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December 23, 2009

VIA ECFS

Marlene H. Dortch
Secretary
Federal Communications Commission
The Portals
445 - 12th Street, SW
Washington, DC 20554

Re: Notice of *Ex Parte* Presentation, *International Comparison and Consumer Survey Requirements in the Broadband Data Improvement Act,* GN Docket No. 09-47; *A National Broadband Plan for our Future,* GN Docket 09-51; *Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, as Amended by the Broadband Data Improvement Act, A National Broadband Plan for Our Future*, GN Docket No. 09-137

Dear Ms. Dortch:

Yesterday, December 22nd, Tim Regan, Senior Vice President, Corning Incorporated, David Kozischek and Scott Torrey, Product Managers, Corning Cable Systems, and I, on behalf of the Fiber-to-the-Home Council, met with Peter Bowen of the staff of the Federal Communications Commission. The purpose of the meeting was to review the attached presentation by Corning, *Residential Bandwidth Modeling*.

Should you have further questions about this meeting, please contact me.

Sincerely,

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Counsel for the Fiber to the Home Council

Attachment: Corning, *Residential Bandwidth Modeling*

cc: Peter Bowen

CORNING

Cable
Systems

Residential Bandwidth Modeling

David R. Kozischek

Corning Cable Systems

Residential Bandwidth Modeling

Methodology

Inputs

- Demographics and Regulation
- Application + Technology Change
- User Experience Change

Modeling Techniques

- Fisher-Pry Substitution
- Gompertz Substitution
- Linear Regression
- Monte-Carlo Simulation

Outputs

- Forecasting Probability Curves

Downstream Technology Analysis

Residential Bandwidth Modeling-Modeling Assumptions

Monte Carlo Analysis	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bandwidth Requirements	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps
Bandwidth Requirements	HSD 2003	HSD 2004	HSD 2005	HSD 2006	HSD 2007	HSD 2008	HSD 2009	HSD 2010	HSD 2011	HSD 2012
HSD Users (Mbps) MN	0.8	1	1.2	1.4	2	3	4	5	6	7
HSD Users (Mbps) ML										
HSD Users (Mbps) MX	1	2	3	4.8	7.7	12.3	19.7	31.5	50.3	80.5
Voice	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
VoD	4	4	4	4	4	3	3	3	3	2
Std TV	4	4	4	4	4	3	3	3	3	2
HDTV	19	15	13	10						
HDTV (1080p)										
PVR Factor (% HDTV)	7%	12%	18%	25%	33%	41%	49%	57%	64%	70%
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Digital Streams	Qty	Qty	Qty	Qty	Qty	Qty	Qty	Qty	Qty	Qty
Data (Dwn)	1	1	1	1	1	1	1	1	1	1
Voice	1	3	3	3	3	3	3	3	3	3
	VoD 2003	VoD 2004	VoD 2005	VoD 2006	VoD 2007	VoD 2008	VoD 2009	VoD 2010	VoD 2011	VoD 2012
VoD MN	0	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25
VoD ML										
VoD MX	1	1	1	1	1	1	1	1	1	1
	STD 2003	STD 2004	STD 2005	STD 2006	STD 2007	STD 2008	STD 2009	STD 2010	STD 2011	STD 2012
Std TV MN	1	1	1	1	0.5	0.5	0.5	0.5	0.5	0.5
Std TV ML										
Std TV MX	1.5	2	2	2	2	2	1.5	1.25	1	1
	HD 2003	HD 2004	HD 2005	HD 2006	HD 2007	HD 2008	HD 2009	HD 2010	HD 2011	HD 2012
HDTV (1080i) MN	0	0	0	0	0.5	0.5	0.5	0.5	0.5	0.5
HDTV (1080i) ML	0									
HDTV (1080i) MX	0	0.5	0.75	1.25	2	2.25	2.75	2.5	2.25	2
	FHD 2003	FHD 2004	FHD 2005	FHD 2006	FHD 2007	FHD 2008	FHD 2009	FHD 2010	FHD 2011	FHD 2012
HDTV (1080p) MN	0	0	0	0	0	0	0	0	0	0
HDTV (1080p) ML	0	0	0	0	0	0				
HDTV (1080p) MX	0	0	0	0	0	0	0.5	1.25	1.75	2.25
Add Stream	0	0.09	0.14	0.19	0.25	0.31	0.37	0.43	0.48	0.52
	Bw 2003	Bw 2004	Bw 2005	Bw 2006	Bw 2007	Bw 2008	Bw 2009	Bw 2010	Bw 2011	Bw 2012
Res BW Requirements	4.86	8.53	9.38	15.12	17.31	21.44	24.69	28.85	34.19	40.35
	VD Bw 2003	VD Bw 2004	VD Bw 2005	VD Bw 2006	VD Bw 2007	VD Bw 2008	VD Bw 2009	VD Bw 2010	VD Bw 2011	VD Bw 2012
Video Requirements w/DVR	4.0	7.3	7.8	12.9	14.8	17.2	18.7	21.6	22.4	23.6
	HSD Av 2003	**HSD Av 2004**	**HSD Av 2005**	**HSD Av 2006**	**HSD Av 2007**	**HSD Av 2008**	**HSD Av 2009**	**HSD Av 2010**	**HSD Av 2011**	**HSD Av 2012**
HSD Availiable @ 25Mbps	21	18	17	12	10	8	6	3	3	1
HSD Availiable @ 50Mbps	46	43	42	37	35	33	31	28	28	26
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of Video Streams MN	1.0	1.1	1.1	1.4	1.5	1.6	1.6	1.7	1.7	1.8
Number of Video Streams ML	1.0	1.6	1.6	2.2	2.8	3.3	3.6	3.9	4.0	4.3
Number of Video Streams MX	2.5	3.6	3.9	4.4	5.3	5.6	6.1	6.4	6.5	6.8

