Canadian Electricity Association | Association canadienne de l'électricité

May 15th, 2019
Secretary General of the Commission
CRTC
Ottawa, Ontario
K1A 0N2

Subject: Notice of Consultation CRTC 2019-57

1. On October 30th the Canadian Electricity Association (CEA) submitted our request for a Mobile Network Code (MNC) to allow our members to operate a Private Virtual Network Operator (PVNO) system. The CRTC responded that CEA was strongly recommended to wait for the upcoming Wireless Framework review and now that the opportunity to participate is open **CEA requests to appear at the public hearing.**

2. At the hearing CEA looks forward to meeting with the commission to explain why we believe that regulatory changes to how MNC's are awarded to critical infrastructure will be of significant benefit to Canadians.

The Canadian Electricity Association

3. CEA is 128 years old and is the National Voice of Electricity. CEA members generate, transmit, distribute, and market electricity to industrial, commercial, and residential customers across Canada. Canada's electrical grid is 82% non-emitting and getter cleaner every year. CEA, and its members promote electricity as a key economic, environmental and social enabler that is essential to Canadian prosperity and the Clean Energy Future.

4. To that end Canadian electric utilities (CEUs) need telecommunications networks to: 1) maintain secure and dependable tele-protection systems, 2) monitor and control electric infrastructure, and 3) enable the safe and efficient dispatch of their field workforce for routine and recovery operations.

5. Utilities typically make use of both commercial services and private networks. This combination often provides the best overall cost, performance, resiliency, and coverage. CEA members operate infrastructure across Canada in the largest cities and, due to remote electrification mandates and distant generation assets, in the most remote populated regions. They require a range of telecommunications options that can meet the challenges imposed by this diverse geography.

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Regulatory Changes by the CRTC can Enable the Smart Grid

6. The following submission focuses on CEA's answer to question 17 of the consultation[1]

> Q17. Are there any other matters, issues, or proposals related to mobile wireless services, beyond those listed above, that the Commission should be aware of and potentially make determinations on as part of this proceeding? Identify and explain why those issues are relevant and include proposed regulatory solutions.

7. Our response is focused on why CEA believes a Private Virtual Network Operator (PVNO) solution, first requested in Oct of 2018[2] is a good option for Canadians. The text also touches on several of the other questions posed by the commission, namely questions 1-6, and 13-15. Please take the following as a holistic response that encapsulates answers to all these questions. The following is CEA's perspective on the policy reasons why the granting of an MNC will be good for Canada by supporting innovation, competition, incorporate new technology and ensure markets provide economically efficient solutions to current and emerging wireless communications needs. Specifically, this submission will cover, in order,

[1] https://crtc.gc.ca/eng/archive/2019/2019-57.htm
[2] https://electricity.ca/wp-content/uploads/2018/10/CEA-Part-1-Application-Final-with-Appendices-20181030.pdf

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PVNO – Canadian Regulatory Precedent Exists for PVNO

8. CEA recognizes the MNC's are finite and that as a public resource should be put to the benefit of Canada. A PVNO does not offer traditional services, such as internet access or texting to the public, but the other services it will enable (discussed later) will significantly improve the public good. Accordingly, CEA believes that because a PVNO would offer significant public good, the PVNO should be considered a non-traditional public service, and as such it is reasonable to allocate an MNC for this purpose.

9. CEA agrees with the CRTC that regulatory changes should only be done to improve 1) public good, 2) interconnection and 3) innovation. These terms are well formalized in paragraph 51 of CRTC Telecom Regulatory Policy CRTC 2015-326[3] and CEA is confident that our request for an MNC, to allow PVNO, achieves these important criteria and should be granted on those merits.

10. Furthermore, CEA believes three additional pieces of CRTC regulatory precedent support our PVNO request. Two relate to Telecom Decision CRTC 2015-496[4], where in it 1) full MVNOs are able to obtain MNCs and 2) the definition of MVNOs, paragraph 15 and 17, are functionally similar to what CEUs wish to develop with PVNO; the only difference is that with a PVNO CEUs will service internal communications needs, not external customers. And the last is that Public Safety Canada was granted the ability to obtain a MNC[5] for reasons similar to why CEA members wish one; to increase telecommunications reliability, and security in an effective and economically efficient way.

11. It is also important to note that because many CEUs are rate regulated agents of the crown they do not have the goal, nor the ability, to turn a PVNO into a profit at the expense of the public. Any savings achieved by these regulated companies from a PVNO improving operations will be returned to customers or used to offset future rate increases.

