


Measuring Broadband America

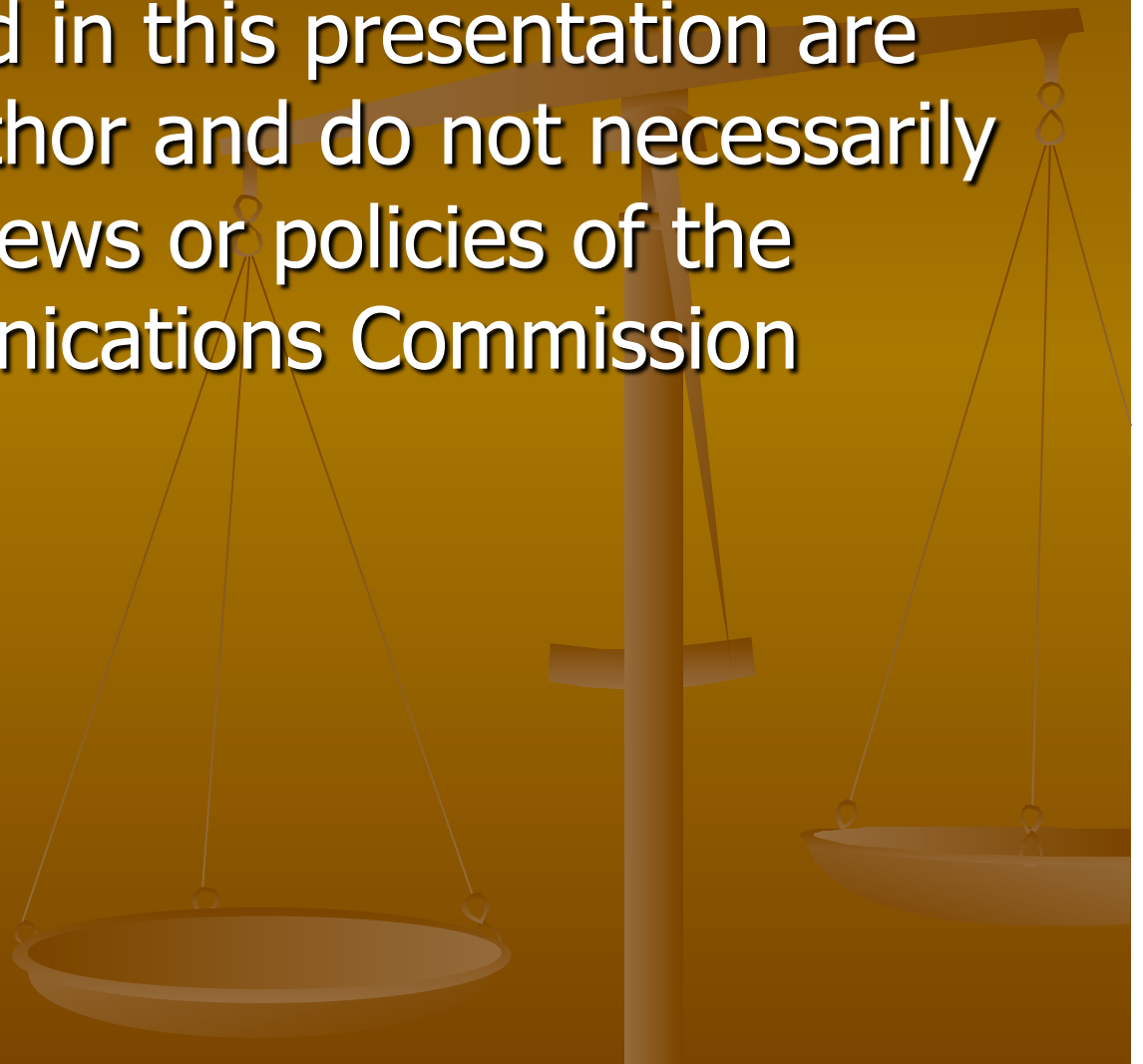


Walter Johnston, Chief ECC
Federal Communications
Commission

NANOG – 10-11-11

Disclaimer

- Views expressed in this presentation are those of the author and do not necessarily represent the views or policies of the Federal Communications Commission



