

Gigabit Broadband, Interconnection propositions, and the Challenge of Managing Expectations

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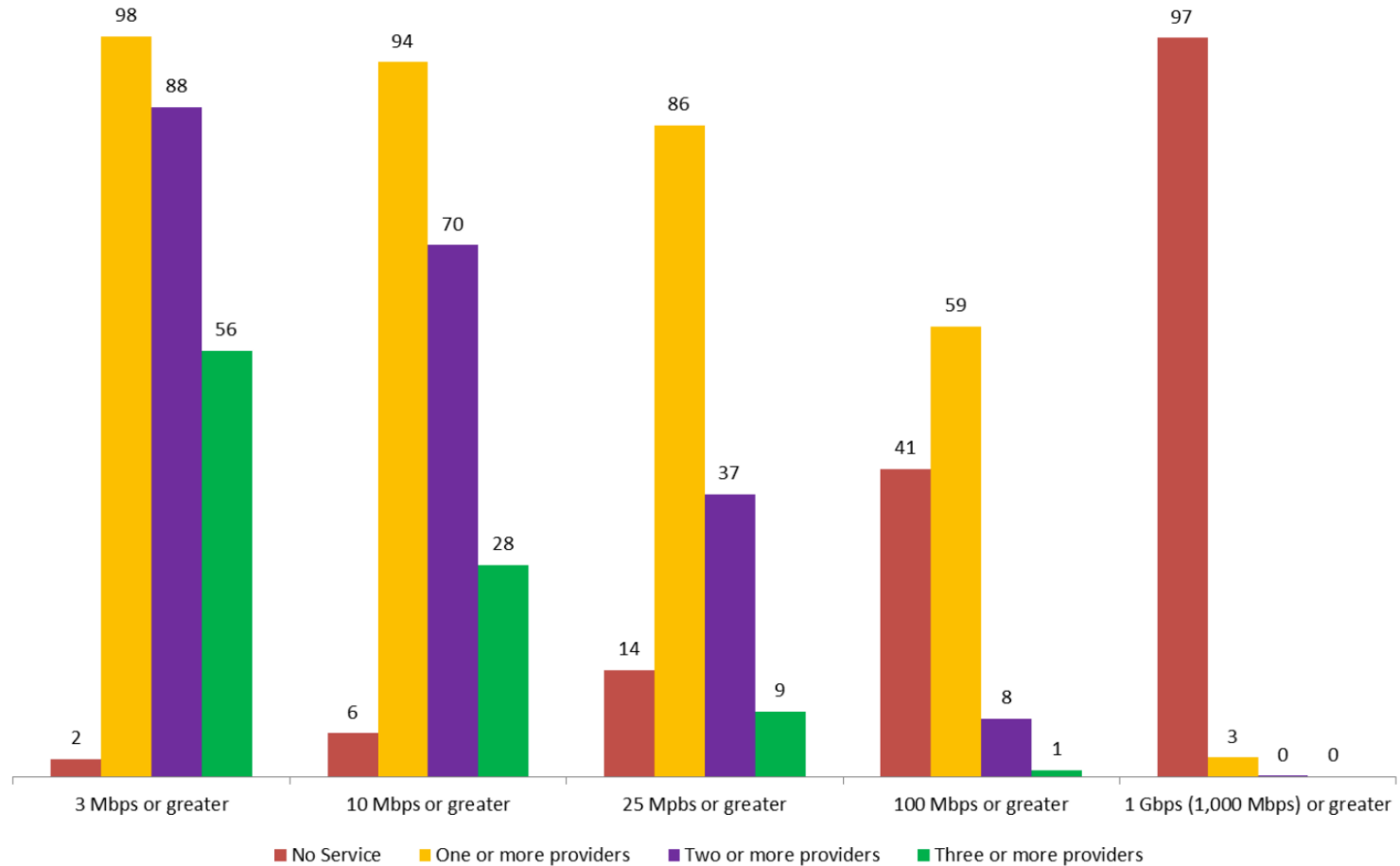
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Motivation

68% have access >100Mbps, 3% >1Gbps



Population shares by numbers of available fixed broadband providers by maximum available advertised download speeds in Mbps

Source: Figure 2 in Department of Commerce, Competition Among U.S. Broadband Service Providers, Dec 2014
<http://esa.doc.gov/sites/default/files/competition-among-us-broadband-service-providers.pdf>

Why care about Gigabit Broadband?

