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CSMG

A TMNG Global Company

National Broadband Plan Policy Evaluation

Prepared for: FTTH council | fiber to the home

November 2, 2009

"We Make Strategy Work"

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There are a number of useful applications enabled by next-generation access networks (NGA) that will generate public benefits that outweigh the costs of deployment

1. At current course and speed, next-generation access (NGA) broadband will be available to a minority of US homes by 2015 and many homes will have only one provider of NGA service
2. This base case deployment scenario will be inadequate for enabling next-generation services such as HD/3D video, cloud computing, and very large downloads/uploads due to throughput constraints and QoS limitations
3. Accelerating NGA broadband deployment to 80% of the US (101.6M homes) by 2015 will facilitate widespread adoption of next-generation applications
4. Incremental annual consumer and public good benefits over our base case stemming from services enabled by NGA broadband acceleration could reach $5.7B (if 54% homes passed), $8.9B (if 69% HP), or $11.3B (if 80% HP)
5. The total investment required for deploying NGA broadband at an accelerated pace would be $33.3B (if 54% HP), $62.2B (if 69% HP), or $89.2B (if 80% HP) – scales of investment that are possible given historical capex levels of major service providers
6. The incremental cost to connect anchor institutions within a broad deployment of NGA broadband would likely be much less than a program specifically targeting those institutions alone
7. Other national governments in Asia, Europe, and Australia/New Zealand have aggressively pursued initiatives to expand the depth and breadth of NGA broadband deployment, in some cases seeking to deliver speeds of up to 1 Gbps and covering ~90% of households
8. Tax-credit bonds may be one effective policy tool for incenting NGA broadband deployment. An Empiris study has shown that $1.3B in tax credits over 3 years could potentially lead to the $30B in NGA investment required for 54% deployment, thus generating $5.7B in public benefits in addition to substantial economic stimulus

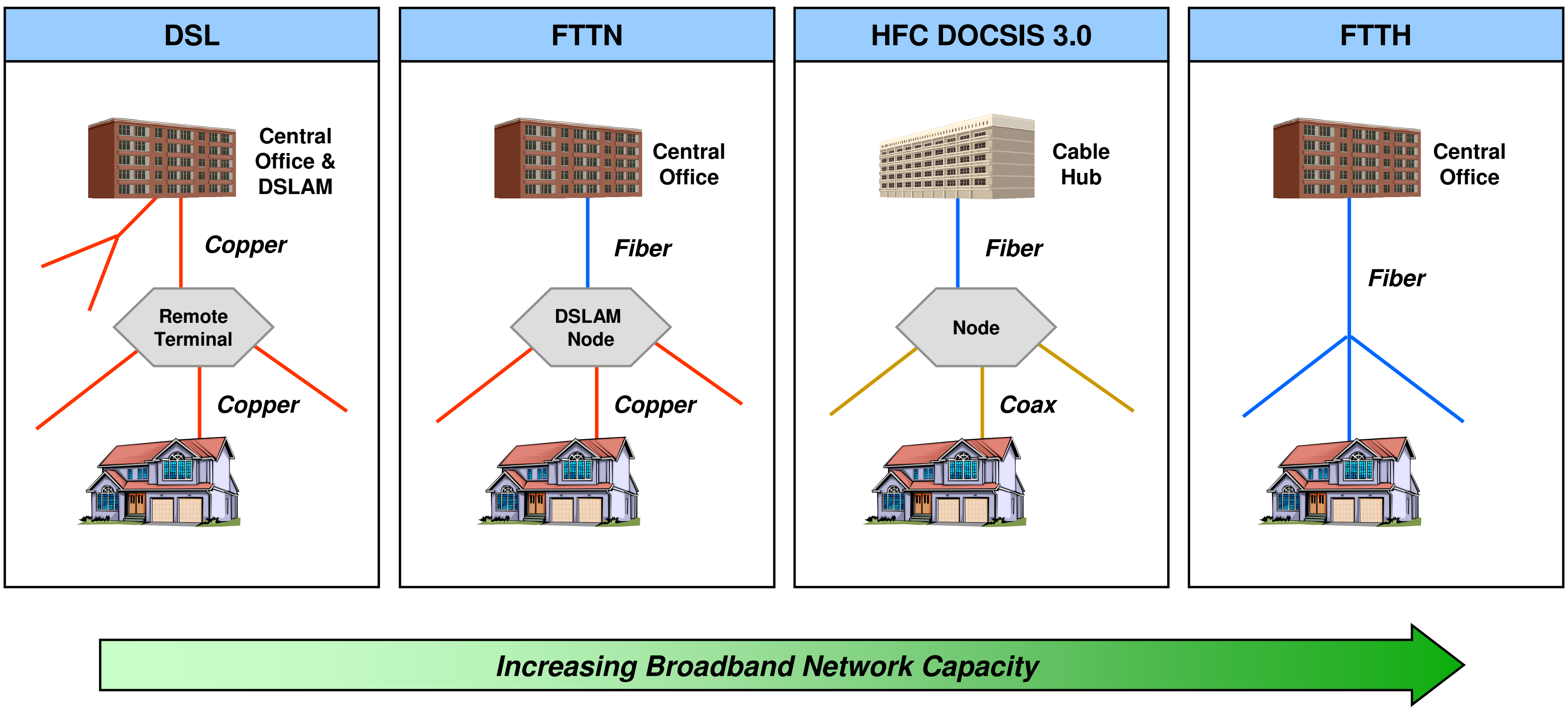
Today's discussion

- Base Case Network
- Application Assessment
- Cost vs. Benefit Analysis
- International Examples
- Policy Options

Today, a variety of network access methods are used to enable broadband

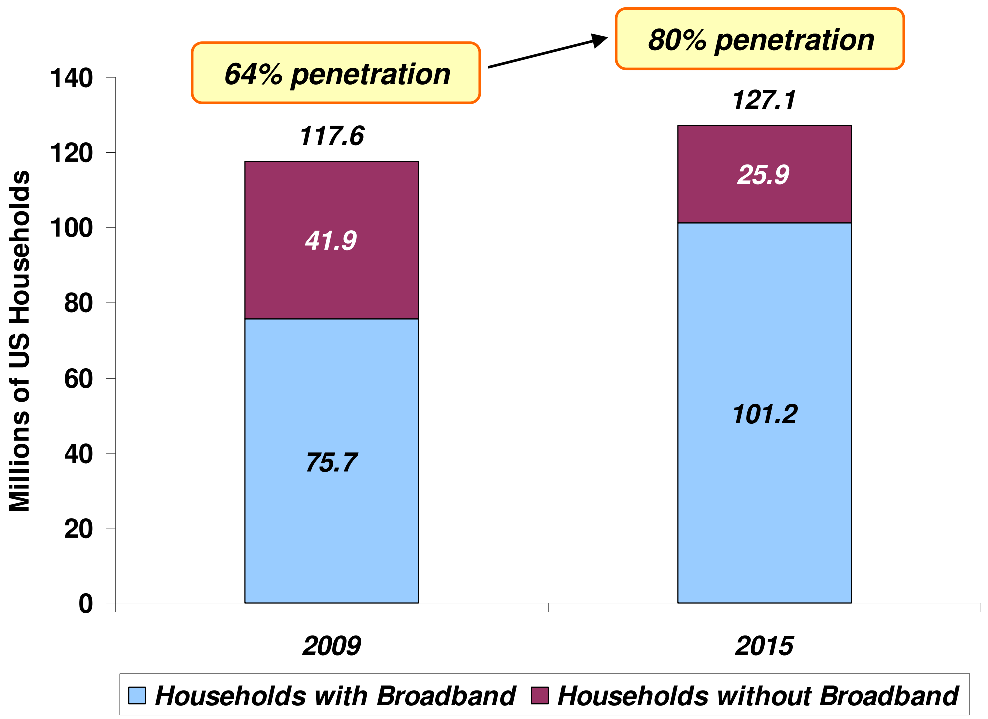
- A national broadband policy should consider the benefits of fast, next-generation broadband availability in addition to lower speed broadband availability
- In this presentation we focus on wired networks, which generally offer the fastest speeds and greatest reliability, rather than wireless networks, which generally enable lower speed portable and mobile broadband

Wired Broadband Network Alternatives



We expect that at current course and speed, the US will continue to see deployment of broadband technologies but that DSL and HFC will be the prevailing alternatives

US Household Broadband Penetration, Current and Future – Base Case



HHs Passed by Technology Type – Base Case (M)

 # Households

	2009	2015
DSL / FTTN	85.5	94.4
HFC	110.2	121.0
FTTH	18.0	34.5
Total Households	117.6	127.1

Sources: SNL Kagan, OECD, CSMG Analysis

In this study, we focus on the benefits of applications enabled by networks capable of 25 Mbps symmetric throughput, which we define as Next-Generation Access (NGA) networks

- Our methodology assesses applications that are degraded from a use case perspective below 25 Mbps

Current Generation Access (CGA)		Criteria		Next Generation Access (NGA)
• CGA networks are slower overall but are especially limited in upstream throughput	✘	**25+ Mbps** (Actual Throughput Up and Downstream)	✓	• NGA networks have the bi-directional throughput to serve rich interactive applications
• High rates of contention and lack of traffic prioritization impact real-time app performance	✘	**High QoS**	✓	• Traffic management/ prioritization or lack of contention minimize latency and jitter optimizing real-time apps – DOCSIS 3.0 does not generally have the same QoS capabilities as FTTH

Example CGA Technologies

- DSL (ADSL, VDSL, etc)
- FTTN
- HFC DOCSIS 2.0
- HFC DOCSIS 3.0 (as commonly deployed)
- 3G and 4G wireless

Example NGA Technologies

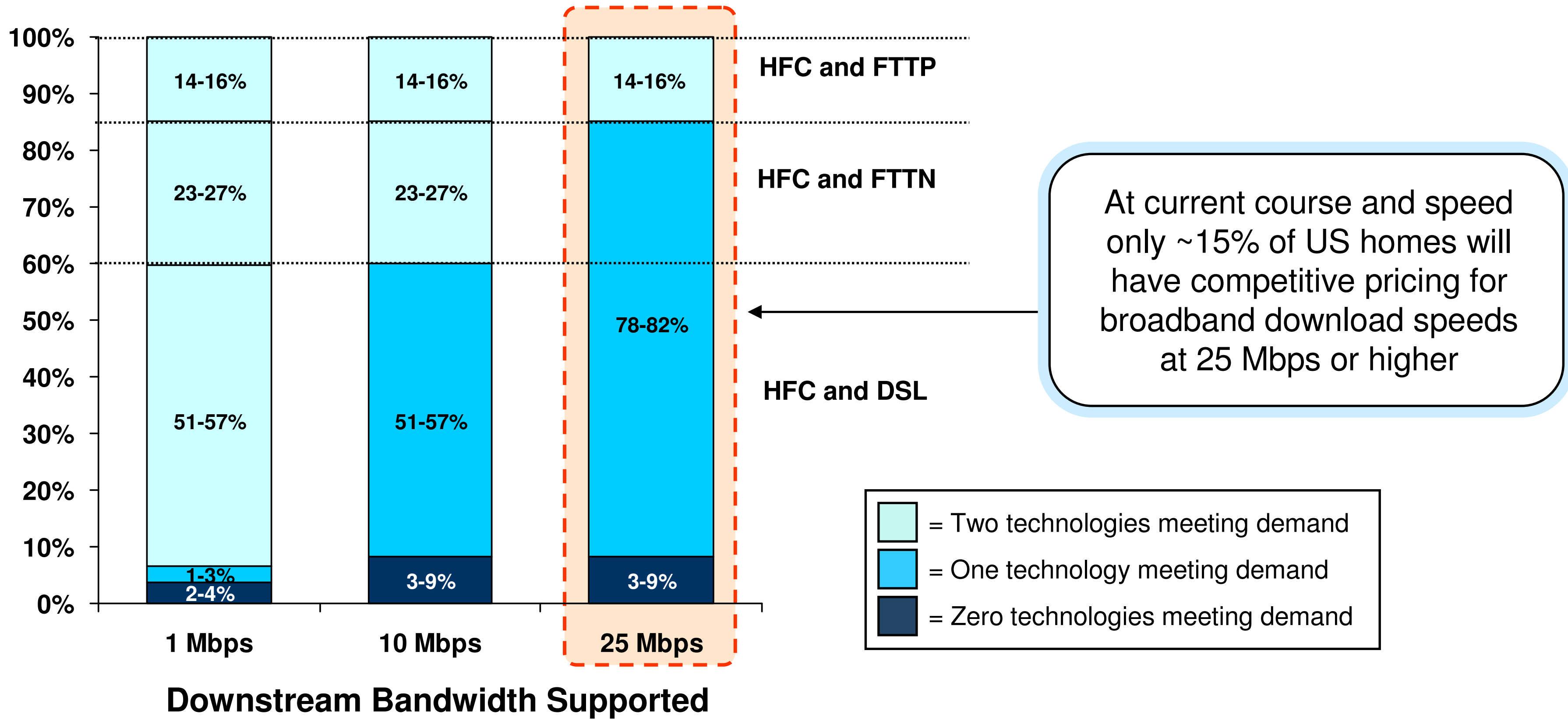
- FTTH
- HFC DOCSIS 3.0 (enhanced with node splits and 8-channel bonding)
- Bonded VDSL2