12. Other investor owned CEUs, or unregulated arms of publicly owned CEUs, may be able to undertake activities not regulated by provincial utility commissions, including operating as a full MVNO and providing services to the public, this is already permitted in CRTC regulations. However, in order to establish bulk roaming agreements and to build resilient connections to PVNO assets, CEUs will need to execute agreements with Radio Access Network (RAN) owners which will stipulate the fair use of their networks through mutually agreed upon Terms of Service. Part of those agreements would be the inclusion of the wholesale roaming rates that are have been correctly and effectively set by the commission which ensures that RAN owners are fairly compensated for 3rd party use of their assets.

[3] https://crtc.gc.ca/eng/archive/2015/2015-326.pdf
[4] https://crtc.gc.ca/eng/archive/2015/2015-496.pdf
[5] https://crtc.gc.ca/public/cisc/cn/CNRE096A.DOCX

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In this way, and for significant reasons further explained in the security section of this document, a PVNO is for CEU internal use only.

What PVNO Will Accomplish

13. Canadian Electrical Utilities (CEUs) want to improve the delivery of safe, secure, reliable, and sustainable electricity and power services offered to Canadians by building a Smart Grid. However, they are limited in their ability to do so because of current constraints in the commercial wireless telecommunications market operated by Mobile Network Operators (MNO). The most economically efficient solution to meet our needs is a Private Virtual Network Operator (PVNO), a network of networks, which can be granted by a regulatory change.

14. The PVNO will also have significant, cost benefits throughout Canada, including to MNOs, as well as individual Canadian citizens, see figure 1. These benefits are realized from both enabling the Smart Grid as well as sharing wireless network infrastructure with other institutions such as Public Safety, Railways, and MNOs both big and small, to improve the reach and quality of various telecommunications related services delivered throughout Canada.

Figure 1. Benefits of a PVNO are diverse and significant to Critical Infrastructure Operators such as CEUs and Rail, Public Safety, Mobile Network Operators as well as the Canadian Public

PVNO - Primary Statement

15. Because it would enable significant benefits to Canada and Canadians the CRTC should enact regulatory changes that will allow Critical Infrastructure Operators (CIOs) to be allocated Mobile Network Code (MNC) number(s) without having to be a Mobile Network Operators (MNOs) or own spectrum designated for Mobile Wireless Services. This is why in October of 2018 CEA, on behalf of its

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members requested an MNC from the CRTC[6] to allow the creation of a Private Virtual Operator Network (PVNO). The PVNO is similar to a Mobile Virtual Network Operator (MVNO) model but no direct telecommunications services to the public are offered, hence a private network. A PVNO would allow CEUs to overcome their challenges with the current, for profit commercial, wireless market, relating to issues of geography, different business priorities between MNOs and CEUs, as well as technical requirements.

PVNO – Benefits to CEUs, Canadians & MNOs

16. The regulatory changes to permit a PVNO will allow CEUs to provide better (more reliable and more secure) electricity services to Canadians by enabling significant innovation in the electrical market and electrification of the Canadian economy. These innovations, the "Smart Grid"[7], include but are not limited to;
    - Optimal electrification of the transportation sector with electric vehicles (EVs),
    - Further enabling the deployment of virtual power plant technology to improve grid resiliency and reduce the ecological footprint of power generation,
    - Improving the integration of Distributed Energy Resources (DER) such as wind, and solar,
    - Increasing grid automation to improve safety for line workers, first responders, and the public,
    - Significantly improving the reliability and quality of power delivered, an essential requirement of emerging high-tech industries.

17. The Smart Grid relies on extremely reliable and secure machine to machine (M2M) telecommunication services (increasingly wireless) to communicate in real time between constantly changing electricity sources, and customer needs, as well as the sensors and controls (a.k.a field devices) that operate the system.

18. The most economically efficient solution for CEUs to satisfy the growing need for M2M communications is to use commercial cellular in populated areas, and private LTE in remote zones. The challenge with today's commercial cellular service is that it is not reliable nor secure enough to handle the Smart Grid's mission critical activities and private LTE cannot be efficiently used without an MNC to allow network interconnection.

19. Improving wireless telecommunications reliability and security are critically important because should the Smart Grid, because of telecommunications failure from natural disaster, unplanned maintenance or cyberattack, not be able to deliver power the economic and social impacts will be more significant the more electrified the economy is. For example, imagine if 100,000 people in any given Canadian

[6] https://electricity.ca/wp-content/uploads/2018/10/CEA-Part-1-Application-Final-with-Appendices-20181030.pdf
[7] https://electricity.ca/wp-content/uploads/2017/05/SmartGridpaperEN.pdf

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city couldn't charge their electric vehicles overnight[8] because the CEU was locked into a single cellular service provider which had an outage that made it impossible for the CEU to operate the Smart Grid. This type of a scenario is far from hypothetical, and there are already instances of this happening as reported by the CBC in 2017[9].

