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Economics of Rural Broadband: An Interactive Session

The Economics of Rural Broadband

A global to local perspective on options and strategies

Bridging the Digital Divide Canada's Rural & Remote Broadband Conference

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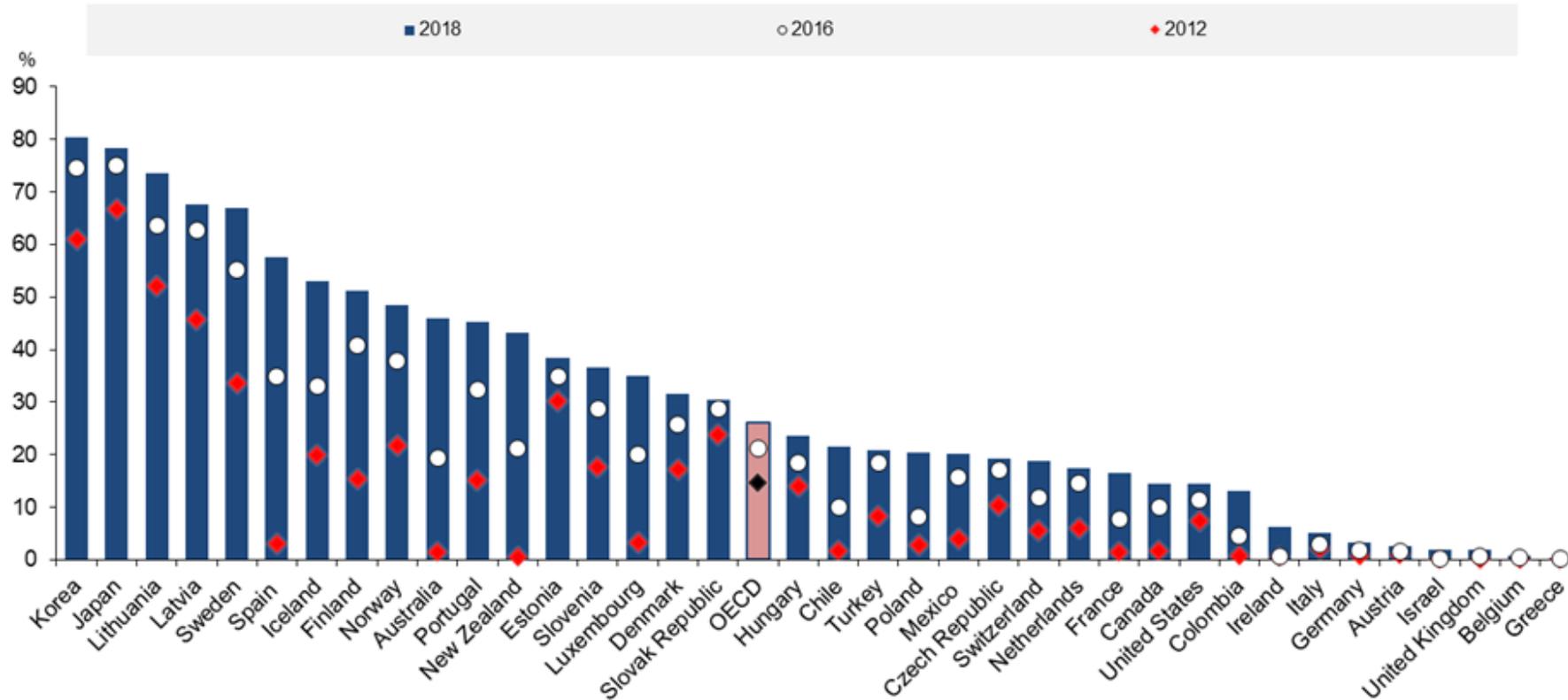
1. Rural broadband a global problem with local solutions

→ 2000s to today: From special projects to universal access

- **Demand:** Matters more than ever to people in rural areas + others/urban
e.g. regional and global food systems, public finance: more efficient delivery of public services, higher property values/local tax base/less need for transfers, etc.
- **Technology:** 2nd generation personal and business apps./services require more reliable/low latency service: Better than “best effort” with minimum QoS/SLAs
→ min. standards particularly important for rural/remote prone to market failures/underinvestment; need for redundancy/resilience
- **Supply:** New technologies, business models for counteracting rural digital divide; falling costs, but revenue/expected take up low
→ Network deployment local enterprise requiring private coordination
→ Network provisioning/management, other functions: Scale economies
Are/can be outsourced → Vertical separation/specialization
- **Economics of public goods:** Positive externalities/value added from network effects hard to capture/monetize by private sector provider of public infrastructure
→ Market failures/sub-optimal private supply/investment incentives

