

QoE Measurement: Economic & Policy Considerations

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Workshop on Tracking Quality of Experience in the Internet

(jointly sponsored by NSF & FCC)

October 21-22, 2015

Princeton, NJ



MIT COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE LABORATORY

MIT Communications Futures Program

*"Defining the roadmap for communications
and its impact on adjacent industries."*

What is goal of QoE measurement?

Enable better “evidence-based” decision-making

- Who? Consumers, Edge-providers, ISPs, regulators
- What decisions?
 - Consumers: what service to buy? (how easy to switch?) how to use?
 - Edge-providers: how to design products that use BB? What to buy (whsl)?
 - ISPs: what service to sell? (QoS & P are product features, differentiate)
 - Regulators: universal access, help market work better (meet mandates)

Context matters ⇔ Strategic, Collective Learning/Evolvable

- What data needed depends on the question to be answered
- Who (and how) decision is being made
- Economic Environment
 - Complex, multi-stakeholder value chain ⇔ Strategic
 - Asymmetric, imperfect information ⇔ Collective learning/search
 - Lots of problems: public goods, externalities, Lemons, Path dependence
 - Process : all decisions are part of larger decision context

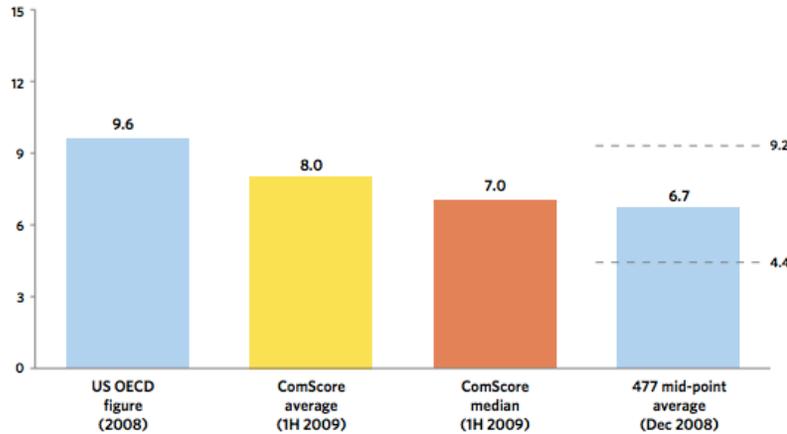
Want best decisions for society (not for each individual)

What's Economic Research Agenda?

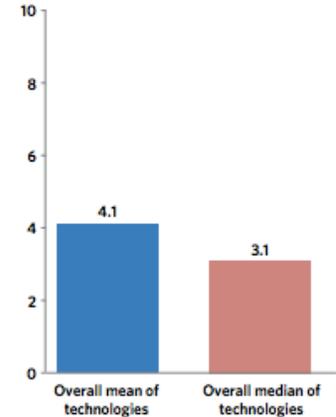
- **Design measurement ecosystem that is robust, evolvable**
 - Need toolbox: who/what/why \leftrightarrow tool
 - Multiple perspectives (FCC Measure BB America *and* edge-based, etc.)
 - Flexible/adaptable
 - *Incentive compatible* (participation, info sharing/collective learning)
 - Privacy/security
 - Cost sharing
 - Strategic (private v. social returns)
- **What is the Role of Regulator**
 - FCC not only regulator (also, market \leftrightarrow contracts (SLAs, etc.))
 - Disclosure & Transparency policies
 - Methods, not necessarily data
 - Consumers may not be principal target of info
 - (1) Convener; (2) Curator; and (3) Authoritative source (for limited subset)
- **Measurement infrastructure building blocks : net.info....**
- **Multidisciplinary: explicitly consider incentives....**

