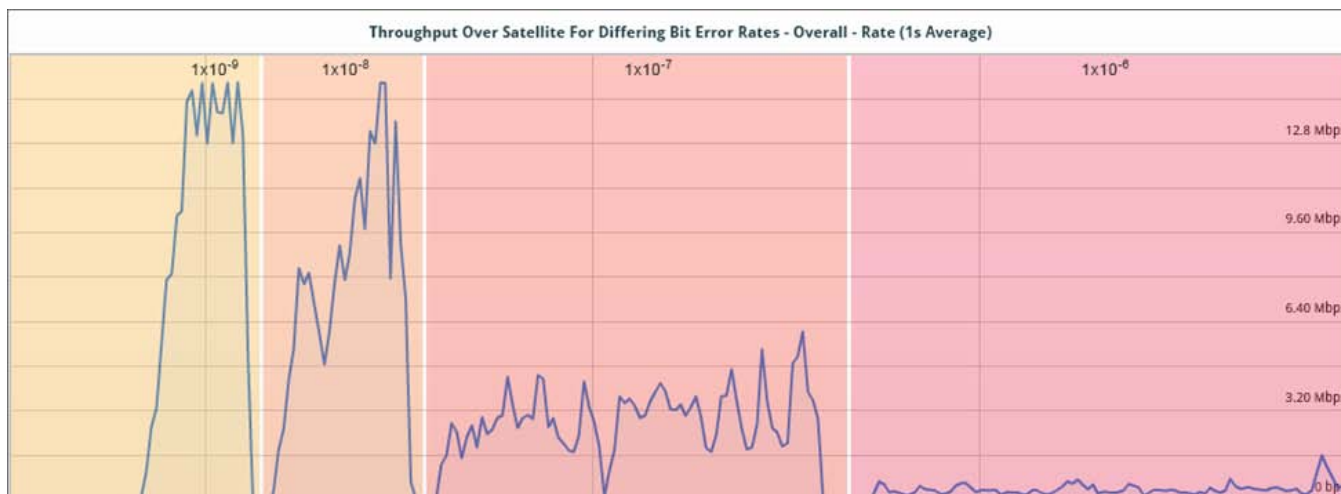
For example, if you want to examine the effect of the bit error rate on performance, simply enter the values of interest to you and run the test again. The figure below shows a series of tests with bit error rates of 1×10^{-9} , 1×10^{-8} , 1×10^{-7} , and 1×10^{-6} . The results are summarized in the table, and show that the same file transfer takes 25x longer to transfer over a link with an error rate of 1×10^{-6} compared to a nearly error-free link.

Of course, this tested only application, FTP, running between two particular Linux machines. Run the same test yourself between two different devices or transfer the file using a different application such as Windows file sharing or HTTP, and you'll likely get very different results.

Bit Error Rate	Time to Transfer 100 MB File
1×10^{-9}	82.4 sec
1×10^{-8}	106.9 sec
1×10^{-7}	300.1 sec
1×10^{-6}	2081 sec

That is why it's critical to test applications yourself. A report, or an article like this, can only show only a few applications and the results are specific to particular devices and network conditions. While that can provide instructive background information, you need to know how your applications – everything from windows file sharing to databases to VoIP and video – will work for your users over your network. And the best way to find out is to run your actual devices and applications over an emulated network configured to match your exact conditions.

Best of all, once you're able to measure the performance of your applications, you can understand where the issues lie



and examine solutions to optimize and improve specific problem areas.

Since the performance issues are caused by the application design and protocols choice rather the bandwidth, latency, and loss conditions themselves, well-designed applications may work surprisingly well over satellite while others may be nearly useless. Even similar applications such as video conferencing from different vendors may work better or worse depending on how well they respond to the network conditions, so testing offerings from different vendors with realistic network conditions needs to be an integral part of any product evaluation and procurement process.

Imagine an oil company with users in remote locations such as Angola and Kazakhstan or stationed on offshore oil rigs. The telecoms team is responsible for installing a satellite network to connect these locations back to headquarters, but the IT team has to make the applications work. To set-up their office applications, they have a variety of architectures they can choose: client-side native applications with or without an accelerators or VDI connected to application infrastructure hosted at a datacenter. Which architecture will work best?

The answer depends on the particular application, the specific acceleration system, and the individual VDI software, as well as the satellite network itself and the amount of bandwidth available per user. One option would be to send all of the different systems out to multiple remote facilities and see what users prefer, but that's expensive, time consuming, and subjective. A WAN emulator makes it simple to compare the alternatives side-by-side, test and optimize each one, then make informed decision.

Fortunately, today's WAN emulators make that both easy and affordable, and every satellite user should have an emulator at hand as part of their tool chest.



DC Palter is president of **Apposite Technologies**, a leader in enterprise-class WAN emulation products, and author of the textbook *Satellites and the Internet: Challenges and Solutions*. He was previously Vice President of Mentat, the pioneer in application performance acceleration. He can be reached at: dc@apposite-tech.com

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What Will Satellite Services Businesses Look Like Tomorrow?

by Robert Bell

I am often asked if the future of the satellite services business is all about consolidation. Over the past decade, we have seen a handful of service providers grow from small, entrepreneurial companies into multinational businesses that operate across every time zone. The “majors” now include Encompass Digital Media, GlobeCast, RRSat Global Communications, Globecom and Harris CapRock, while regional players like Arqiva, SpeedCast and Signahorn Trusted Networks dominate in their regions.

To some, the rise of the majors makes it appear that every teleport in the world will wind up in the hands of one of them, and that the entrepreneurial spirit that has always driven the growth of the business will be snuffed out. It is a bit like the old joke about the US defense budget. As the cost of big weapons systems spirals higher and higher, someone did a bit of arithmetic and calculated that, a few decades from now, the entire budget will buy just one airplane. But it would be one amazing airplane.