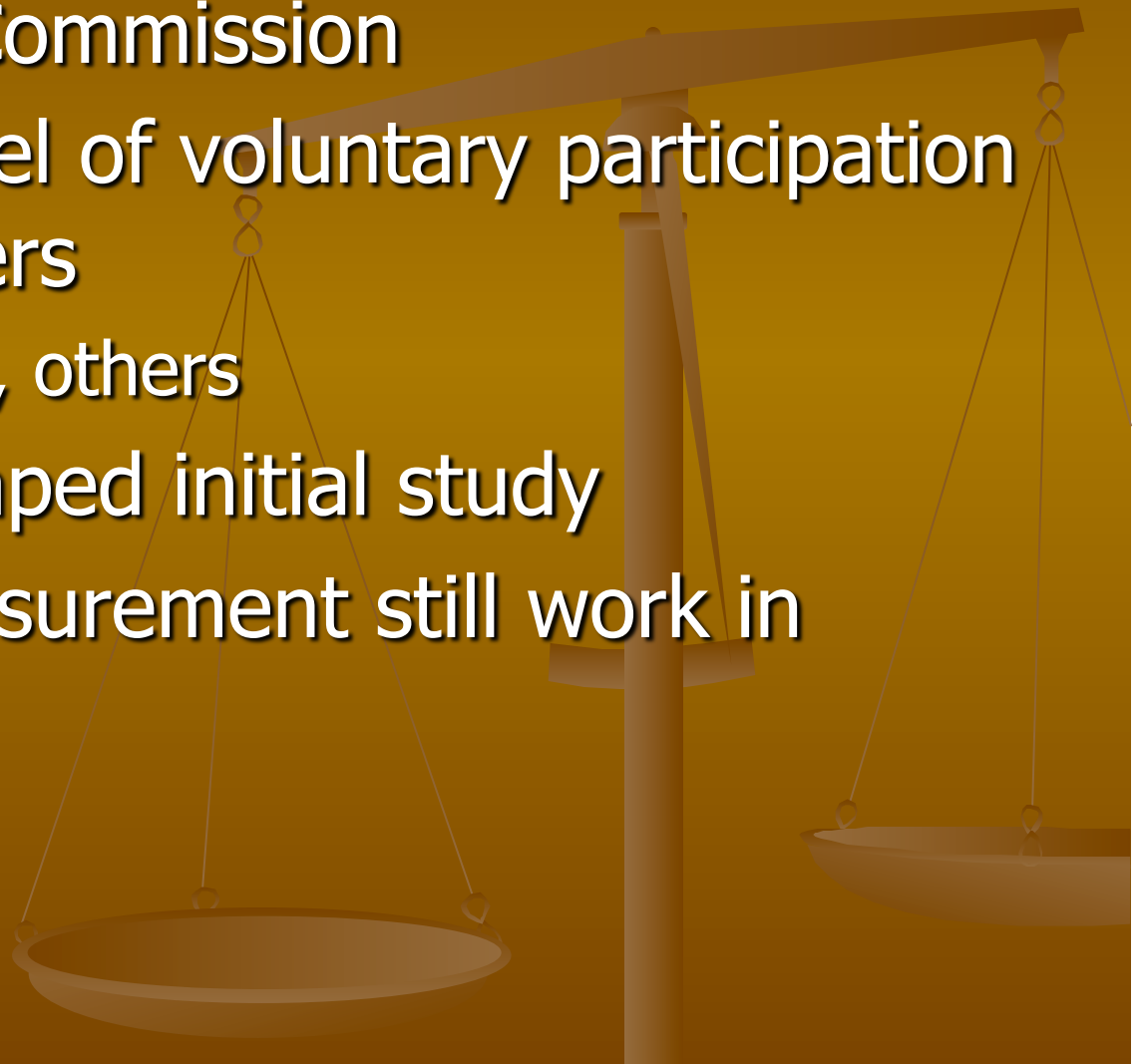
Measurement History



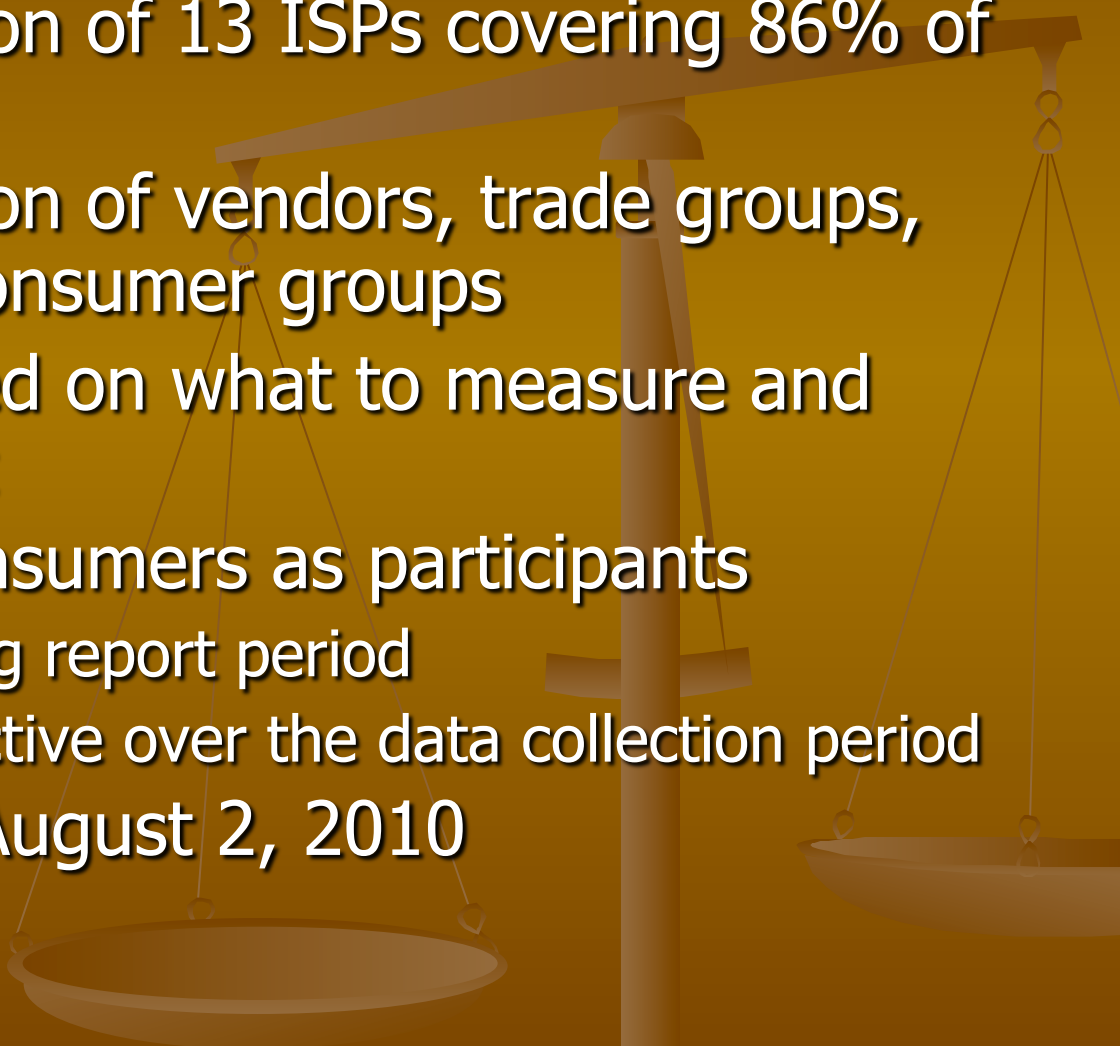
- FCC has an evolved schema in place to acquire and analyze data on legacy PSTN
 - Broadband networks and the Internet have not been general focus of these study efforts
- More recent and evolving broadband interest
 - Section 706 of Telecommunications Act, 1996, required annual report on availability of advanced telecommunications services to all Americans
 - Resulted in information on deployment of broadband technology but not its performance
 - FCC's National Broadband Plan – March 2010
 - Proposed performance measurements of broadband services delivered to consumer household
 - Work plan evolved from recommendations of National Broadband Plan

Broadband Measurement Study

- First effort for Commission
- Sought high level of voluntary participation from stakeholders
 - ISPs, academia, others
- Interactions shaped initial study
- Broadband measurement still work in progress



What Was Done

- Enlisted cooperation of 13 ISPs covering 86% of US Population
 - Enlisted cooperation of vendors, trade groups, universities and consumer groups
 - Agreement reached on what to measure and how to measure it
 - Enrolled 9,000 consumers as participants
 - 6,800 active during report period
 - A total of 9,000 active over the data collection period
 - Issued report on August 2, 2010
- 

