

特集

米国におけるコンシューマ向けブロードバンド衛星  
サービスの現状

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編集部よりのコメント:

この資料は、2007年11月にハワイにて開催されたJUSTSAP(日米科学技術宇宙応用プログラム)シンポジウムにおいてバイチマン氏が発表されたものをご本人に了解を得て掲載するものです。

会議後の一部修正と説明用のノートをご本人に加えていただきました。

米国における衛星によるブロードバンドサービスの現状と最新動向についてまとめられています。日本でも、WINDSが今年打ち上げられ、利用実験が開始されようとしておりますが、今後の日本における衛星ブロードバンドサービスの展開のためにも大いに参考になるものと思われます。

**JGB**

**Consumer Broadband Satellite Service  
in the USA**

A practical and effective solution  
for the Digital Divide

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## The Digital Divide: A problem for the US & Japan

- Modern society demands access to broadband for **ALL** citizens
- BUT, Japan & the US have a Digital Divide problem:
  - **Japan: 2 – 3 million households**
  - **US: 10 – 15 million households**

How to solve this problem? Can JUSTSAP help?

Japan estimate is from recent MIC studies; US estimate is a consensus from many sources. There is no “official” US government estimate. Many people in the industry think the number may be higher – up to 20,000,000

## Some Digital Divide Solutions

Solution	Merit	Issues
Satellite US: primary	<ul style="list-style-type: none"> <li>• Immediate coverage</li> <li>• No local infrastructure</li> <li>• Existing technology &amp; equipment</li> </ul>	<ul style="list-style-type: none"> <li>• Capacity limits</li> <li>• Signal delay</li> <li>• Antenna installation</li> </ul>
Wireless (WiMax) Japan: primary	<ul style="list-style-type: none"> <li>• Capacity flexibility</li> <li>• Local control</li> <li>• Small antenna</li> </ul>	<ul style="list-style-type: none"> <li>• New technology</li> <li>• Line of sight / range</li> <li>• Cost/subscriber</li> </ul>

Satellite; This is the primary means for serving the digital divide in the US. Terrestrial systems such as WiMax have been ruled out because of the high cost per subscriber. Satellite over –all costs including space segment, hubs and terminals are less expensive and can meet the demand. The consumer demand requirement is for service in the 512kbps to 2 -3 Mbps range. The US has a very good infrastructure for satellite TV, so the service is not viewed as necessary for very broadband services such as IPTV. For the applications considered by most consumers the speeds being offered are adequate.

## **US Satellite Consumer Broadband Status**

- September 2007: 670,000 consumer users
- Two current service providers:
  - HughesNet (365,000 users): Ku and soon Ka band
  - WildBlue (265,000 users): Ka band
- Service levels (**NOT** technical limits)
  - To user: up to 1.5 Mbps
  - From user: up to 512 kbps
- Service price
  - Terminal & Installation: \$0 - \$300
  - Monthly service: \$50 - \$90

The satellite that provide the WildBlue Ka band service are spot beam Ka band satellites, Two satellite are being used one is 17 beams on Anik F2, the Canadian satellite (NOTE: The Canadian spot beams are providing broadband consumer service in Canada). WildBlue also has its own spot beam satellite with 35 spot beams serving the US. (se next slide)