Tomorrow's Teleport Business

This month the World Teleport Association will publish a report that looks inside the consolidation trend and compares these acquisition-driven companies to the entrepreneurs who are growing their businesses organically. *Tomorrow's Teleport Business* will explore the opportunities and challenges facing the independent teleport operator in today's marketplace, where serial acquirers are building global businesses that deliver one-stop, end-to-end service to the world's multinational media, maritime, resource, energy and governmental organizations.

Though they lack scale and buying power, entrepreneurs continue to de-

liver significant innovation in applications, technology and operations, which bigger firms with large installed customer bases can find hard to do. Will the market reward the biggest companies with continued growth opportunities or will size pose limits to their progress? Will small companies find themselves squeezed out of opportunity or will they out-innovate and out-perform their larger competitors?

What Technology Businesses Do The Strategic Investor

With interviews still going on, I don't yet know what the answers will be. But I am pretty sure I know what a robust technology market looks like, and I think the rise of the majors is a hopeful sign for the innovators and entrepreneurs who continue to give birth to new service businesses.

A healthy tech business has multiple levels, with companies at different stages of their evolution. Innovators identify a new niche, new application or unmet need and create a company to serve it. In a capital-intensive business like communications services, that is a significant achievement in itself. If the company succeeds, it looks for opportunities to expand into related niches and applications, funding it with cash on hand, friends-and-family and credit.

This describes the teleport business as it existed back in the Seventies and Eighties. At that point, however, the industry began to scale up through acquisition. Some of it made sense and some – like the Verestar fiasco – was revealed to be a financial play with no underlying business rationale. Today, there are nu-

merous solid multinational businesses that have acquired and continue to acquire smaller companies to add capabilities or geographic reach. They serve multinational customers who seek what is essentially an outsourced solution: the ability to take over a complete business process from end to end, whether it is TV program origination or the management of a highly secure data network.

In today's market, the multinationals need the entrepreneurs to find new applications and niches, as well as to provide a pool of capabilities they can integrate into their portfolios. The entrepreneurs need the multinationals because they provide company founders with a reward for their hard work and new capital for expansion. They are also valuable because a strategic investor, seeking to fill a gap in its business, can find much greater value in a service business than a purely financial investor. (Our report, *Best Practices in Teleport Valuation*, goes into the details.)

So, yes, this is a period of consolidation in the industry. It is also a period of entrepreneurship in the industry. They co-exist and are co-dependent, as they are in all healthy technology markets. Just how the dynamic works, and how multinationals and entrepreneurs see the road ahead, will be the subject of *Tomorrow's Teleport Business*.



Robert Bell is Executive Director of the World Teleport Association, which represents the world's most innovative teleport operators, carriers and technology providers in 20 nations. He can be reached at:

rbell@worldteleport.org

Providing Cellular Services to Remote Communities in Malaysia



The Malaysian government has made reliable telecommunications a top priority for every community within the nation's 329,000 square miles. Its Universal Service Provision (USP) program was specifically developed to provide voice and Internet connectivity for people living in its two major land masses, Peninsular Malaysia and East Malaysia, separated by the South China Sea. But reaching the population of approximately 8 million living in rural and remote areas presented a major challenge—as the cost of terrestrial networks is prohibitive, in contrast with the 20 million in metropolitan areas who are well-served by cellular 2G and 3G networks.

Enter Hughes and Maju Nusa Sdn Bhd, a premier Malaysian

satellite service provider. Maju Nusa Sdn Bhd (MajuNusa), incorporated September 1993, is a managed network service provider company based in Malaysia. MajuNusa has been involved in various businesses related to VSAT networks, Mobile Data and Managed Services to provide innovative, reliable and cost effective products and solutions to their customers using state-of-the-art technologies.

Together they have successfully solved the problem by implementing a novel and cost-effective Multiple Operator Radio Access Network (MORAN) solution. So named because the same infrastructure enables multiple operators to deliver services, MORAN is comprised of a Hughes HX System with terminals co-located in each 2G/3G cell site, connecting traffic via satellite between the BTS (base transceiver station) and the core cellular network. Unlike terrestrial solutions for which costs are distance sensitive, employing the HX Satellite Backhaul system means uniform Capex and Opex costs, no matter where the cells are located.

The Malaysian government owns the network and contracts with Maju Nusa to manage it on a long-term basis. Maju Nusa resells wholesale services to the cellular operators which include managing radio, transmission, BSC, and RNC portions end-to-end. Cellular Operators, in turn, resell cellular services to end users.

The Hughes HX system has several key features that enable it to meet and exceed Maju Nusa's network requirements:

- Low latency and jitter, making it ideal for cellular backhaul;
- An optimized encapsulation scheme on the outroute and advanced LDPC (low-density parity check) coding on the inroute, for maximum bandwidth efficiency;
- Integrated traffic management techniques, such as dynamic channel assignment and as-needed sharing of capacity between multiple sites, yielding best-in-class throughput and lowest operational cost on satellite links;
- Interoperability with a wide range of cellular provider networks and technologies.

In addition, the HX system is easily installed by one person



Basic equipment of the Hughes HX system in a cell site in rural Malaysia (photo courtesy of Hughes)

and can be solar powered to increase its versatility in areas with limited infrastructure.

"We have been using the Hughes HX System for the last three years for various services that include broadband Internet, maritime and mobility services. It was last year when we were awarded this GSM deployment project and we can proudly say that

the HX System allowed us to connect remote parts of the country and offer cost-effective backhaul for cellular mobile services without having to worry about jitter and latency on the satellite network," said Faris Najhan Hashim, Chairman of Maju Nusa.

Ramesh Ramaswamy, vice president of sales and marketing, International at Hughes commented, "For people who live in these rural areas, this will be the first time they have cellular service in their communities. Hughes is deeply committed to delivering solutions that meet the challenge of providing cost-effective communications in rural and remote areas worldwide."

With this important initiative, people across Malaysia will be connected to the global Internet marketplace and have the opportunity to help expand its economy, now the world's 29th largest and third largest in Southeast Asia, with steadily growing manufacturing, agriculture, tourism and financial services industries—no matter where they choose to live or work.



