Third Generation Satellite Broadband Communications and the Australian National Broadband Network

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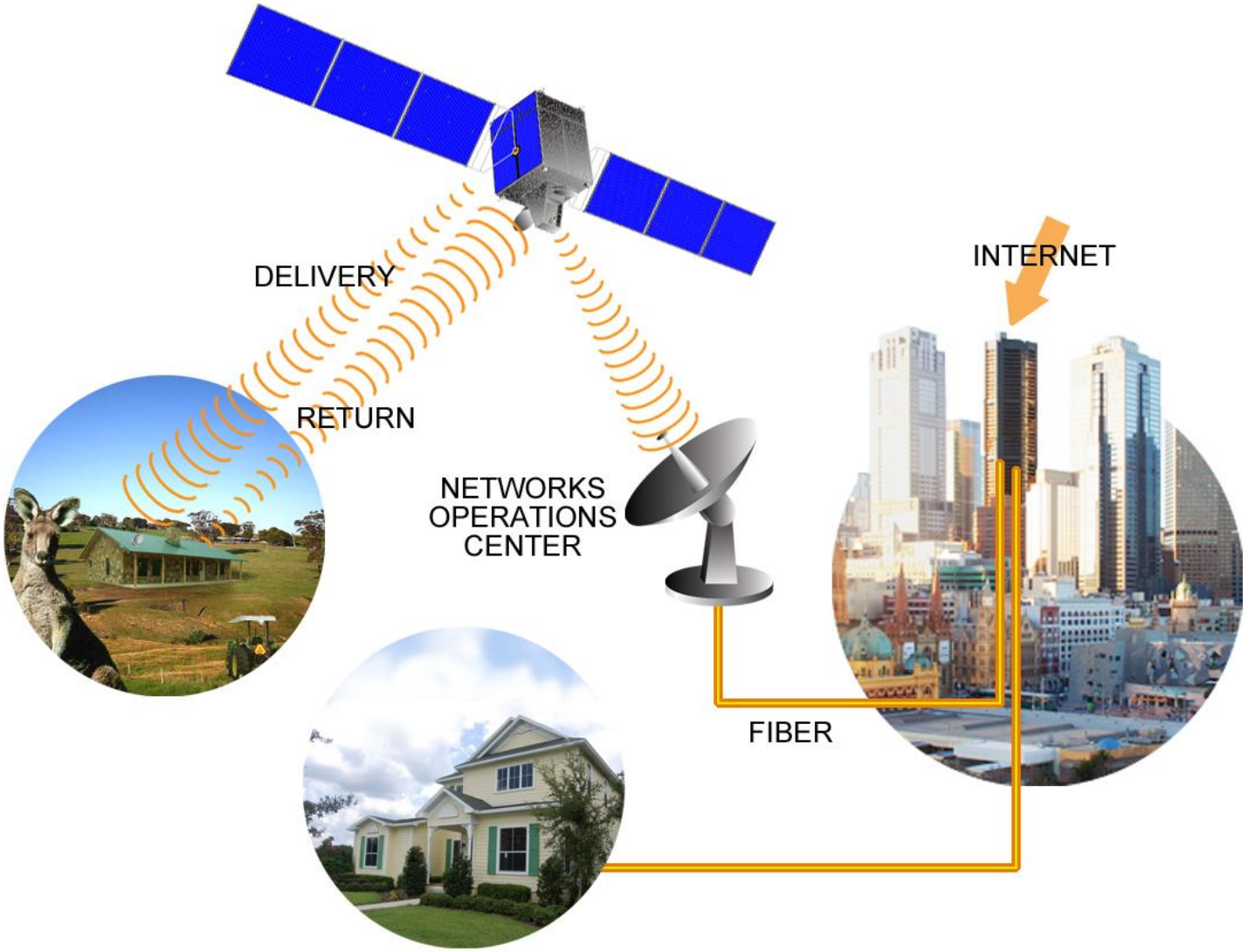
Topics