Residential Bandwidth Modeling

Downstream Analysis

- Number and Type of Digital Streams Increase
  - PVR's and Pic-in-Pic will increase bandwidth Requirements
  - HDTV will increase bandwidth requirements

HSD BW Demand Grows at 42% CAGR for ML and 60% for MX

High Speed Data…this matches *Speed tests results for Sept. 2006 through May 2007; most participants had DSL or cable modem connections Source: CWA Communications*

Monte Carlo Analysis	2003	2004	2005	2006	2007	2008
Bandwidth Requirements	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps
Bandwidth Requirements	HSD 2003	HSD 2004	HSD 2005	HSD 2006	HSD 2007	HSD 2008
HSD Users (Mbps) MN	0.8	1	1.2	1.4	2	3
HSD Users (Mbps) ML	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HSD Users (Mbps) MX	1	2	3	4.8	7.7	12.3
Voice	0.064	0.064	0.064	0.064	0.064	0.064
VoD	4	4	4	4	4	3
Std TV	4	4	4	4	4	3
HDTV	19	15	13	10	[illegible]	[illegible]
HDTV (1080p)						
PVR Factor (% HDTV)	7%	12%	18%	25%	33%	41%

Residential Bandwidth Modeling

Downstream Analysis

- High Speed Data is determined by:
  - Web Pages
  - File Downloads
  - Gaming
  - P2P Apps

Monte Carlo Analysis	2003	2004	2005
Bandwidth Requirements	Mbps	Mbps	Mbps
Bandwidth Requirements	HSD 2003	HSD 2004	HSD 2005
HSD Users (Mbps) MN	0.8	1	1.2
HSD Users (Mbps) ML			
HSD Users (Mbps) MX	1	2	3

Bandwidth Requirements Mbps per Application	WP2003	WP2004	WP2005
Internet Web Page Requests (MN)	0.5	0.6	0.6
Internet Web Page Requests (ML)			
Internet Web Page Requests (Mx)	2.1	2.3	2.6
	FD2003	FD2004	FD2005
File Downloads (MN) Music, Videos, Pics etc	1.6	1.7	1.8
File Downloads (ML) Music, Videos, Pics etc			
File Downloads (MX) Music, Videos, Pics etc	3.3	4.1	6.6
	GM2003	GM2004	GM2005
Gaming, P2P, Voice (MN)	0.45	0.5	0.6
Gaming, P2P, Voice (ML)			
Gaming, P2P, Voice (MX)	1.7	2.2	3.5