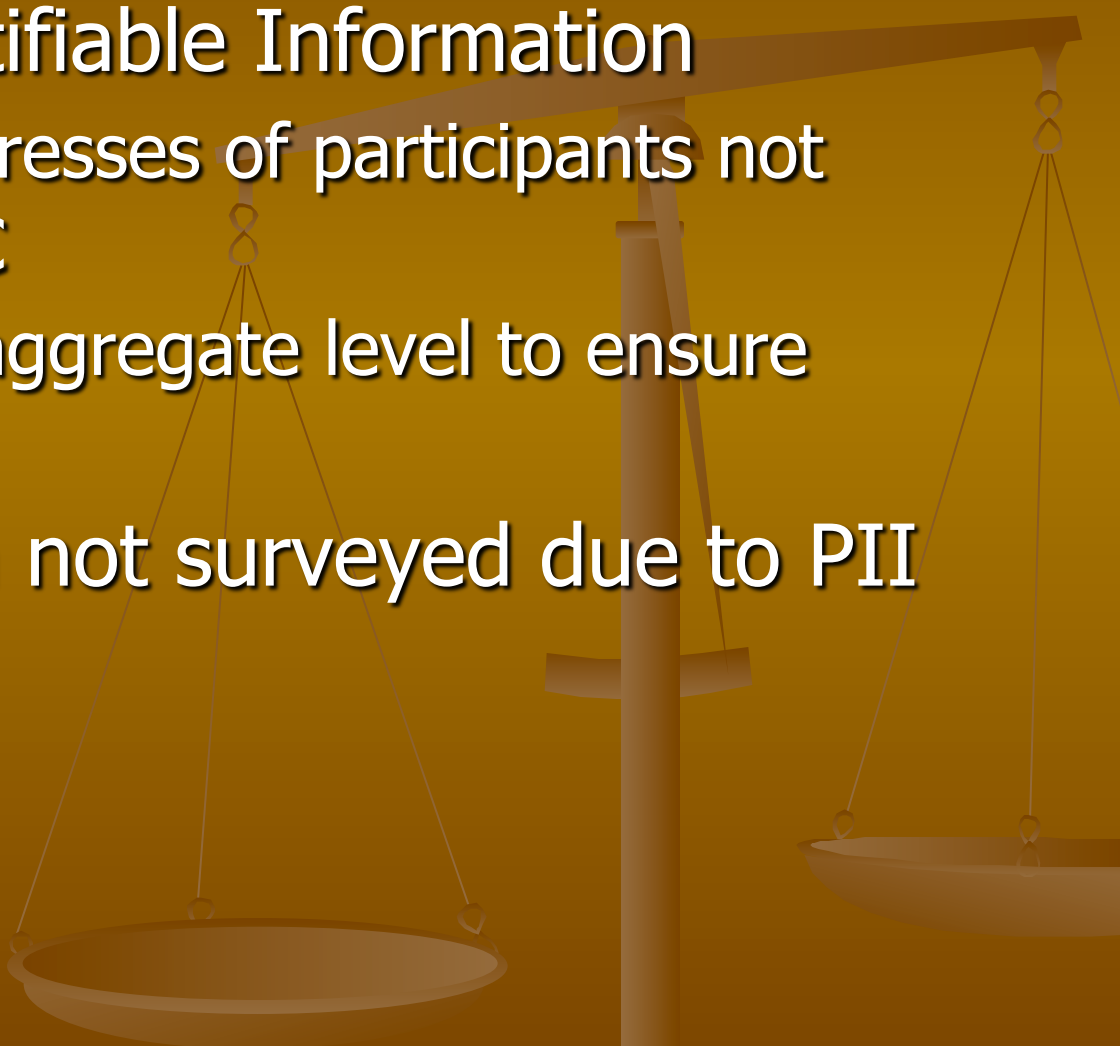
What Was Released

- Measuring Broadband America Report
 - Main Section describing conclusions and major results
 - Technical Appendix describing tests and survey methodology
- Spreadsheet providing standard statistical measures of all tests for all ISPs and speed tiers measured
- March data set (report period) with 4B data elements from over 100M tests
 - Data set presented as used with anomalies removed
 - Documentation provided on how data set was processed
- Data set from February thru June
 - All data, as recorded
- Geocoded data on test points recently released
- Information available at <http://www.fcc.gov/measuring-broadband-america>

What Was Measured

Sustained Download	Burst Download
Sustained Upload	Burst Upload
Web Browsing Download	UDP Latency
UDP Packet Loss	Video Streaming Measure
VoIP Measure	DNS Resolution
DNS Failures	ICMP Latency
ICMP Packet Loss	Latency Under Load
Total Bytes Downloaded	Total Bytes Uploaded

What Was Not Measured/ Recorded

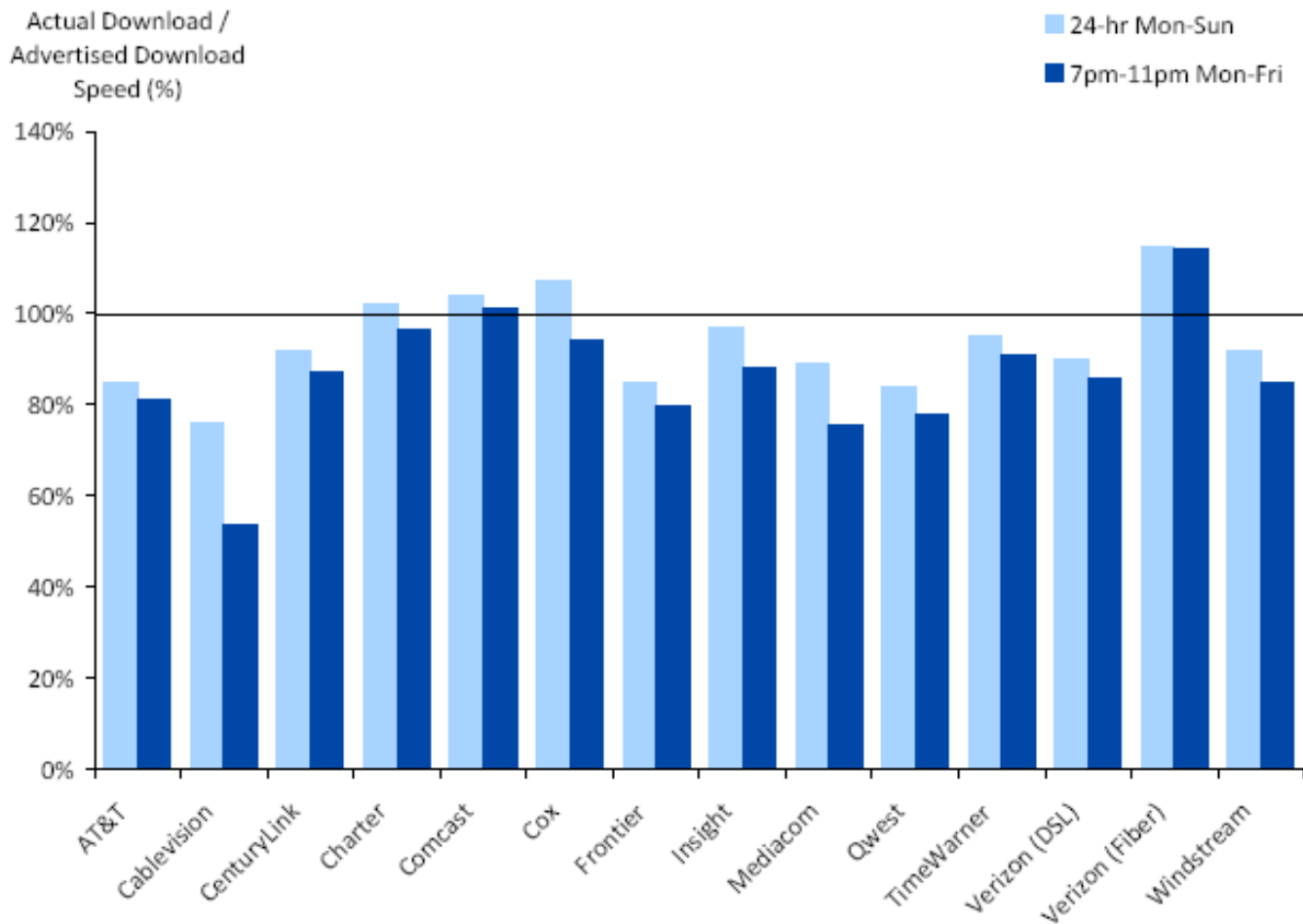
- Personally Identifiable Information
 - Names and addresses of participants not retained by FCC
 - Geotagging at aggregate level to ensure privacy
 - Application data not surveyed due to PII policy
- 