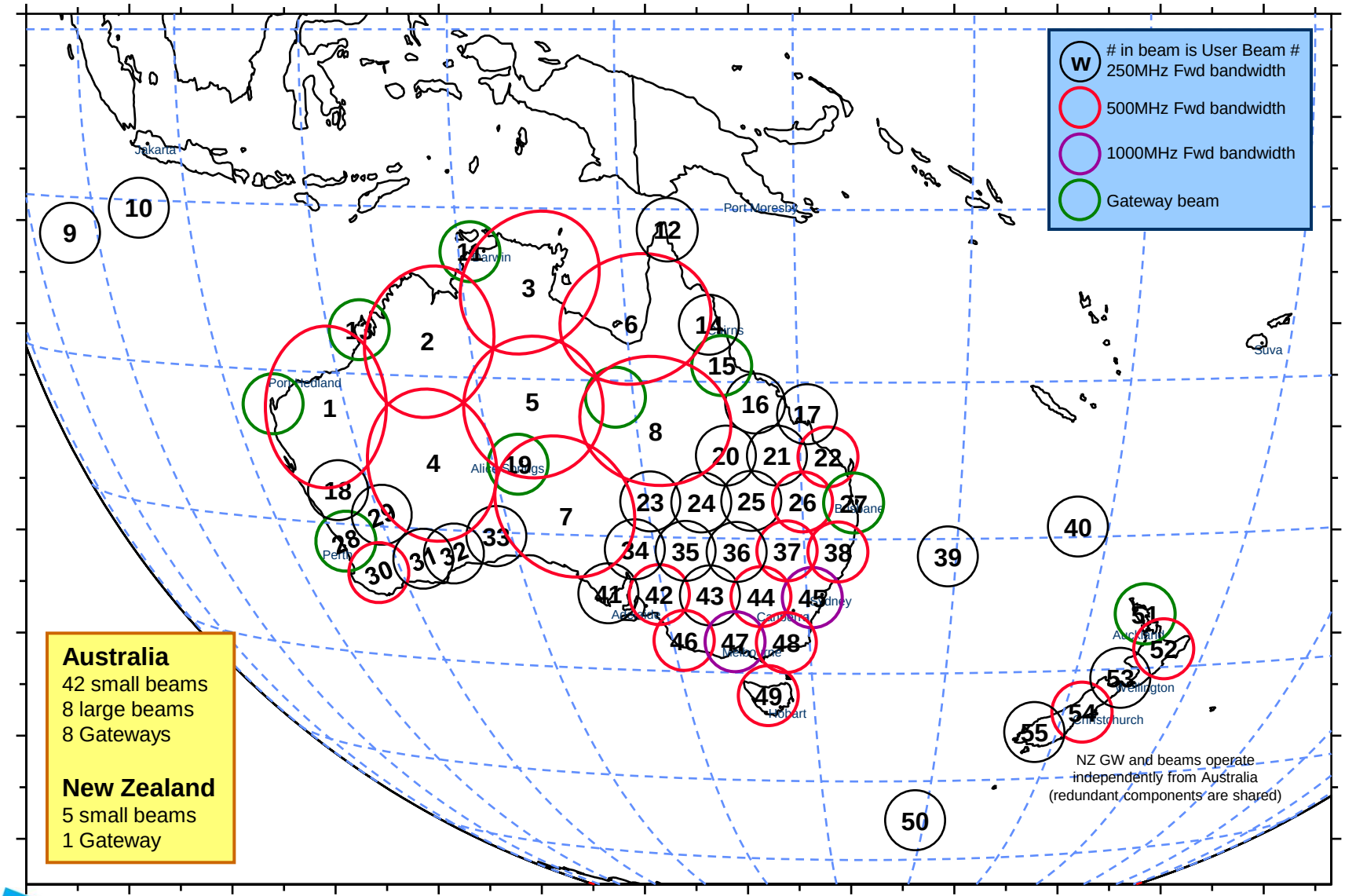
- KaComm Overview
- Objectives of the Australian National Broadband Network
- The Demand for Broadband
- Three Generations of Satellite Broadband
- The New Customer Experience of Third Generation Satellite Broadband
- Summary

KaComm Overview

Satellites Have Provided "Network Extension" Access Since the 1980s



KaComm will Provide Satellite Broadband Internet Service via Ka-band Spot Beams Covering 100% of Australia & New Zealand



KaComm Communications Pty Ltd

- An Australian SME formed for the purpose of delivering wholesale broadband Internet capacity via Ka-band satellite
- Will provide nationwide high speed (12+ Mbps) wholesale broadband service reaching all Australians (including offshore islands)
- Unique focus on underserved, regional, and remote users
- A national broadband network independent of terrestrial infrastructure: A separate, independent, fully operational network in times of emergency
- Senior management has extensive international experience in satellite broadband
- Unique regulatory rights to key Australian Ka-band spectrum via ACMA-submitted ITU filings
- Strategic relationships with world leaders in broadband satellite services and equipment manufacture
  - Loral a major shareholder and active participant

Wholesale only – open access

Objectives of the Australian National Broadband Network

The National Broadband Network Will Deliver Next Generation Internet Capabilities to All Australians[1]