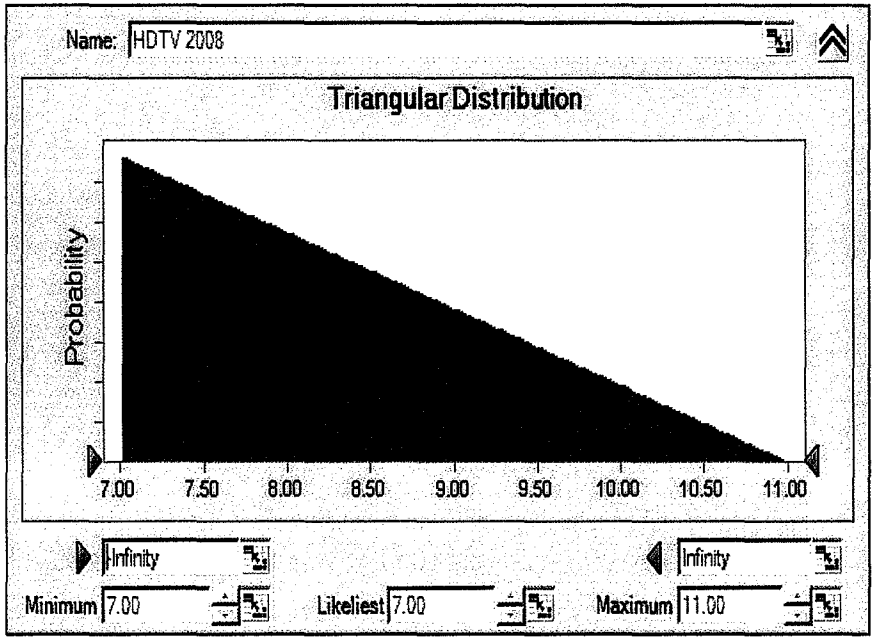
Streams per Application	IWST 2003	IWST 2004	IWST 2005
Internet Web Page Requests (MN)	0	0.0	0.0
Internet Web Page Requests (ML)			
Internet Web Page Requests (Mx)	0.5	0.5	0.5
	FDST 2003	FDST 2004	FDST 2005
File Downloads (MN) Music, Videos, Pics etc	0	0.0	0.0
File Downloads (ML) Music, Videos, Pics etc			
File Downloads (MX) Music, Videos, Pics etc	0.5	0.5	0.5
	GMST 2003	GMST 2004	GMST 2005
Gaming, P2P, Voice (MN)	0	0.0	0
Gaming, P2P, Voice (ML)	0	0.0	
Gaming, P2P, Voice (MX)	0	0.0	0.5

Computer per HH	1	1	1.5
Total Streams MN	0	0	0
Total Streams ML	0.5	1	1
Total Streams MX	1	1	1.5
	XBWDemand 2003	XBWDemand 2004	XBWDemand 2005
BW Demand			