2. Global context: Divergence in FTTP diffusion

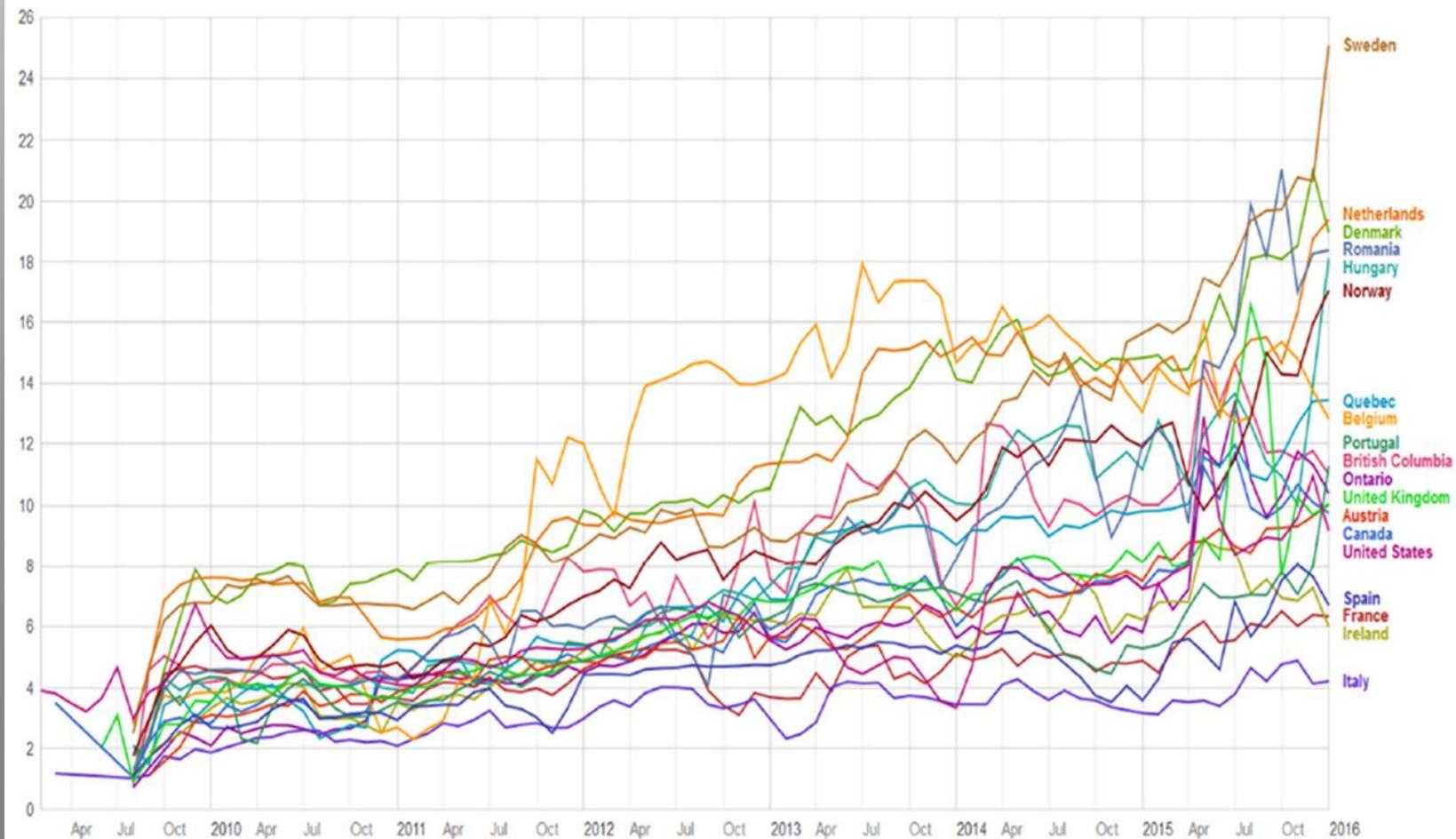
- Risk of both over-investment (in legacy) and under-investment (in fibre/4/5G)
- “Sweating the copper” strategies can be dominant and persistent



% FTTP in total broadband (Source: OECD)

3. Global context: Divergence in effective speeds

- Growing necessity: Demand, but divergence in network capacity improvements
- Clustering in effective speeds/QoS across and within countries



Median download speeds in selected countries (Source: M-Lab/Google)

4. Rural fibre & 5G: Substitutes or complements?

→ Without “deep fibre”/backhaul, as 5G deployed in urban cores:

- rural fall further behind due to no 5G deployment capacity?
- higher capital intensity in 5G in cities diversts capex from longer range LTE/4G and extending fibre hops deeper into rural?



Limits of 5G in rural broadband applications (Source (Source: Samsung/NTT))

5. Drivers of divergent network outcomes

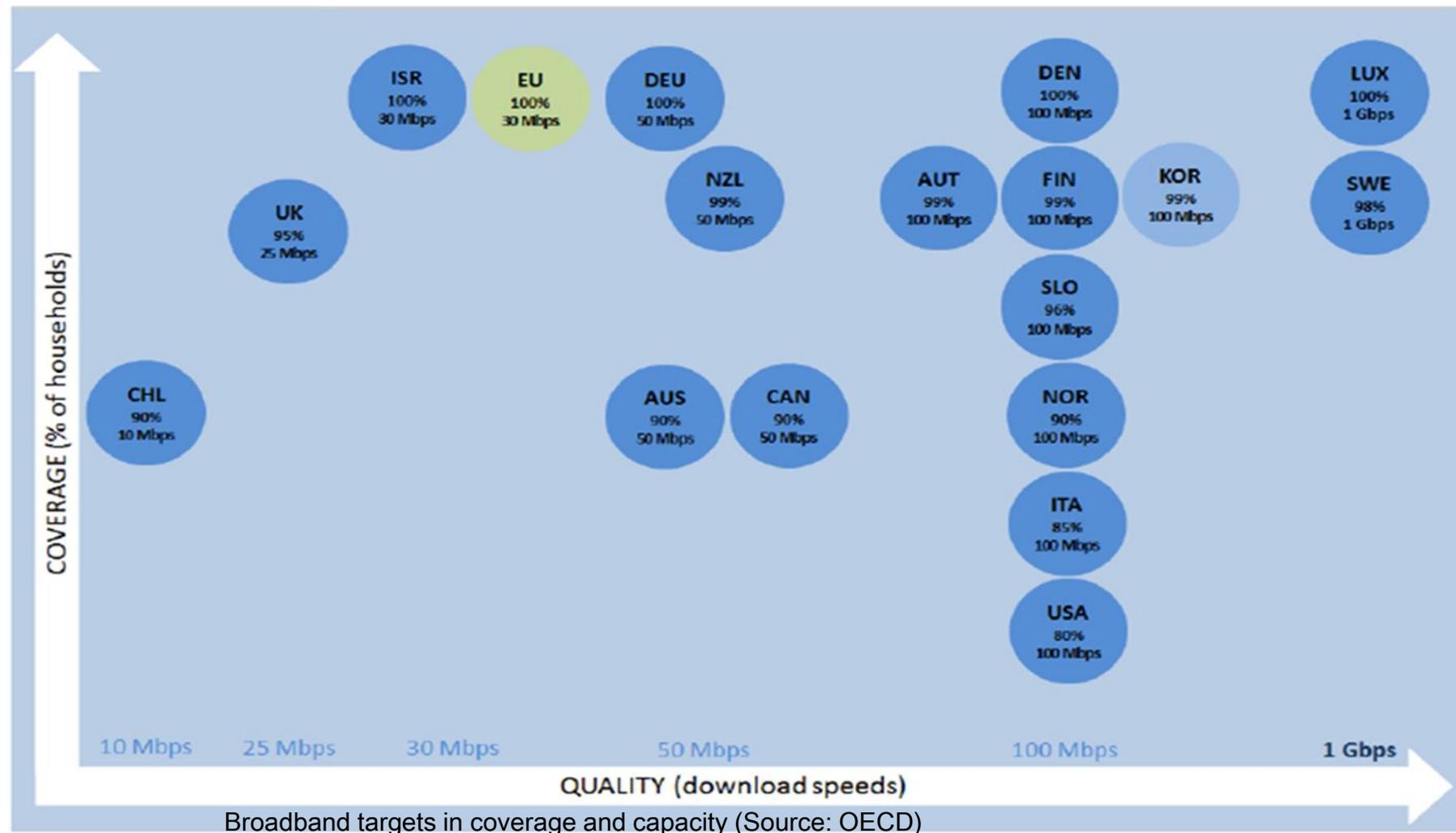
- International evidence suggests driven primarily by:
 - a) **Strategic choices** of large infrastructure providers; which are driven by firm level technology endowments, investor expectations....
 - b) National **regulatory policy** strategies
 - Strategies that limit the scope for “sweating the copper”, **inefficient duplication**, promote **risk sharing**, **co-investment**, **specialization**
 - Minimize capex in fixed assets and expand network (e.g. privately negotiated e.g. Bell/Telus, or nudged with some policy instrument)
- Particularly important for bridging the rural/urban digital divide
 - Facilities-based competition may be feasible/economically efficient in some very low cost urban centres, but not generally
 - High cost/low revenue areas: **Coordination failures**
 - Demand for community fibre, regional transport, PPP coordination