Our estimates suggest – and are corroborated by draft FCC data – that at current course and speed most households will not have access to at least two network providers capable of 25 Mbps throughput

- This two provider dynamic for next-generation broadband will exist primarily in the Northeastern US

Wireline Broadband Technology Platform Coverage (After Completion of Announced DOCSIS 3.0 Build-out)

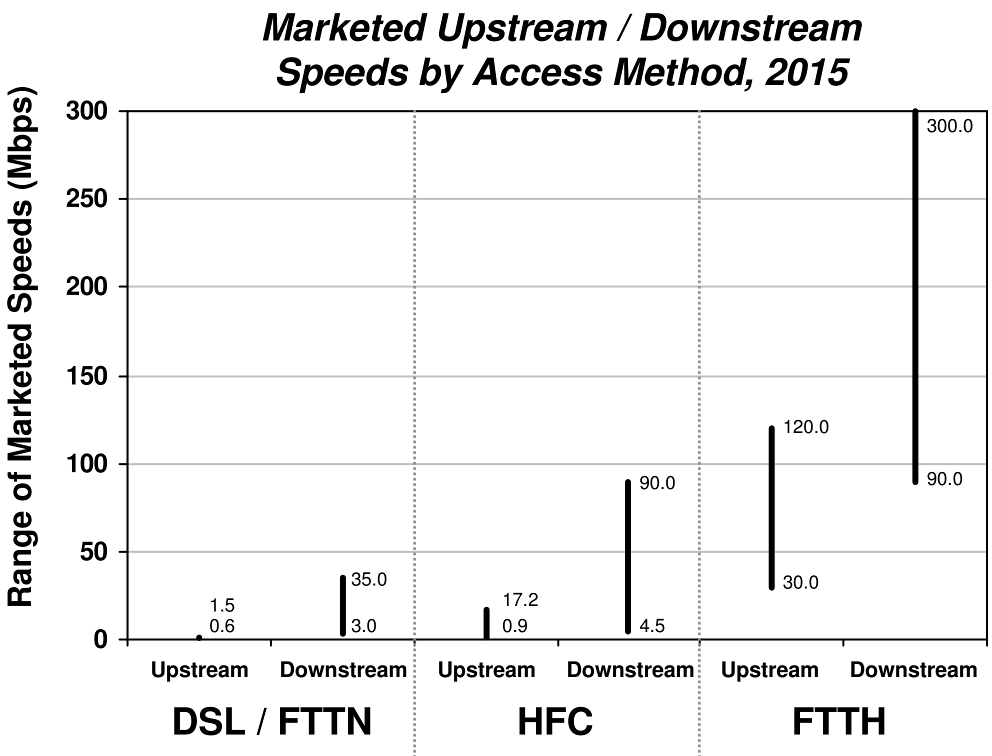
Percent of HUs Passed



Source: Draft FCC National Broadband Plan

While some technologies are inherently capable of providing faster speeds, market speeds vary by commercial segmentation

- Actual speeds vary based on technology type, speed tier, and contention



Comments

- We have forecasted broadband adoption by service tier (budget, standard, and premium) for each technology type
  - Across all broadband subs, 42% use budget, 39% use standard, and 19% use premium service within their respective technology type
- Actual throughput received by subscribers is often significantly lower than marketed speeds
  - We expect median actual throughput across all broadband HHs to increase from 2.4 Mbps in 2009 to 11.1 Mbps by 2015 at current course and speed
- Across all technologies, we estimate that 48% of subs today receive actual speeds of 3 Mbps and less
  - FCC and comScore report ~50% receiving <3 Mbps

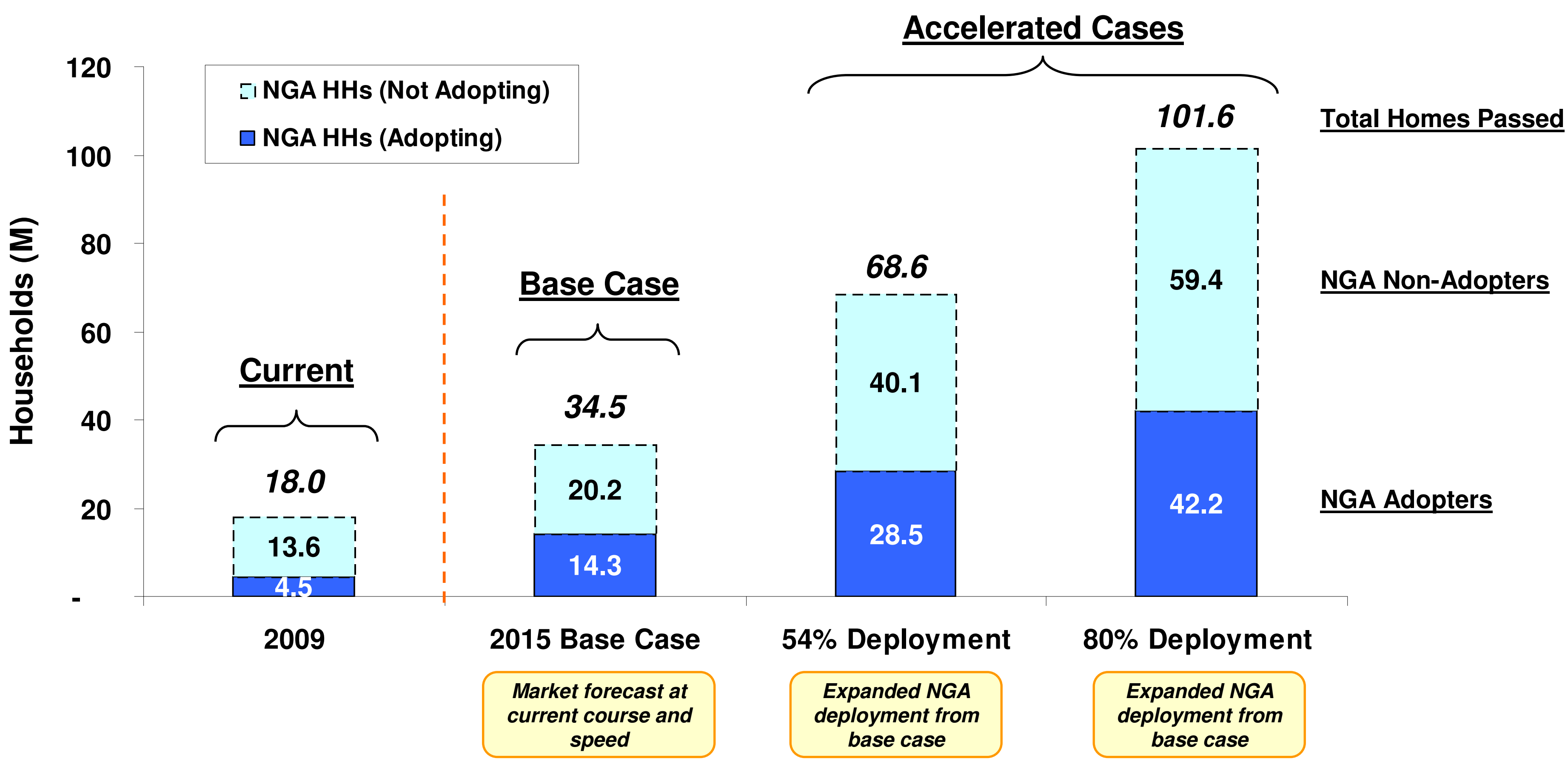
In this study, we focus on actual throughput enabled by all broadband network types

Source: SNL Kagan, CSMG analysis

There will be relatively few households with next-generation broadband in our base case scenario

- If deployment is accelerated (e.g. to the point at which 80% of households have access to NGA), we believe adoption of next-generation applications will be proportionately higher

Next-Generation Broadband Subs & Homes Passed Scenarios



Source: SNL Kagan, CSMG analysis

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The applications that require NGA broadband are forward-looking, but many are beginning to be offered today

Applications Enabled by NGA Broadband

	Description	Example	Requirements
Advanced HD Video	• Next-gen super high-resolution video: – **Quad HD**: 3840 x 2160 (2160p)[1] – **Ultra HD**: 7680 x 4320 (4320p)[1]	• Technical approaches are being defined[2] • Quad HD hardware in development[3]; currently available in Japan • Ultra HD undergoing testing in Japan[1]	• Real-time and streaming: – Quad HD: **64 Mbps**[1] – Ultra HD: **256 Mbps**[1] • Moderate to high QoS requirements
3D/HD Video	• HD stereoscopic video content • Requires 3D-enabled content and hardware (TV set, glasses, etc.)	• Leading CE vendors plan to unveil 3D-capable TV sets beginning in 2010[1] • Recent 3D movie titles include *Toy Story 3*, *Monsters vs. Aliens*, *Up*, and others[4]	• Real-time and streaming 3D video requires **32 Mbps** per stream[1] • Moderate to high QoS requirements
Advanced HD/3D Video	• Combination of advanced HD (Quad or Ultra) and 3D video formats	• Philips and other manufacturers have trialed 3D Quad HD TV sets[5] • London 2012 Olympics could potentially be shot in 3D and Quad HD[6]	• Requires 2-4X bandwidth of single Quad/Ultra HD stream[1] • Potential for **256+ Mbps** requirement • Moderate to high QoS requirements
Massive Downloads & Uploads	• Non real-time downloads and uploads of very large files (10+ GB) including images, videos, etc.	• GigaPan & Photosynth stitch 100s of photos together (multi-gigapixel images)[1] • Other types of rich imagery are emerging (satellite, panorama, etc.)[1]	• 12 min HD video can be uploaded in ~10 min with **10 Mbps** • Reduced to <10 sec with **1 Gbps** • Low QoS required (non real-time)
Cloud Computing	• Computing processing power shifted to the network • Desktop machine used as thin client	• Cloud-based consumer apps emerging (e.g. Google Docs, MS Office 2010) • Potential to drive move to thin client computing	• Very high QoS required to minimize latency to sustain program performance • Current generation bandwidth is sufficient