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Space Symposium Highlight Market Disruptions

by Elisabeth Tweedie, Associate Editor

For the first time in many years the Space Symposium was held in May, and therefore did not clash with the annual NAB (National Association of Broadcasters) Show. This gave those who normally choose Las Vegas over Colorado Springs the opportunity to attend. However, the change of date had nothing to do with the NAB schedule, it was merely to permit renovations at The Broadmoor Hotel in Colorado Springs, where the symposium is held, to be completed. This year also marked the year that the word “National” was dropped from the title. Considering that the 11,000 attendees came from 26 different countries, this seems like a good decision.

However in the United States, Colorado has the nation’s third largest aerospace economy, after California and Florida (number one and two respectively), being home to such well known indus-

try names as Echostar, ViaSat Excede (formerly WildBlue), Goodrich, GeoEye, Kratos, Lockheed Martin and Raytheon, to name but a few.

During the symposium, Colorado Governor John Hickenlooper, took the occasion to sign into law House Bill 1178: Sales and Use Tax Exemption for Qualified Property Used in Space Flight. This means that space equipment may now be stored in Colorado without incurring any tax liabilities. The bill is part of the state’s strategic initiatives to move Colorado to at least the number two place in the aerospace economy ranks. Ironically – largely at the behest of Elon Musk (Founder and Chief Designer, SpaceX), California also passed a bill granting tax exemptions to certain property used in space flight in April of this year.

That bill was not the only thing that got signed during the course of the conference. Doubtless there were numerous non-disclosure agreements and contracts changing hands during the many side meetings that were taking place around the Broadmoor; but on a larger scale The US, The UK, Canada and Australia, announced that they had signed a Memorandum of Understanding (MoU) committing them to “a partnership on combined space operations”. It may be a few years before we learn precisely what that means. From various comments made during presentations at the symposium it appears that one focus is definitely space situational awareness.

on activities such as identifying and understanding what objects are in space,

A British statement mentioned that “the partnership will allow for more effective and coordinated use of space capabilities through cooperation on activities such as identifying and understanding what objects are in space,

ensuring uninterrupted satellite operations, and avoiding satellite collisions”.

Most of the sessions taking place had a strong civil and military focus, as is traditional at the symposium. However one panel, “How consumers are disrupting the SATCOM market” had a totally different focus. Bruce Hoffmeister, Global Chief Information Officer, Marriott International, was the first speaker and he gave some interesting statistics illustrating how significantly things will be changing in the next few years. By 2025 the population of Africa will be greater than the population of China; at the end of last year there were 650 million mobile phone users in Africa, and by the end of next year that figure is projected to rise to one billion. This is notable, not only because of the amount of



11,000 people participated in the 30th Space Symposium. The numbers include representatives of more than companies and organizations from 26 countries.

(photo courtesy of the Space Foundation)

bandwidth that will be required to support this, but also, due to the inadequacy of the fixed infrastructure, for the sheer volume of commerce that will be handled by these mobile devices. Currently 50% of the Kenyan GDP moves through mobile transactions. More generally, by 2019 Generation Y (otherwise known as the Millennials) will represent 50% of the world population and as we all know this is the technology generation, who expect – and create – a technology driven world.

Kevin Hertz, Chief Technology Officer and Co-Founder, VoxOx (a VOIP provider) talked about how traditional cellular operators were being impacted by Over the Top (OTT) services. He reported that last year the mobile community lost US\$ 180 Billion in revenue to OTT, with six times the number of OTT messages being sent each day than there are regular SMS texts. One third of all international calls are now made through an OTT service. While Bruce and Kevin gave some very interesting and significant figures relating to changing bandwidth consumption, it was left to Peter Platzer, Co-Founder and CEO, Nano Satisfi to provide some interesting satellite statistics. As would be expected from the name his company builds nano satellites – three of which went from design in a garage, to being in orbit in the space of nine months. He reported that next year there will be more nanosats launched than the sum total of all satel-

“...next year there will be more nanosats launched than the sum total of all satellites that have been built to date....”

lites that have been built to date. An interesting thought; that space situational awareness agreement came not a moment too soon!



Elisabeth Tweedie has over 20 years experience at the cutting edge of new communication and entertainment technologies. She is the founder and President of Definitive Direction a consultancy that focuses on researching and evaluating the long term potential for new ventures, initiating their development and identifying and developing appropriate alliances. During her 10 years at Hughes Electronics she worked on every acquisition and new business that the company considered during her time there. www.definitivedirection.com She can be reached at:

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CommunicAsia 2014 Showcase New Products, Innovation

by Virgil Labrador, Editor-in-Chief

CommunicAsia in Singapore this year served once again as a platform for companies to launch new products and services for the Asia-Pacific region. Attracting over 50,000 attendees from over 50 countries, the exhibition featured 2,000 exhibits, 160 of which were satellite companies.

One of the most notable product launch was Thailand-based satellite operator Thaicom, which become the first in Asia to introduce commercial In-Flight Connectivity Services using Ku-band to provide broadband on commercial flights. Thaicom announced a deal with Thailand's premium low cost airline Nok Air, which last year transported nearly six million passengers. With 48,000 flights per year the

and fixed networks. However remote the location, the IsatHub service will enable a user to talk, text, access the internet and apps using their own smart device. Todd McDonnell, V-P Global Government Solutions of Inmarsat said that the iSatHub product has a compelling case for widespread consumer adoption with its small size, portability and costs competitive with cellular services.

Newtec also launched for the Asian

pecially design for the satellite Industry, Satmotion Pocket opens the door to final customer VSAT installation; and now with Google Glass both hands are free for antenna alignment purposes, allowing the installer to look at the critical line up parameters in the most extreme weather conditions.

Austria-based Siemens Convergence Creators launched **its new one satellite interference localization solution** called SIECAMS® ILS ONE which puts

next-generation geolocation at the fingertips of satellite operators. Overcoming the limitations and complexity of existing interference localization tools, it is an ideal solution for ensuring high-quality satellite communication, without the need for adjacent satellites.