- FCC only upgraded benchmark from 4/1Mbps to 25/3Mbps Jan2015
- 2020 policy goals are >100Mbps (in US & many other OECD markets)

Why care about performance expectations of regulators, users, edge providers?

- Potential to delay or disrupt deployment of very high-speed broadband
- **Current measurements and expectations are not adequate or sustainable in a gigabit broadband world**

Existing performance
expectations

Regulatory Expectations

- Actual speeds should closely match advertised speeds on access networks.
- Some level of consistent performance should be maintained across time.
- Performance to sites beyond the access network matters (and is currently inadequate at times) but concrete expectations have not yet been established.

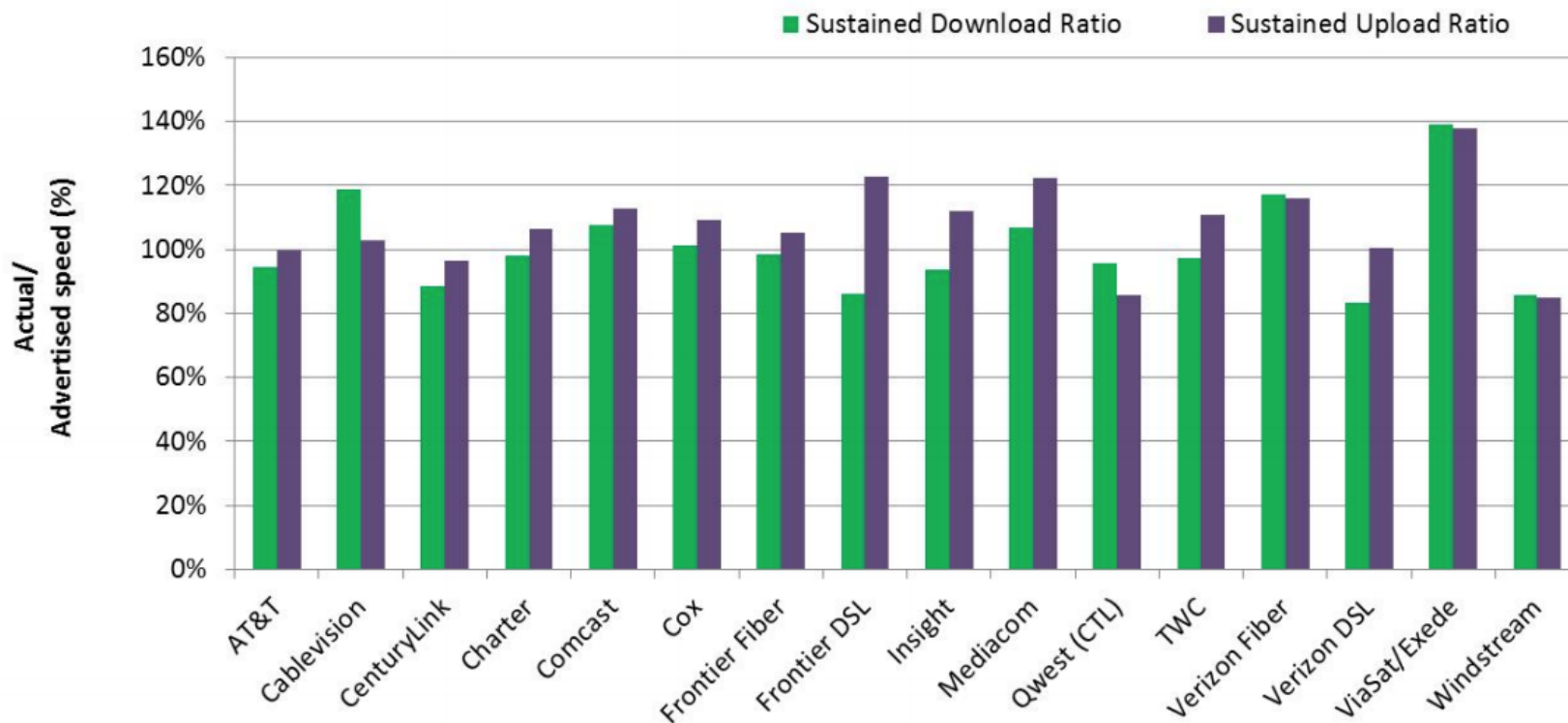
Consumer expectations

- Consistently good quality of experience to popular services, particularly video, gaming and web browsing should be possible.
- Should be able to conduct speed measurements to on-net and off-net locations (though still relatively nearby) and achieve good results relative to access network advertised speed.

Edge provider expectations

- Should be able to provide consistently good quality of experience to end-users.
- Improving quality to an increasing number of end users over time should be possible.

Even during peak periods, actual performance is expected to be near advertised