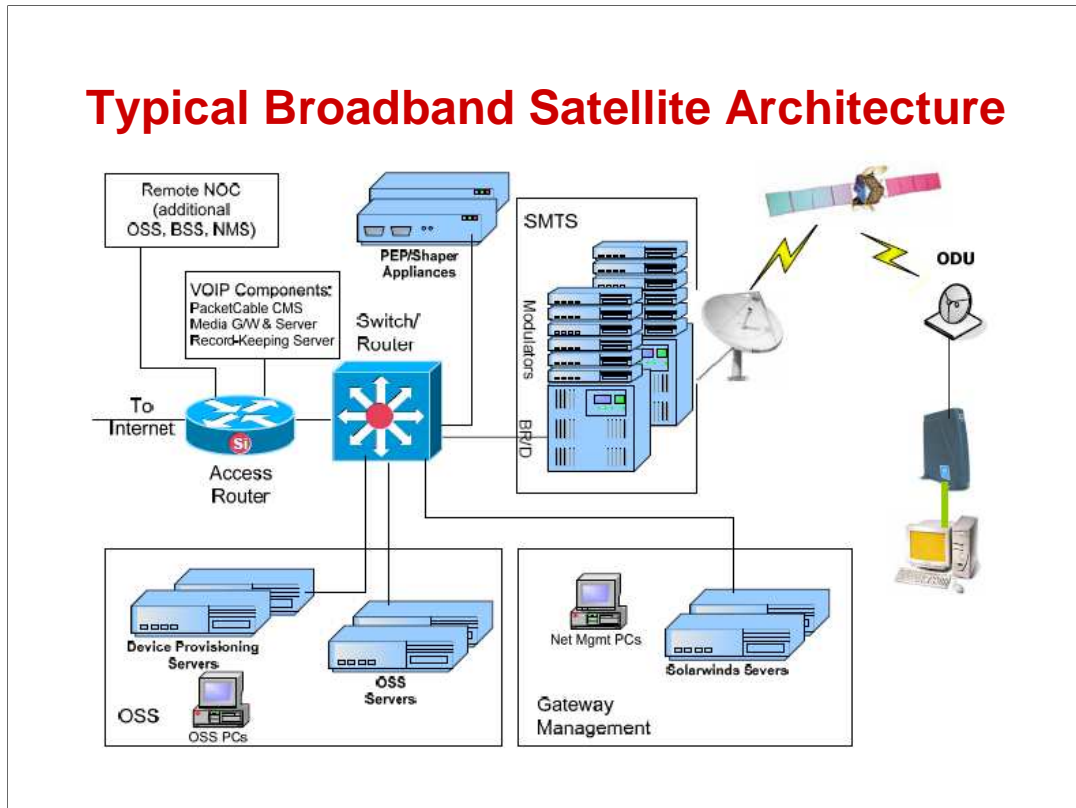
## Satellite Characteristics

Throughput (Gbps)	Example	Status	Features
1	Conventional Ku	Many in service	National beam; 1GHz bandwidth
3	WildBlue 1	In service	Ka band; 35 spots Bent pipe
10	SpaceWay 3 (WINDS)	On orbit Service soon	Ka band; switched spots; base band processing
50 – 100	Next generation (ViaSat-1)	Under contract Service: 2011	Ka band, 72 spot beams; Bent pipe
100 – 200	Next-next gen	Studies	Ka band; ????

**POINT: COST/BIT** 

The whole issue is to reduce the cost per bit to allow either lower prices to consumers for the existing service speeds (More customers can be served) or to provide higher speeds at the same cost. Note that ViaSat will enter the US and Canadian markets in 2011 with ViaSat-1 claimed to have 100 Gbps throughput capacity. ViaSat has obtained a Ka band orbit slot and has announced that the satellite will be procured from Loral Space & Communications. ViaSat claims that it will be able to compete on service quality and price with ADSL at comparable speeds in many locations. The Hughes Spaceway 3 satellite has been in orbit since August and has been tested and has been accepted by Hughes, but at this point Hughes has not announced service plans for the satellite. Hughes now leases more than 100 transponders on 13 conventional Ku band satellites for their HughesNet service. It is expected that about 40% of these Ku band customers will be shifted to Ka band. Satellites and systems providing 100 -200 Gbps throughput are now in design.

## Typical Broadband Satellite Architecture



OSS = operations support system; BSS = business support system; NMS = network management system; NOC = network operations center; PEP = performance enhancement proxy; SMTS = Satellite modem termination system; ODU = Outdoor unit (customer's antenna)

## **Adaptive Coding Modulation for Ka Band Service**

### **ACM: Effective Rain “Countermeasure”**

- Every active customer terminal polled every two second to measure link conditions to determine rain fade condition at each customer location
- Forward link coding adjusted for each customer for each packet; provides 7 db of dynamic margin
- Customer return link speed and coding commanded by Network Control Center
- Permits small antenna with fixed margin (typical 3 dB) and additional 7 dB during rain fade to improve link reliability

For the WildBlue (Produced by ViaSat) system coding goes from 8/9 8PSK to  $\frac{1}{2}$  QPSK for the outbound TDM carrier and systems could be extended higher or lower. Each TDM forward link carrier is up to 120 Mbps (a number that will increase in the future)





**WILDBLUE**  
COMMUNICATIONS

## **WildBlue Communications**

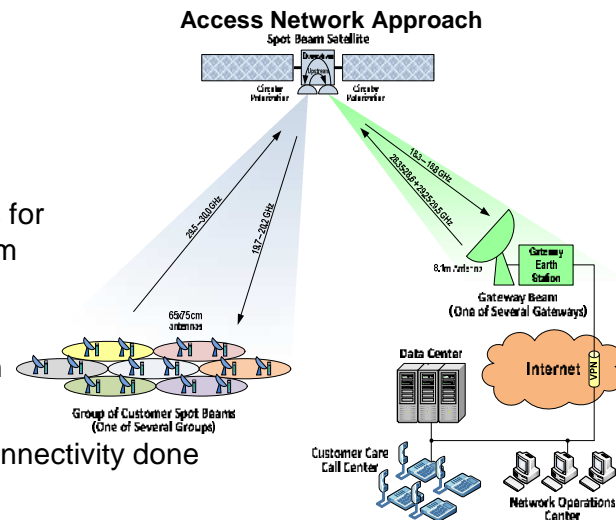
**WildBlue is a “Broadband Internet via Satellite” service provider approaching 300,000 customers in the continental United States.**