I was privileged to moderate a couple of sessions at the Satellite track of the CommunicAsia Summit Conference. One



Newtec VP for Asia Mario Querner speaking at the launch of their Dialog platform at CommunicAsia 2014. Behind him is Newtec CEO Serge van Herck.

carrier will provide broadband Wi-Fi services on many of its aircraft starting in August. The unique feature of the in-flight service is that it will be offered by Nok Air free of charge. Nok Air CEO Patee Sarasin said that providing in-flight wi-fi on a complimentary basis is what consumers expect, just as free wi-fi is now readily available in cafes and other public area.

Inmarsat launched its IsatHub product with live demos at their booth. Scheduled for commercial launch in August 2014, the new service will be a powerful, portable solution available for connecting smart devices when users are beyond the reach of terrestrial mobile

market its Dialog® platform, a scalable and flexible multiservice satellite communications platform that allows satellite service providers to build and adapt their network easily as their business grows. Key features of the Dialog® platform include the ability to support multiple satellites, multiple frequency bands, regular and spot beam satellites and is scalable from 5 to +100,000s of terminals.

Spain-based satellite monitoring company INTEGRASYS released its Satmotion Pocket Remote Commissioning Solution for Google Glass, at CommunicAsia. As the first Google Glass App es-

session was on "The Changing Business of Teleports." This is a subject close to my heart as I worked in the teleport business in Singapore at the beginning of my career. Speakers including Doron Revivi, COO of Satlink, Sandeep Kumar, Head of Global Sales at Telstra and Keith Ramsey, VP-Engineering of Gateway Teleport, took turn in highlighting the changes in the teleport business in view of the new multimedia delivery environment today. Changing customer requirements have led teleports to provide many innovative services. The panel emphasized the need for creative solutions that utilizes a hybrid of satellite and terrestrial services.



U-Verse is the Key to the Proposed ATT/DirecTV Merger

by Armand Musey

AT&T's proposed US\$ 48 billion acquisition of DIRECTV is based on two simple business facts: 1) AT&T has broadband but needs a stronger video product to compete with cable; and 2) DIRECTV needs a voice and broadband product to compete with cable. By combining services, they can save money on customer service, back office and an estimated \$1.6 billion in annual programming costs. On the surface, it seems like a merger that will create a stronger competitor to cable systems everywhere. So what's the regulatory concern?

The first issue is that AT&T has a video offering with its U-Verse service. U-verse is a state of the art high-end fiber to the node (FTTN) service that also offers video, much like Verizon's FiOS. Thus in markets where U-verse operates, video competition will be reduced. But this is not an insurmountable hurdle.

AT&T/DIRECTV will argue that consumers will still have two other options in those markets – DISH and the local cable company, not to mention OTT services such as Netflix, Hulu and Amazon Prime. Moreover, mobile broadband speeds are approaching the point where they will be able to offer a competitive video service in the foreseeable future. In necessary, AT&T could also a third party to market U-verse to ensure it competes with DIRECTV – much in the way Time Warner allowed Road Runner to market its internet service after the AOL merger.

The second issue is that content providers will likely object on the grounds the combined entity will have disproportionate buying power. But we don't believe this will be a significant regulatory issue. The buying power of the

combine entities is roughly 26 million homes. This is well below the 30% informal market share screen used for identifying disproportionate media buying power. And it's certainly well below the buying power of a combined Comcast/Time Warner merger.

The third and largest hurdle to FCC approval is the FCC's analysis of merger's medium to longer-term impact on broadband deployment in the US. And this issue is far more complicated. This is because building out U-verse is very expensive. The current U-verse business model is dependent on a combination of revenue from voice, video and data subscriptions. In many

“...For the AT&T/DIRECTV merger to succeed, it likely will need to offer significant evidence that it will not slow its investment in new broadband deployment, particularly U-Verse...”

areas AT&T cannot justify it even with these three revenue streams that total an average approximately \$106 per month. If AT&T acquires DIRECTV, they would be able to get video subscribers from DIRECTV, a much more economical system for video broadcasting. U-verse would lose the video revenue stream and it would be harder to justify additional U-verse build-out. Moreover, any additional build-out might be done cheaper and with less capacity as it would not need to offer speeds sufficient to support a robust video offering. AT&T's ability to save on these U-verse capital expenditures is undoubtedly one of the primary benefits of the merger. But it's also one of the potential problems from the FCC's perspective.

The FCC's mission, to a large part, is to facilitate the deployment and adoption of advanced communi-

cations services. But if AT&T acquires DIRECTV and is incentivized to slow U-verse build-out, that goal is undermined. And it is significant. U-verse uses the most advanced communication technology and is run by one of the country's largest telecom behemoths. This is at a time when the FCC is already on the defensive due to a perception that landline Internet speeds in the US are slower than other countries and putting the country and an economic disadvantage. Moreover, if the FCC approves an AT&T/DIRECTV merger, they will be hard pressed to deny a merger between DISH and Verizon, potentially creating an opportunity for them to reduce investment in their

FiOS system. A slowdown of U-verse deployment, not to mention a slowdown of FiOS deployment, would put a massive dent in the country's broadband growth. Is this what the FCC Commissioners want to see happening on their watch?

For the AT&T/DIRECTV merger to succeed, it likely will need to offer significant evidence that it will not slow its investment in new broadband deployment, particularly U-verse. AT&T is emphasizing its potential savings on programming savings when, the regulators' eyes are going to be on the potential CapX savings that could slow the country's broadband deployment.



J. Armand Musey heads Goldin's Media, Telecom and Satellite Practice. Armand specializes in the satellite, media and telecommunications industries. He has a unique blend of 16 years of equity research, investment banking and consulting experience. He can be reached at: amusey@goldinassociates.com

KVH Industries Acquires Videotel

Midletown, R.I., July 3, 2014 – KVH Industries, Inc., announced that it has acquired Videotel, a producer of high-quality training films and e-Learning services for the commercial maritime industry. Servicing over 11,000 vessels, Videotel is a market leader in the provision of maritime training services, offering video, animation, e-Learning computer-based training (CBT), and interactive distance learning courses.