See Chart 1 in <http://data.fcc.gov/download/measuring-broadband-america/2014/2014-Fixed-Measuring-Broadband-America-Report.pdf>

Gigabit broadband performance propositions

What are reasonable expectations for gigabit broadband?

- Prop #1: Gbps everywhere
- Prop #2: Gbps island
- Prop #3: Gbps in aggregate only
- Prop #4: Gbps somewhere
- Prop #5: Growing toward Gbps paths

Prop 1: Gigabit everywhere

- Average ~ 1Gbps, consistently, end-to-end
- This would sustain today's expectations, but would be very expensive.

"Even if our Fiber network and your devices are fully capable of achieving 1Gig speeds, **Google cannot ensure that you will receive 1Gig speeds from end to end.** Once your communication leaves the Fiber network, it might encounter segments of the Internet providing slower service—often due to heavy traffic or substantial rerouting delays—at any time. It is our hope that overall Internet performance will improve over time."

Prop 2: Gigabit Islands

- Average ~ 1Gbps, consistently, but only in access network.
- Does not meet existing performance expectations
- Since not e2e, is this valuable? YES.
 - Gbps access is what we can measure today, and what we are deploying. Google Fiber, etc. Have to start somewhere.
 - Gbps Islands are valuable. Lots of local traffic. Universities, communities.