- The National Broadband Network will be the single largest investment in broadband infrastructure in Australia's history
  - Up to $43 billion committed for roll-out over eight year period
- Optical fibre-to-the-premises will deliver download speeds of up to 100 Mbps to 90% of Australian homes and businesses
  - 100 times faster than those data connections currently used by many households and businesses
- Third generation satellite broadband will be used to extend the National Broadband Network to the remaining 10% of Australian homes and businesses in rural locations, "black spots," and, in fact, in any location that proves to be efficient for satellite service at download speeds of >= 12 Mbps

[1] Information obtained from www.minister.dbcde.gov.au/media/media_releases/2009/022

Household Percentage Broadband Penetration as of June 2009

1 South Korea	95%	30 Greece	39%
2 Singapore	88%	31 Turkey	37%
3 Netherlands	85%	32 Hungary	34%
4 Denmark	82%	33 Slovakia	33%
5 Taiwan	81%	34 Poland	32%
6 Hong Kong	81%	35 Argentina	31%
7 Israel	77%	36 Romania	31%
8 Switzerland	76%	37 Latvia	30%
9 Canada	76%	38 Czech Republic	28%
10 Norway	75%	39 Mexico	28%
11 Australia	**72%**	40 Chile	27%
12 Finland	69%	41 Croatia	23%
13 France	68%	42 China	21%
14 United Kingdom	67%	43 Malaysia	21%
15 United Arab Emirates	65%	44 Venezuela	17%
16 Japan	64%	45 Brazil	17%
17 Sweden	63%	46 Russia	14%
18 Estonia	62%	47 Bulgaria	13%
19 Belgium	62%	48 Peru	11%
20 USA	60%	49 Saudi Arabia	7%
21 Slovenia	58%	50 Thailand	7%
22 Germany	58%	51 Vietnam	7%
23 Ireland	58%	52 Philippines	5%
24 Spain	57%	53 Albania	5%
25 New Zealand	**57%**	54 Ukraine	4%
26 Lithuania	51%	55 Egypt	3%
27 Italy	51%	56 India	2%
28 Austria	50%	57 Indonesia	1%
29 Portugal	40%		

From: Strategy Analytics

The Demand for Broadband

Significant Growth Will Occur in Broadband Usage

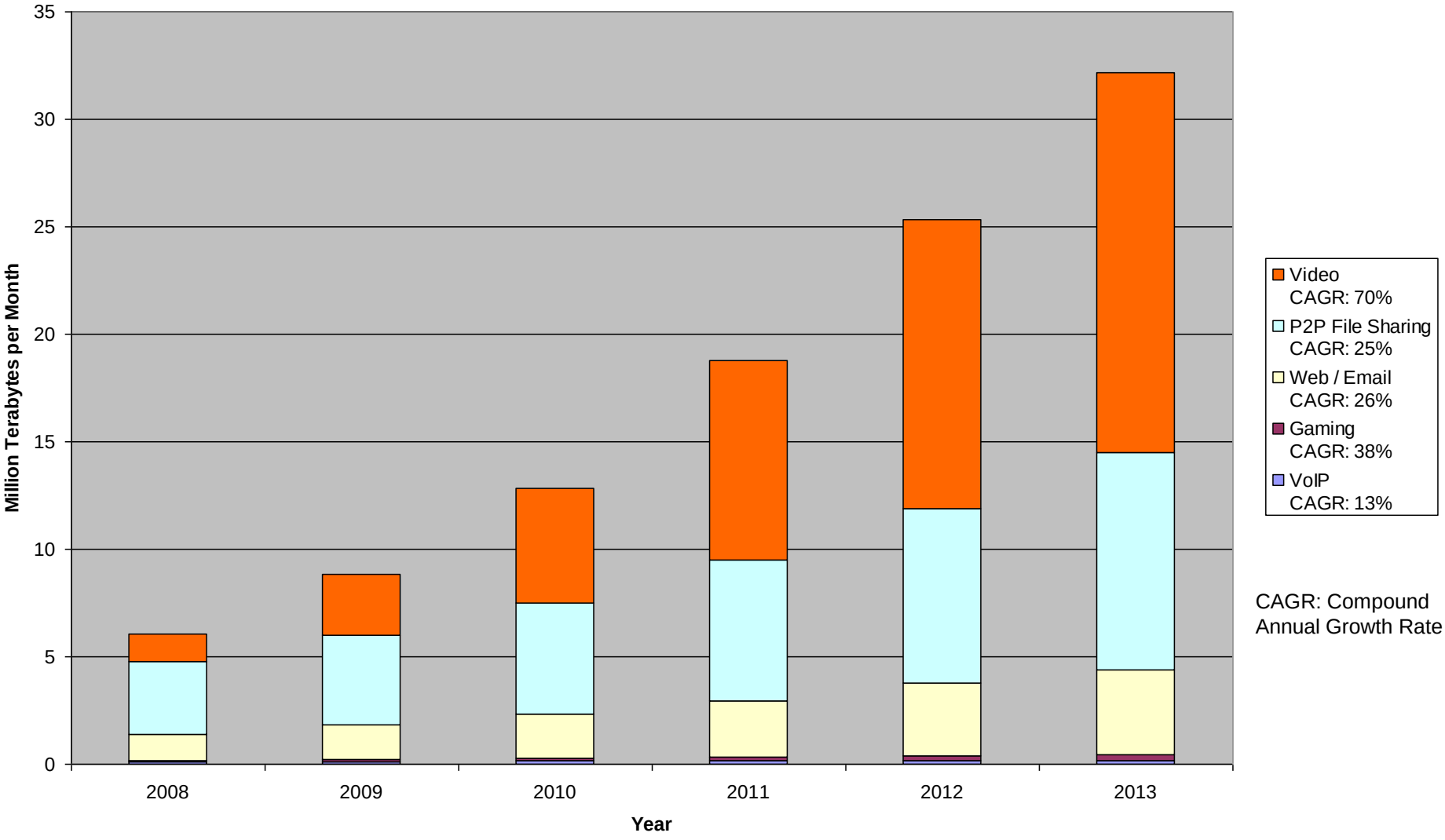
- Australians downloaded 99,993 terabytes of data during June 2009 compared to 81,352 terabytes in December 2008, growing at an annualized rate of 46%[1]
- Australians continue the trend towards higher download speeds with 57% of Internet service subscribers using a download speed of 1.5 Mb/s or greater in June 2009, compared with 51% in December 2008[1]
- Cisco projects global Internet traffic will experience a compound annual growth rate (CAGR) of 40% from 2008 to 2013, quintupling during this time period[2]
  - In 2013, the Internet will be nearly four times larger than it is in 2009
  - Peer-to-Peer (P2P) is growing in volume, but declining as a percentage of overall Internet traffic
  - Video communications traffic growth is accelerating and will increase tenfold from 2008 to 2013
    - Internet video will account for over 60% of all consumer Internet traffic by 2013
    - Real-time video is growing in importance