“The acquisition of Videotel is an important addition to our portfolio of services targeting the needs of commercial seafarers and supports our strategic vision of extending our maritime broadband service to include delivering premium content to vessels,” said Martin Kits van Heyningen, KVH’s chief executive officer. “We already offer maritime companies crew connectivity through our mini-VSAT Broadband network, including Internet café,

Voice over IP phone calls, and crew entertainment services via our IP-MobileCast service. With this acquisi-



tion, we will now also offer an extensive library of seafarer training courses and related training services.”

“Videotel operates in a growing sector of the e-Learning market where in-

creasing levels of regulation and a shortage of trained and experienced seafarers drive the need for comprehensive training solutions,” Mr. Kits van Heyningen added. “The £28.7 million (US\$ 48.9 million) transaction is anticipated to be accretive to KVH earnings per share in 2014. The company financed the transaction from its cash on hand and proceeds from a new credit facility.

The audited financial statements of the acquired Videotel group companies showed annual combined revenues in 2013 of £14.0 million, of which approximately 93% was derived from multi-year subscription-based services. During 2013, Videotel’s combined gross profit margin was approximately 73%.

Akin Gump Strauss Hauer & Feld LLP acted as legal counsel to KVH.



Speedcast Purchases Oceanic Broadband

Singapore, June 18, 2014 – SpeedCast, announced at CommunicAsia the acquisition of Oceanic Broadband, an integrator and solutions provider in the Oceania region.

Oceanic Broadband specializes in providing end-to-end wireless and satellite services, and has been a long-term SpeedCast partner. The successful relationship has seen the companies support a broad range of customers and applications, particularly in the Papua New Guinea market, which accounts for the majority of Oceanic’s business.



With Oceanic’s technical expertise and network infrastructure in Papua New Guinea, SpeedCast strengthens its ability to design, install, operate and support communications networks for its oil & gas, mining and NGO customers, as they expand into this growing market. In particular, the Port Moresby teleport will provide SpeedCast customers with the benefit of an additional point of presence and allow them to connect their remote sites to Port Moresby in one single satellite hop, according to a company statement.

Oceanic’s outstanding customer base in the natural re-

source, Government, and NGO sectors will benefit from SpeedCast’s extensive engineering and support capabilities, world-class network infrastructure, global coverage and broad portfolio of communications solutions. The acquisition further reinforces SpeedCast’s dedication to delivering the best-in-class communications services to its customers operating in the Australasian markets.



Pierre-Jean Beylier, CEO of SpeedCast, said: “This latest investment, like

our recent SatComms Australia acquisition, further cements our ability to provide our natural resource customers with an unmatched level of local infrastructure and support in the key markets where they operate. In addition, it establishes a strong point-of-presence for SpeedCast in the fast growing PNG market, strengthening our position as the leading satellite service provider in the Asia-Pacific region.”

This acquisition follows SpeedCast’ other acquisitions of satellite companies in the Australasia region, including Australian Satellite Communications, Pactel International and SatComms Australia, over the past 18 months, as well as Elektrikom Satellite Services in the maritime sector.



XCOR Acquires Space Expedition Corp.

Mojave, Calif., July 1, 2014--XCOR Aerospace announced that it has closed the acquisition of all operational subsidiaries of Space Expedition Corporation, the previously independent Dutch company also known as SXC.

SXC served as XCOR's general sales agent for XCOR Lynx flight sales and as their lead wet lease customer. The new sales entity, XCOR Space Expeditions, will continue to focus on sales, commercial partnerships and participant (customer) training on a global level, and will serve as an open sales channel available for all future XCOR Lynx wet lease clients.



XCOR's Lynx Mark-I spacecraft which will carry paying passengers into space.

Expeditions, we look forward to making the most of their expertise and insights with customers and commercial partners. With their sales and marketing engine now a part of the XCOR brand, we deepen the connection between customers and Lynx."

"Both as a founder of SXC, and through my background in e-Business and Formula One, I understand that exceptional engineering and design are vital for performance and the overall customer experience," said SXC co-founder and XCOR Aerospace board member Michiel Mol. "XCOR Aerospace is the best I've

seen in spacecraft and rocket engine design. With this acquisition XCOR Space Expeditions will provide direct connection to the XCOR brand and more up-to-date information about Lynx for individual ticket holders, wet lease customers and commercial partners. The result is an integrated XCOR that will inspire our customers and investors, and deliver a more seamless and exciting experience overall."

Detailed terms of the transaction were not disclosed. The all-stock transaction was reviewed by the United States Treasury Department's Committee on Foreign Investment in the US (CFIUS) which determined the acquisition and exchange of shares was not a "covered transaction."



Google Buys Skybox Imaging

Mountain View, Calif., June 13, 2014--Google has entered into an agreement to buy Skybox Imaging for US\$ 500 million in cash, subject to adjustments. Skybox's satellites will help keep Google Maps accurate with up-to-date imagery.

"Over time, we also hope that Skybox's team and technology will be able to help improve Internet access and disaster relief — areas Google has long been interested in," said Google in a statement.

In a company statement, Skybox Imaging said: "We've built and launched the

world's smallest high-resolution imag-



ing satellite, which collects beautiful and useful images and video every day. We have built an incredible team and

empowered them to push the state-of-the-art in imaging to new heights. The time is right to join a company who can challenge us to think even bigger and bolder, and who can support us in accelerating our ambitious vision."

Google's acquisition of Skybox Imaging makes sense for the search giant's Google Maps and Google Earth offerings. Google now has access to the company's high-quality, real-time photos and videos, according to analysts.

The transaction is subject to customary closing conditions, including regulatory approvals in the US.



Irdeto Appoints New SVP for Sales & Marketing

Amssterdam, The Netherlands, July 2, 2014—Irdeto announced the appointment of Richard Scott as SVP of Sales and Marketing. His new role with Irdeto will encompass strategic planning for key accounts, new business acquisition, developing new growth opportunities, leading Irdeto's global sales and marketing team.