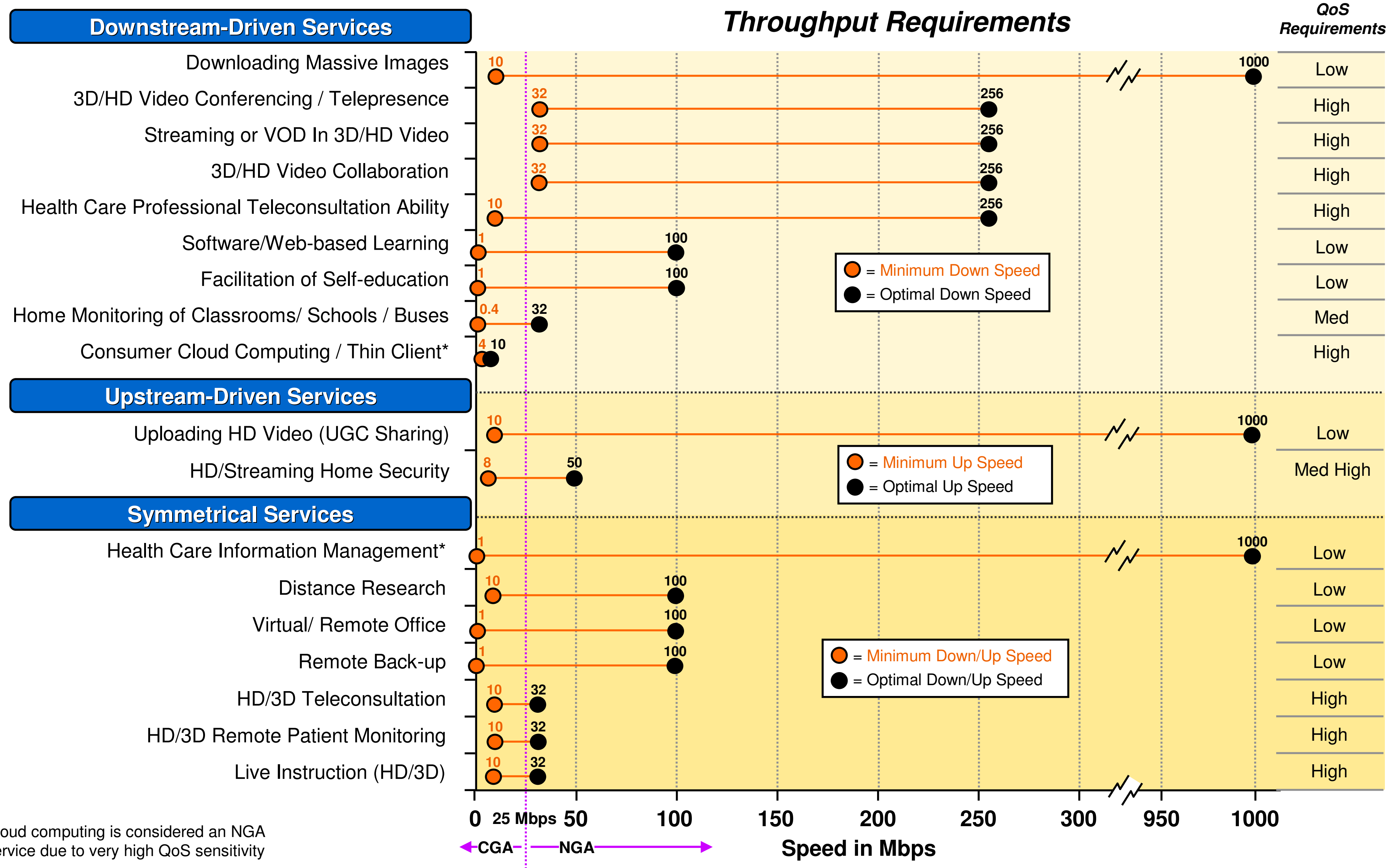
Source: (1) ITIF, 2009; (2) SMPTE, 2008; (3) Engadget, 2008; (4) CSMG; (5) Wired, 2008; (6) HDTV Org; CSMG analysis

We have identified 19 services with possible public benefits enabled by next-generation applications

- We believe these services provide incremental benefits over current-generation broadband

	Service Name	Description / Public Benefit
(Advanced) HD/3D Video	• HD/3D Video Conferencing / Telepresence	• Real-time 1-to-1 or multiparty video communication with friends/relatives (in HD and/or 3D)
	• Streaming Video or VoD in 3D/HD	• Download streaming high-resolution webcast or VoD content (replaces physical media)
	• HD/Streaming Home Security	• Upload high-resolution streams from (one or multiple) home security cameras
	• Place Shifted HD/3D Video	• Ability to view home DVR contents from another location (e.g. HD/3D Slingbox)
	• Uploading HD Video (UGC Sharing)	• Quickly upload very large high-res (HD/3D) video files; Not real-time – QoS not required
	• Real-time HD Video Blogging	• Upload HD webcast in real-time (one-to-many); Stream may be buffered
	• HD Video Collaboration	• HD telepresence capabilities combined with collaborative document sharing & editing tools
	• HD/3D Teleconsultation	• HD/3D video consultation and/or diagnostic-focused interaction between patient and doctor
	• HD/3D Remote Patient Monitoring	• HD/3D video monitoring & vital sign tracking of remote patients; enables treatment at home
	• Health Care Professional Teleconsultation Ability	• Enables remote doctors to perform real-time HD/3D consultation, diagnosis, telesurgery, etc.
	• Live Instruction (HD/3D)	• 1- or 2-way HD/3D interactive video instruction with tools for multimedia and collaboration
	• Home Monitoring of Classrooms / Schools / Buses	• Enables parents, sick students, and school admin to observe class (or school bus) in HD/3D
Massive Downloads & Uploads	• Downloading Massive Images	• Quickly download very large, multi-gigapixel images (e.g. GigaPan, Photosynth) or HD video
	• Virtual / Remote Office	• Improved telework functionality (VPN, file share/backup, security, etc.) due to enhanced speed
	• Distance Research	• Immediate access to very large databases, files, & collaborative tools for academic researchers
	• Health Care Information Management	• Real-time access to patient records, medical databases, and very large medical images
	• Software/Web-Based Learning	• Non real-time virtual instruction, learning, & training tools for students (K-12, college, etc.)
	• Facilitation of Self-Education	• Improved access to publicly-available educational materials on the web due to higher speeds
Cloud Computing	• Consumer Cloud Computing / Thin Client	• Network-based processing power; Could reduce need for frequent hardware upgrades

Each of these NGA services have use cases or requirements for 25+ Mbps of symmetric throughput or high QoS



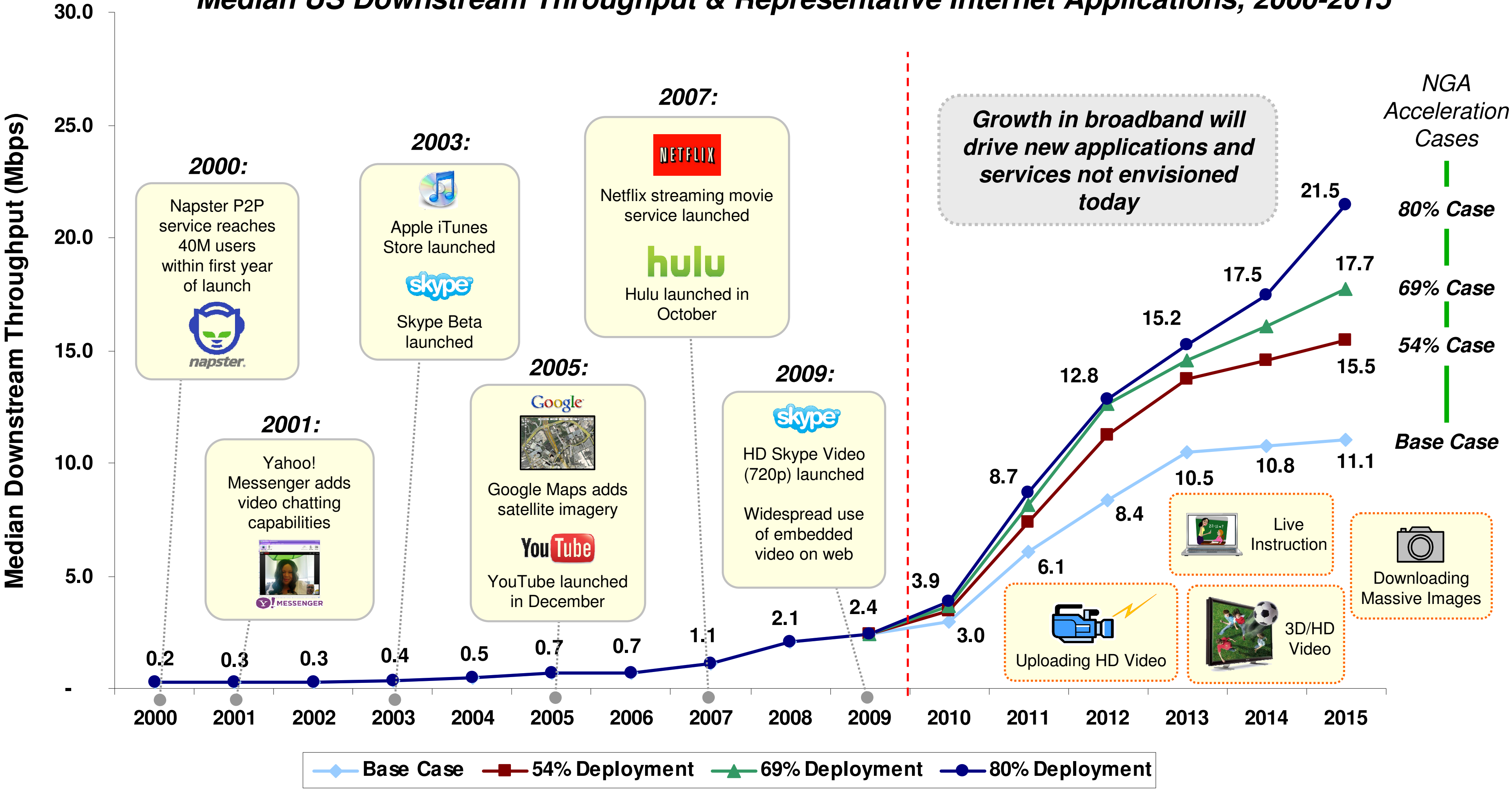
* Cloud computing is considered an NGA service due to very high QoS sensitivity

Source: ITIF, CSMG analysis

History has shown that innovative application development is preceded by increases in bandwidth

- We anticipate but do not quantify benefits from these future undefined applications

Median US Downstream Throughput & Representative Internet Applications, 2000-2015



Source: SNL Kagan, Company websites, CSMG analysis

Today's discussion

- Base Case Network
- Application Assessment
- **Cost vs. Benefit Analysis**
  - Benefit Sizing
  - Cost Analysis
- International Examples
- Policy Options

We have grouped the NGA-enabled services together in order to estimate their incremental public benefits

Consumer	Service Sized As…
HD/3D Video Conferencing / Telepresence	*"HD/3D Video Conferencing / Telepresence"*
Streaming or VoD in 3D/HD Video	*"Streaming or VoD in 3D/HD Video"*
HD/Streaming Home Security	*"HD/Streaming Home Security"*
Place Shifted HD/3D Video Uploading HD Video (UGC Sharing) Real-time Video Blogging (HD Video Streaming) Downloading Massive Images	Not quantified
Consumer Cloud Computing / Thin Client	*"Consumer Cloud Computing / Thin Client"*

Business / Telework Related	Service Sized As…
HD Video Collaboration Virtual/ Remote Office Distance Research	*"Virtual / Remote Office"*

Health Care Related	Service Sized As…
HD/3D Teleconsultation	*"HD/3D Teleconsultation"*
HD/3D Remote Patient Monitoring	*"HD/3D Remote Patient Monitoring"*
Health Care Information Management	Included under *"Virtual / Remote Office"*
Health Care Professional Teleconsultation Ability	Included under *"HD/3D Teleconsultation"*

Education	Service Sized As…
Live Instruction (HD/3D) Software/Web-based Learning Facilitation of Self-Education	*"Live Instruction"*
Home Monitoring of Classrooms/ Schools / Buses	Not quantified

Other Social/Economic Benefits to Model	Service Sized As…
Innovation Boost Updated Emergency Broadcast System/ Amber Alert Interactive Webcast of Government/Civic Events	Not quantified

In every case, we focus on the benefits from these services associated with next-generation applications vs. those enabled by current-generation applications

We have focused on public goods and positive externalities from NGA-enabled services, excluding the value of direct consumer spending on broadband

- We have quantified only a portion of the potential benefits from these services

Benefit Types		Benefits Included
Public Goods	Health	• Reduced consumer medical costs resulting from more efficient treatment/ monitoring
	Education	• GDP benefits from bridging portion of US educational performance gap relative to top-performing OECD countries
	Environmental	• CO_2 reduction from fewer private trips/ less gas consumption
	Productivity	• Reduced absenteeism among workforce via remote office (e.g. sick workers) • Productivity from retirees who remain in the workforce via remote/virtual office • Productivity from disabled workers and parents of young children
Consumer Surplus	Mileage-Driven	• Fuel and vehicle maintenance savings from reduced driving • Benefits from reduced traffic congestion (e.g. lower insurance premiums) • Time savings from reduced / avoided driving (e.g. to and from work, doctor's office, video store, etc.)
	Other Consumer Benefits	• Fewer computer purchases due to new technologies (i.e. thin client/ cloud computing) • Savings from reduced burglaries • Airfare savings from reduced flights to visit friends/family

We have taken a bottom-up approach to calculating the incremental benefit of each application by estimating the uptake rate and per household benefit for each

*Methodology for Incremental Benefit Calculations**

Uptake x **Total BB HHs** = **Adopting HHs** x **Annual Benefit per HH if Taken** = **Total Benefit** ▶ **Incremental Benefit**

Uptake
- Number of HHs taking the app as % of total HHs
- Calculated for **Accelerated Case** and **Base Case** scenarios
- Based on:
  - **Optimal uptake rate**: Full uptake % if all QoS & bandwidth reqs are met
  - **Bandwidth/QoS constraints**: Uptake rate is discounted from full rate based on % of optimal bandwidth delivered by broadband service tier

Total BB HHs
- Projected total number of broadband HHs from third-party forecasts = **101.2M**
- Identical for both Accelerated and Base case scenarios, as we assume no new broadband subs from accelerated NGA deployment