Video will be the strongest growth driver of Internet traffic

[1] Australian Bureau of Statistics Internet Activity Survey, June 2009

[2] Cisco Visual Networking Index — Forecast and Methodology, 2008–2013, 9 June 2009, Cisco Public Information, www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-481360.pdf

Global Consumer Internet Traffic[1]



CAGR: Compound Annual Growth Rate

[1] Cisco Visual Networking Index — Forecast and Methodology, 2008–2013, 9 June 2009

Three Generations of Satellite Broadband

Evolution of Satellite Technology for Network Access

- Satellite technology has evolved through two generations of data network access capability since the 1980s and is now entering the third generation
- Each succeeding generation has improved performance and reduced costs
- The earlier deployments of satellite technology for connectivity to the telephone network in remote, unwired locations were based on analog technology and pre-Internet Protocol (IP) digital technology that were subject to bandwidth limitations and quality limitations due to such artifacts as echo and excessive delay (latency)
- By combining the increased bandwidth available on newer, Ka-band spot-beam satellites with the advanced, latency-management processing surrounding the transmission of IP data, these artifacts have been greatly reduced, throughput and quality have been increased, and costs have been reduced
- Third generation technology is extending these improvements so that NBN-compatible performance, i.e., ≥12 Mb/s download speeds, can be achieved for Australians located beyond the practical reach of wired FTTP solutions

