POLICY BRIEF

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RURAL FIBRE AND 5TH GENERATION WIRELESS: SUBSTITUTES OR COMPLEMENTS?

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Summary: **The development of next (5th) generation (5G) mobile technologies promises to improve wireless data throughput and reduce latency significantly compared to today's 4G LTE networks.**

Based on promises of 5G which will be on the market in the next 5 to 10 years, mobile equipment manufacturers and network providers have started to characterize 5G as a viable substitute to deploying fixed fibre access networks in rural communities. Limited range and potential bottlenecks on 5G compared to the proven reliability of fibre cast doubt on this hypothesis. While emerging 5G networks will likely enable adoption of some new types of applications, 5G diffusion itself will be contingent on the availability of affordable access to ultra-high capacity/low latency local fibre access networks.

The prospects of 5G "revolution" accentuates the importance of targeting scarce rural broadband subsidies to deploying ubiquitous fibre (i.e "deep fibre" versus upgrading old and slow copper and fixed wireless facilities) in addressing the urban-rural digital divide.

Definition: Cellular networks include original "macro" cell sites (1-40 km apart), with "fill-in" small cells (micro, pico or femtocells, which have ranges of less than 2km, 200m and 10m respectively) to boost bandwidth in low-throughput and/or high use areas. 5G refers to the evolution of mobile technologies that rely on higher radio frequencies (micro-millimeter wave) to carry larger amounts of data than is possible with 3G/4G LTE networks available today. Despite this advantage, the range of high frequency 5G networks is expected to be much shorter than 4G (around 1/10 the range according to recent 5G tests) and less resilient to environmental interference (e.g. walls, foliage).

Context: Over the past few months, there has been significant media attention paid to the advent and the potential of the 5G wireless technologies. According to these reports, 5G will enable speeds that are 100 times faster than current 4G technologies and a wide range of futuristic applications for users, but will cost a lot to deploy, suggesting strategic or exclusive rather than ubiquitous deployment. This media attention coincides with growing calls by Canada's wireless network operators on the federal government to auction public 5G spectrum sooner than later and for public funding commitments to support pre-commercial 5G technology development and testing.
A notable example of these initiatives is ENCQOR, a public-private partnership with $200 million from the federal, Ontario, and Quebec governments to explore the benefits of 5G in small and medium sized (SME) business and research applications.

Applications: 5G networks of the future are predicted to offer significantly faster connections with lower latencies relative to existing 3G+/4G LTE (Long Term Evolution) networks. A 2018 report commissioned by the Canadian Wireless Telecommunications Association (CWTA) from Accenture outlines some of the potential applications of 5G: precision agriculture, predictive maintenance in the Oil Sands, immersive entertainment, or connected ambulances. Outside of high-value production and emergency service situations, we can imagine 5G in remote/rural communities for intensive, open access applications, including blockchain agri-food systems, main street hot-spots, smart city/home/business applications, and intense-use recreational areas (e.g. ski hills, beaches).

Motivation: CWTA/Accenture estimates that the adoption of 5G networks and applications in Canada by 2026 will lead to an incremental increase of $40 billion in GDP and 250k in sustained job creation; but will require $26 billion in investment by wireless carriers. To encourage 5G deployment, the report recommends releasing spectrum, making further public investments, and "modernization and streamlining of relevant administrative processes …. for enabling 5G deployment; this includes shorter approval timelines, appropriate exemptions, and reasonable and non-discriminatory fees for accessing and using government infrastructure." The emphasis by industry on making it easier to affix 5G towers and access to passive infrastructure (poles, buildings) reflects the recognition that compared to existing 4G networks, the range of high throughput 5G networks is likely to be limited requiring a large number of small cells to cover an area. Aesthetic implications of affixing a large number of 5G transmitters are likely to raise concerns by residents and businesses in the vicinity whose property value may be perceived to be impacted by these antenna deployments.

The wireless industry is asking the federal government to make it easier to override local and provincial processes that normally regulate standards of access to passive infrastructure and limit the potential for aesthetic interference with the local environment. Scarcity of passive attachment infrastructure needed to enable 5G deployments makes it extremely valuable to "first movers" and likely inefficient to duplicate outside of a few low cost/high use urban areas. Limited scope for infrastructure competition in the emerging 5G ecosystem raise concerns about the scope for future competition in the provision of over-the-top (OTT) services that are likely to most benefit from 5G deployments, such as Internet of Things (IoT) and smart city/home/business applications.

Strategic considerations: While the wireless industry's examples of potential applications, estimates of economic gains, and required investments may be relevant, 5G reports such as the CWTA/Accenture paper do not consider the opportunity costs of private and public capital expenditures in 5G. In terms of the mobile submarket, increased investment in small cell 5G networks can mean less investment in 4G/LTE capacity that offers better coverage than 5G, if at lower speeds and higher latency. For high-density low-cost/high-revenue communities, this technological trajectory may not be an issue as it may be economically feasible to deploy small cell 5G networks. However, this is not necessarily the case in low-density, high-cost/low-revenue rural areas. As such, increasing private and public expenditures on 5G capabilities may actually accentuate rural coverage and capacity gaps of wireless service providers.