HIGHLIGHTS



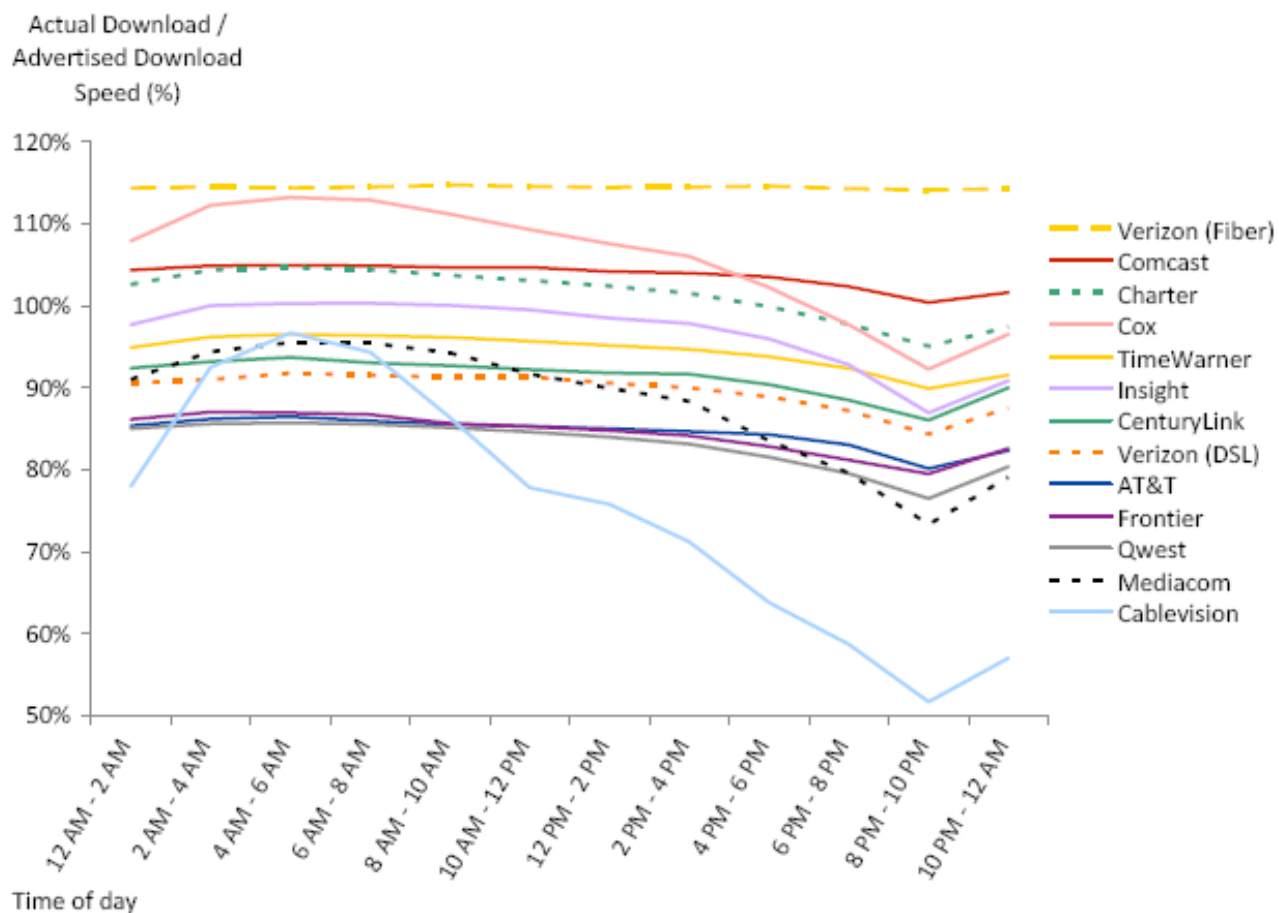
Most ISPs Deliver Close to Advertised during Peak Hours

Chart 1: Average peak period and 24-hour sustained download speeds as a percentage of advertised, by provider



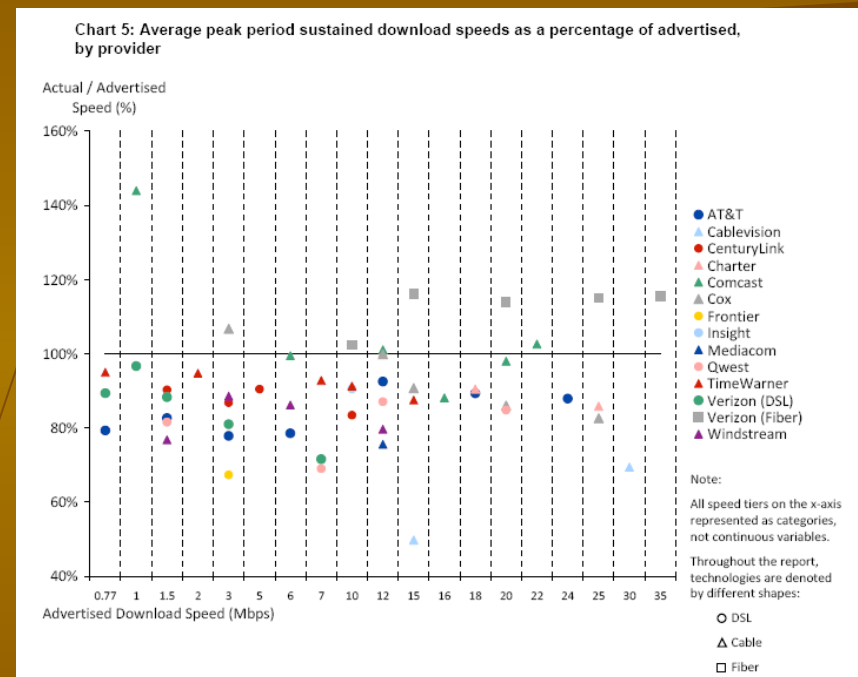
Some Don't

Chart 11: Average sustained download speeds as a percentage of advertised over a 24-hour period, by provider