“First Generation” Satellite Broadband VSAT Systems

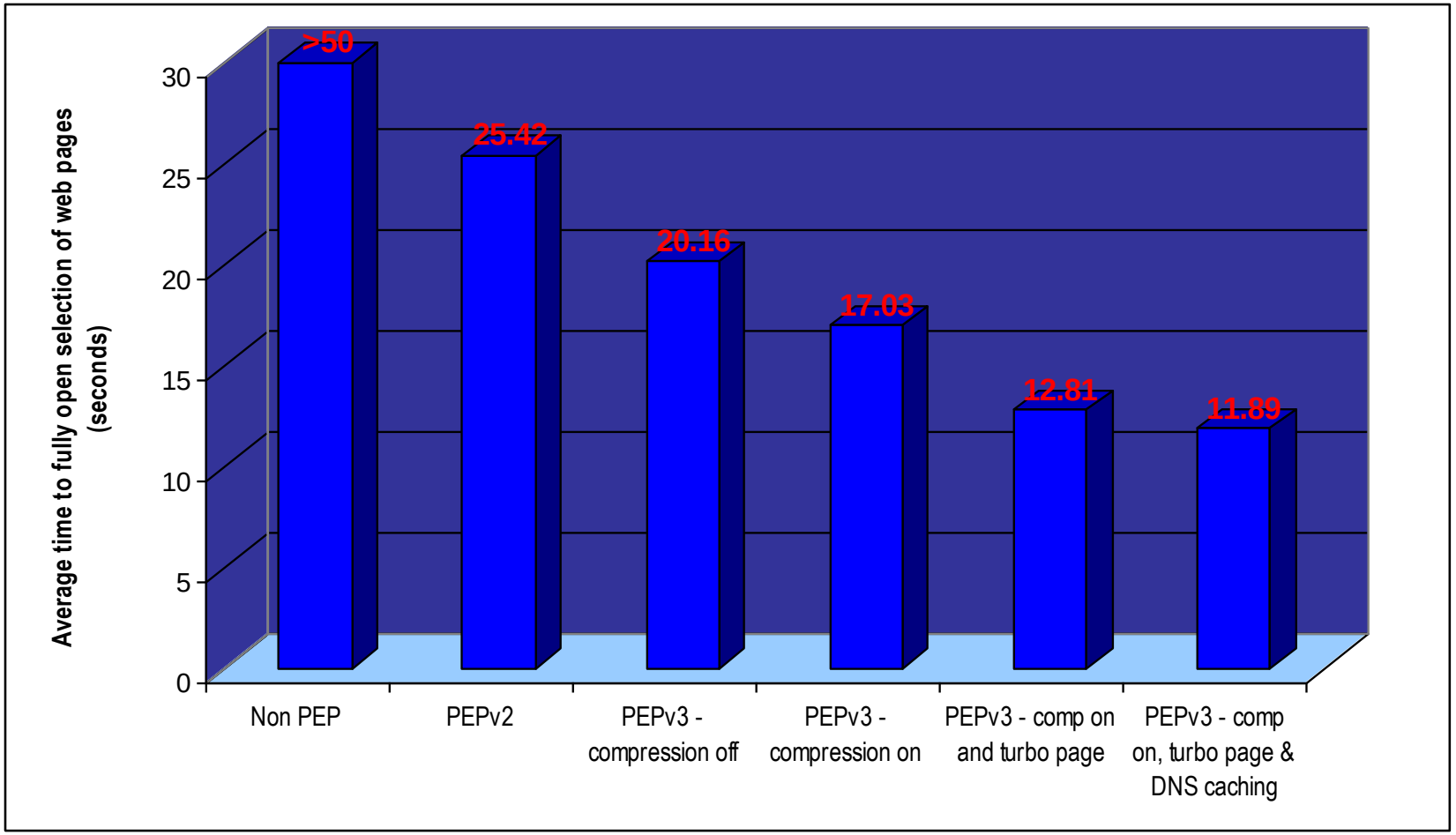
- 1980s to present
- 56 kbps – 256 kbps throughput per user
- Primarily business networks for corporate users with dispersed operations
  - “Point of Sale” transaction verification for retail companies
  - Corporate LAN extension to all locations
  - Telephone company connectivity extension to remote villages
- Characterized by bursty data usage with limited need for continuous, real-time circuits
- Early systems deployed before general availability of Internet and designed with proprietary, non-IP-based standards
- Typically use a portion of a transponder on a satellite shared among many customers and applications
- Enabled by satellite modem and terminal technology from companies such as Hughes Network Systems, Gilat, ViaSat, others
- “Business grade” VSAT terminals costing U.S. $5,000 – U.S. $10,000

“Second Generation” Satellite Broadband VSAT Systems

- Systems launched 2005–2007
- 256 kbps – 3 Mbps throughput per user
- “Born of the Internet Age” to extend Internet connectivity and feature-rich applications to underserved users
- Majority of current customers are consumers and small businesses
- Largest systems use dedicated satellites (IPSTAR, WildBlue, Spaceway) and are migrating from Ku-band to Ka-band to increase system capacity and user throughput via high-gain spot beams with frequency re-use
- Enabled by integration of IP routing technology and IP Quality of Service (QoS) management with software-defined modems and advanced coding and modulation schemes resulting in smaller, more capable “consumer-grade” VSAT terminals costing ~U.S. $500
- Introduced advanced latency-management technology
  - Compensating for latency-sensitive TCP/IP protocols via Performance Enhancement Proxy (PEP) to allow TCP/IP transmission over satellite links at arbitrarily high data rates
  - Accelerating latency-sensitive applications via pre-fetching of subsequently requested and commonly requested information to reduce response time
  - Prioritizing traffic to meet timing and jitter requirements
  - Compressing IP headers and payloads to reduce transmission time