Adopting HHs
- Total number of households adopting the service
- Uptake rate * Total broadband HHs
- Calculated for **Accelerated Case** and **Base Case** scenarios

Annual Benefit per HH if Taken
- Estimated annual benefit for HHs that take the service
- Derived from other third-party studies and publicly available information
- Identical for both Accelerated and Base case scenarios
- Benefits are specific to NGA capabilities

Total Benefit
- Total aggregate benefit across all subscribers
- Annual Benefit per HH if Taken * Adopting HHs
- Calculated for **Accelerated Case** and **Base Case** scenarios

Incremental Benefit
- Accelerated case total benefit minus Base case total benefit
- **Total aggregate benefit** from accelerated NGA deployment

*Note: All calculations have been segmented by Accelerated Case and Base Case scenarios in order to demonstrate our methodology for calculating total incremental benefit

Teleworking could produce ~$5.4B in annual benefits due to reduced commuting and increased productivity from a larger workforce

2015 Incremental Benefits from Virtual/Remote Office

	Uptake		Total BB HHs		Adopting HHs		Annual Benefit per HH if Taken		Total Benefit
Accelerated	11.5%	x	101.2M	=	11.7M	x	$800.32	=	**$9.33B**
Base	4.9%	x	101.2M	=	4.9M	x	$800.32	=	**$3.94B**

Incremental Benefit

$5.39B

(Accelerated – Base)

Uptake Rate

- Optimal uptake rate in 2015 is predicted to be 35%
  - Fiber users are likely to telecommute 1-2 days more than other broadband users[15]
- Optimal throughput is estimated at 100 Mbps (symmetrical); minimum is 1 Mbps (symmetrical)
- Adoption is 25.6% among NGA subs and ~1.4% among CGA subs
- Greater number of NGA subs in accelerated case increases uptake from **4.9%** (base) to **11.5%** (accelerated)

Benefit per Household Using Service

Benefits Included

- Reduced work trips; increased productivity of retirees, absent workers, disabled, and parents
  - Avg. of 1.7 office visits avoided per month[1]
    - $22.32 (mileage[2]); $2.69 (other driving[3]); $0.81 ($CO_2$[4]); $8.85 (time[5]) = **$416.04 annually per HH**
- 11.1% of workforce over 65 and non-working[6]. Assuming 1% will work from home with avg. weekly wages of $644[7] = **$96.72 yearly benefit per HH**
- $378 lost per HH due to absenteeism[8], 20% avoided by telework = **$84.70 benefit/HH**
- Disabled pop = ~27M[9]; Percent of pop in labor force = 22%[10], employment rate = 83%[11]
  - Assume 10% increase in labor force participation and ~1.5% increase in employment % = 0.4M new workers at $488 weekly wage[12] = **$81.76 annual benefit per HH**
- Net change to labor force if parents of children <6 are employed at same % of other parents = 2.1M[13]
  - Weighted avg. yearly wage (full-time and part-time): $33,887[14]
  - Assume 20% of employment gap closed via telework = **$121.12 annual benefit/HH**
- $416 (reduced trips) + $384 (retirees/absentees/disabled/parents) = ~**$800 per HH**

Potential Additional Benefits

- Potential additional benefit could include enhancements to productivity due to improved collaboration with colleagues
- Reduced traffic and congestion during rush hour for general public, given fewer vehicles on the road

Source: CSMG analysis, (1) RVA, (2) US GSA, World Resources Institute, (3) Edlin & Mandic, (4) EPA, IPCC, (5) Connected Nation, ABC / Washington Post, BTS, (6) US Census Bureau, (7) BLS, (8) Commonwealth Fund, (9-11) US Census Bureau, (12-14) BLS, (15) RVA

HD medical teleconsultation could lead to $1.4B in benefits by lowering medical costs and decreasing time, mileage, and carbon emissions from hospital trips

2015 Incremental Benefits from HD/3D Teleconsultation

	Uptake		Total BB HHs		Adopting HHs		Annual Benefit per HH if Taken		Total Benefit
Accelerated	7.9%	x	101.2M	=	8.0M	x	$291.45	=	**$2.32B**
Base	3.1%	x	101.2M	=	3.1M	x	$291.45	=	**$914.2M**

Incremental Benefit

$1.41B

(Accelerated – Base)

Uptake Rate

- Optimal uptake in 2015 is estimated at 19%
  - Medical video conferencing is "very important" to 16%; "somewhat important" to 43%[7]
    - 16% + one-half of 43% = 38%
    - Discounted by half to account for limited availability = **19% baseline penetration**
- Throughput ranges from 10 Mbps symmetrical (min) to 32 Mbps symmetrical (optimal)
- Adoption is 18% among NGA subs and ~0.3% among CGA subs
- Greater number of NGA subs in accelerated case increases uptake from **3.1%** (base) to **7.9%** (accelerated)

Benefit per Household Using Service

Benefits Included

- Annual benefit of $291.45 from HD/3D medical teleconsultation – direct healthcare savings and reduced medical/dental trips
- Estimated **$217 in direct savings** per person due to broadband[1]
- On average, 4.2 medical trips reduced per month[2]
  - **$6.20 in monthly non-healthcare benefits:** $3.99 (mileage[3]); $0.48 (other driving[4]); $0.14 ($CO_2$[5]); $1.58 (time[6])
  - $6.20 * 12 = **$74.45 annually**
- $217 + $74.45 = **$291.45 in annual per HH benefits**

Potential Additional Benefits

- Vast majority of healthcare spending is not driven by consumer decisions
  - Large potential additional benefit if systemic healthcare benefits are accounted for
- Other potential sources of social and economic benefits may include:
  - Reduction in in-person visits from home healthcare workers
  - Increased productivity from healthier workforce
  - Time savings as a result of decreased waiting time

Source: CSMG analysis, (1) Connected Nation, (2) Ibid, (3) US GSA, (4) Edlin & Mandic, (5) EPA, IPCC, (6) Connected Nation, ABC / Washington Post, BTS, (7) RVA

Personal HD/3D video conferencing could generate $1.35B in benefits from reduced trips as face-to-face meetings are replaced by electronic communication

2015 Incremental Benefits from 3D/HD Video Conferencing & Telepresence

	Uptake		Total BB HHs		Adopting HHs		Annual Benefit per HH if Taken		Total Benefit
Accelerated	10.7%	x	101.2M	=	10.9M	x	$192.59	=	**$2.09B**
Base	3.8%	x	101.2M	=	3.8M	x	$192.59	=	**$737.1M**

Incremental Benefit

$1.35B

(Accelerated – Base)

Uptake Rate

- Optimal uptake rate in 2015 is estimated at 50%
  - Telepresence is shifting to mass market; will likely be popular among NGA HHs
- Optimal throughput is estimated at 256 Mbps down and 128 Mbps up
- Adoption is 25.4% among NGA subs and ~0.02% among CGA subs
- Greater number of NGA subs in accelerated case increases uptake from **3.8%** (base) to **10.7%** (accelerated)

Benefit per Household Using Service

Benefits Included

- Per HH benefit in reduced trips to visit family/friends
  - Avg. of 12,000 miles per vehicle[1], 1.9 vehicles per HH[2] = 22,800 miles per HH
  - 5.3% of all miles for visiting friends/family[3]; assume 15% reduction = **15.1 miles saved per HH monthly**
  - **$12.93 in monthly benefits**: $8.33 (mileage[4]); $1.00 (other driving[5]) $0.30 ($CO_2$[6]); $3.30 (time[7])
- Avg. of 1.7 round-trip flights per year[8], 2.6 people per HH[9]
  - Assume half of HH goes on each trip = 2.2 annual flights per HH
  - Yearly avg. of 6,181 passenger flight miles per HH[10]
  - Avg. speed = 500 MPH[11]; total hrs. spent flying per HH = 13.36 annually
  - Avg. airfare = $392.74[12]; total spent on airfare: $1,005 per HH
- 56% of long-distance trips for pleasure[13]; assume 40% is for visiting friends/family
  - If 15% reduction = **$3.36 monthly benefit** ($0.55 from time, $2.82 from airfare)
- $12.93 (driving) + $3.36 (flying) = $16.03 monthly * 12 = **$192.59 annual benefit**

Potential Additional Benefits

- Does not reflect work-related benefits – could potentially include productivity and innovation impacts
- CO_2 reduction from decrease in flights to visit family and friends

Source: CSMG analysis, (1) EPA, (2) NHTS, (3) Ibid, (4) US GSA, (5) Edlin & Mandic, (6) EPA, IPCC, (7) Connected Nation, ABC / Washington Post, BTS, (8) Gallup, (9) US Census Bureau, (10) Business Travel Monitor, (11) US Skylink, (12) Business Travel Monitor, (13) BTS: National Household Travel Survey

A conservative view of savings from remote patient monitoring shows over $1.3B in incremental benefit from NGA broadband

2015 Incremental Benefits from HD/3D Remote Patient Monitoring

	Uptake		Total BB HHs		Adopting HHs		Annual Benefit per HH if Taken		Total Benefit
Accelerated	3.6%	x	101.2M	=	3.7M	x	$627.98	=	**$2.30B**
Base	1.5%	x	101.2M	=	1.5M	x	$627.98	=	**$966.2M**

Incremental Benefit

$1.34B

(Accelerated – Base)

Uptake Rate

- Optimal uptake in 2015 is estimated at 8.3%
  - 45% of the US pop suffers from at least one chronic condition[3]; discounted by 37% who believe medical video is important, and 50% for limited availability[4]
    - 8.3% optimal uptake
- Symmetrical throughput ranges from 10Mbps (min) to 32Mbps (optimal)
- Adoption is 8.0% among NGA subs and ~0.4% among CGA subs
- Greater number of NGA subs in accelerated case increases uptake from **1.5%** (base) to **3.6%** (accelerated)

Benefit per Household Using Service

Benefits Included

- Annual reduction in healthcare costs due to improved care with HD/3D remote patient monitoring based on reduced
  - Home healthcare costs: $11/mo[1]
  - Other healthcare costs: $42/mo[2]
  - Total ($53 * 12 months) = **$628** / **yr per HH**
- Controlled, 17 month Kaiser study compared total cost of care and cost of home healthcare for patients with chronic conditions
  - Only difference in care was video monitoring
  - Benefit excludes the cost of equipment and telecom service

Potential Additional Benefits

- Vast majority of healthcare spending is not driven by consumer decisions
  - Large potential additional benefit if systemic healthcare benefits are accounted for
- Additional (and likely larger) benefit could derive from:
  - Reduction in in-person visits from home healthcare workers
  - Other real potential benefits not quantified include delaying hospitalization/ institutionalization and reducing days spent in post-op recovery

Source: CSMG analysis, (1) Kaiser Permanente, (2) Ibid, (3) Litan, (4) RVA

Education via real-time, high-quality online video could result in nearly $1B in GDP impact by partly bridging the performance gap with other developed nations

2015 Incremental Benefits from Live Instruction

	Uptake		Total BB HHs		Adopting HHs		Annual Benefit per HH if Taken		Total Benefit
Accelerated	6.5%	x	101.2M	=	6.6M	x	$258.95	=	**$1.71B**
Base	2.7%	x	101.2M	=	2.8M	x	$258.95	=	**$717.8M**

Incremental Benefit

$994.5M

(Accelerated – Base)

Uptake Rate

- Optimal uptake in 2015 is estimated at 15%
  - Studies have demonstrated effectiveness of online & video learning as supplement to face-to-face
  - Uptake will likely increase rapidly and reach broad adoption in long term
- Bandwidth requirements range from 10 Mbps (symmetrical) to 32 Mbps (symmetrical)
- Adoption is 15.0% among NGA subs and ~0.8% among CGA subs
- Greater number of NGA subs in accelerated case increases uptake from **2.7%** (base) to **6.5%** (accelerated)

Benefit per Household Using Service

Benefits Included

- Annual GDP impact of improving US educational performance vs. top-performing nations (e.g. Finland, Korea)
  - US schools currently underperforming (25^{th} out of 30 OECD countries)[1]
  - GDP impact of bridging gap estimated at $1.3-$2.3 trillion[2]
- Assuming that live interactive instruction addresses 1% of GDP gap, $13B in potential savings
- # of households in 2015: 127.1M[3]
  - ~40% of HHs have students[4]
  - ~50.2M total HHs
- $21.58 monthly benefit per HH
- $21.58 * 12 = **$258.95 yearly benefit per HH**

Potential Additional Benefits

- Increase in productivity due to flexibility of remote learning (continuing education)
- Benefits of reduced absenteeism in schools facilitated by remote learning
- Cost savings vs. traditional forms of education to increase performance