- Headquartered in Denver, Colorado
  - Privately held
  - Began service June 2005
- Infrastructure:
  - 2 Ka-band spot beam satellites: WildBlue 1, Anik F2
  - Current satellite total capacity: 750,000 users
  - 11 Gateway Earth Stations
  - Network Operations Center
  - Business Systems Data Center
  - Customer Call Center

Company remains privately owned, Largest owner is Liberty Media, a CATV operator. WildBlue is adding about 10,000 – 15,000 customers every month. They recently ordered 500,000 terminals from ViaSat

## Low Cost Satellite Bandwidth

- Satellites optimized for Internet access
  - No on-board processing
- Not transponders
  - Different payload designs for upstream and downstream
  - About 90% of payload power is dedicated to downstream transmission
- “Internet does the work”
  - Customer-to-customer connectivity done through the Internet



The network is “star” configuration optimized for Internet access; satellites are bent pipe; details of design are not public, but it is known that the Anik F2 has 17 spot beams covering the US and WB-1 has 35 US beams.

## Key Features of the WildBlue Network

- Optimized for Internet access
- Low cost satellite bandwidth
  - Ka-band, spot beams, high power
  - Large hubs, Gateway Earth Stations
- Standards-based using Data-over-Cable System Interface Specification (DOCSIS)
  - Customer's Indoor Unit is a "*modified Cable Modem*"
  - Gateway has a "*modified Cable Modem Termination System*"
- Business systems, network management done with DOCSIS-based technology
- Sophisticated latency mitigation, IP traffic management systems and rain-fade countermeasures

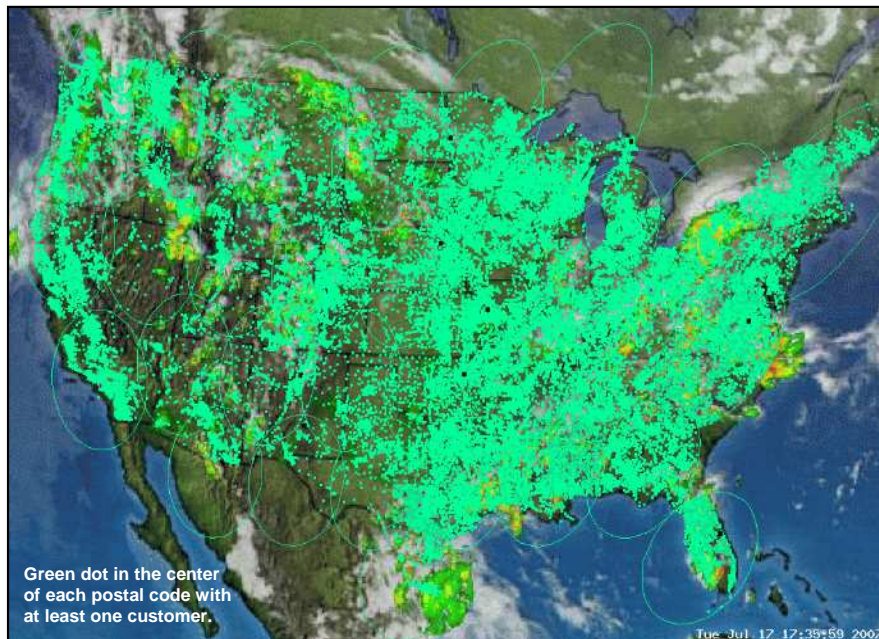
## Consumer Service Offerings



Service Offering	Value Pak	Select Pak	Pro Pak
<b>Speeds</b>			
Downstream	512 kbps	1.0 Mbps	1.5 Mbps
Upstream	128 kbps	200 kbps	256 kbps
<b>Consumption Limits</b>			
Downstream / 30 days	7.5 GB	12 GB	17 GB
Upstream / 30 days	2.3 GB	3 GB	5 GB
<b>ISP Services</b>			
Email Accounts	5 × 100 MB	5 × 100 MB	10 × 100 MB
Web Hosting	10 MB	10 MB	20 MB
Free Dial-up	–	–	10 hrs/month
<b>Upfront Price (\$US)</b>			
Equipment	\$199 - 299	\$199 - 299	\$199 - 299
Installation	\$ 0 - 179	\$ 0 - 179	\$ 0 - 179
Total	\$199 - 478	\$199 - 478	\$199 - 478
<b>Monthly Service (\$US)</b>			
	\$49.95 – 54.95	\$69.95	\$79.95