6. General options and strategies

- a) **Do nothing:** Wait for technological innovation in wireless/LEO satellites
→ Likely only option for very remote (5, 10% of HH?)
- b) **Targeted subsidies:** Direct fixed (operational?) cost subsidies to private providers willing to serve high cost/low return rural from the public budget; tax incentives (Canadian federal approach past two decades). How effective/efficient?
- c) **Essential facilities obligations:** Wholesale access obligations on dark/lit fibre transport capacity to minimize duplication/promote co-investment/cooperation in rural. Common in Europe/Asia. Rural communities have been asking CRTC for 20 years to mandate. Time to rethink?
- d) **Universal service fund:** Fees on large providers dominating low cost/high revenue areas to subsidize rural. U.S. approach, now CRTC bb fund
→ Note post election: Call for “Internet tax” for CanCon vs. rural bb
- e) **Universal service mandate:** Leverage internal cross-subsidies from low to high cost areas to deploy NGN into rural transport/access, decommission copper. Monitoring and implementation problems. Is it feasible and/or desirable today?
- f) **Decentralized public/PPPs/managed service:** Municipal/regional fibre/lit transport/retail: Lots of experimentation in Canada and around the world

7. Long term aspirational universal service policy targets

→ Rural connectivity/net neutrality: Trend towards minimum speed/QoS standards of “basic service” (e.g. CRTC 50 ms RTT latency to offnet)