Performance Varies

- ISPs seem to impose network wide performance standards
- However, there can be exceptions by speed tier

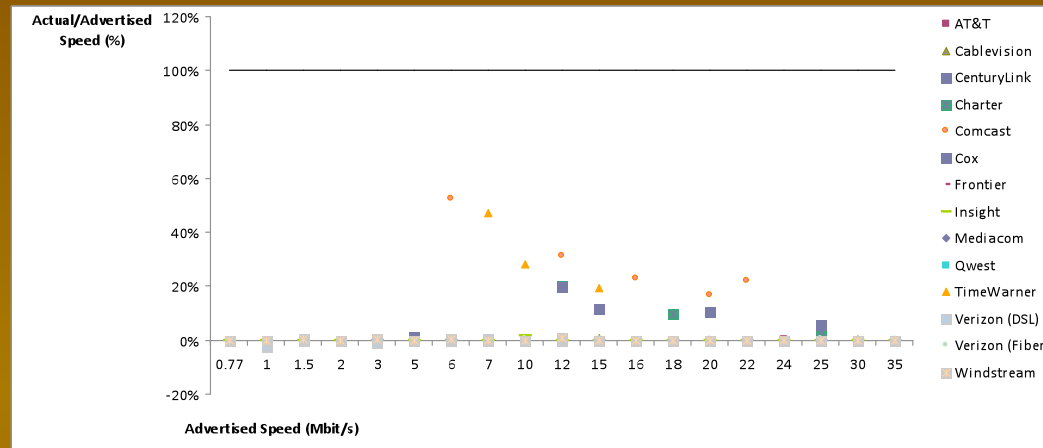


Cable/Telco Tussle



- Some Cable companies advertise burst speed
 - Quota based technique providing temporary speed increase of < 15 seconds
 - Also affected by other household activity
 - Can't be applied generally to DSL where sync rate often limiting factor
 - Marginal value to fiber where each subscriber has potentially available 37 Mb/s to 75 Mb/s provisioned bandwidth
- Compromise to measure both burst and sustained speed
- Burst speed does have some potential to improve browsing, gaming and like applications

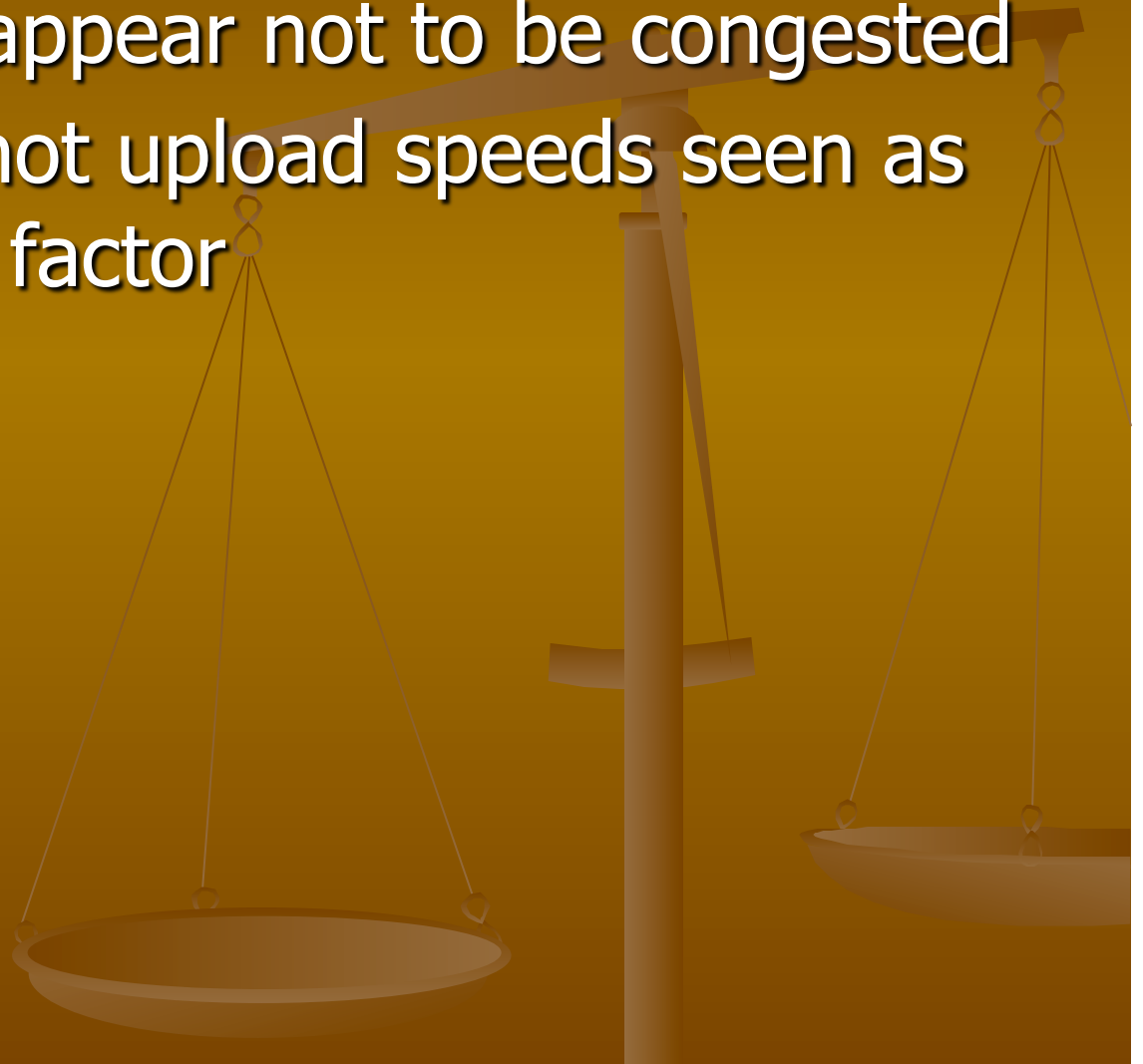
Burst Speed Increase



- Most impact of burst speed seen between 6 and 12 Mb/s
- Note: This chart not in report and shows calculated difference between burst and sustained performance

Upload Speeds

- Upload speeds appear not to be congested
- Download and not upload speeds seen as present limiting factor