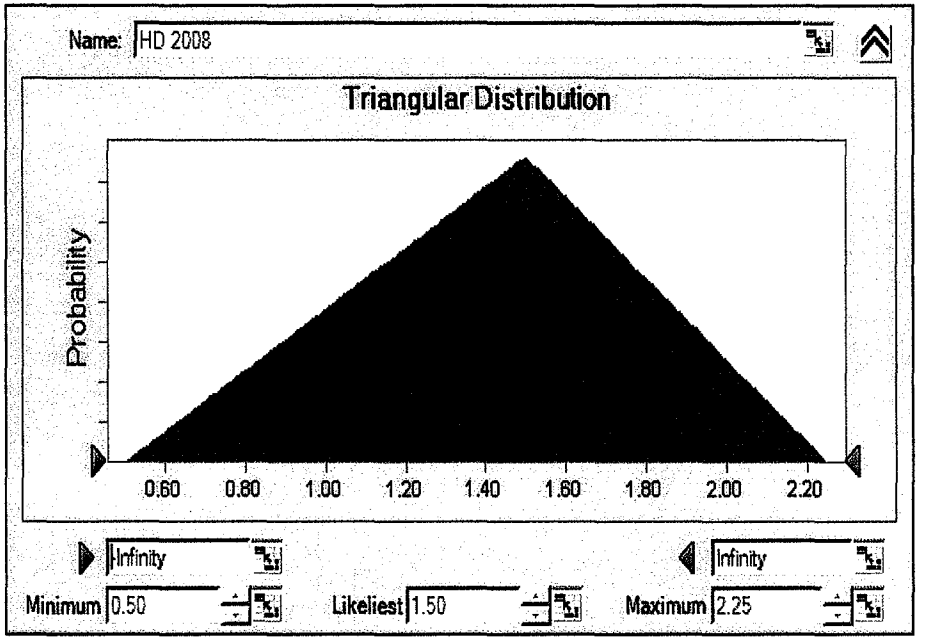
Residential Bandwidth Modeling

Downstream Analysis

- Distribution Variables are Set for:
  - Bandwidth per Stream
  - Number of Streams per Household



HDTV Bandwidth



HDTV Streams

Residential Bandwidth Modeling
Downstream Analysis

- Number of Video Streams

Standard Digital	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of SDTV Video Streams MN	1.0	1.0	1.0	1.3	0.8	0.8	0.8	0.8	0.8	0.8
Number of SDTV Video Streams ML	1.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Number of SDTV Video Streams MX	2.5	3.0	3.0	3.0	3.0	3.0	2.5	2.3	2.0	2.0

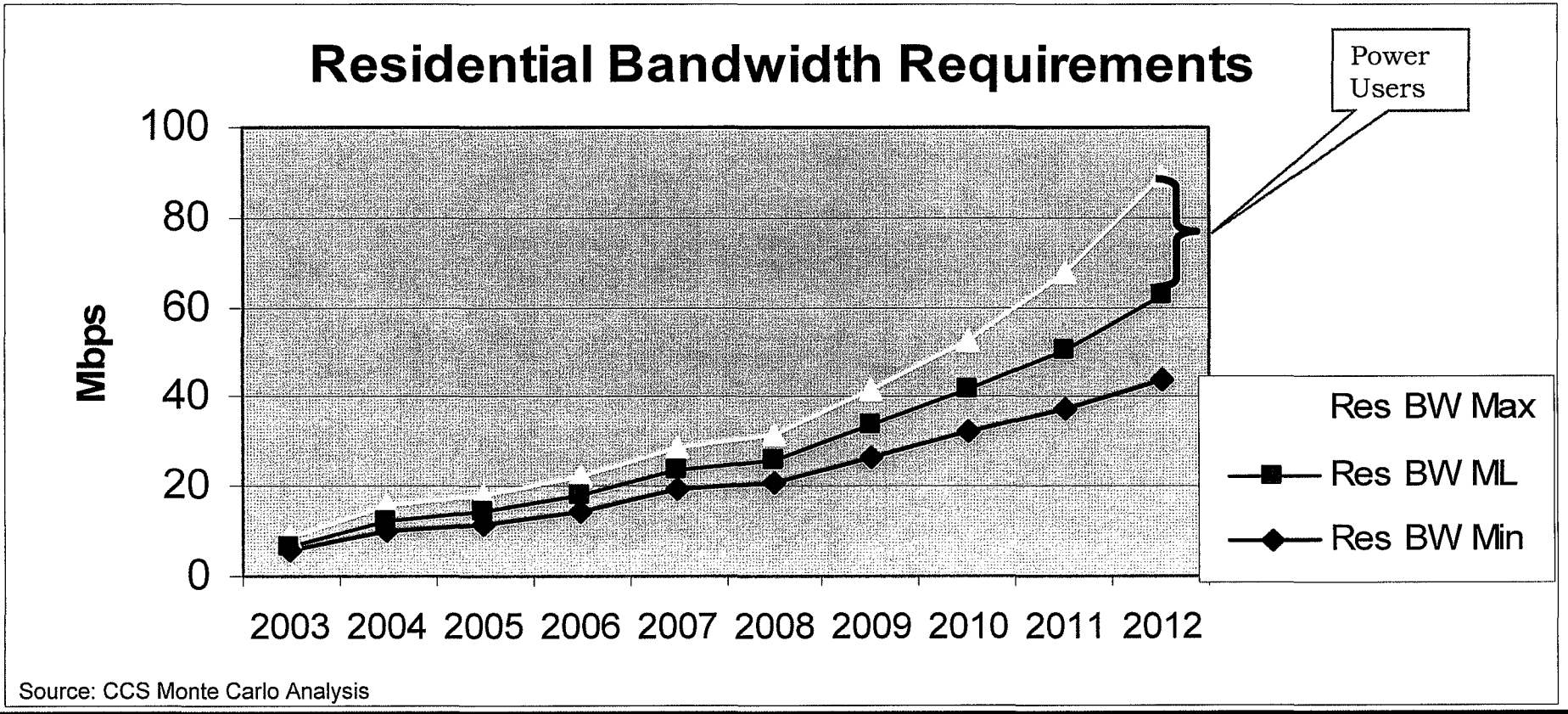
HDTV	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of HDTV Video Streams MN	0.0	0.1	0.1	0.2	0.8	0.8	0.9	0.9	1.0	1.0
Number of HDTV Video Streams ML	0.0	0.1	0.1	0.7	1.3	1.8	2.1	2.4	2.5	2.8
Number of HDTV Video Streams MX	0.0	0.6	0.9	1.4	2.3	2.6	3.6	4.2	4.5	4.8