Source: CSMG analysis, (1) PISA, (2) McKinsey, (3) SNL Kagan, (4) US Census Bureau

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Benefits of up to ~$600M could be realized as consumers make fewer trips to the movie rental store in favor of streaming video and Video on Demand services

2015 Incremental Benefits from HD/3D Streaming Video or VoD

	Uptake		Total BB HHs		Adopting HHs		Annual Benefit per HH if Taken		Total Benefit
Accelerated	7.3%	x	101.2M	=	7.4M	x	$126.03	=	**$935.8M**
Base	2.7%	x	101.2M	=	2.7M	x	$126.03	=	**$344.3M**

Incremental Benefit

$591.4M

(Accelerated – Base)

Uptake Rate

- Optimal uptake rate in 2015 is estimated at 30%
  - Streaming/VoD currently comprises 20% of video rental market[1] – expected to grow dramatically
  - NGA users are likely to have leisure time for movie rentals & purchases
- Adoption is 17.1% among NGA subs and ~0.3% among CGA subs
- Greater number of NGA subs in accelerated case increases uptake from **2.7%** (base) to **7.3%** (accelerated)

Benefit per Household Using Service

Benefits Included

- Growth in advanced HD formats expected to drive resurgence of physical media
- Benefits from reduced trips to video store and associated fuel, carbon, and time benefits
  - Total physical video rental market: $6.2B per year[1]
  - Average price per rental: $3.25[2]
  - Total physical videos rented per year = ~1.9B
- Assuming 117.6 households in 2015[3], # of videos rented monthly per HH = 1.3
- Assume 1.5 videos rented each trip
- 0.9 monthly trips reduced using VoD
- $10.50 monthly benefit: $6.76 (mileage[4]); $0.82 (other driving[5]); $0.24 ($CO_2$[6]); $2.68 (time[7])
- $10.50 * 12 = **$126.03 annual benefit / HH**

Potential Additional Benefits

- Other sources of benefit could potentially include:
  - Reduced cost of shipping videos for by-mail rentals (e.g. Netflix via mail)
  - Cost efficiencies associated with content delivery (i.e. reduction of costs associated with production of physical media)

Source: CSMG analysis, (1) Blockbuster, Consumer Electronics Association, (2) Ventura County Star, (3) SNL Kagan, (4) US GSA, World Resources Institute, (5) Edlin & Mandic, (6) EPA, IPCC, (7) Connected Nation, ABC / Washington Post, BTS

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As cloud computing shifts toward the consumer segment, we believe computer lifecycles will increase resulting in ~$200M in annual direct benefits by 2015

2015 Incremental Benefits from Consumer Cloud Computing/Thin Client

	Uptake		Total BB HHs		Adopting HHs		Annual Benefit per HH if Taken		Total Benefit
Accelerated	6.7%	x	101.2M	=	6.7M	x	$125.69	=	**$847.3M**
Base	5.1%	x	101.2M	=	5.1M	x	$125.69	=	**$646.5M**

Incremental Benefit

$200.8M

(Accelerated – Base)

Uptake Rate

- Optimal uptake in 2015 is estimated at 10%
  - Nascent market which will not gain widespread traction until capabilities are fully developed (5 years+)
- Downstream bandwidth requirements of app range from 4 Mbps (min) to 10 Mbps (optimal); upstream from 500 Kbps to 1 Mbps
- Very high QoS requirements reduce adoption rate for CGA broadband subs
- Adoption is 10.0% among NGA subs and ~4.3% among CGA subs
- Greater number of NGA subs in accelerated case increases uptake from **5.1%** (base) to **6.7%** (accelerated)

Benefit per Household Using Service

Benefits Included

- Annual benefit of $125.69 – reduction in spending on computers as consumers require less processing power
  - **64.7M computer shipments** in the US[1] (2008)
  - Avg. cost of computer: **$686**[2]
  - **$31.42 in monthly computer sales** per HH
  - Assuming 33% reduction in HH computer costs due to cloud computing / thin clients: **$10.47 monthly benefit**
- $10.47 * 12 = **$125.69 annual benefit per household**

Potential Additional Benefits

- Other sources of benefit include:
  - Software savings from use of SaaS
  - Productivity benefit from the availability of greater processing power on demand
  - Reduced environmental cost of more efficient computing
  - Societal benefit of democratization of computing

Source: CSMG analysis, (1) Gartner, (2) NPD, IDC

Reduced burglaries due to HD streaming home security video could result in savings of ~$11M

2015 Incremental Benefits from HD/Streaming Home Security

	Uptake		Total BB HHs		Adopting HHs		Annual Benefit per HH if Taken		Total Benefit
Accelerated	3.8%	x	101.2M	=	3.8M	x	$5.09	=	**$19.5M**
Base	1.6%	x	101.2M	=	1.6M	x	$5.09	=	**$8.1M**

Incremental Benefit

$11.4M

(Accelerated – Base)

Uptake Rate

- Optimal uptake in 2015 is estimated at 10%
  - Likely low, as security system purchases are primarily driven by factors other than broadband
  - Currently ~24% household penetration of home security systems[4], but few with video
- Downstream requirements are minimal; upstream requires 8 Mbps (minimum) to 50 Mbps (optimal)
- Adoption is 8.5% among NGA subs and ~0.4% among CGA subs
- Greater number of NGA subs in accelerated case increases uptake from **1.6%** (base) to **3.8%** (accelerated)

Benefit per Household Using Service

Benefits Included

- HD/streaming home security video benefit of $21.60 per HH – value of items saved due to reduced burglaries
  - 29.5 burglaries annually per 1,000 HHs[1]; **0.03 burglaries per HH**
  - Homes with security systems are 3 times less likely to be burglarized[2]: 0.02 burglaries reduced per HH due to security systems
  - Assuming streaming HD video enables 15% of reduction, **0.003 burglaries prevented by HD video**
  - Average burglary loss: $1,725[3]
- **Yearly benefit per HH: $5.09** ($1,725 * 0.003)

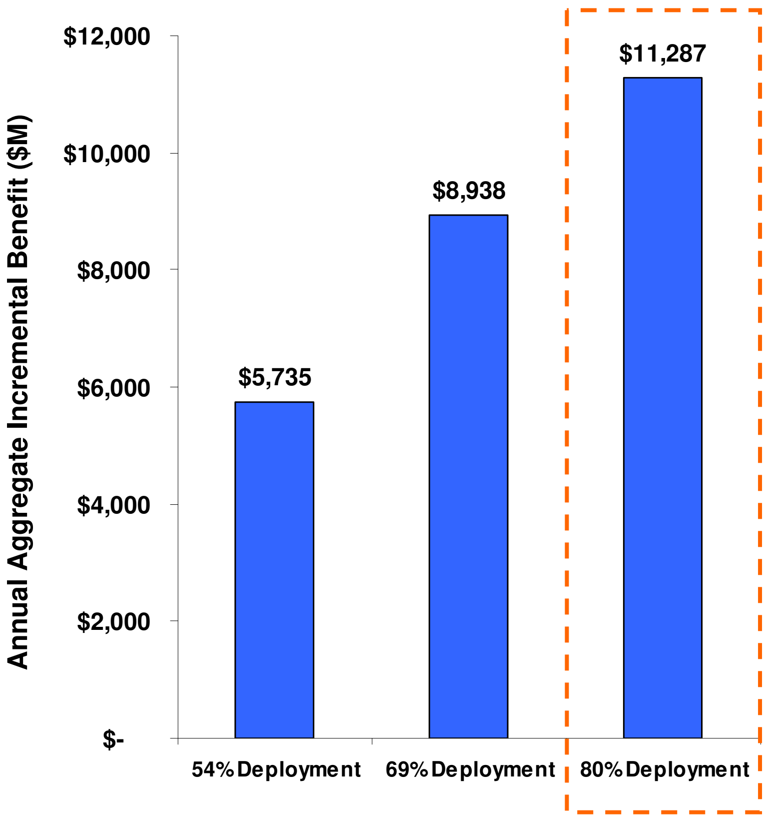
Potential Additional Benefits

- While incremental benefit opportunity is currently very small, other potential benefits have not been quantified
- Law enforcement / 911 cost savings due to reduced crime
- Greater community investment due to safer neighborhoods
- Potential for "neighborhood watch" or other related public safety / national security applications

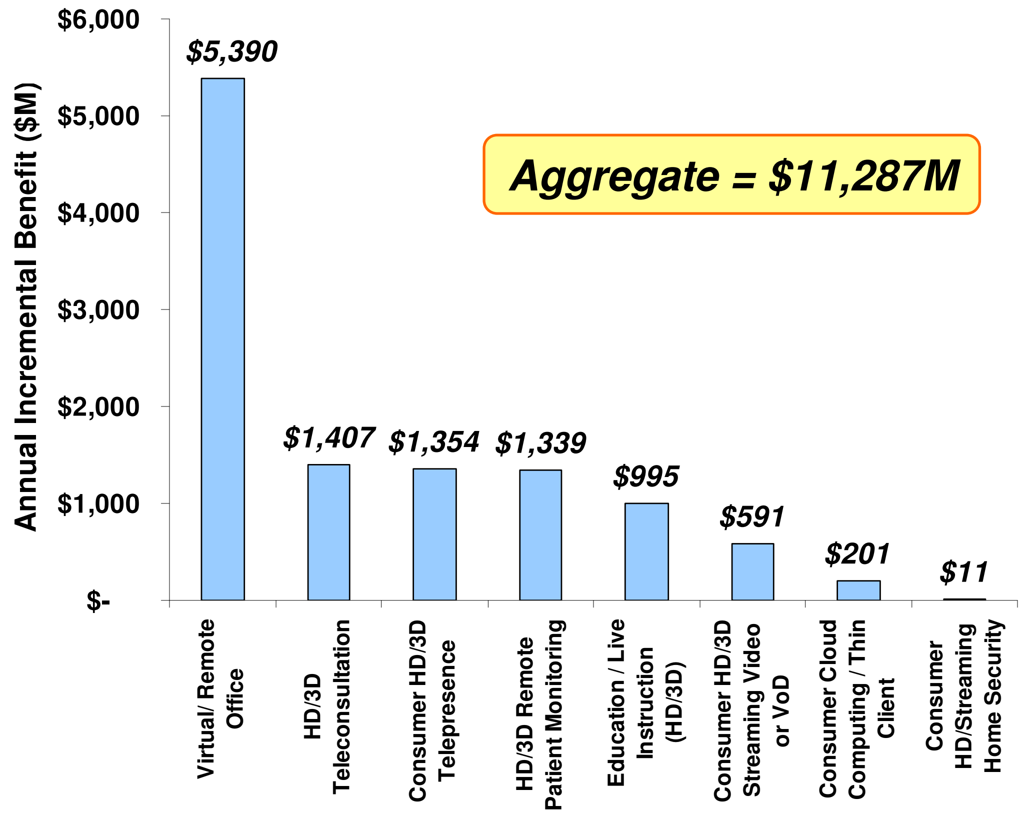
Source: CSMG analysis, (1) Department of Justice – National Crime Victimization Survey, (2) Temple University, (3) Dep't of Justice – Crime in the United States, (4) Security Products Magazine

If NGA broadband is deployed widely, total incremental benefits over our base case could exceed $11B, driven primarily by remote office, e-health, and video conferencing services