Richard Scott

Before joining Irdeto, Richard spent over six years as Senior Vice President Global Sales & Service at Harris Broadcast where he oversaw over \$300M in global sales leading multiple cross functional teams and employees based in offices on all continents. Prior to that, he was senior vice president, systems and technology services, EMEA, at Ascent Media, where he led the expansion of a systems integration business into EMEA. Richard also spent five years as vice president and managing director of EMEA for Pinnacle Systems, seven years as director at Sony Corporation and eight years as technical director at Panasonic.

Scott will be based and work from one of the company's largest global offices in Hoofddorp, Netherlands. He holds a degree in Electrical & Electronic Engineering from the University of Portsmouth (UK) as well as diplomas in General Management from The University of Cranfield (UK) and IMD Lausanne (Switzerland).

Cooning Appointed President of Boeing N&SS

St. Louis, Mo., July 1, 2014—Boeing has named Craig R. Cooning president of its Network & Space Systems (N&SS) businesses, effective immediately. Cooning succeeds Roger Krone, who took a posi-

tion at another company.

Cooning had been the vice president and general manager of Space & Intelligence Systems within N&SS. He now reports directly to Chris Chadwick, president and CEO of the Boeing Defense, Space & Security business unit.



Craig Cooning

Cooning is a retired U.S. Air Force major general who concluded his military career as director of Space Acquisition in the Office of the Under Secretary of the Air Force. Starting today he leads Boeing's activities in intelligence, security, and surveillance systems, information systems, and space exploration, in addition to its satellite work.

Cooning, who holds degrees from Auburn University and the University of Alabama, will also be on the board of directors of United Launch Alliance, the Boeing-Lockheed Martin rocket launch joint venture.

Azibert Takes on Commercial and Development Responsibilities at Eutelsat

Paris, France June 16, 2014

—Eutelsat Communications announced changes in the management structure with Michel Azibert, Deputy CEO, taking commercial and development activities under his direct responsibility as of June 23. He succeeds Jean-François Leprince-Ringuet who becomes special advisor to the CEO.

Michel de Rosen, Chairman and CEO of Eutelsat, commented: "Under the commercial leadership of Jean-François



Michel Azibert

Leprince-Ringuet, Eutelsat has broadened its business in terms of applications and regions served, strengthened its sales force and increased proximity to clients via offices in key markets. With commercial activity now placed under the stewardship of Michel Azibert, and a tightened management structure, we will more than ever focus our energies on enhancing the quality of service we provide our customers, expanding our user base and seizing opportunities presented by an evolving business environment."

Michel Azibert joined Eutelsat as Deputy CEO in 2011 from TDF where his appointments included Development and International Director and Group Deputy CEO.

MEASAT Promotes Alex Tan to Senior Sales Director

Kuala Lumpur, Malaysia, June 16, 2014—MEASAT Satellite Systems Sdn. Bhd.

announced the promotion of Alex Tan from Sales Director to Senior Sales Director – Telecoms & VAS (Asia Pacific). In his new role, Alex will continue to lead the Asia-Pacific Telecoms sales team with focus on growing MEASAT's business across the region.



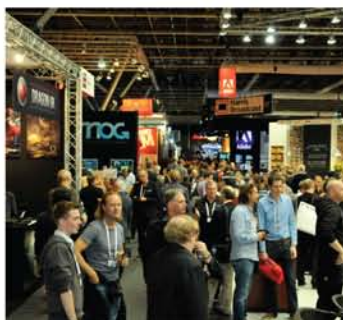
Alex Tan

Alex has over 17 years of experience in the satellite and telecommunications industry. Prior to joining MEASAT, Alex served as Senior Regional Manager, Business Development with SpeedCast Limited, focusing on development of VSAT business within South East Asia, Indochina and Central Asia.

Alex holds a Bachelor of Engineering in Electronic Engineering, majoring in telecommunications. He graduated with Honours (2nd Class Upper) from University of South Australia, Australia.

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Global Connected TV Passes One Billion Units

Boston, Mass., July 10, 2014--The global installed base of Connected TV devices (including Smart TVs, Games Consoles, Blu-ray Players, Digital Media Adapters and Set-Top Boxes) will double over the next 5 years exceeding 2 billion units by 2018 according to the Strategy Analytics Connected Home Devices (CHD) service report.

Other key findings from the report include:

- IP connectivity is fast becoming ubiquitous as IP-enabled CE devices accounted for 87 percent of all CE devices shipped in 2013.
- Global households own an average of 2.8 connected CE devices with the USA seeing the highest levels of ownership at 7.7 devices.
- Global retail spend on Consumer Electronics products will exceed US\$ 1 trillion for the first time in 2017.
- Average global retail spend per household on all Consumer Electronics products grew 2.9 percent in 2013 reaching US\$ 485.00.



David Watkins, Service Director, Connected Home Devices commented: "The growth in ownership of Connected TV devices is having a profound effect on the way in which people access and consume media content on the TV set. Furthermore they are helping to provide opportunities for companies outside of the traditional TV industry such as Google, Apple and Amazon to compete for a share of the TV audience."

Eric Smith, Analyst, Connected Home Devices said: "On a global scale, IP-enabled flat panel TVs are the most common Connected TV device in living rooms today, occupying close to 30 percent of the installed base of such devices, a figure that is set to rise towards 50 percent by 2018. However, that is not to say that IP-enabled TVs will necessarily become the default device that consumers use to access OTT content as there will continue to be various device options available to consumers."



Demand for Nano and Microsatellites Increasing

Wilmington, DE, July 7, 2014—NSR's Nano and Microsatellite Markets report, released today, finds increasing reliability and capabilities driving uptake of 1-50 kg satellites across all applications, operators, and regions. In 2013 this nascent market surged into view with a trebling of total launches compared to 2012, and this higher launch rate will be sustained through the remainder of the decade and beyond.

Opportunities exist to use nano/micro satellites both as a complement to existing GEO assets and as independent missions.