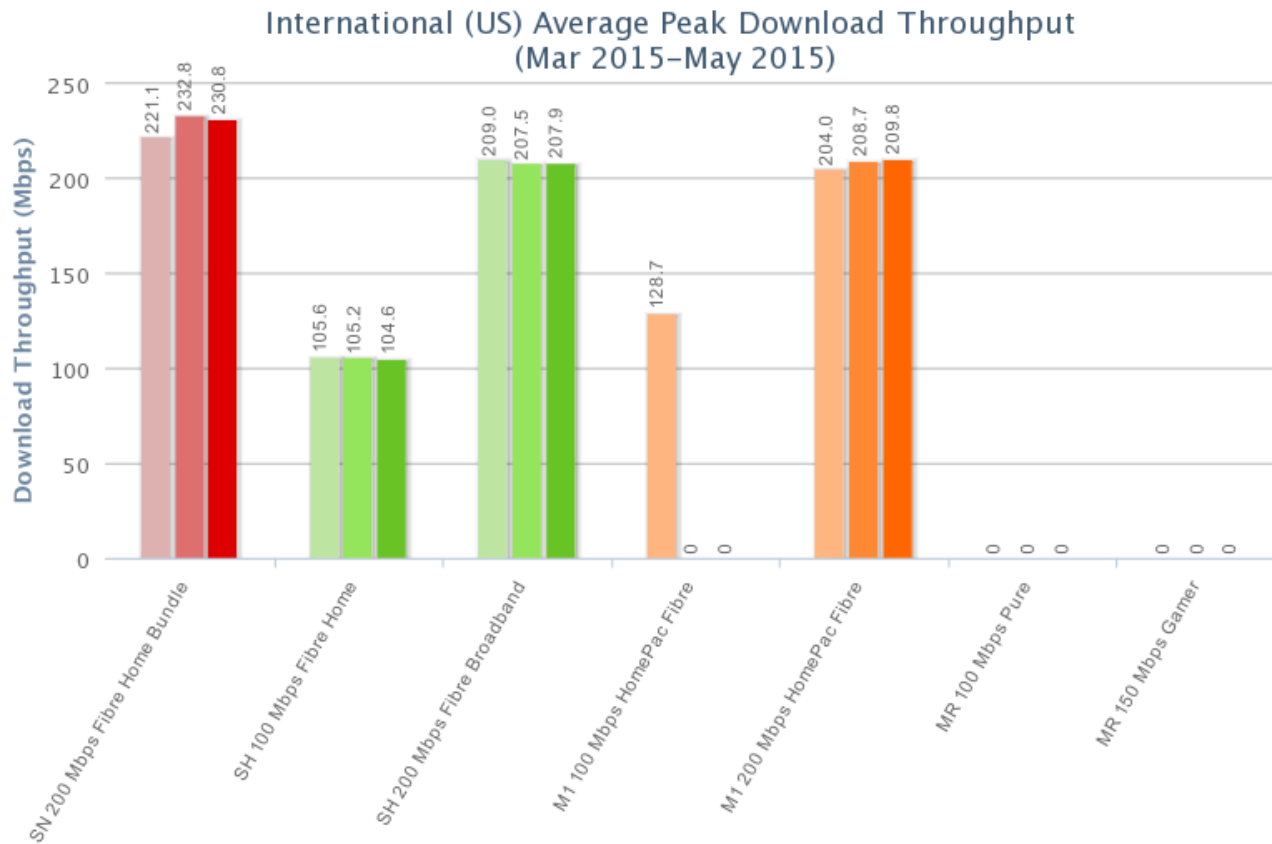
Prop 3: Gigabit in aggregate only

- No individual Gbps flows, but Gbps in aggregate (all users in household, etc.)
- Does not meet existing performance expectations

Prop 4: Gigabit somewhere

- Gbps to select popular locations or apps (Netflix, Google, etc.)
- Does not meet existing performance expectations

Broadband speeds from Singapore to USA



Prop 5: Growing to Gigabit paths

- Ramping demand and capacity efficiently
 - Interconnection agreement include bilateral commitments and notification requirements to scale capacity with actual traffic
- Does not meet existing performance expectations

Policy

Nuanced policy: raise all ships but applaud Gigabit islands

- On average, everyone should have *at least X (instead of average for everyone should be X)*
- Policy should embrace diversity, while still ensuring everyone has at least minimal access.
 - Not everyone needs Gbps, but some do; and over time, the minimum that everyone does need will increase.
- Shift from focusing on peak, to concerns about minimal access

Encourage end-to-end, multilateral dialog

- Don't dumb down debate to make it simple. Gigabit broadband is complicated.
- Learn from cases (Singapore living the future? Kansas City?)
- Encourage information sharing (Disclosure and transparency policies.... see Kenneally, Lehr and Bauer, TPRC 2015).

Questions

Policies

- Nuanced policy: raise all ships but applaud Gigabit islands
 - On average, everyone should have *at least X* (instead of average for everyone should be X)
 - Policy should embrace diversity, while still ensuring everyone has at least minimal access. Not everyone needs Gbps, but some do; and over time, the minimum that everyone does need will increase.
 - Shift from focusing on peak, to concerns about minimal access
- Expand measurement capabilities
 - FCC MBA / Samknows measures are good, but need extension to beyond access
 - Other platforms (multiple perspectives are complementary). E.g., edge-based, application-specific, third-party.
 - Edge-based measurement capabilities (e.g., net.info).
- Encourage end-to-end, multilateral dialog
 - Don't dumb down debate to make it simple. Gbps broadband is complicated.
 - Learn from cases (Singapore living the future? Kansas City?)
 - Encourage information sharing (Disclosure and transparency policies key.... see Kenneally, Lehr and Bauer, 2015).