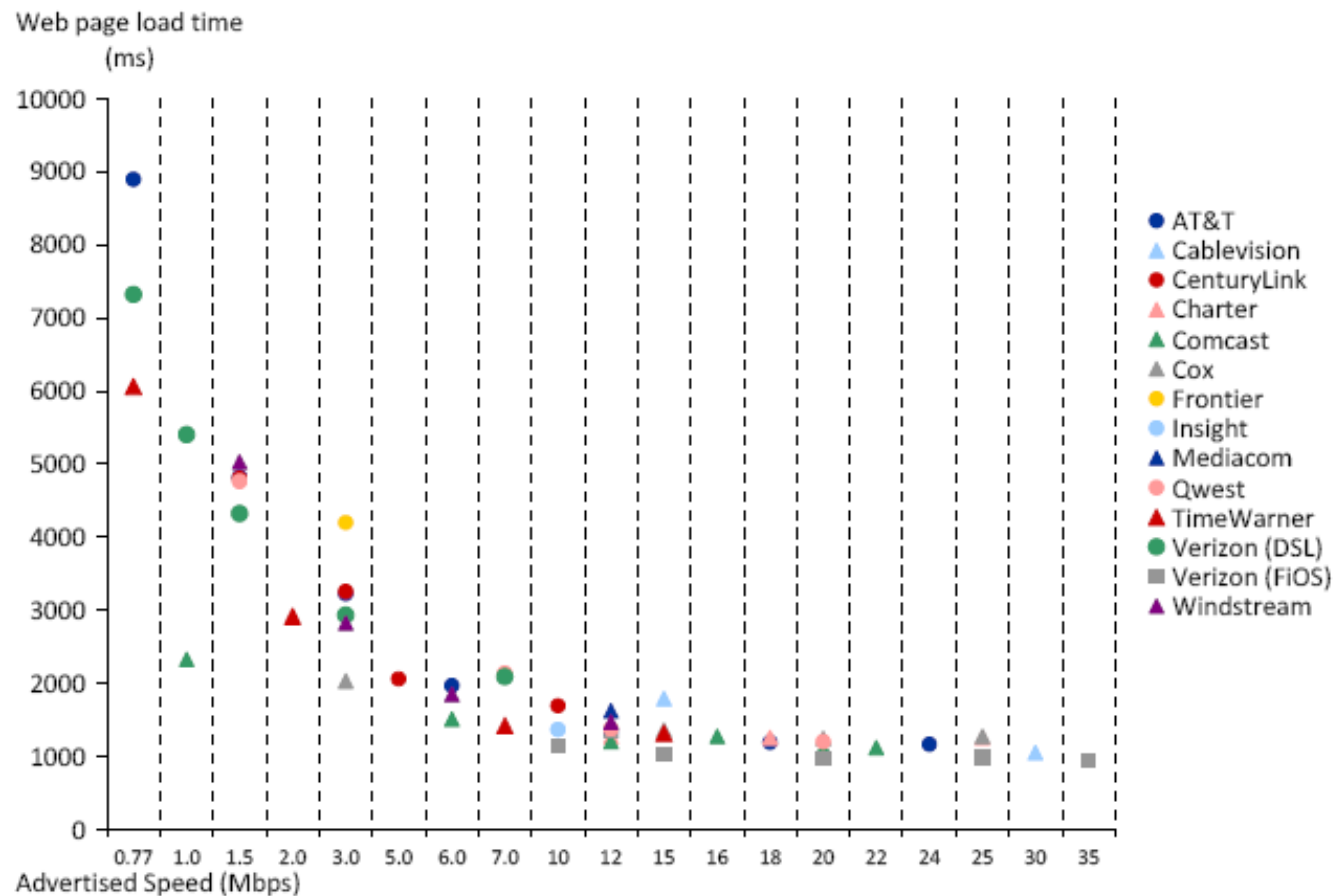
Reliability



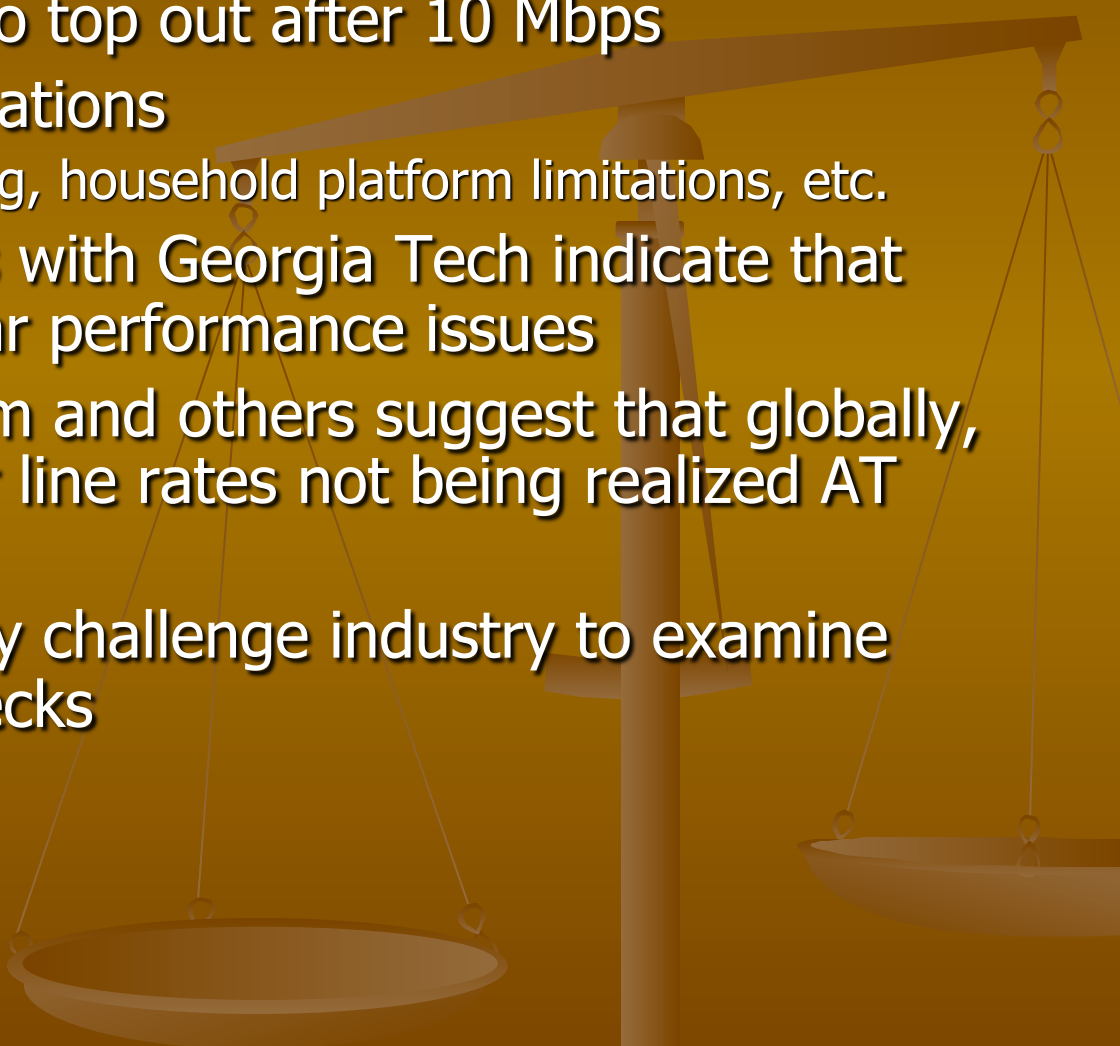
- Packet loss rate < 1%
- Correlation between peak periods and packet loss
 - Higher loss during peak hours
- Most companies during peak experience < .4% packet loss
- Worst case seen during March .8%
- Data from other periods may have numbers in excess of 1% (Georgia Tech)
- 1% packet loss often cited as video threshold