Aggregate Incremental Benefit, 2015

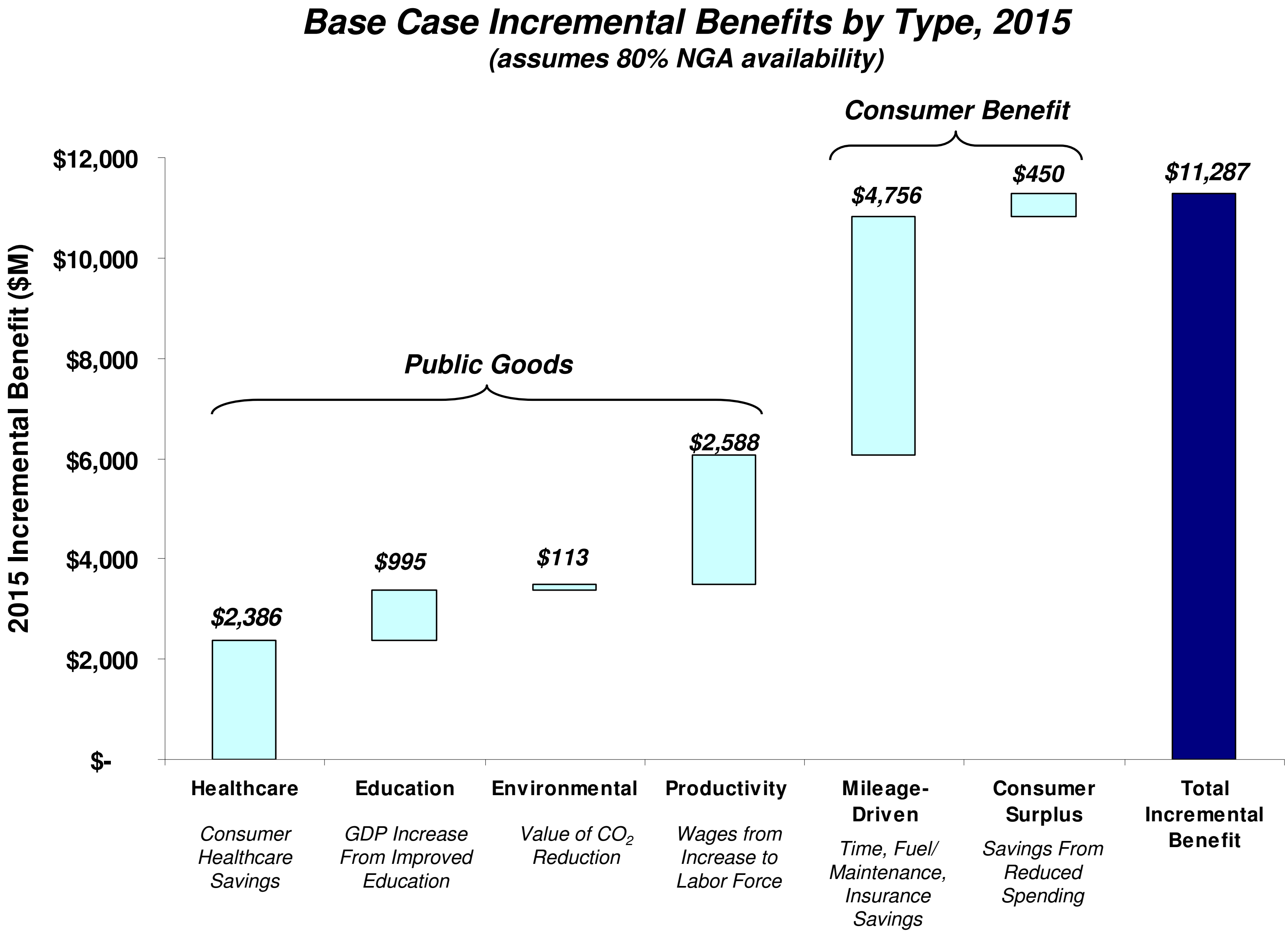


Incremental Benefit by Service, 2015
(assumes 80% NGA availability)



Source: CSMG analysis

These $11.3B in bottom-up quantified benefits are split roughly equally between public and private benefits



Source: CSMG analysis

The estimated benefits from NGA deployment are relatively small compared to the national metrics they are impacting

Benefits as % of US Aggregate

(assumes 80% NGA availability)

Forecasted benefits due to NGA network adoption	*Total Benefits (B)*	*% of US Total*	National Metric Description
Reduced Driving (Miles)	5.4B	0.2%	• Total of ~3.0 trillion aggregate miles driven in the US
Healthcare Savings (Costs $)	$2.4B	0.7%	• Total consumer healthcare expenditures of $342B (includes insurance, services, drugs, etc.); Excludes public expenditures
Education Improvement (GDP Impact $)	$1.0B	0.08%	• Total GDP impact of closing educational gap between top-performing nations is estimated at ~$1.3 trillion
Productivity Enhancement ($)	$2.4B	0.02%	• 0.02% impact vs. US GDP of $14.2 trillion in 2008
Consumer Surplus ($)	$0.45B	0.01%	• Aggregate US consumer expenditures total ~$6.0 trillion annually

Source: US Department of Transportation, BLS, World Bank, McKinsey, CSMG Analysis

In addition there are a number of additional benefits associated with NGA deployment that we have not included in our base case forecast

- More work is required to validate these benefits but they would clearly be substantial

Incremental Potential Benefits (Not Included in Forecast)

Category	Description	Potential Additional Annual Impact
Consumer Surplus From Other Broadband Applications	• Survey on willingness to pay for NGA broadband indicated a substantial consumer surplus in moving to higher throughput	~\$2.7B
Increased Adoption of Current Generation Applications	• Non-quantified benefit of improved performance and greater adoption of CGA apps from NGA acceleration is assumed to at least equal the consumer surplus above	Additional ~\$2.7B
Innovation / Productivity Boost	• Assumes accelerated case NGA adoption drives just 1% of the jobs increase that Brookings found was driven by the adoption of 200+ Kbps broadband (in 2003-05)	~\$2.2B
Other Environmental & Mileage-Driven Benefits	• Central office power savings of NGA vs. CGA (~20 kWh per line) • Road maintenance and non-carbon environmental benefits of reduced driving (e.g. SO_2 and other particulates)	~\$40M+ (Central office power savings)
Economic Stimulus	• Estimates on stimulus effects of BB vary significantly • One study puts the economic stimulus multiplier effect at around 2-3X NGA network investment	Not Quantified
Multiple Providers of Next-Generation Broadband	• FCC indicates that the presence of competitors drives significant improvements in speeds available and pricing • Additional NGA deployment will drive competition	Not Quantified
Other NGA Benefits	• SMB productivity benefits from NGA broadband • Systemic healthcare savings from improved care (i.e. incremental to consumer-based benefits accounted for in this study)	Not Quantified

Source: Brookings, BLS, Compass Lexicon, Verizon, Energy Information Administration, Empiris, CSMG Analysis

After analysis of other national studies (adjusted for comparison with NGA-only benefits), our initial benefits estimate appears to be conservative

Adjusted Annual Benefits as % of GDP – Estimated Comparable NGA Benefits Alone

		NGA-Specific Benefits		US GDP Equivalent	
	National GDP (2008)	Estimated NGA Benefit*	NGA Benefit as % of GDP	US GDP (2008)	US Annual GDP Equivalent
New Zealand (NZ Institute)	$131 billion	$268.1M	**0.20%**	$14.2 trillion	**$29.1B**
United States (Criterion)	$14.2 trillion	$24.0B	**0.17%**	$14.2 trillion	**$24.0B**
United States (CSMG)	$14.2 trillion	$11.3B	**0.08%**	$14.2 trillion	**$11.3B**
United Kingdom (BSG)	$2.6 trillion	$2.1B	**0.08%**	$14.2 trillion	**$11.1B**

*Note: Based on CSMG analysis of components of each study

Our review of other studies suggests that the benefits from NGA broadband deployment could potentially reach levels 2-3X higher than our estimates

Source: New Zealand Institute, Criterion, BSG, CSMG analysis

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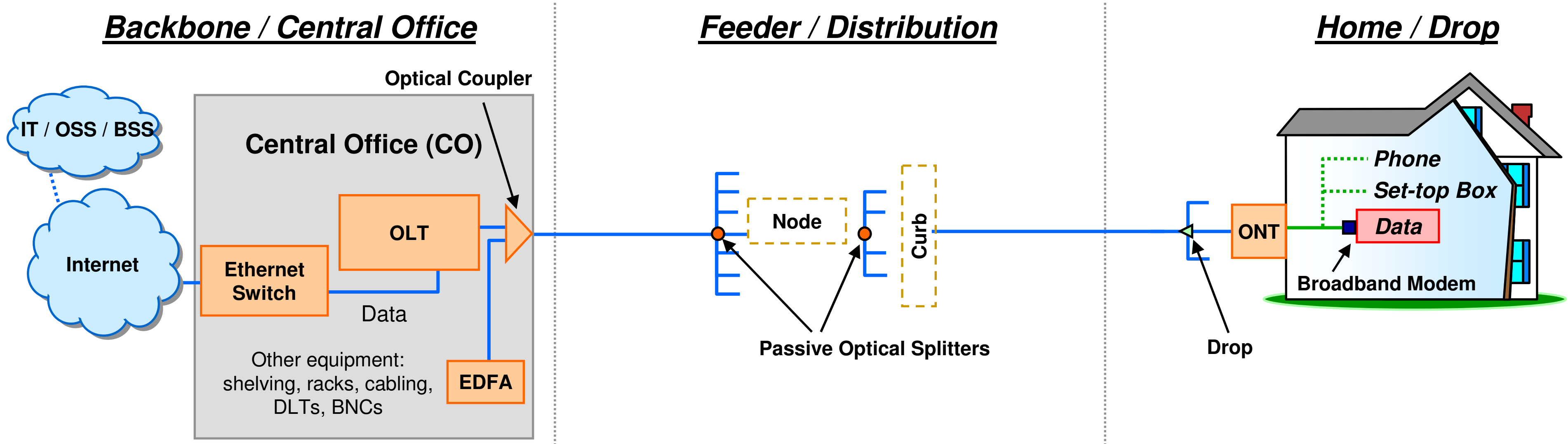
- **Cost vs. Benefit Analysis**
  - Benefit Sizing
  - Cost Analysis
- International Examples
- Policy Options

FTTH is one way to enable robust Next-Generation Access

- FTTH architectures are based on several components whose investment requirements vary based on the interplay of multiple factors



	Backbone / Central Office	Feeder / Distribution	Home / Drop
Cost Component	• OLT • Backbone (allocation) • CO Labor (installation) • Other CO Equipment (passive and active components)	• Feeder and Distribution Fiber Costs • Feeder and Distribution Fiber Labor Costs • Passive Optical Components	• Drop Fiber Cost • Drop Fiber Installation Cost • ONT • Broadband Modem Cost
Costs Vary By	• Homes per CO • Subscribers per CO • Labor and equipment cost/efficiency improvement over time	• Length of feeder and distribution fibers • Extent of buried vs. aerial plant • Labor and equipment cost/efficiency improvement over time	• Length of drop (housing lot size) • Installation efficiencies • Labor and equipment cost reductions

Factors that increase the FTTH investment required include: lower household density, greater linear distance between households, fewer homes per CO, higher service uptake, more buried plant

Source: CSMG analysis

Note: The pictured architecture is not specific to any single vendor, but instead is representative of the topology for a typical FTTH build in the US

FTTH investment requirement estimates based on large-scale deployments and US averages place the cost to pass at ~$700 per HH and cost to connect at an incremental ~$650 per subscriber HH

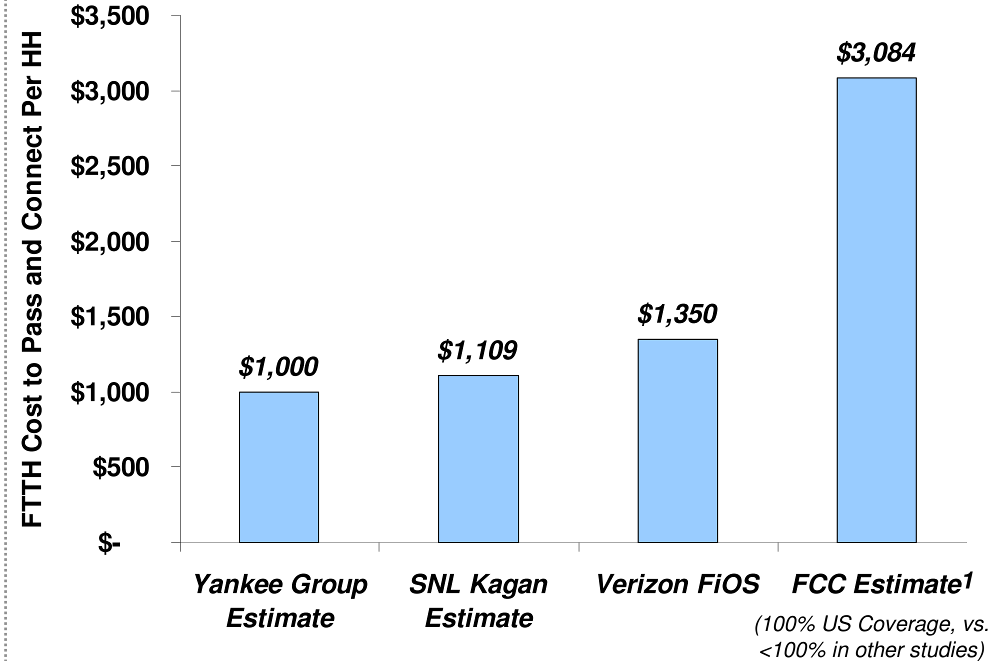
2009 Benchmarks – FTTH Cost to Pass or Connect – Urban and Suburban Builds