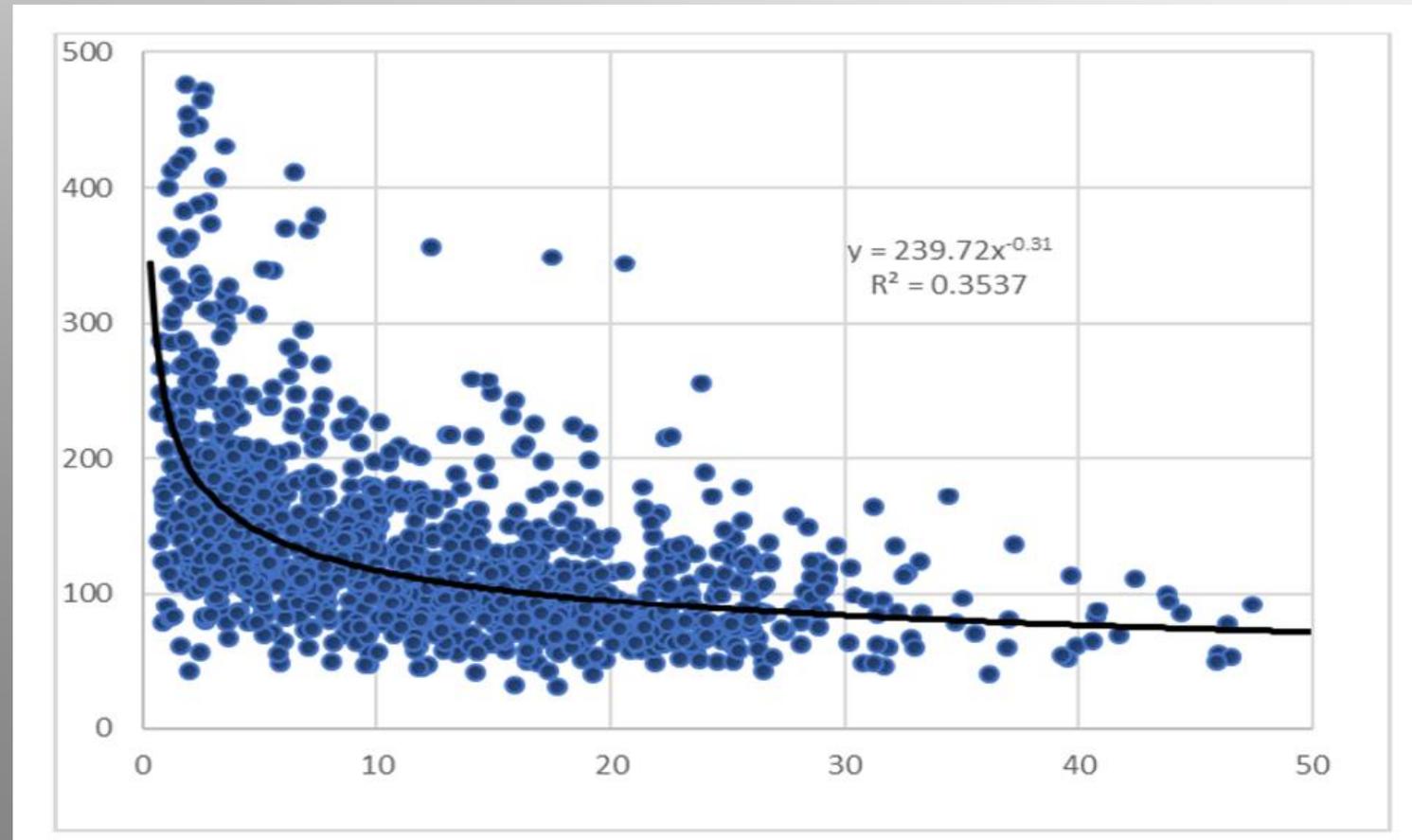


8. Canadian context

- **Canadian federalism:** Telecom regulation mostly federal, but provision of social and business infrastructure provincial/regional/municipal
 - Potential for misalignment of regulatory incentives at different levels, Demand from communities/lower levels of government on feds; statutory basis in S.7. of Telecom Act.
- **Federal responses** to universal access policy demand to broadband: In 2000s ad hoc panels of telecom executives, institutional investors, others e.g. National Broadband Task Force (2001), TPRP (2006)
 - Mostly targeted subsidies to upgrade DSL, wireless speeds
 - No SLAs/minimum speed/quality standards: Initial speed improvements not sustainable: Rajabiun & Middleton (2013); Auditor General CTI (2018)
- **Diversity of provincial/rural/regional solutions** have come (and gone)
 - Privatization/sale of public fibre assets deployed in the 2000s; e.g. Atria, Ontera. Hydro fibre assets? Critical for rural.
 - Existing fibre assets not necessarily affordable/access via **dark fibre IRUs** to underserved communities/small ISPs

9. Broadband divergence in Canadian municipalities

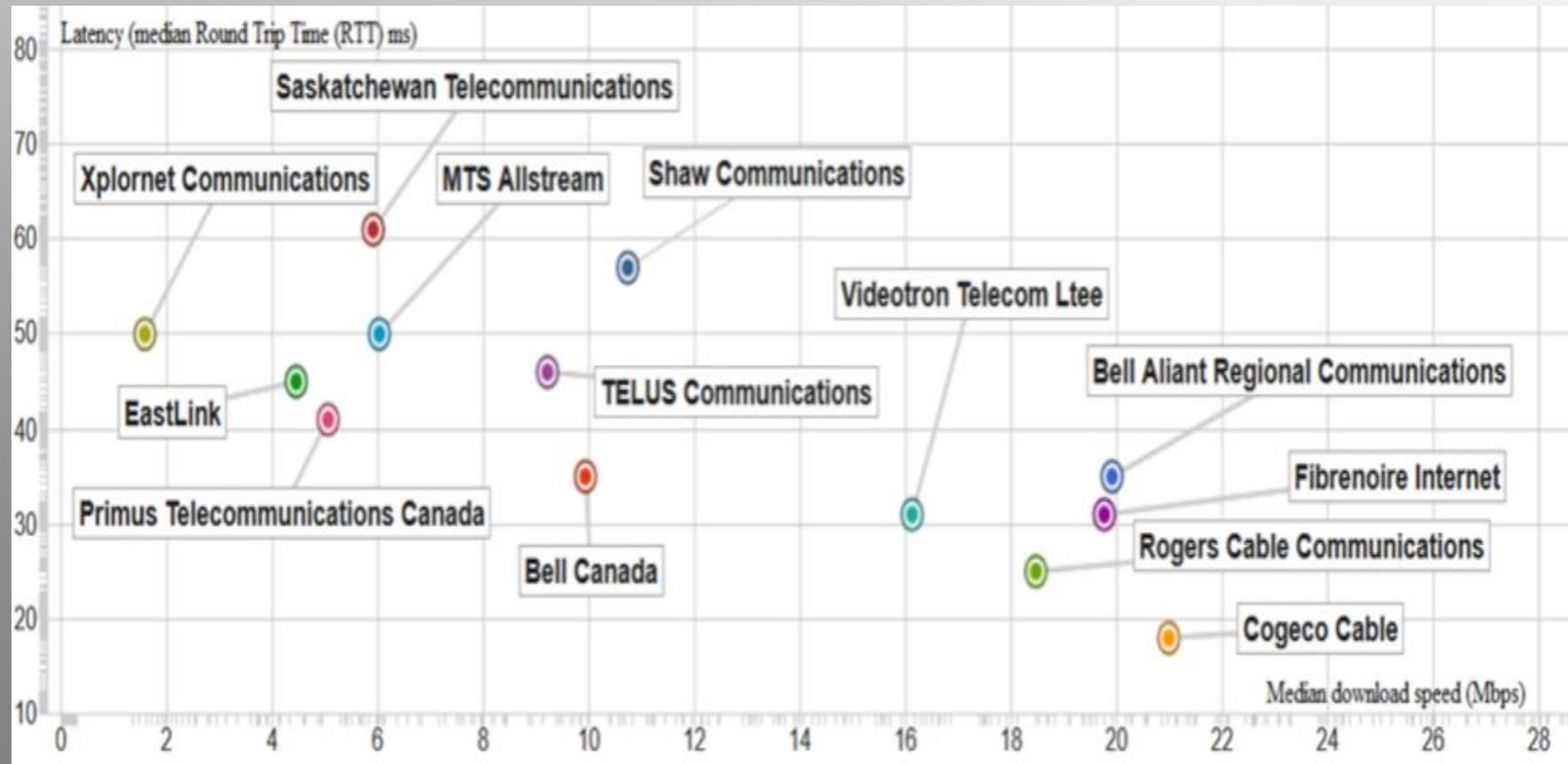
- Harder to improve QoS as speeds increase; need for “deep fibre” in rural
- Is the 50/10 mbps long term “basic service” objective sufficient for 2030?



