

Measuring Internet Performance when Broadband is the Next PSTN

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Broadband Internet *becoming* the new PSTN

Three separate trends....

(1) From Telephone to Internet

- Voice telephony “silo” → Async data hour-glass
- 4KHz VG circuit → “best effort” packet data over anything

(2) From Internet to Cloud Computing Utility

- Transport → Services (VoIP, Netflix, Facebook,....)
- E2e Peers → Cloud services (storage, CDN, trust)

(3) From Public Utility Regulation to Markets

- Command & Control → Market discretion

Need for Performance Metrics

Challenge is increased:

- Heterogeneity (no one size fits all)
- Dynamism (flexible provisioning)
- Complexity (adaptability, evolvability)
- Asymmetric information → markets (more discretion)
- Distributed control → coordination problems

Markets need information to operate efficiently

- Buyers & Sellers → informed choice (wholesale/retail, invest/consump)
- Network Mgmt/SLA monitoring for operators & end-users
- Accounting and enforcement

Increased complexity, wider dispersion expertise, rapidly changing technology

Challenges

- Separating signal/noise: Uncertainty, Lemon's and Cheap Talk problems
- Free-riding/public goods problems: Expensive to create, cheap to share
- Asymmetric information → strategic games
- Coordination problems (e.g., standardization)

Policy Needs for Performance Metrics

Universal Service

- Target sources/uses of fund
- What is BB?
 - Speed is not enough to characterize.
 - Are mobile/fixed distinct services?
 - Average v. Minimum performance: how much variability is ok?
- Explicit or implicit definition?

Interconnection Regulation

- What (if any) of legacy PSTN regulations should be mapped to BB?
- What about NN?
- Monitor performance to figure out if intervention needed.

Reliability of critical infrastructure

- Consumer protection: quality of BB user experience?
- Systemic reliability and disaster recovery

BB Performance Metrics

ISP data

- Best support for key data for foreseeable future
- E.g., Reliability and Usage (per subscriber/app)

SamKnows

- Tool for isolating and cross-validating

M-Lab

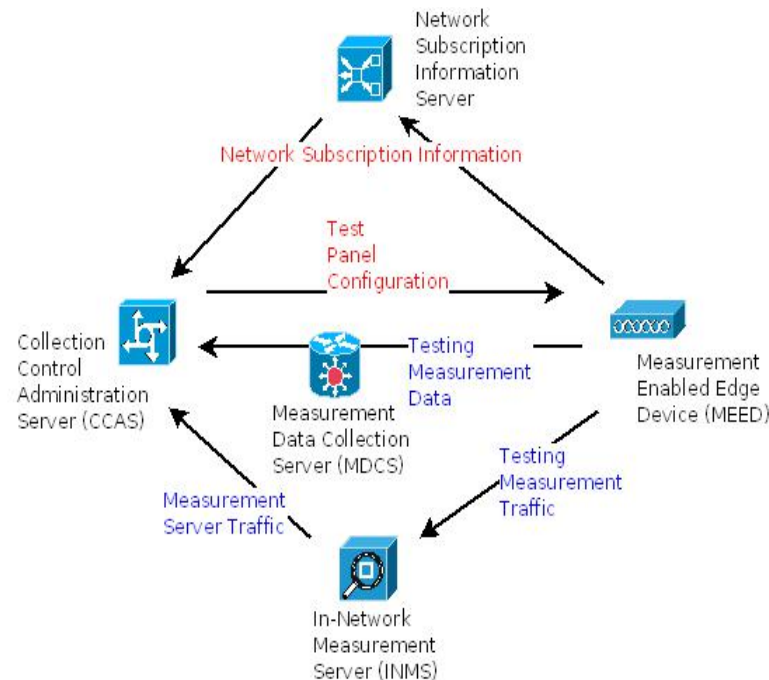
- Open platform for metric design, implementation, research
- Data aggregation, presentation, and analysis tools
- Data sets

Sandvine/Akamai/etc.

- Lots of specialized views

Need for MEED (Measurement Enabled Edge Devices)

- **FCC Next-Generation Measurement Architecture Standardization and Outreach Group (NMASOG) – a work in process...**
- **Imagine: distributed measurement infrastructure**
 - End-user participation for e2e measurement capability
 - Integrate ISP and other app/content-specific data (e.g., usage tier)
 - Platform for cooperative measurement
 - Real-time network management



Policy Recommendations

Metrics serve multiple purposes

- Lots of folks will be measuring performance
 - ISPs/App/Content: real-time network mgmt, provisioning, investment
 - End-users: market research, “SLA” monitoring
 - Policy-makers:
 - Less need to compel data, less hope to be “authoritative source”
 - Leverage other sources
 - Recognize strategic import of FCC measurement/reporting decisions

No ‘one-size’ fits all solution desirable

- Resist temptation to over-simplify
- Granular detail whenever possible (s.t., cost & confidentiality concerns)

Transparency and Disclosure of Methods

- Confidentiality concerns need to be addressed
- Commit to open and flexible, adaptive process

Shift to ex post enforcement

- Active monitoring required for credible enforcement expectation

Summing Up

Broadband is becoming the new PSTN

- **Unregulated Internet colliding with the regulated PSTN**
- **Markets instead of legacy PSTN regulation**

Broadband Internet a much more complex measurement challenge

- **Platform instead of single service**
- **Many more market players/layers**

Performance measurement and Policy

- **Compelling need for performance measurement w/ new metrics**
- **Measurement (metrics) increasingly strategic (contentious)**
- **Leverage many sources of market data**
- **Open disclosure of methods, commit to open dialog**