Average advertised download speeds in U.S. in 2009 6.7Mbps, but actual 3.1Mbps

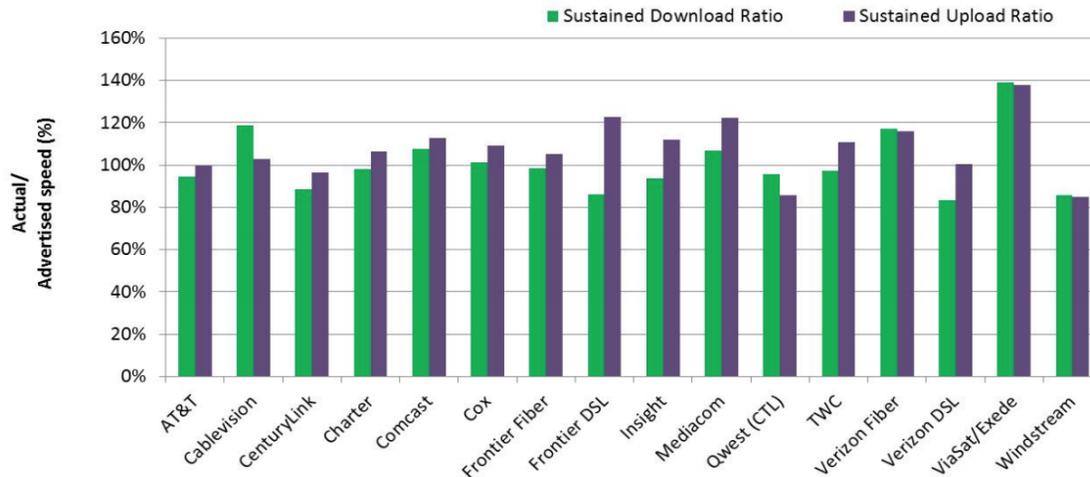
*Exhibit 14:
Advertised Download
Speeds by Various Data
Sources (Mbps)*



*Exhibit 17:
Average (Mean)
and Median Actual
Download Speeds,
Overall and By
Technology (Mbps)*



- Advertised peak ("up to") speeds, not "actual". What *should* expectation have been?
- Measurement problems. FCC launches Measuring BB America (MBA) in 2010.



In 2014, FCC reports
"actual" ~ 100%
"advertised"

Other Economic Questions of Interest

- **Economic impacts of Information Technologies**
 - Of Internet, of Broadband (v. lower speed), of Mobile (v. Fixed)
 - Of flexibility (v. optimized for current or specific service)
- **Antitrust**
 - Market definition (and shares)
 - Market power
- **Industrial Policy**
 - Essential infrastructure
 - Jobs, Productivity, Innovation, Consumer Welfare,
- **(Spillovers to all other domains...)**
 - Fiscal policy
 - “e” – everything (healthcare, government, first-responders, ...)

Incentives: Carrots & Sticks...

-- Regulator: “Carry a big stick...” (e.g., safe harbor & MBA)

- How to best leverage Measuring BB America platform?
- (Not only platform nor should it be...but cannot avoid engagement)

-- Education (sometimes it’s just ignorance....)

-- Cost sharing (subsidies & lower costs for willing collaborators)

- Standardize measurements (BITAG?)
- Avoid regulatory impediments to sharing. Engage actively with researchers. (But who funds??)

-- Interconnection, markets and bilateral bargaining

- Vertical integration a solution, but may create a worse problem. (Closed systems easier to manage.)
- What types of “light-handed” performance standards can encourage cooperation, without constraining innovation, market bargaining (excessively)?

References

Bauer, Steve, William Lehr, and Shirley Hung (2015), "Gigabit Broadband, Interconnection Propositions, and the Challenge of Managing Expectations," TPRC2015, Alexandria, VA, September 2015, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2586805.

Lehr, William, Erin Kenneally, and Steve Bauer (2015), "The Road to an Open Internet is Paved with Pragmatic Disclosure & Transparency Policies," TPRC2015, Alexandria, VA, September 2015, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2587718.

Clark, D., S. Bauer, W. Lehr, K. Claffy, A. Dhamdhere, B. Huffaker, and M. Luckie (2014), "Measurement and Analysis of Internet Interconnection and Congestion," 2014 TPRC Conference Paper. Available at SSRN: <http://ssrn.com/abstract=2417573>

Lehr, W. (2012), "Measuring the Internet: the data challenge," Organization for Economic Cooperation and Development (OECD) Digital Economy Working Paper 184, ISSN 2071-6826, April 2012, available at: http://www.oecd-ilibrary.org/science-and-technology/measuring-the-internet_5k9bhk5fzvzx-en

Bauer, Steven and Clark, David D. and Lehr, William (2010), "Understanding Broadband Speed Measurements (August 15, 2010). TPRC 2010. Available at SSRN: <http://ssrn.com/abstract=1988332>.