Benefits of Successive Improvements in Latency Management

- **Typical performance of Hughes Network Systems latency-management technology**



"Third Generation" Satellite Broadband VSAT Systems

- Systems planned for launch starting 2010
- Throughput per user compatible with ADSL2+ ≥12 Mbps
- Designed to deliver video-driven capacity requirements of the next generation Internet applications
- Will use dedicated satellites combined with terminal technology to achieve ~70 - 100 Gbps capacities[1]
  - Each satellite can serve up to 2–3 million users
  - The instantaneous throughput per user can be as high as ~25 Mbps[2]
- Enabled by high power Ka-band spot-beam satellites with efficient frequency re-use and next-generation terminal modems that increase physical layer capacity 10x from ~50 Mb/s to up to ~500 Mb/s in VSAT terminals costing under U.S. $500 with a clear trend towards even lower prices
- Use of advanced coding and modulation (ETSI DVB-S2; adaptive coding and modulation; low density parity check) to mitigate rain-fade effects and increase availability
- The first third-generation satellite systems KA-SAT, ViaSat-1, and Hughes Jupiter will be deployed in 2010, 2011, and 2012, respectively, to serve Europe, the United States, and Canada

[1] Press releases by Eutelsat (7 Jan 2008), ViaSat (7 Jan 2008), and Hughes (16 June 2009)
[2] Hughes presentation at World Summit for Satellite Financing, 10 Sep 2009

Advanced Coding and Modulation Delivers Good Availability to High Rain Regions Such as Darwin