Web Page Downloading

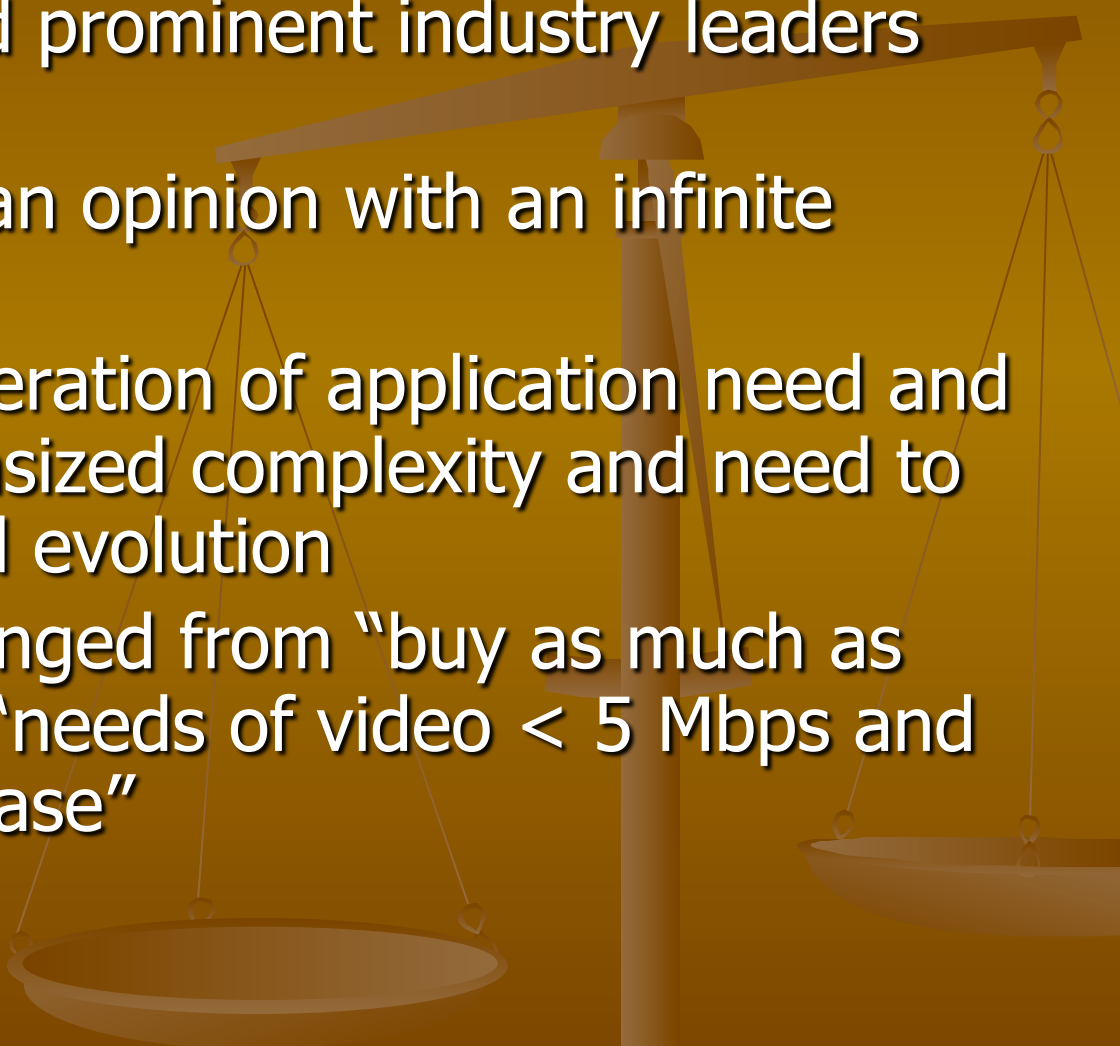
Chart 10: Web loading time by advertised speed, by technology



Web Page Downloading Canary in the Coal Mine?

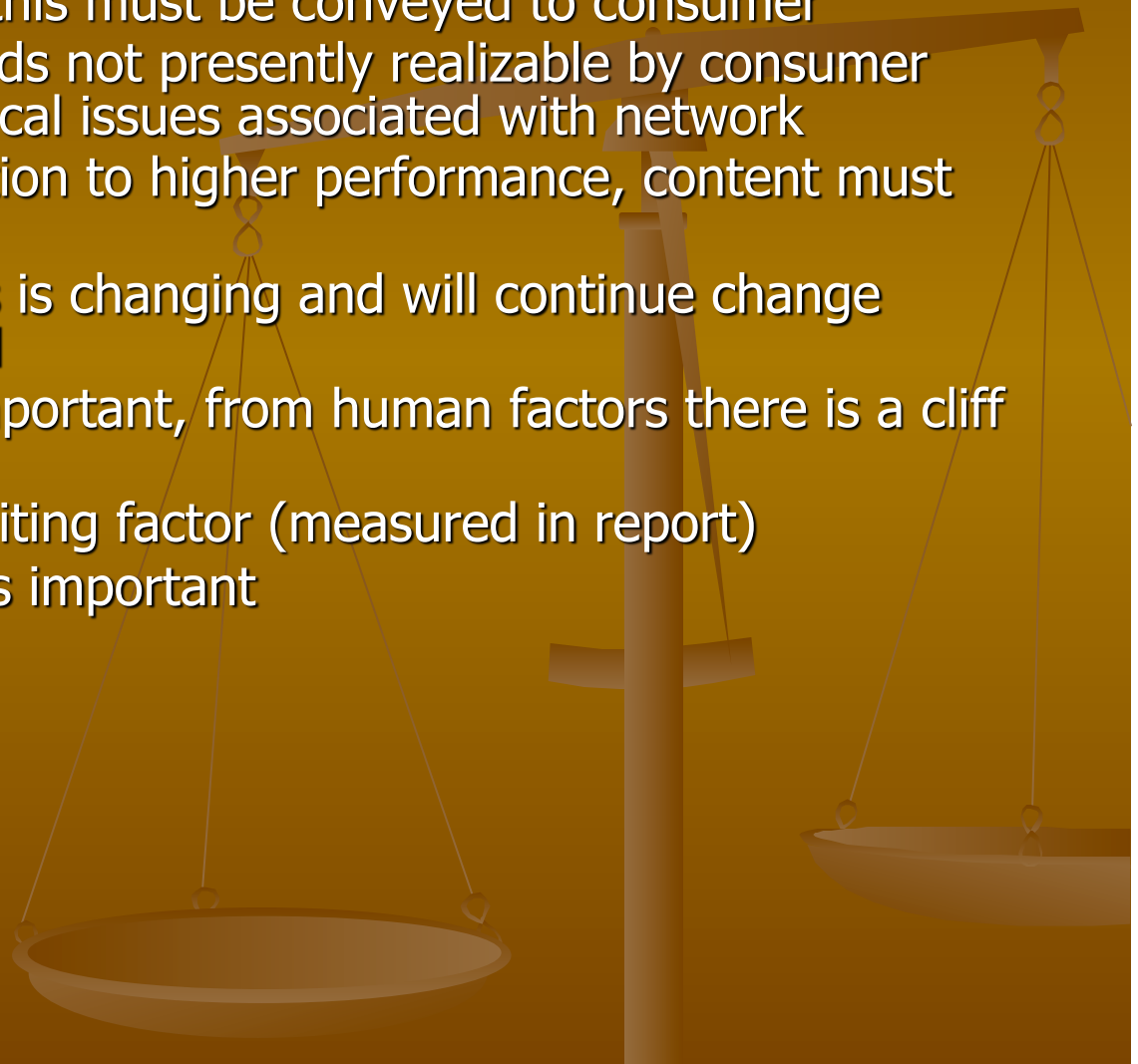
- Performance seems to top out after 10 Mbps
 - Many possible explanations
 - Latency, server loading, household platform limitations, etc.
 - However, discussions with Georgia Tech indicate that they have seen similar performance issues
 - Discussion with Ofcom and others suggest that globally, full benefits of higher line rates not being realized AT PRESENT
 - Higher ISP speed may challenge industry to examine performance bottlenecks
 - More data needed
- 