Broadband Divergence in Canadian Municipalities (x-axis, effective bandwidth, Mbps; y-axis, Round Trip Time (RTT) ms Source: M-Lab/Google, Rajabiun & McKelvey, Information Society 2017)

10. Service quality variation among service providers

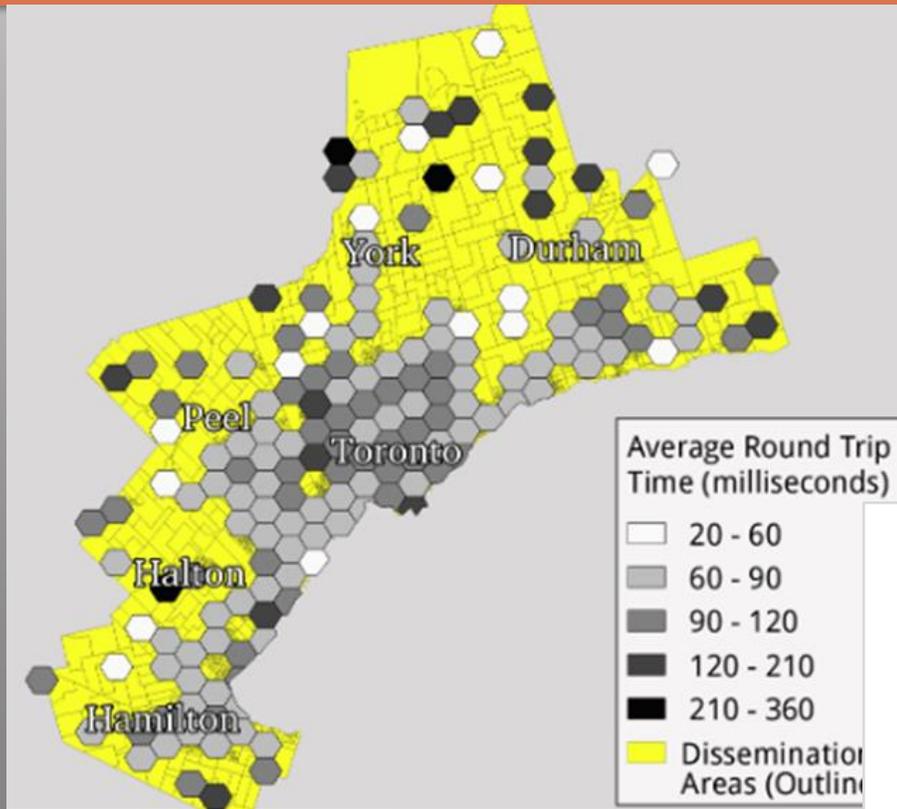
→ Driven by: Technological endowments + capacity provisioning incentives



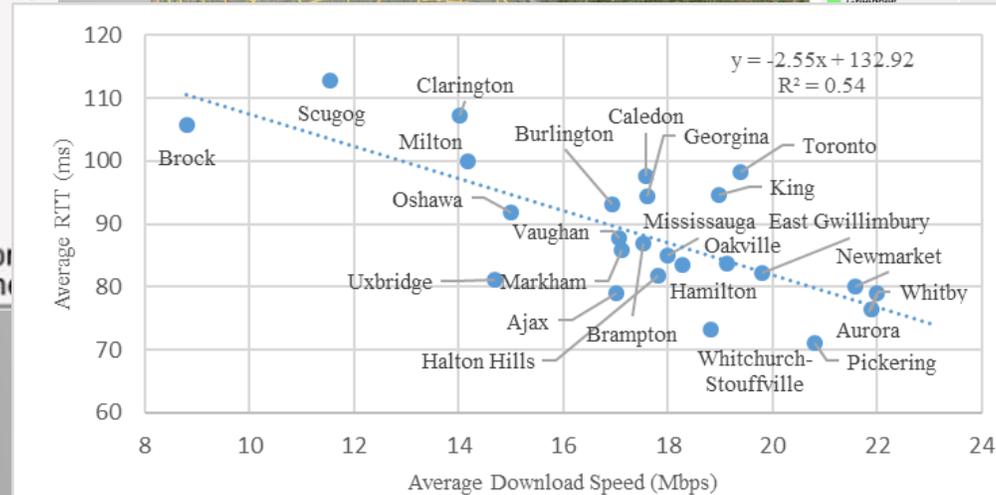
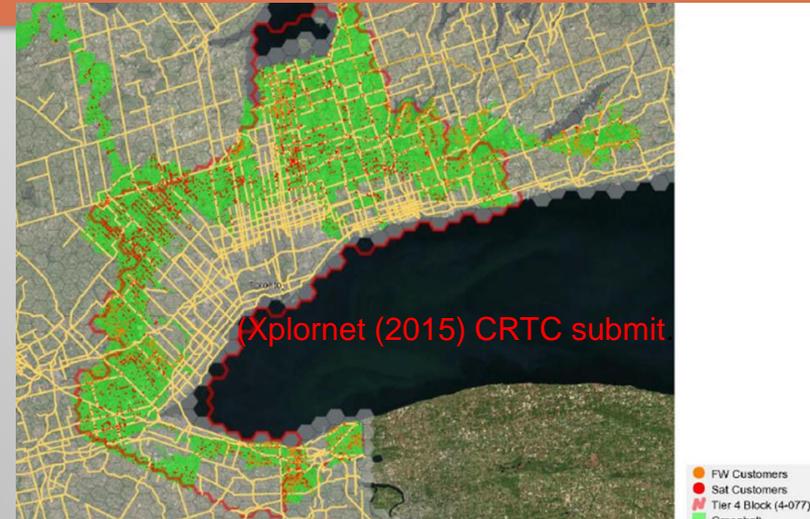
Broadband Service Quality Variation in Canadian Internet Service Providers (medians.
Source: M-Lab/Google; 2016)

11. Regional divergence: On the edges of urban in GTHA

- Large proportion satellite users in GTHA + demand for fibre in SME/residential
- Mayors' BB task force/Chamber of Commerce: Importance of municipal leadership
- est. IRR for FTTN to FTTP 13%, just under expected IRR of large telcos
- But positive enough for small ISPs/muni. Networks if can aggregate demand?