Total	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of Video Streams MN	1.0	1.1	1.1	1.4	1.5	1.6	1.6	1.7	1.7	1.8
Number of Video Streams ML	1.0	1.6	1.6	2.2	2.8	3.3	3.6	3.9	4.0	4.3
Number of Video Streams MX	2.5	3.6	3.9	4.4	5.3	5.6	6.1	6.4	6.5	6.8

Mix of 1080i/1080p Change Bandwidth requirements by 2009

Residential Bandwidth Modeling
Downstream Analysis

- IP Video Delivery
  - Digital Data (Mbps) Requirements-Data, Voice and Video
  - Graphic View (Max-Power Users and Average Users) 2003-2012



Source: CCS Monte Carlo Analysis

Upstream Technology Analysis

Upstream Technology Analysis

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bandwidth Requirements (MAX) File Size	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps
Internet Web Page Requests	0.4	0.56	0.78	1.10	1.54	2.15	3.01	4.22	5.90	8.26
Peer to Peer Video Transfer (MPG2)	480	480	480	480	489.60	499.39	509.38	519.57	529.96	540.56
Peer to Peer Audio Transfer (MP3)	32	32	32	32	32	32	32	32	32	32
Peer to Peer Soft Transfer (exe)	58	60.90	63.95	67.14	70.50	74.02	77.73	81.61	85.69	89.98
Email send Pics (Dig Photos)	30	33.00	36.30	39.93	43.92	48.32	53.15	58.46	64.31	70.74
Large File (exe) aka Norton Antivirus	800	816.00	832.32	848.97	865.95	883.26	900.93	918.95	937.33	956.07
Large File (Video) 2hr DVD	48000	48000	48000	48000	48000	52800	58080	63888	70277	77304
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bandwidth Requirements (MAX) Streaming Apps	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps	Mbps
Gaming	0.50	0.70	0.98	1.37	1.92	2.69	3.76	5.27	7.38	10.33
Peer to Peer Video	0.38	0.58	0.86	1.30	1.94	2.92	4.37	6.56	9.84	14.76
Voice	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	0.95									
Upload Time Max (sec)	200000	114000	64980	37039	21112	12034	6859	3910	2229	1270
Avg Num of Computers/HH	1	1	1.5	1.5	1.75	2	2	3	3	3

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Digital Streams	Qty	Qty	Qty	Qty	Qty	Qty	Qty	Qty	Qty	Qty
Internet Web Page Requests	1	1	1	1	1	1	1	1	1	1
Peer to Peer Video Transfer (MPG2)	1	1	1	1	1	1	1	1	1	1
Peer to Peer Audio Transfer (MP3)	1	1	1	1	1	1	1	1	1	1
Peer to Peer Soft Transfer (exe)	1	1	1	1	1	1	1	1	1	1
Email send Pics (Dig Photos)	1	1	1	1	1	1	1	1	1	1
Large File (exe)	1	1	1	1	1	1	1	1	1	1
Large File (Video) 2hr DVD	1	1	1	1	1	1	1	1	1	1