How Much Speed Is Needed and for What?

- Surveyed ISPs and prominent industry leaders for advice
 - Answer was a mean opinion with an infinite variance
 - ISPs urged consideration of application need and household, emphasized complexity and need to encourage upward evolution
 - Industry advice ranged from “buy as much as you can afford” to “needs of video < 5 Mbps and will possibly decrease”
- 

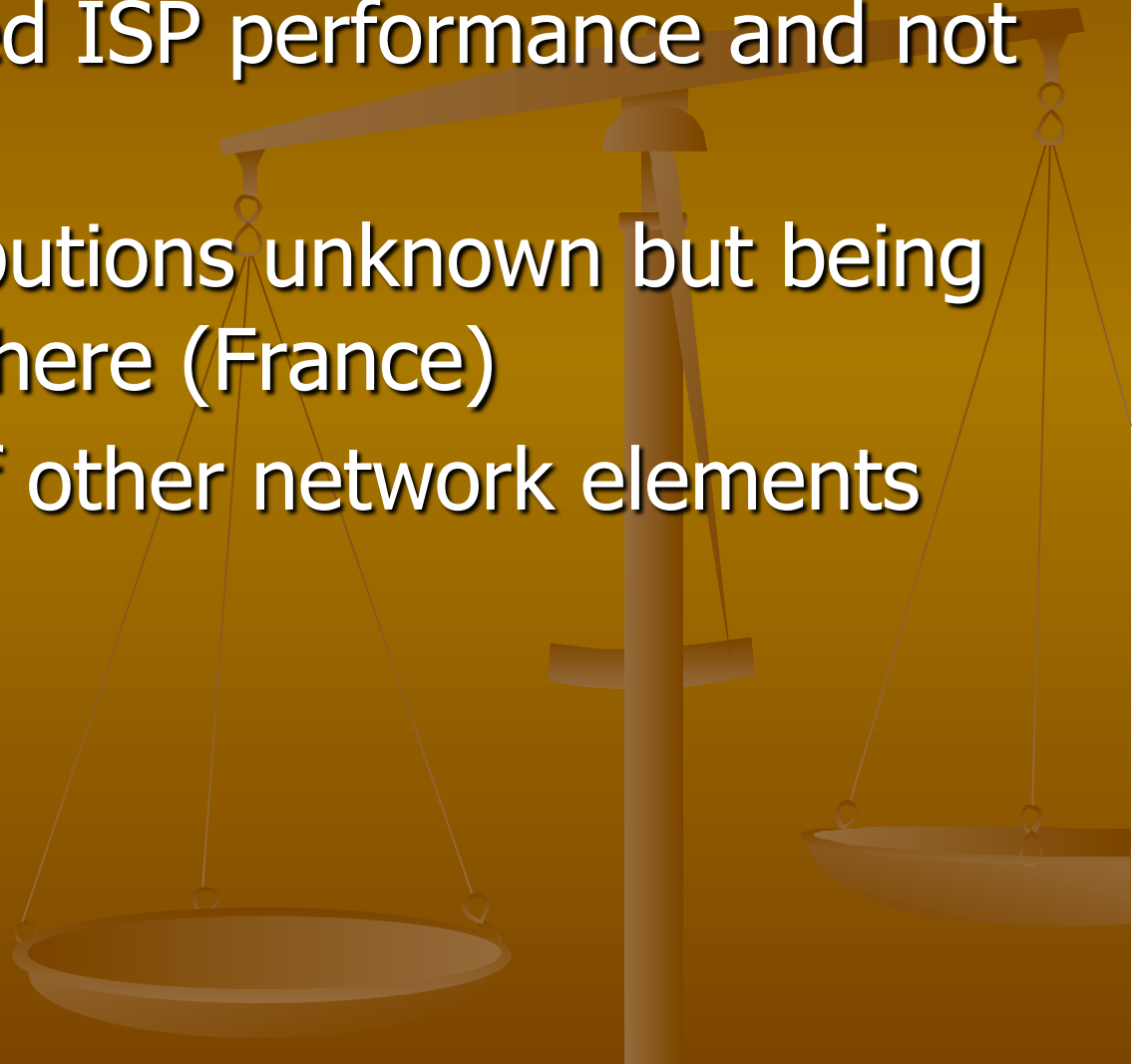
Interesting Observations

- It's a moving target and this must be conveyed to consumer
- Higher performance speeds not presently realizable by consumer end to end, due to technical issues associated with network
- CDNs are necessary solution to higher performance, content must be close to consumer
- Cloud computing services is changing and will continue change demand for upload speed
- Latency is increasingly important, from human factors there is a cliff effect around 100 ms
- DNS resolution is also limiting factor (measured in report)
- Reliability of connection is important



Unknowns

- Report measured ISP performance and not end to end
- In-home contributions unknown but being looked at elsewhere (France)
- Contributions of other network elements not correlated



Future Directions



- Open Internet: Transparency
 - ISPs must disclose typical performance to consumers
- Looking at:
 - Continuing SamKnows on interim basis
 - Automating measurement process
 - Build into modems
 - Produce reports with no/little manual intervention
 - Re-looking at mobile initiative
 - Address rural environment
 - 13 ISPs -> 1000s
 - Other end to end measurement points?