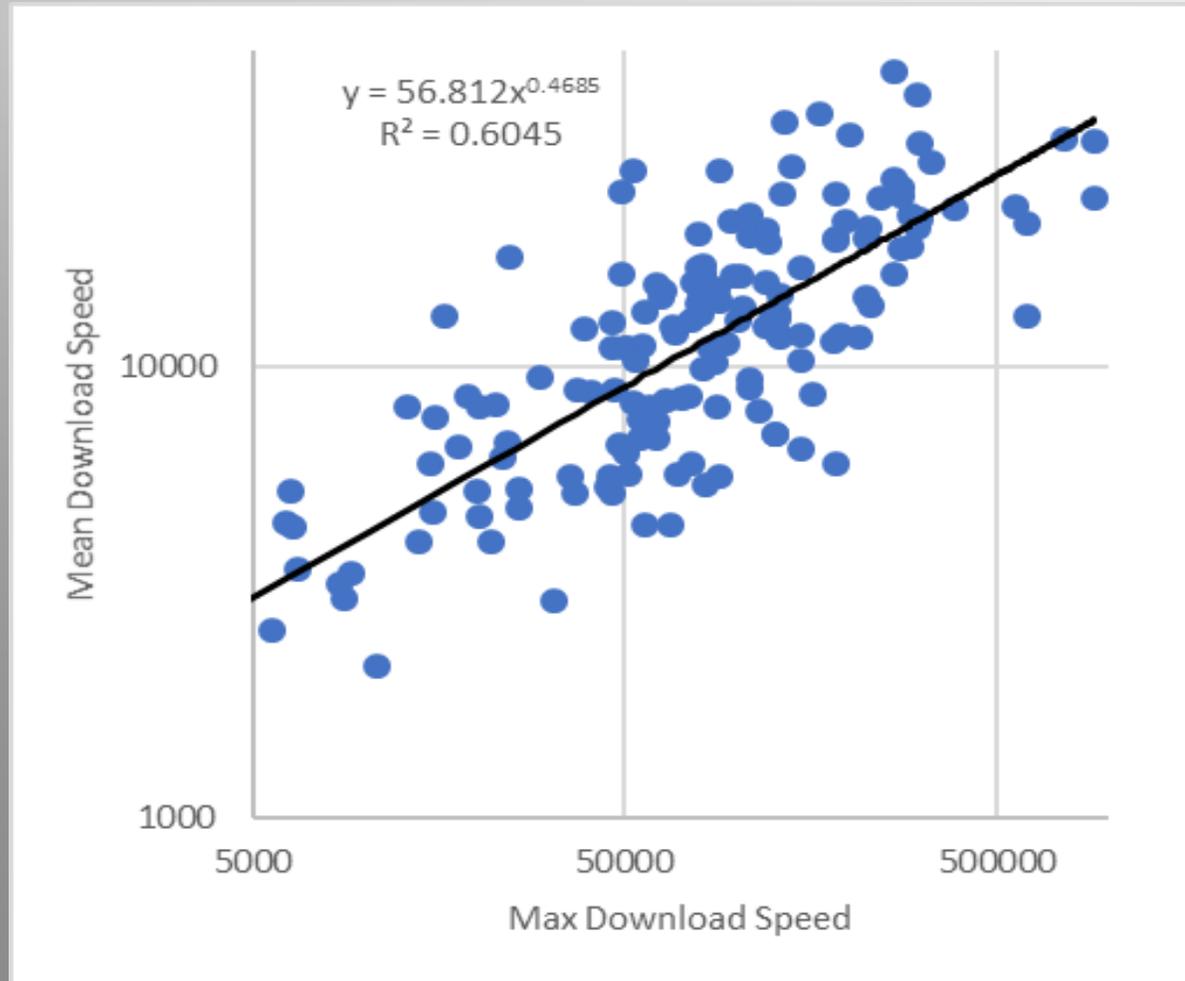


Rajabiun (2017), MOI



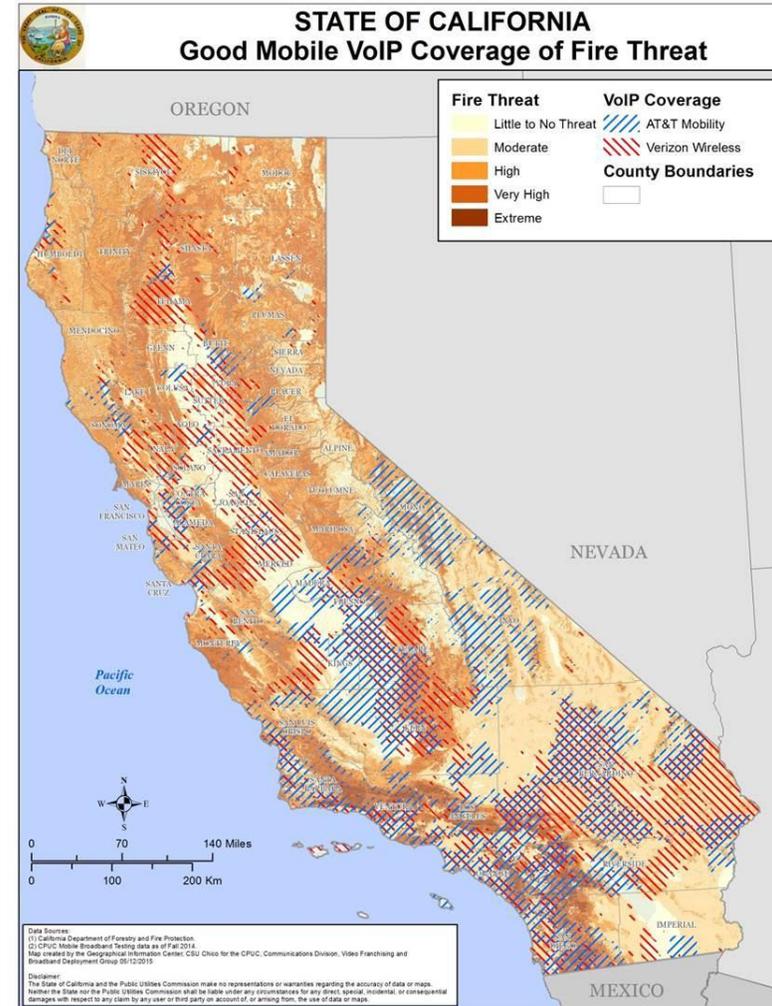
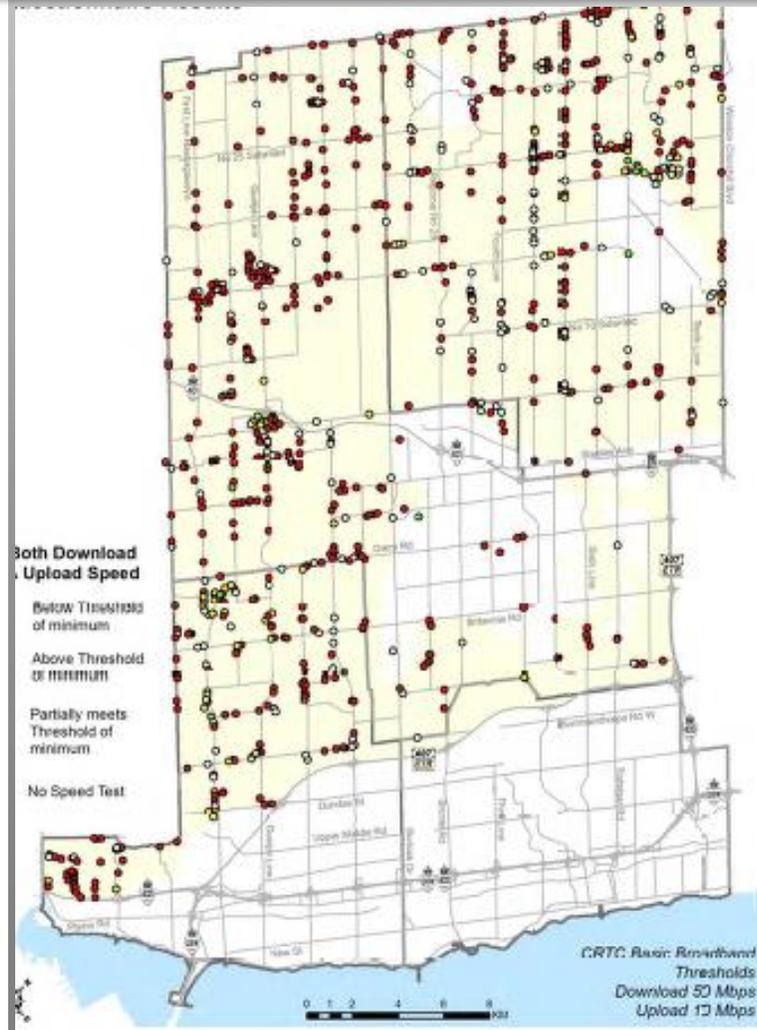
12. Magnitude of regional/localized gaps

- Significant: 3-5x down average; higher in terms of upload/latency