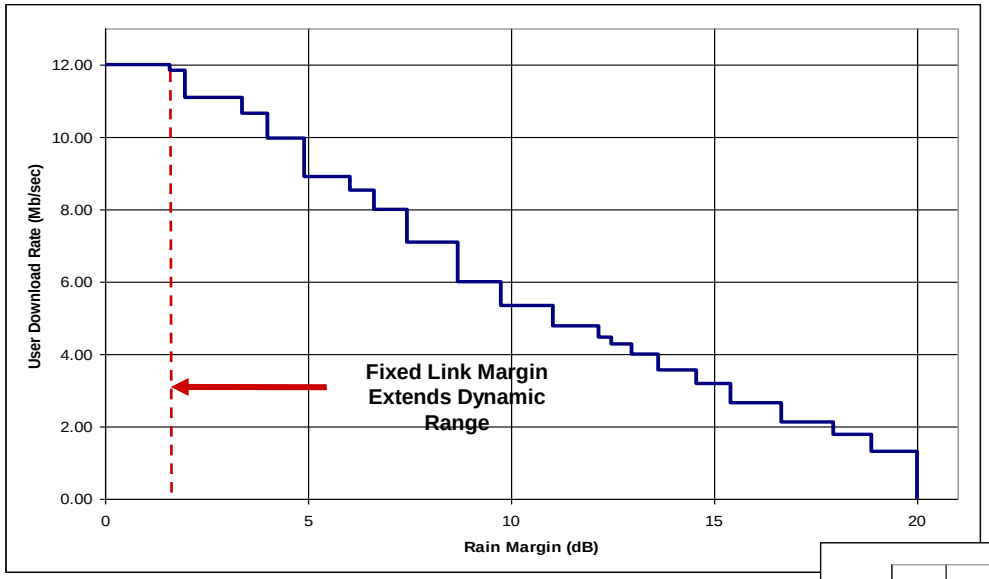


Figure 1. ACM Performance with Fixed Satellite Resource Allocation

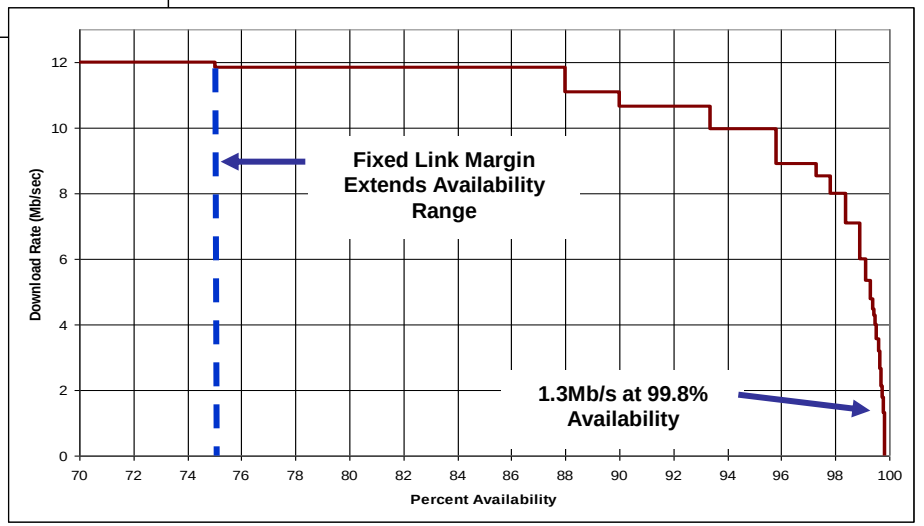


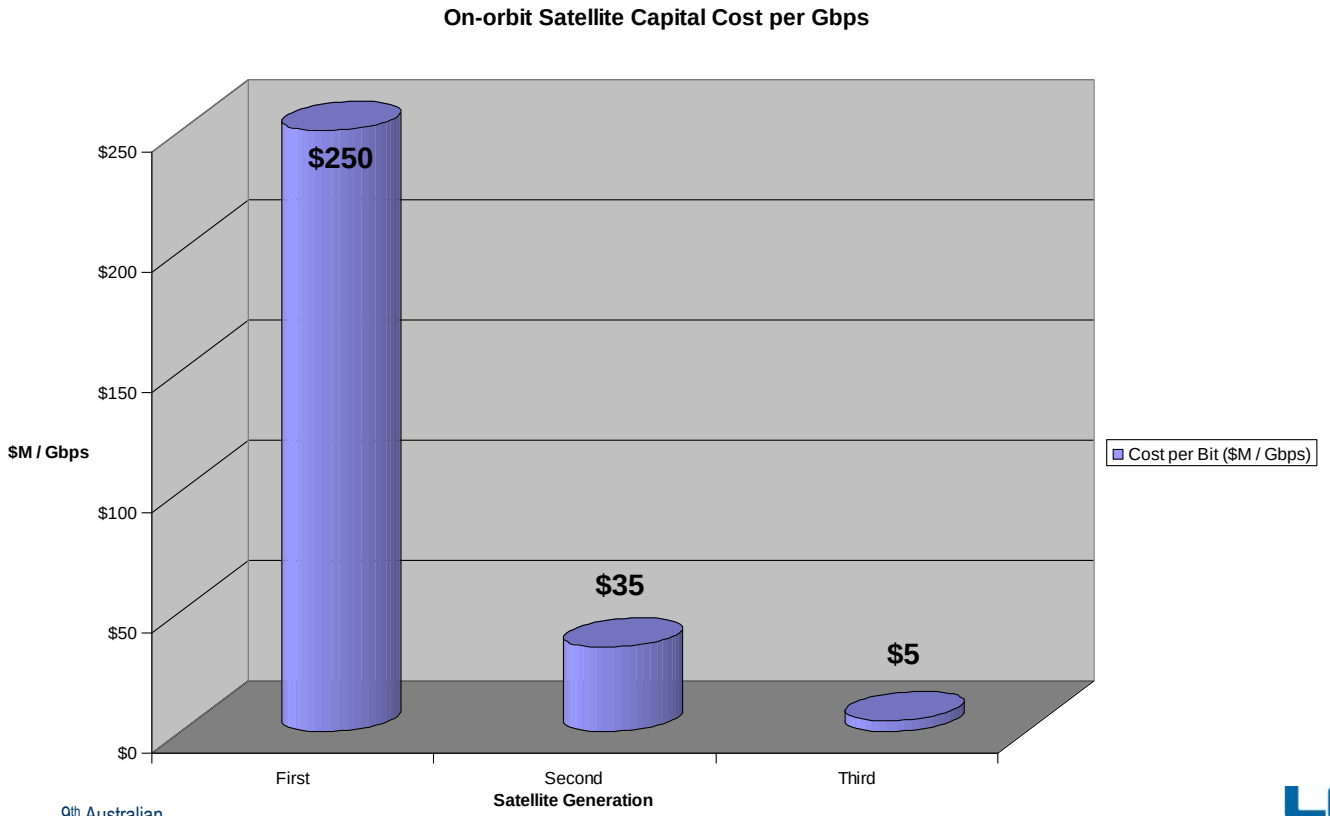
Figure 2. ACM Extends Availability: Typical Download Performance due to Rain in Darwin Region