Originally a platform for university and technology development projects, we are now seeing interest from the commercial, government, and military sectors in using 1-50 kg satellites operationally, explains NSR Analyst and

report author Carolyn Belle. Operators who had been waiting for these platforms to demonstrate reliability and sufficient capabilities are now beginning to build satellites and deliver services in Earth Observation, Science, and Tracking/AIS. Because they are so cheap and fast to build, 1-50 kg satellites can rapidly address changing needs and new opportunities with little risk to the operator. NSR forecasts that Earth Observation will experience the most growth, largely driven by commercial and military constellations.

The low cost per unit of these satellites facilitates the creation of constellations; operators will use the high revisit rate provided by constellations as compensation for low spatial resolution, less precise measurements, or fewer instruments per satellite. Constellations will be a dominant element in the

1-50 kg market over the next 10 years, a trend that has already begun to manifest.

Despite growing capabilities and demand for nano/micro satellites, NSR finds that the market will continue to be restrained by limited launch opportunities.

Whether operators are most impacted by the minimal control regarding orbit, schedule, or risks of a rideshare launch model, more diverse offerings in the launch market are required to address nano/micro satellite operator needs. Fortunately, heightened demand for launch slots and the promise of continued demand due to rapid constellation replacement cycles means that the time is right for one of the many dedicated nano/micro satellite launcher projects to finally reach fruition.



The Satellite Markets 25 Index™

Company Name	Symbol	Price (Jul 15)	% Change from Last Month	52-wk Range			% change from 52-wk High
Satellite Operators							
Asia Satellite Telecommunications	1135.HK	30.95	-1.12%	27.50	35.00	↓	11.57%
Eutelsat Communications S.A.	ETL.PA	24.97	-2.76%	20.41	25.88	↓	3.53%
APT Satellite Holdings Ltd.	1045.HK	12.48	17.96%	6.08	12.54	↓	0.48%
Inmarsat Plc	ISAT.L	745.50	1.92%	80.01	784.00	↓	4.91%
SES GLOBAL FDR	SES.F	27.437	2.51%	20.81	28.66	↓	4.28%
Satellite and Component Manufacturers							
The Boeing Company	BA	129.10	-4.55%	101.77	144.57	↓	10.70%
COM DEV International Ltd.	CDV.TO	4.16	6.67%	3.42	4.40	↓	5.45%
Lockheed Martin Corporation	LMT	162.62	-0.63%	112.57	168.87	↓	3.70%
Loral Space & Communications, Inc.	LORL	72.37	0.04%	60.38	82.13	↓	11.88%
Orbital Sciences Corp.	ORB	29.55	12.87%	17.26	34.16	↓	13.50%
Ground Equipment Manufacturers							
C-Com Satellite Systems Inc.	CML.V	1.45	0.69%	1.32	2.37	↓	38.82%
Comtech Telecommunications Corp.	CMTL	35.20	7.74%	23.84	40.48	↓	13.04%
Harris Corporation	HRS	73.16	-5.29%	51.42	79.32	↓	7.77%
Honeywell International Inc.	HON	95.96	3.02%	78.88	96.49	↓	0.55%
ViaSat Inc.	VSAT	57.04	5.18%	53.03	74.78	↓	23.72%
Satellite Service Providers							
Gilat Satellite Networks Ltd.	GILT	4.78	-3.04%	4.09	6.11	↓	21.60%
Globecom Systems Inc.	GCOM	14.10	0.00%	10.49	14.91	↓	5.43%
International Datacasting Corporation	IDC.TO	0.1150	15.00%	0.07	0.23	↓	50.00%
ORBCOMM, Inc.	ORBC	6.74	5.64%	4.51	8.21	↓	17.90%
RRSat Global Communications Network Ltd	RRST	8.95	-1.76%	6.97	9.60	↓	6.77%
Consumer Satellite Services							
British Sky Broadcasting Group plc	BSYBY	61.573	3.40%	50.09	63.79	↓	3.48%
DIRECTV	DTV	86.49	4.91%	57.05	89.46	↓	3.32%
Dish Network Corp.	DISH	65.33	11.37%	42.85	67.50	↓	3.21%
Globalstar Inc.	GSAT	4.15	19.94%	2.33	4.53	↓	8.39%
Sirius XM Holdings Inc.	SIRI	3.38	3.05%	2.98	4.18	↓	19.14%

INDEX	Index Value (July 15, 2014)	% Change from Last Month	% Change Jan. 03, 2014
Satellite Markets 25 Index™	1,757.56	1.72%	2.73%
S & P 500	1,973.28	2.58%	7.75%