- Highly localized transport and access network market failures/bottlenecks



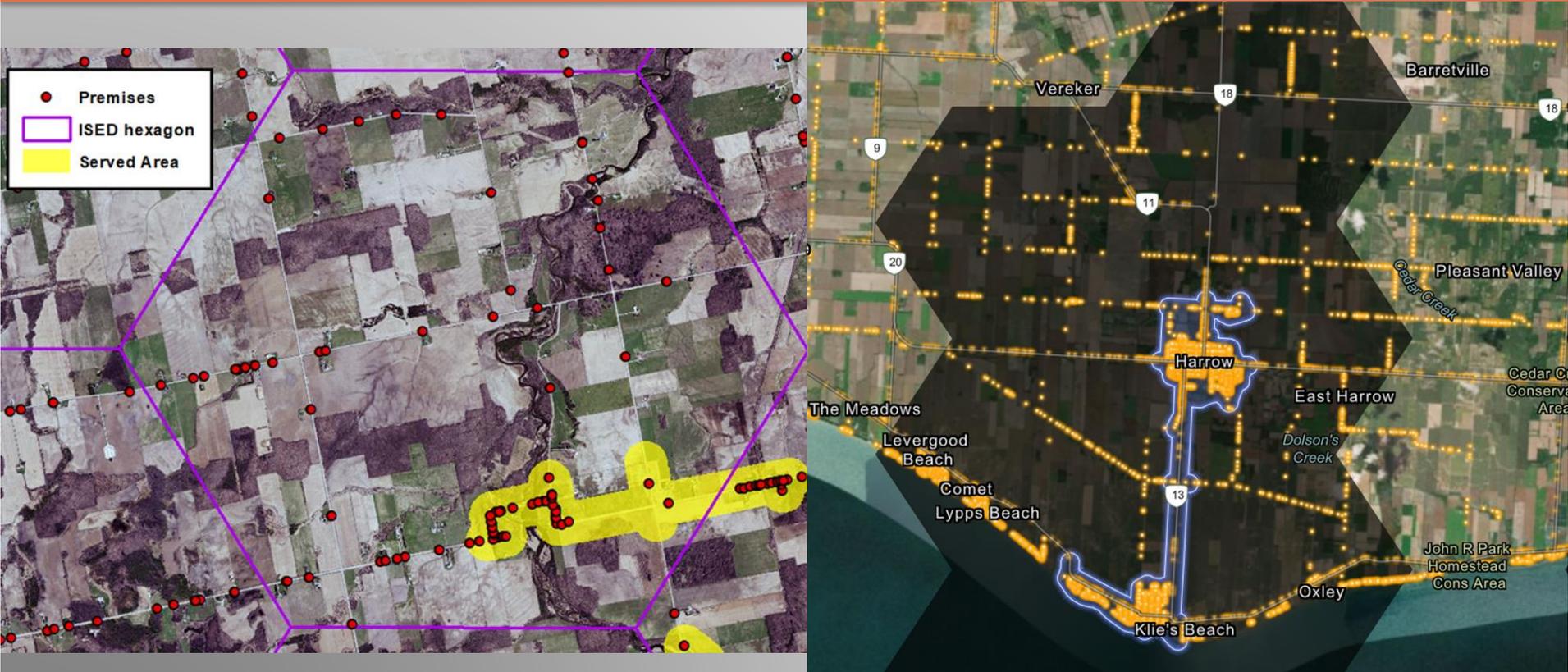
13. Towards evidence-based decision making: Examples from Halton/R2B2 and California Public Utilities