It is important to note that the speeds shown are NOT technical limitation. These speeds are the result of a combination of customer needs compared to the price of service. For the next generation of satellites, these services can be provided at lower cost because there are more customers using the satellite or higher speed services can be provided to the same number of customers at a higher price. What is likely to happen is that the menu of services will expand to include both higher speeds at high price and lower speeds at a lower price than is now shown. The antenna shown is 67 cm (effective) and is used in all regions of the US, even in the high rain regions in the Southeast (Florida). The modem is “book-size”

## Relative Customer Density



The most interesting point about this map is that most of the customers are NOT in the deeply rural parts of the US, but in areas of much more dense population where there are “holes” in the terrestrial coverage that can not be economically served by terrestrial systems (ADSL, CATV, fiber, wireless). This WildBlue has actually sold out the capacity of many spot beams in the Northeast and Midwest part of the country. In order to maintain the quality of service for customers, it has been necessary for WildBlue to stop new sales in those areas.



## **Hughes Network System, LLC**

- **Largest VSAT system company**
  - **Produced & installed 1.2 million VSATs worldwide**
  - **Owns & operates HughesNet in USA**
    - **World's largest VSAT network**
    - **Customers: Government, Enterprises, Consumers**

Hughes Network Systems, LLC is a subsidiary of the holding company Hughes Communications. People often use the term "Hughes" when they are really referring to Hughes Network Systems (HNS)

## HughesNet

- 365,000 consumer users; 10,000 new users each month;
- Service now using Ku band national beams
- Current service offerings:
  - Modem, antenna, installation: \$300

<b>Service (forward/return)</b>	512 kbps 128kbps	1 Mbps 200 kbps	1.5 Mbps 256 kbps
<b>Monthly fee (\$)</b>	60	70	80

- Modem, antenna, installation: \$0

<b>Service (forward/return)</b>	512 kbps 128kbps	1 Mbps 200 kbps	1.5 Mbps 256 kbps
<b>Monthly fee (\$)</b>	80	90	100

Again, these data rates are not a technical limitation but a trade off between price, speed and customer needs. The service now uses more than 100 transponders on 13 different domestic satellites. Except for DBS services (DirecTV and EchoStar) HughesNet is the largest user of transponders in the US



## HughesNet Ku Band Consumer Terminals



Modem



Antenna (75 cm)

HNS Makes the equipment for their network. The transmission format of the current Ku band network is Hughes-proprietary, although it is similar to DVB-S2

# HughesNet™ Network – USA



## 2007 Network Stats

- ❖ 450,000 sites
- ❖ Largest managed network services provider in USA
- ❖ Over 100 transponders across 13 satellites (Ku band)

**Largest US user of Ku band service!**

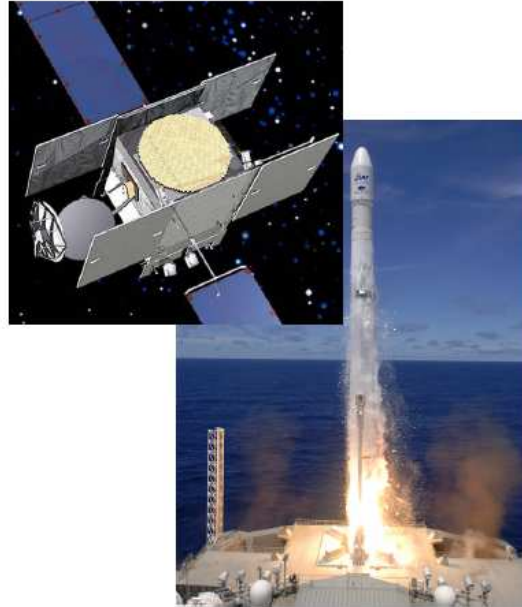
## Spaceway 3: New HughesNet Satellite

- Launched August, 2007; On-orbit testing underway; Service early 2008
- Features
  - Ka band 10 Gbps throughput
  - Fast beam RF switching and baseband switching
  - Spot beams: 780 forward (fast switching); 112 return
  - Each forward beam capable of 440 Mbps.
- Single hop mesh capability (VPN/enterprise applications)
- New service offerings/prices not yet announced
- Targets: Consumers, enterprises, small businesses
- 40% of existing Ku customer to be switched to Ka band