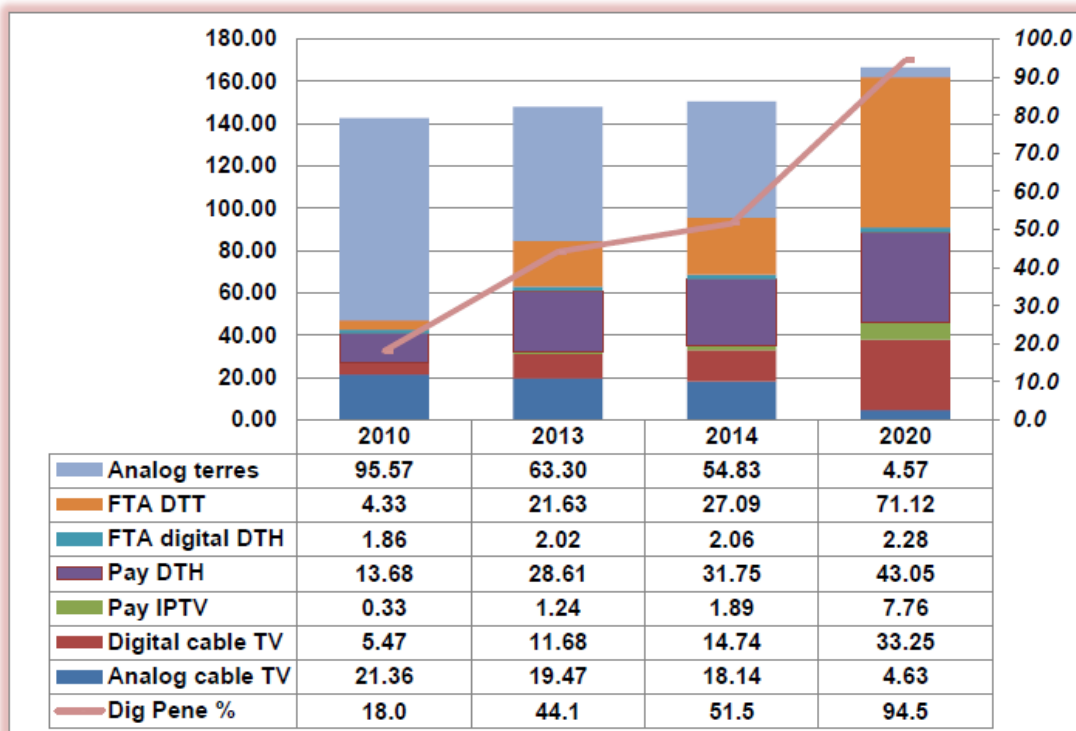
The Satellite Markets 25 Index™ is a composite of 25 publicly-traded satellite companies worldwide with five companies representing each major market segment of the industry: satellite operators; satellite and component manufacturers; ground equipment manufacturers; satellite service providers and consumer satellite services. The base data for the Satellite Markets Index™ is January 2, 2008--the first day of operation for Satellite Market and Research. The Index equals 1,000. The Satellite Markets Index™ provides a benchmark to gauge the overall health of the satellite industry.

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DTT Driving Digital TV Growth in Latin America

Latin America TV household forecasts by platform (million)



Digital TV is finally taking off in Latin America – from only 18.1% penetration of TV households at end-2010 to just over the halfway mark by end-2014 and onto 94.5% by 2020, according to a new report from Digital TV Research. To put it another way, 132 million digital TV households (in the 19 countries covered in the [Digital TV Latin America](#) report) will be added between 2010 and 2020 to take the total to 157 million. DTT will provide half of the additional digital TV homes to be added between 2010 and 2020.

Simon Murray, Principal Analyst at Digital TV Research, said: “Much of this growth is being driven by satellite TV, especially lower-cost and prepaid packages – although these subscribers are forcing down average ARPU figures.”

Nearly 14.4 million pay satellite TV households will be added between 2013 and 2020, with 3.1 million more in 2014 alone. Pay satellite TV penetration will grow from 9.6% in 2010 to 21.1% by end-2014 and onto 25.8% in 2020 – indicating that much of the fast growth has already taken place.

Pay satellite TV is the leading digital platform, but primary FTA DTT will overtake it in 2015. The number of primary DTT homes will rocket from 4.3 million at end-2010 (3.0% penetration) to 27.1 million in 2014 (18.0%) and onto 71.1 million by 2020 (42.7%).





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Calendar of Events

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Web: www.setexpo.com.br

Conference: 11 - 15 September 2014, Exhibition: 12 - 16 September 2014, **IBC 2014** - RAI Amsterdam, the Netherlands,
Phone +44 (0) 20 7832 4100 E-mail: info@ibc.org Web: www.ibc.org

September 17-19, 2014, **VSAT 2014**, Millennium Gloucester Hotel, London, UK, phone **Tel:** +44 (0)20 7017 5506,
E-mail: itmevents@informa.com Web: www.vsatevent.com

October 6-8, 2014, **MILCOM 2014**, Baltimore Convention Center, Baltimore, MD, Contact: AFCEA Events, Phone +1-703-631-6130, E-mail: events@afcea.org Web: www.milcom.org

October 27-30, 2014, **CASBAA Convention 2014**, Hong Kong, Contact: Cherry Wong, Phone +852 3929 1714,
E-mail: cherry@casbaa.com Web: www.casbaa.com

28-29 October 28-29, 2014, **VSAT Mobility 2014**, The Mira Hotel, Hong Kong Phone: +44 (0)20 7017 5506
E-mail: itmevents@informa.com Web: www.mobility.vsatevent.com

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August 25-27



Advantech Wireless is your one-stop source for advanced, affordable, reliable solutions for all your RF, Satellite and Wireless Communications needs. We design, manufacture and deploy networking solutions for broadband connectivity, broadcast solutions and backhaul requirements using satellite and terrestrial wireless communications.

The New SapphireBlu™ Series of UltraLinear™ GaN based SSPAs and BUCs is the **Ultimate Solution for DTH TV**. Able to cover simultaneously all transponders of a specific satellite, regular or extended bands. Low energy consumption, high efficiency and high reliability.

The new line of VSAT Discovery Hubs based on Adaptive Satellite Access Technology (A-SAT™) is designed to minimize the cost of upgrading and is capable of meeting the functional and performance requirements of the most demanding system configurations. Whether you need to service 10, 1000 or 10,000 subscribers - Advantech Wireless has the best solution.

For broadcast backhaul needs, nothing beats Advantech Wireless Microwave Radios and satellite broadcast solution. Being the first to market with True Adaptive Coding and Modulation, optimized for Next Generation Telecom and Digital Broadcast Networks.

Advantech Wireless manufactures solid state, embedded, efficient and reliable solutions for IP networking. We offer a complete line of Antennas. From the smallest 75cm VSAT to 16m Broadcast Antennas at the best possible price. We have total solutions to meet your needs.



Next Generation Discovery Series
VSAT with A-SAT™ Optimization



1250W Ku-Band
GaN Based - SapphireBlu™ Series



DVB-S/S2 Broadcast Modems



Modular Design with built in Redundancy
3kW Ku-Band System
GaN Based - SapphireBlu™ Series



One button - DSNG / Flyaway
Fully Integrated Antennas,
Controllers & Modems



Satellite Frequency Converters &
Test Loop Translators



6.6kW C-Band or X-Band
Rackmount SSPA
GaN Based - SapphireBlu™ Series



Government &
Military Applications

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