Given that Canada's "big three" wireless providers are also dominant players in the fixed broadband market, their increased capital expenditures on mobile/5G will further restrict their capacity to invest in the transition from old and slow copper fixed broadband networks to next generation fibre-to-the-premises (FTTP) broadband technologies.

Rural implications: 5G and FTTP do not necessarily represent substitutable technologies for improving connectivity in rural communities and closing the urban-rural digital divide, despite statements like the following in the CWTA/Accenture report: "With the advent of 5G, there is an opportunity to not only close this gap between rural and urban access, but also keep stride with evolving expectations of speeds and capacity.

Given the cost to deploy Fibre to the Premises (FTTP) in rural markets, carriers may look to leverage wireless as opposed to fixed lines for this 'last mile connectivity'. It is estimated that 5G-based Fixed Wireless Access (FWA) can reduce the initial cost of establishing last-mile connectivity by as much as 40% in comparison to FTTP. In addition, 5G can significantly accelerate rollout times by eliminating the need to lay cables as required for FTTP rollouts." Although lower "initial" capital intensity of 5G relative to FTTP may be a valid assumption, the implication that they represent substitutable Internet access technologies is not evident due to the likely range and quality limitations of high throughput 5G relative to FTTP.

Complementarities: As noted, a key limitation of 5G technologies is their range compared to slow/higher latency 4G LTE networks. 5G technologies are also not expected to be as resilient to interference from the landscape, buildings, foliage, and other variations in signal propagation paths which are common in rural areas. Consequently, bringing the benefits of 5G will depend on locating a large number of the "small cell" transmitters as close local fibre links as possible, much like last link wi-fi connection on which most users and devices ultimately connect to the Internet today. It is for this reason that a 2017 report by Delloitte has recently centralized the importance of "deep fibre" for enabling the development of the 5G ecosystem, estimating that in the U.S. it will cost at least $130 billion in fibre investments to become 5G ready. 5G investments in Canada need to recognize this aspect of the problem. To date, there is little linkage between fibre infrastructure and 5G funding programs. Although 5G technologies are still under development and there are a lot of uncertainties, the figure below presents the results of recent 5G tests by Samsung that should illustrate the "depth" high-capacity fibre pass-through needs to go for enabling 5G small cell deployments in suburban/rural settings. It is not clear if the costs of fibre pass-through that enables FTTP deployment in all such premises today would be that much higher than dropping the fibre in spot and trying to cover the rest of the last mile with 5G antennas when they arrive in the market in the next 5-10 years.

The costs of 5G technologies that will be in the market tomorrow will ultimately shape cost differences between fibre-to-the-node (FTTN) plus 5G versus end - to-end FTTP deployments that are possible to implement today. What is clear today is that the scalability and reliability of FTTP surpasses reasonable expectations we can have from 5G mobile technologies of the future. There is also considerably more certainty about the costs and benefits of deploying FTTP than waiting for the promise of tomorrow's wireless technologies. In the meantime, deploying open access fibre middle mile and pass through facilities will enable both full FTTP drop and prepare rural communities for 5G when and if carriers start to deploy it outside of test-beds and city centres. Access to sufficient upstream middle mile and transport capacity will be critical for the development of both FTTP and 5G at the very local level.

REFERENCES/NOTES:

[1] Southwestern Ontario stakeholders have adopted such a strategy in developing the South Western Integrated Fiber Technology (SWIFT) and have also asked the Canadian Radio-television and Telecommunications Commission (CRTC) to do the same in the design of its rural broadband subsidy regime. See https://services.crtc.gc.ca/pub/ListeInterventionList/Documents.aspx?ID=2407 60&en=2017-112&dt=i&lang=e&S=C&PA=t&PT=nc&PST=a

[1] https://www.fiberbroadband.org/page/paving-the-road-to-5g-with-fiber

[1] See e.g. What is a 5G Network and how can it change your life? CBC News: https://www.cbc.ca/news/thenational/what-is-a-5g-network-and-how-can-it-change-your-life-1.4575301

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[1] Canada to hold key 5G spectrum auction in 2020, CBC: https://www.cbc.ca/news/busines s/5g-wireless-spectrum-auction-1.4694214

[1] $66.7 million each. See https://www.encqor.ca/

[1] Fuel for Innovation: Canada's Path in the Race to 5G: https://www.5gcc.ca/wp-content/uploads/2018/06/CWTA-Accenture-Whitepaper-5G-Economic-Impact_Updates_WEB_06-19-2018.pdf

[1] Ibid. Page 13.

[1] See e.g. submission by Eastern Ontario Wardens' Caucus/Regional Network to CRTC basic service proceeding: https://services.crtc.gc.ca/pub/ListeInterventionList/Documents.aspx?ID=223915&en=2015-134&dt=f&lang=e&S=C&PA=t&PT=nc&PST=a

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