Carrier / Analyst Estimate	Cost to Pass per HH	Incremental Cost to Connect Per HH
Verizon FiOS	$ 700	$ 650
Jaguar Communications (Minnesota)[1]	$ 474	$ 586
Hiawatha Broadband (Minnesota)[2]	$ 800	$ 750
Analyst Estimate - SNL Kagan	$ 697	$ 412
VARIATION IN COST	**$474 - $800**	**$412 - $750**

1. Jaguar Communications market - Blooming Prairie City MN (their sole urban market)

2. Hiawatha Broadband markets – Winona, Wabasha, St.Charles, Stockton, Lewiston, Rollingstone (all in MN)

2009 Benchmarks – FTTH Cost to Pass and Connect – National Large Scale FTTH Deployments and Estimates

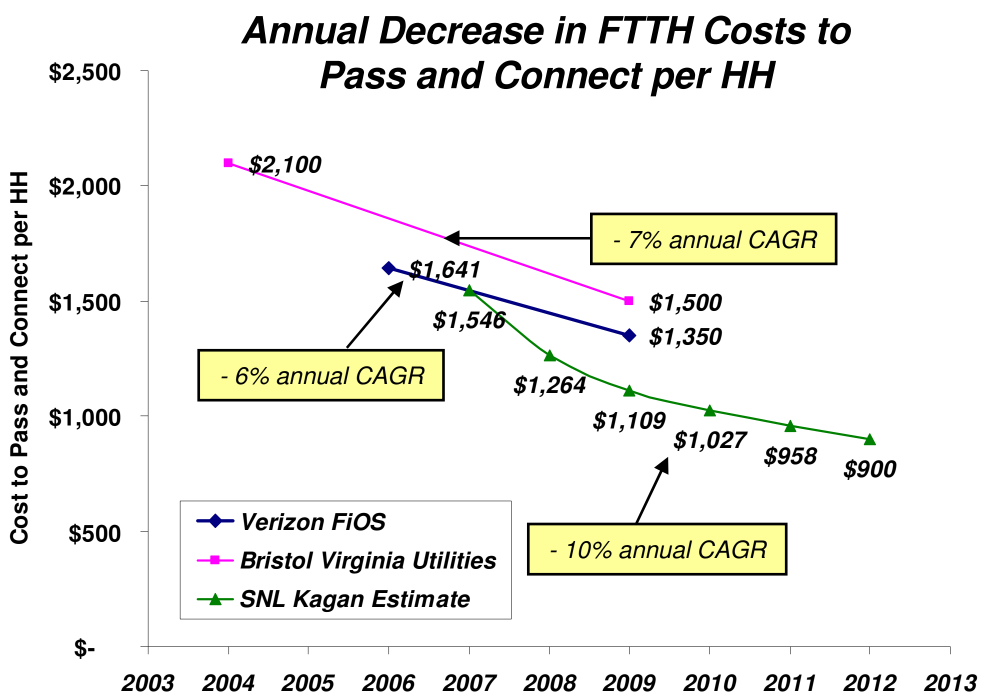


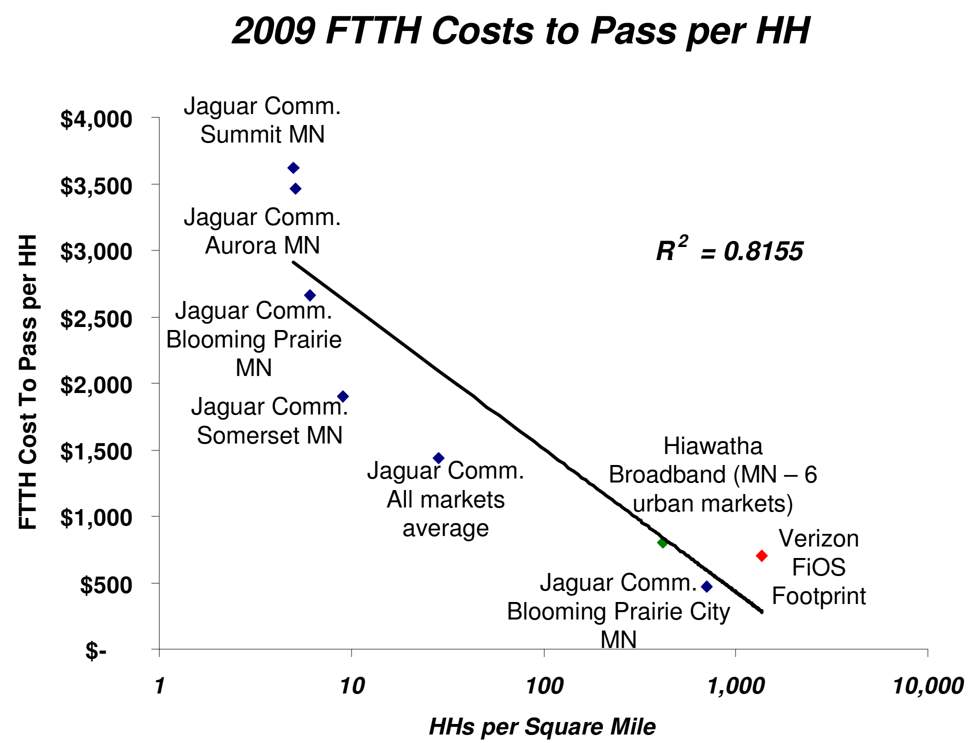
- These figures are representative of realized investment requirements for deployment in relatively dense territories, reflecting the focus of FTTH builds to date in the US
- Verizon's original FiOS deployment was planned for 54% of VZ territory (prior to recent rural line divestitures); Verizon territory pre-divestiture compares roughly to the US as a whole in terms of population densities
- Deployment to more sparsely populated areas will likely surpass these levels of investment, though there are pockets of density and unit deployment costs are often much lower in rural areas
- Note that estimates of the cost to pass AND connect involve assumptions about service uptake rates, which may account for variation in these figures

1. FCC estimate per HH based on total cost of $350B for universal availability to 113.5M housing units (mean of 111-116M housing units). It includes the cost to pass and connect 100% US homes (assuming a greenfield build irrespective of planned FTTH networks) and present value of opex.

Source: FCC Filings, Verizon, SNL Kagan, Yankee Group, CSMG Analysis

Investment requirements for FTTH have decreased substantially over the past few years and vary considerably depending on the topography being served





- These reductions in investment required over time are driven by three major factors:
  - Field efficiency improvements by service providers through improved procedures, training, and use of innovative labor-saving methods
  - Materials cost reductions through increasing purchase volumes and manufacturing efficiency
  - Fixed cost allocation across a larger number of passed households and subscribers
- It is noteworthy that multiple service providers (not just Verizon) have achieved cost declines – we expect future deployments by other service providers to reap many of these benefits

- We observe a 5X difference in FTTH costs per HH passed over the range of HH densities with publicly reported data
- This range of densities represents a wide spectrum of HH densities from rural (5 HHs per sq. mile) to urban (1,375 HHs per sq. mile)

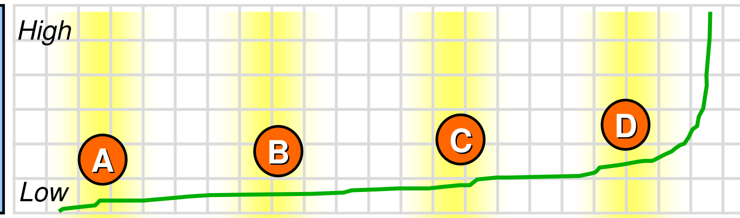
Source: FCC Filings, SNL Kagan, CSMG Analysis

The investment required to pass 80% of homes, beyond the 27% projected to be deployed by 2015, would be ~$71B, with an additional $18.2B to connect subscribers

- The basis for universal broadband service should be US households – not housing units
- There are currently 18 million US households with FTTH availability, plus an additional 16.5 million forecasted by 2015 funded by private capital. All 34.5 million should be considered in estimates for universal availability requirements
- Based on current FTTH build investment requirements (FiOS and rural providers), CSMG estimates that the average cost to pass and connect all but the 20% most expensive remaining non-FTTH households in 2015 is ~$1,704 per HH
- The incremental cost to connect will only be incurred for a subset of homes passed, reflecting FTTH service uptake levels. FTTH penetration short of 100% is recommended – CSMG estimates 41.5% based on current benchmarks and forecasts
- The cost to pass and connect the most rural areas could be significantly higher than the cost of FTTH deployment in non-rural areas
- Though future efficiencies in deployment practices and technology are expected to decrease the cost to connect each FTTH HH, these have not been factored into the estimation for investment required

NOTES:

1. Current 2009 FiOS Cost to pass per HH
2. Current urban and rural FTTH costs to pass per HH benchmarks
3. 2009 urban and rural FTTH provider cost to connect per HH benchmarks
4. Analyst estimate of expected 2015 FTTH uptake rates



FTTH Network Deployment Costs per HH	Like FiOS to Date	More Costly	Significantly More Costly	Not Evaluated	
# 2015 HHs not already Covered by FTTH (M)	34.3	19.1	14.0	25.4	
Average HHs Per Sq. Mile	879.5	174.9	71.9	NA	
Percentiles Covered	28-54%	55-69%	70-80%	81-100%	
Modeled Cost to Pass per HH	$700[1]	$1,246[2]	$1,661[2]	NA	
Incremental Cost to Connect per Sub[3]	$650	$650	$650	NA	
Assumed Penetration[4]	41.5%	41.5%	41.5%	NA	
Cost to Pass ($B)	$24.0B	$23.7B	$23.2B	NA	**$71.0B**
Cost to Connect ($B)	$9.3B	$5.1B	$3.8B	NA	**$18.2B**
Total Investment Requirement ($B)	$33.3B	$28.9B	$27.0B	NA	**$89.2B**

Major US broadband service providers have been investing an average of $35B a year into their wireline networks, suggesting private sector funds exist for widespread NGA deployment

Wireline CapEx as a % of Wireline Revenue By Major Carrier

	Wireline CapEx (Average Annual)	CapEx (Avg. % of Revenue)	Time Period
Verizon	$9,837M	21%	2005-2008
AT&T	$11,625M	16%	2006-2008
Qwest	$1,723M	13%	2007-2008
Comcast	$4,833M	18%	2005-2008
Time Warner	$3,507M	22%	2007-2008
Cablevision	$727M	16%	2006-2008
Other Major Wireline SPs and MSOs	$2,749M	16%	2006-2008
Totals:	**$35,001M**	**18%**	**2006-2008**

Source: SNL Kagan, Annual Reports

Passing 80% of homes with NGA by 2015 could reduce the investment required to connect anchor institutions by $2.9B - $6.7B as an ancillary benefit of the program

Illustrative Anchor Tenant Savings from Broad NGA Deployment

1 Estimate Anchor Institutions

- Schools (K-12)
- Libraries
- Community Colleges
- Other Colleges and Universities
- Hospitals and Clinics

123K

X

~80%

% Without NGA Broadband

=

100K

# of Institutions Needing NGA Broadband

X ~68% = 67K

# of Institutions Incidentally Passed with NGA BB

2 Estimate Incidental Coverage

Institutions Incidentally Passed by NGA Broadband as a % of HHs Passed: 84.6%[1]

Passed By NGA BB

% of HHs	% of Anchor Institutions
54%	46%
69%	58%
80%	68%
100%	85%

3 Connection Cost Savings

Weighted Average Cost per Typical Build	$49K - $101K[2]
–	
High-Level Cost per Incidentally Passed Building	$2,000 - $5,000[3]
=	
Savings per NGA-Connected Institution	$44K - $99K
X	
# of Incidentally Passed Anchor Institutions (60% of total)	67K
=	
Savings from Connecting Institutions via NGA	**$2.9B - $6.7B**

ILLUSTRATIVE

1. Assumes 90% of schools (K-12) and libraries are incidentally passed (but no colleges or hospitals). Would require additional upfront planning / design to achieve
2. Weighted average of Gates Foundation estimated cost ranges for connecting anchor institutions with fiber ($5-10B for ~100K institutions). Ranges indicate low-end (aerial installation with 30% new poles) and high-end (40% aerial, 60% trenching) deployment costs
3. Cost is likely more expensive than for a typical home, but less than for a direct fiber lateral. Assumed to be comparable to FTTH small business service

Source: Gates Foundation: Preliminary Cost Estimates on Connecting Anchor Institutions to Fiber (2009), CSMG analysis

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A number of countries have undertaken national NGA broadband projects with a mix of public and private funding