Evolution of Three Generations of Satellite Broadband Systems

Characteristic	First Generation	Second Generation	Third Generation
Timeframe of Operation	1980s to present	mid 2005 to present	2010+
	Increasing Satellite Capacity		
System Capacity	~1 - 2 Gbps	~10 - 40 Gbps	~70 - 100 Gbps
	Increasing Data Rate per User (Improved User Experience)		
Typical Data Rate per Terminal	56 kbps - 256 kbps	256 kbps - 3 Mbps	3 Mbps - 25 Mbps
	Increasing Number of Subscribers		
Maximum Number of Subscribers per Satellite	100,000 - 500,000	750,000 - 1,000,000	2 million - 3 million
Satellites	All FSS satellites; Example: Hughes leases ~100 xpnders worldwide	IPStar; SES ASTRA2Connect; Eutelsat TooWay; Wildblue; Telesat; Spaceway	KA-SAT; ViaSat-1; HNS Jupiter; KaComm
Satellite Payload Characteristics	24 Ku-band transponders w/ regional coverage & 36 - 72 MHz bandwidth	Ku-band & Ka-band spot beams w/ 36 - 72 MHz bandwidth	Ka-band spot beams with wide bandwidth transponders
Major VSAT Terminal Suppliers	Hughes, Gilat, ViaSat	Hughes, Gilat, ViaSat, iDirect	Announced by Hughes and ViaSat
	Decreasing Cost		
Cost of VSAT Terminal	$5,000 - $10,000	$500 - $1,000	< $500
Typical Applications	Point-of-sale transactions	Broadband access for enterprise & consumer	Broadband access for enterprise & consumer
Data Protocol	Proprietary and non-IP based	IP based	IP based
	Improving Performance		
Connection Type	Bursty; Non-real-time data	Continuous; VoIP & video streaming capable	Continuous; VoIP & HD video streaming capable

Cost Reductions Across Three Generations of Satellite Technology

- **Third generation satellite and terminal technology is increasing by ~10x the capacity per satellite, reducing the cost per bit and increasing average throughput per subscriber**
  - **Bandwidth per spot beam increasing**
  - **Data receiving capacity of consumer VSAT terminals increasing from ~50 Mb/s to up to ~500 Mb/s while keeping cost < $500**



Architectural Considerations: GEO vs. LEO

Attribute	Geostationary Orbit System	Low Earth Orbit System
Satellite Altitude	35,786 km	1,414 km (Globalstar) 781 km (Iridium) 8,063 km (O3B)
Round Trip Propagation Time	480 – 560 ms	120 – 145 ms (O3B)
Latency Management	PEP; Pre-fetching; Prioritization; Compression	PEP; Pre-fetching; Prioritization; Compression
Coverage Characteristics	Region of earth up to 1/3	Bands centered on the Great Circle defined by each orbital plane
Terminal Antenna Type for Broadband	Fixed, High Gain	Tracking or Broadbeam Low Gain with Large Fleet
Field of View Required at User Location	View of Single Orbital Location	View of Entire Orbital Arc
System Capacity	Up to 100 Gb/s per satellite for Australia	160 Gb/s total for 16 satellites (O3B) ~30 Gb/s available for Australia[1]

[1] Up to ¼ of system capacity (40 Gb/s) is within field of view of Australia at any given time; at least 25% (10 Gb/s) of this capacity will be serving Asia.

Conclusion: A Geostationary Orbit Satellite System delivers:

- greater capacity to Australia better suited to the number of expected users and the expected throughput requirements;
- a more efficient antenna system for household and small business installations;
- good application performance supported by latency management.

The New Customer Experience of Third Generation Satellite Broadband

Satellite Broadband Comes of Age with a New Customer Experience

- Fast, responsive, quality, robust, affordable
- All Internet services including
  - Web browsing
  - Email
  - VoIP/Telephone
  - Videoconferencing (including High Definition)
  - Video streaming (including High Definition)
  - Large file downloading/uploading
- Delivering
  - Video on demand
  - Telemedicine
  - IPTV
  - Remote education
  - Defence applications
  - Indigenous broadband services
  - Emergency broadband services for disasters and security events

Summary

Third Generation Satellite Broadband Systems Will Bring the Benefits of the National Broadband Network to All Australians

- Within eight years, the NBN will deliver
  - 100 Mbps to 90% of Australian households via fibre-to-the-premises
  - >=12 Mbps to the remaining 10% of Australian households via third generation satellite broadband
- Third generation satellite broadband will be deployed starting in 2010 with
  - Enhanced capacity and throughput per user via Ka-band spot beams
  - Improved performance in such areas as latency management and rain-fade management
- KaComm Communications Pty Ltd, an Australian company, in partnership with Space Systems/Loral and Loral Space & Communications, seeks to use third-generation satellite broadband to extend the NBN to all residents of Australia and New Zealand, especially those in rural and remote areas
  - Four excellent orbital slots: 137.9° EL, 152° EL, 154° EL, and 160° EL
  - Space Systems/Loral is the world's leading manufacturer of high-power, technically advanced communication satellites
  - Loral has successfully managed several space-based programs and is 2/3 owner of the fourth largest global satellite services company, Telesat
  - Substantial IP portfolio in broadband satellite technology

KaComm-1