Recall that this satellite was initially designed 10 years ago. At that time ADSL was not widely available. The design of this satellite was optimized to provide VPN enterprise mesh networks (i.e. a private network between a company's separate facilities. HNS still says that will use the satellite for enterprise service, but is it clear that the market is very different from 10 years ago. Now the real need is for service to individual consumers in the digital divide. HNS has said that about 40% of current Ku band customers will be shifted at HNS cost to Spaceway 3. The savings on transponder leases are greater than the cost of replacement equipment for the customers. As of this day (January 5, 2008) HNS has not announced service plans for the new Ka band satellite. HNS has not stated why it has delayed the introduction of Ka band services. It should be noted that many in the industry believe that the baseband switching employed on Spaceway 3 is not a business or technical advantage for the systems. Bent pie with RF switching may be more attractive for future satellites.

## SPACEWAY 3 Launches August 2007

- ❖ 10 Gbps gross throughput
- ❖ Multiple spot beams with flexible capacity allocation and on-board routing
- ❖ Full small-dish-to-small-dish capabilities
- ❖ Enterprise, Consumer, and SMB applications
- ❖ All new technology successfully tested in orbit

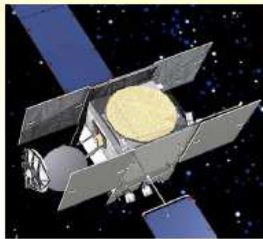


## SPACEWAY Overview

### Key Attributes

- ❖ **First full mesh commercial satellite system**
  - 10 Gigabits/second capacity—addressing a market of over \$20 billion/year
  - Core IP VPN service plans and Bandwidth on demand

### Satellite



### Flexible Capacity Allocation

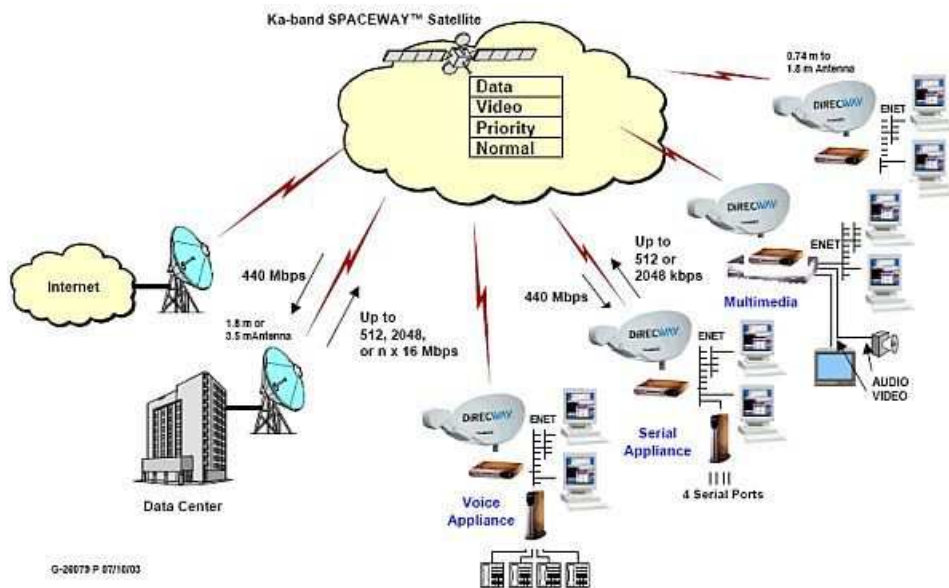


### Base Capabilities

- ❖ **Uplink speeds**
  - 2 Mbps
  - N x 16 Mbps
- ❖ **Downlink carrier speeds:**
  - 440 Mbps
- ❖ **On-board packet replicator**

These specifications and features are unique for this satellite. There is no similar satellite in commercial service anywhere in the world. This one big disadvantage for Hughes: there is no back up or additional capacity available to HNS.

# Spaceway 3 Network Image



**Figure 3-2. HUGHES' Next Generation Technology**

## **US Consumer Satellite Broadband Service Summary**

- Satellite broadband is primary solution for US Digital Divide consumers
- New satellite and systems technology:
  - Efficient low cost per bit Ka band satellites
  - Mass produced low cost terminals
  - Adaptive Coding Modulation: small antennas; high link reliability
- Service is now provided by WildBlue and HughesNet
- A third provider, ViaSat, will enter the market in 2011
- Immediate national coverage without local infrastructure
- Customer satisfaction: Services adding 20,000 customers each month; low churn rate (about 2%)
- Next generation technology promises lower cost/customer and even higher performance.