→ Improving rural broadband requires “big data” approach to infrastructure monitoring, mapping gaps, prioritizing scarce funds, ex post QoS/SLA verification



14. The dreaded hexagons

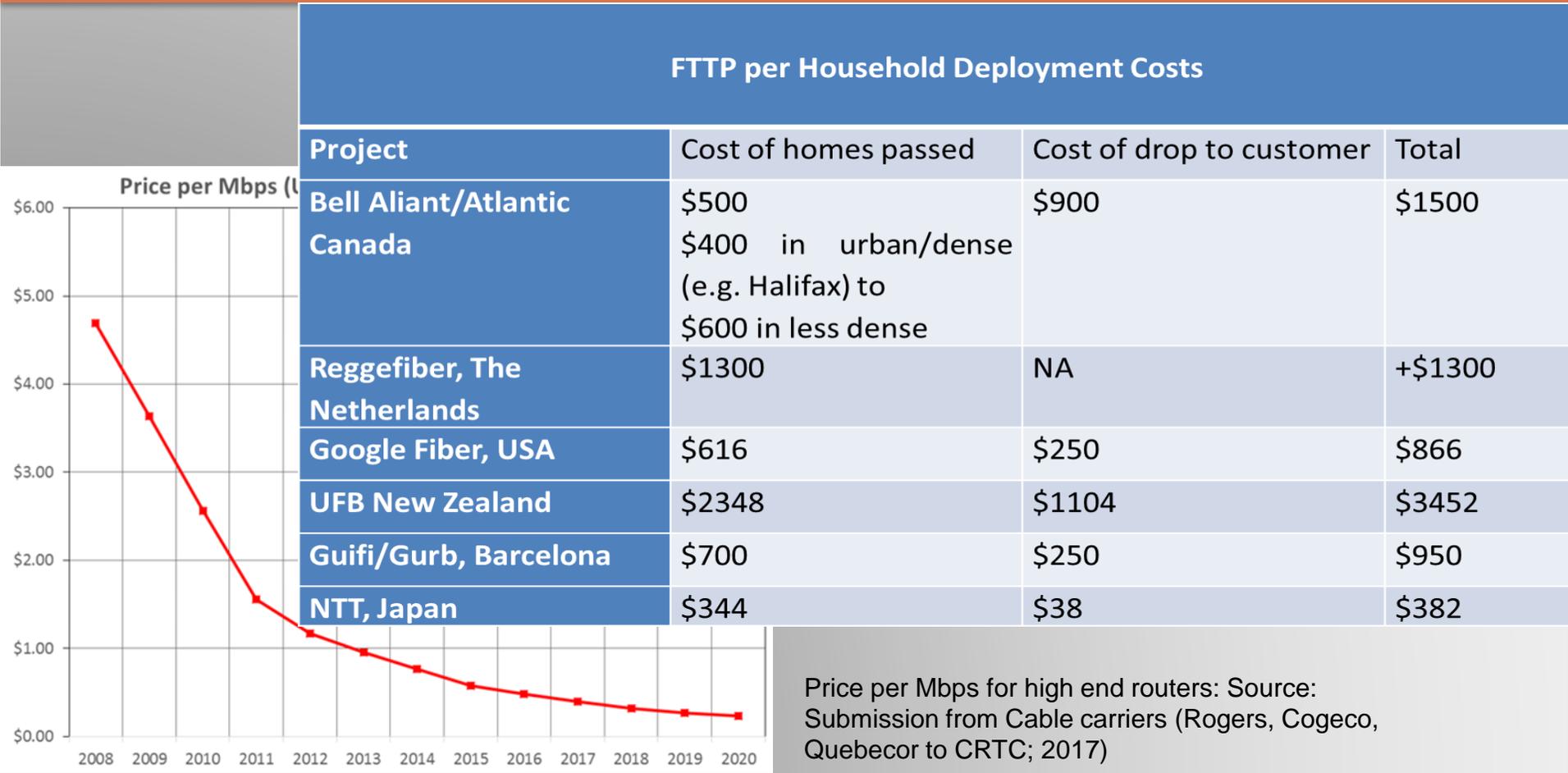
- Reduce the accuracy of real data: Errors: Both equity and efficiency implications; overbuilds, very small projects on remote edges not viable/sustainable
- Value for money/program efficiency; leave many behind → Auditor General CTI



Source: SWIFT

15. Generic cost structures

- Fibre pass through, drop: Varies considerably across regional/local mks.
- Network equipment costs dropping fast; but for how long/trade war?
- Lesson from Europe: Need to offload capex/risk of network equipment to private providers.; scarce public funds to FTTx/other scalable assets with long lifespan



Price per Mbps for high end routers: Source: Submission from Cable carriers (Rogers, Cogeco, Quebecor to CRTC; 2017)

16. Revenue potential and positive externalities

- Additional **willingness to pay** for NGN relative to legacy limited. **Expected take-up** rates from improved service if invest in FTTP/advanced wireless?
- **Few large/high margin users** in rural; older residential
- Incumbent legacy plant operators usually **the least cost supplier with highest revenue potential from fixed/wireless NGN deployment**
 - Also, can save costs if deploy FTTP and decommission old copper plant
 - But, tend to have **better investment opportunities** (urban FTTP, wireless, media)
- **Small incumbents/entrants/municipalities**: Higher costs, access to transport, capital, etc., but potentially satisfied with lower rural IRR with support/subsidies?
- **First Best solution**: Cooperative outcomes that allow incumbent to decommission legacy copper + subsidies to incentivize “deep fibre in high cost areas?”
 - Have been feasible in some Northern European and East Asian countries
 - Not so far in Canada (coordination failures)

Questions and discussion

How to build trust and cooperative rural NGN solutions?

The role of smaller ISPs/towns/regions complement/incentivise?

More efficient/effective subsidy/contractual/organizational models?

Thank you