Digital Streams	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Gaming	1	1	1	1	1	1	1	1	1	1
Peer to Peer Video	1	1	1	1	1	1	1	1	1	1
Voice	1	1	1	1	1	1	1	1	1	1
Max BW for Non_realtime (Mbps)	**49400.4**	**49422.5**	**49445.3**	**49469.1**	**49503.5**	**54339.1**	**59656.2**	**65502.8**	**71932.0**	**79002.1**
Max BW for realtime (Mbps)	0.95	1.34	1.91	2.73	3.93	5.67	8.20	11.90	17.28	25.16

Source: CCS SPBD Modeling	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
File Size (MB)	6175	6178	6181	6184	6188	6792	7457	8188	8991	9875
File Size (Mbps)	49400	49422	49445	49469	49504	54339	59656	65503	71932	79002
	yUp BW 2003	yUp BW 2004	yUp BW 2005	yUp BW 2006	yUp BW 2007	yUp BW 2008	yUp BW 2009	yUp BW 2010	yUp BW 2011	yUp BW 2012
Upstream Rate (Mbps) Power User	1.285	1.842	2.869	4.402	6.966	11.319	19.074	32.138	57.331	102.897
Upstream Rate % Overhead	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Time to Upload (sec)	200000	114000	64980	37039	21112	12034	6859	3910	2229	1270
Upstream Rate (Mbps) Average User	**0.229**	**0.269**	**0.322**	**1.393**	**1.806**	**2.543**	**3.837**	**5.361**	**8.237**	**19.126**

Residential Bandwidth Modeling

Upstream Analysis

- High Speed Data is determined by:
  - File Downloads
  - Streaming Apps

		2003
Growth %	Bandwidth Requirements (MAX) File Size	Mbps
40%	Internet Web Page Requests	0.4
2%	Peer to Peer Video Transfer (MPG2)	480
0%	Peer to Peer Audio Transfer (MP3)	32
5%	Peer to Peer Soft Transfer (exe)	58
10%	Email send Pics (Dig Photos)	30
2%	Large File (exe) aka Norton Antivirus	800
10%	Large File (Video) 2hr DVD	48000
		2003
	Bandwidth Requirements (MAX) Streaming Apps	Mbps
40%	Gaming	0.50
50%	Peer to Peer Video	0.38
	Voice	0.064
		0.95
43%	Upload Time Max (sec)	200000
	Avg Num of Computers/HH	1