Country	Description of Government Initiative
Japan	• Government initiatives have mainly been through unbundling and open access regulation to encourage private investment in fiber builds • Funding support has included private investment write downs, subsidized low cost loans, and encouragement of rural fiber builds by subsidizing local public entities for 1/3 of cost of build • Active and involved regulation allows the incumbent to invest in the network and sell for profit, but prevents abuse of market dominant position • NTT launched the world's largest FTTH build-out; utility companies (K-Opticom) and KDDI have also invested in fiber and are major players • Target is to reach 30M FTTH subscribers by 2010
Korea	• Initiatives I and II – government funding of BB network and IT training programs – total private and public funding estimated at ~$142B from mid-1990s to mid-2000s • Funding initiatives were also accompanied by unbundling regulation and encouragement of apartment complex owners to allow ISP collocation • Latest initiative III – super BB fiber network with ~$1.0B in government funding and ~$27B in private investment for a last mile FTTH build in urban and rural areas • Aims to deliver speeds of 1 Gbps to households by 2012
Sweden	• Combination of open access regulation and free market competition between facilities-based operators • Government funding for local and regional bodies to build an FTTH network in over 200 municipalities • Mandated that state-owned utilities build a fiber network to almost every home by 2004 • Backbone and last mile build in urban and rural areas
Australia	• Direct investment of $40B for a fiber build and $230M to address backhaul black spots • Beginning in July 2010, all new estate developments to install fiber-optic networks to homes and workplaces • Backbone and last mile build in urban and rural areas • Aim to connect 90% of homes and business to an FTTH network over the next 8 years
New Zealand	• $1.3B for an open access, passive fiber network infrastructure and ~$225M to improve rural broadband builds • Backbone and last mile build in urban, suburban, and rural areas • Aims to connect 75% households to a fiber network
Other	• **Singapore**: Intelligent Nation 2015 (iN2015) initiative includes plan to deploy FTTH to every home and business by 2013, with speeds of 1 Gbps • **Malaysia**: Three-phase High Speed Broadband (HSBB) project to build FTTH to 2.2M households by the end of 2017 • **Europe**: A number of nations (including **Sweden**, **Netherlands**, **Denmark**, **Belgium**, **Portugal**, **France**, and **Greece**) have announced national plans which include FTTH as primary network infrastructure

Source: SNL Kagan, AFP, NY Times, Center for Strategic and International Studies - Japan, Sweden PTS, Australian and New Zealand Gov't websites, BSG, FTTH Council, CSMG Analysis

Comparable national programs are largely focused on deploying next generation broadband networks to 75%-90% of HHs

International Broadband Initiatives

Country	Program Duration	Network Type	Speeds	Coverage
Australia	2009-2017	Fiber Backbone and Last Mile	100 Mbps download	90% homes and businesses
France	2009-2012	Fiber Backbone and Last Mile	NA	~33% homes and businesses
Germany	2009-2014	Universal Broadband Coverage	50 Mbps download	75% homes and businesses
Korea	2009-2012	Fiber Last Mile	1 Gbps download	100% homes and businesses
Malaysia	2007-2017	Fiber Backbone and Last Mile	10 Mbps+ download	38% homes and businesses
New Zealand	2009-2019	Fiber Backbone and Last Mile	100 Mbps download	75% homes and businesses
Singapore	2009-2015	Fiber Backbone and Last Mile	1 Gbps download	100% homes and businesses
UK	2009-2017	Next Generation FTTC	24-100 Mbps	75% homes and businesses

Most comparable programs target less than full deployment

Most comparable programs focus on enabling next-generation networks

Source: SNL Kagan, AFP, New York Times, Australian and New Zealand Government Websites, BSG, FTTH Council, Metro UK, Telekom Malaysia, Infocomm Development Authority of Singapore, Telecompaper, Screendigest, CSMG Analysis

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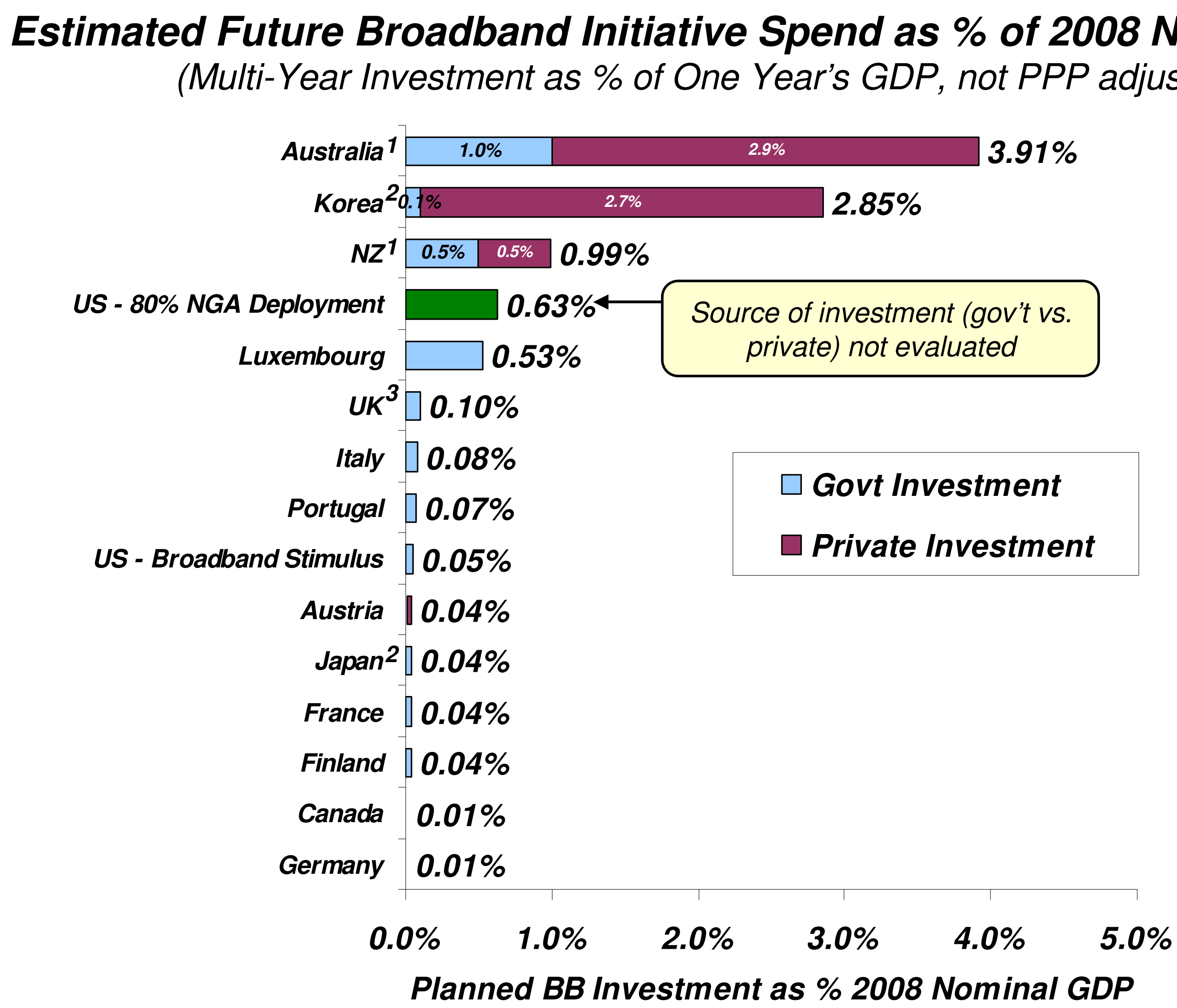
National NGA build programs constitute a substantial portion of national GDPs



NOTES:

1. Australia and New Zealand – Future planned investments announced by the government 2. Korea and Japan – Does not include past government broadband initiatives (e.g. estimated at $85B for Korea historically) 3. UK – Investment calculated based on an estimated initial funding of 200M GBP plus 150-175 Million GBP per year from 2009-2017

Source: The Berkman Center for Internet and Society 2009 Study – Next Generation Connectivity, CIA Factbook

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A primary objective of a national broadband plan should be to address the position of the US relative to other countries in broadband adoption and capability

- The US must increase average penetration by ~35% and speed by ~3X in order to close the gap with leading broadband nations

Broadband Penetration & Speed Rankings

ILLUSTRATIVE

Penetration by Country

Country	HH Penetration
1. South Korea	95%
2. Singapore	88%
3. Netherlands	85%
4. Denmark	82%
5. Taiwan	81%
6. Hong Kong	81%
7. Israel	77%
8. Switzerland	76%
9. Canada	76%
10. Norway	75%
20. United States	**60%**

Avg. Speed by Country

Country	Avg. Speed
1. South Korea	11.0 Mbps
2. Japan	8.0 Mbps
3. Hong Kong	7.6 Mbps
4. Romania	6.9 Mbps
5. Sweden	5.8 Mbps
6. Netherlands	5.7 Mbps
7. Latvia	5.4 Mbps
8. Switzerland	5.1 Mbps
9. Czech Republic	5.0 Mbps
10. Denmark	4.9 Mbps
18. United States	**4.2 Mbps**

Indicates country has actively pursued initiatives to expand high-speed internet coverage and quality

Source: Strategy Analytics, 2008; Akamai, 2Q09; CSMG analysis

CSMG

A national broadband plan should be designed to balance multiple important policy objectives and consider availability, adoption, and speed of broadband

Illustrative National Broadband Plan Objectives

Objectives	Activities	Illustrative Potential Impact
1 **Rural Broadband Coverage**	• Support for broadband in rural communities • Addressability improvements	• Cover an **additional 2-5%** of households currently lacking broadband of any sort (unserved and underserved according to ARRA Broadband NOFA) • An estimated ~80% of these newly-covered HHs will likely adopt service • Likely results in a few points of BB penetration on a national scale
2 **Adoption Programs**	• Various programs to increase adoption at household level	• **Impact likely scales directly with government resources applied** • However, initiatives will have **little to no impact on speed/quality** of broadband service
3 **Connect Anchor Institutions**	• Direct support for anchor institution connectivity	• **Improved access at schools, libraries**, etc. for administrators, users as well as unserved/underserved and lower-income communities • **An important policy goal** which helps communities provide public access to broadband, computers and training, but which does not help close per HH average penetration and speed gaps • Broad deployment of NGA to homes would be synergistic with this objective
4 **Accelerate NGA BB Deployment**	• Pursue policies that incent deployment of next-generation broadband	• **Significant positive public benefits** as quantified in this study • **Significant impact on in internet speeds** – median throughput will increase by **at least 2X** according to our estimates • **Competitive dynamic could drive additional adoption** for high-speed BB, as service provider offerings become increasingly attractive

A big vision is required for our national broadband policy

Source: FCC, CSMG

One policy that would enable widespread NGA deployment is a tax-credit bond

- An Empiris study funded by the FTTH Council indicates that ~$1.3B in tax credits can drive $30B of incremental NGA investment over three years

In January 2009, Empiris LLC completed a study analyzing the economic impact of proposed tax incentives for BB deployment on behalf of the FTTH Council

Empiris LLC – Policy Options Assessed

Tax-Credit Bonds	**Private Sector Tax-Credit Bonds**	• Private sector issues up to $10B in tax-credit bonds per year over the next three years to fund investments on NGA BB deployments (100 Mbps down / 20 Mbps up) • Deployment in any area of the US
	Public Sector Tax-Credit Bonds	• Public sector issues up to $1B in tax-credit bonds per year over the next three years to fund investments on NGA BB deployments (100 Mbps down / 20 Mbps up) • Deployment in any area of the US
Expensing	**Immediate Expensing of NGA**	• Allows immediate expensing (i.e. accelerated depreciation) of 100% of investments by firms deploying NGA BB service (100 Mbps down / 20 up) • Deployment in any area of the US
	Immediate Expensing of Rural CGA	• Allows immediate expensing (i.e. accelerated depreciation) of 50% of investments by firms deploying CGA BB service (5 Mbps down / 1 Mbps up) • Deployment to rural and underserved areas in the US

Potential Course of Action

- Private sector tax-credit bond option has the **largest economic stimulus impact** among the 4 options evaluated
  - An estimated $93.9B in total GDP impact, and 197K jobs over 3 years
- The $30B of total investment enabled by this option would be **sufficient to deploy NGA to 54% of US HHs** (34.1M additional homes passed)
  - Would result in **$5.7B in annual total public benefits**
- Government tax revenues will decrease by by $1.3B from 2009-2011, and $11.2B over the entire15-year life of the investments

Source: Empiris LLC: "Economic Effects of Tax Incentives for Broadband Infrastructure Deployment" (Jan 2009)

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