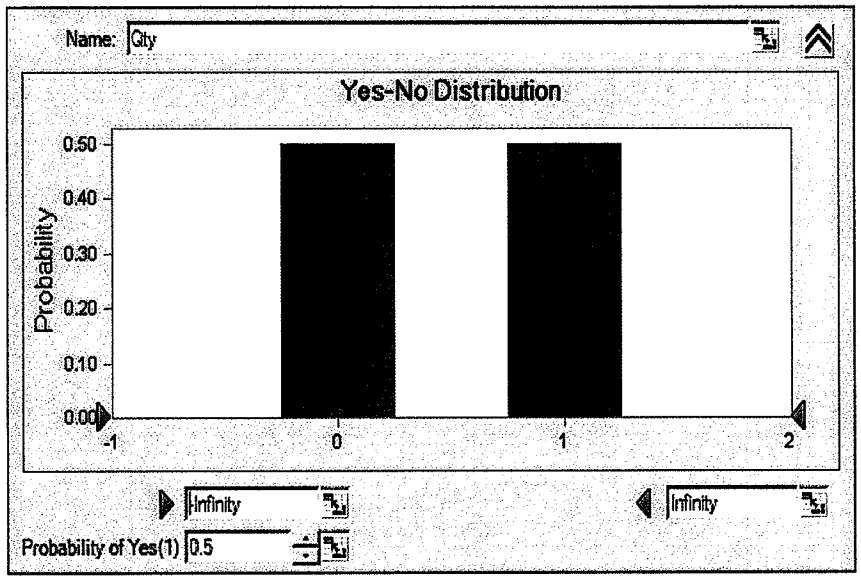
Residential Bandwidth Modeling

Upstream Analysis

- High Speed Data is determined by:
  - Bernoulli Distributions

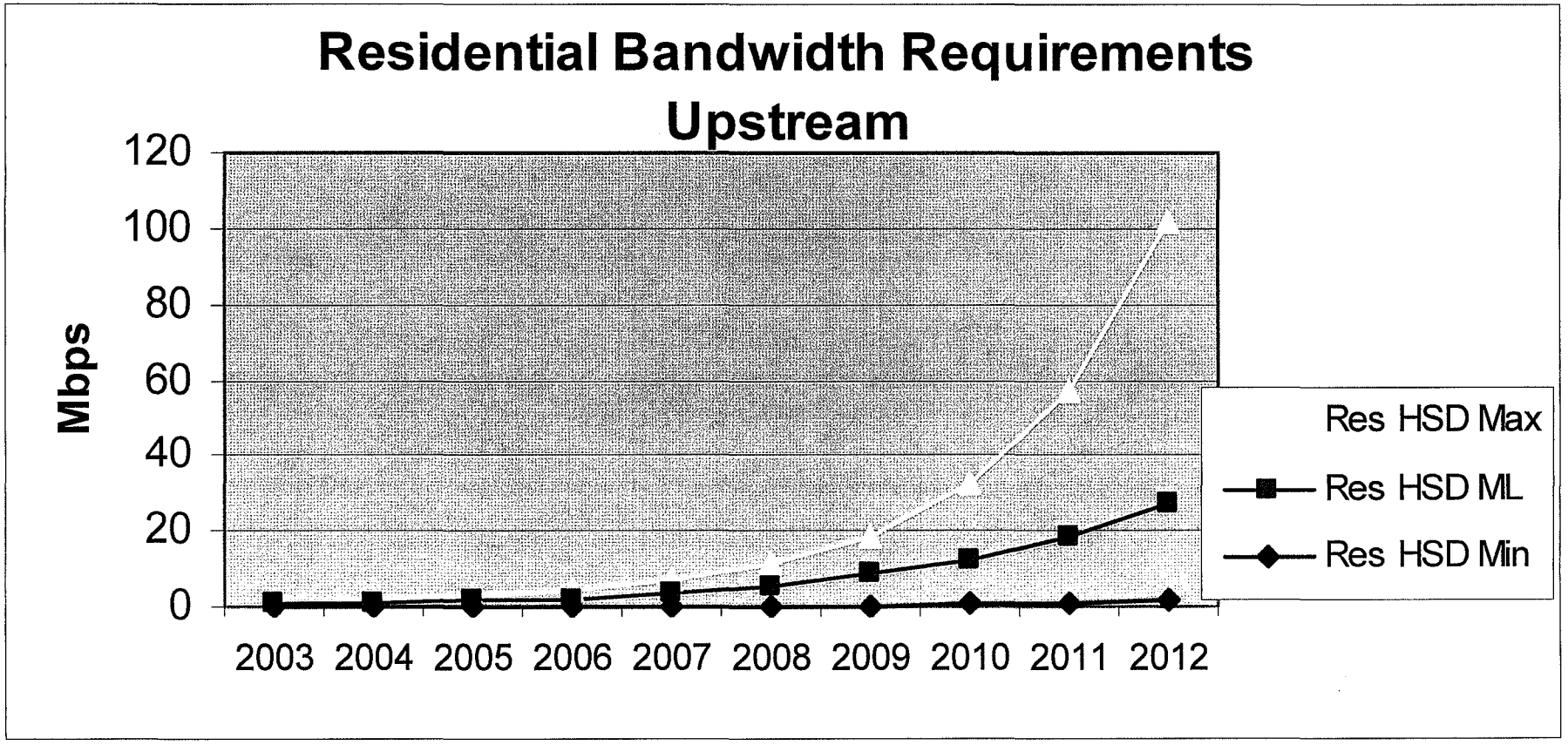
Digital Streams	2003 Qty
Internet Web Page Requests	
Peer to Peer Video Transfer (MPG2)	
Peer to Peer Audio Transfer (MP3)	
Peer to Peer Soft Transfer (exe)	
Email send Pics (Dig Photos)	
Large File (exe)	
Large File (Video) 2hr DVD	

Digital Streams	2003
Gaming	
Peer to Peer Video	
Voice	



Residential Bandwidth Modeling

Upstream Technology Analysis



Source: CCS Monte Carlo Analysis