20. Not being able to connect to their field devices is not an abstract hypothetical problem but one that CEUs already must deal with. Please see Appendix A for both an example of a standard MNO notice to CEUs whereby CEUs must plan for at least 6-hour service disruption even though the maintenance is only expected to take 3 hours and an example of a subsequent unexpected disruption to CEU operations resulting from an MNO maintenance operation. With a PVNO there would be no disruption because the CEU, after receiving notice from its contracted service provider, would move its field devices from the impacted network to an operating alternate one. CEA believes that the commission should put in place rules that mandate public notification and coordination of MNO maintenance windows so that awareness is increased, and wireless service is not lost for PVNO.

PVNO – How it is Structured

21. In a PVNO parts of the cellular network CORE and identification numbers are housed by a critical infrastructure operator (for CEA these would be electrical utilities) so that it can access multiple Radio Access Networks (RAN) as well as easily allow communication between CEU internal wireless networks and commercial cellular RANs, see figure 2.

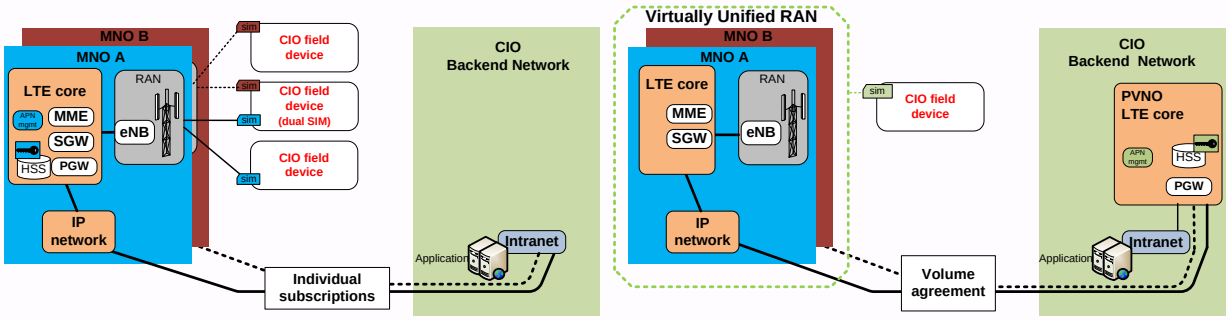

Figure 2. Comparing commercial cellular architecture (left) to a PVNO architecture (right). The important difference is that in a PVNO the network keys, are stored by the CIO network instead of the MNO network. In this way a CIO can always access its network keys.

22. The intent is to make the grid stronger by having wireless communication diversity between different commercial wireless networks and/or CEU private wireless networks. This will increase security by allowing the CEU full control over its field devices subscription keys. And the CEU communications

[8] https://www.freightwaves.com/news/2017/9/22/what-happens-to-electric-vehicles-when-the-power-goes-out
[9] https://www.cbc.ca/news/canada/new-brunswick/bell-aliant-cellphone-landline-1.4235279

will be more efficient to operate by having key configuration details (such as policy and IP address configuration) common across any network used. This is important because it allows the PVNO operator to maintain control of its network policy, configuration, and security controls, which is not the case in the current market and an ongoing major challenge for CEUs.

23. The basic function of the PVNO is to allow the PVNO subscriber devices (the CEU field devices) to communicate from one RAN to another. In this way telecommunications are made more reliable because all RANs must be inoperable for the PVNO user to lose connectivity to their devices. A striking case of why this is important comes out of Florida where following a 2018 hurricane the restoration of power was hampered[10] because in only half of the impacted area Verizon was down, and in the other half AT&T were down. Because the electrical utility couldn't move its wireless connections from a downed network to an operating one recovery efforts were much slower than they could have been. Similar outages are happening in Canada, one for example was in the Maritimes in 2017 ,as reported by the CBC[11]. .

24. It is very important that the commission notes that roaming agreements between MNOs do not satisfy CEU connection reliability needs. This is because if the CEU's primary MNO, for this example called Network A, is down for planned or unplanned maintenance the CEU cannot access its field devices even if it has roaming access to Network B. This is because the network keys are stored by Network A so there is no way to validate the connection of the CEU field device or route the data properly. PVNO solves this problem because the network keys are stored by the CEU and so are always accessible from either MNO RAN.

25. CEUs operate across all of Canada, providing electrical service in areas covered by different and sometimes no MNO. An operational efficiency is gained for the CEU if rather than selecting a best service provider before deploying fixed smart grid equipment, they can deploy with a PVNO SIM and let the device select the best performing network once installed. This reduces engineering cost and subsequently the cost of electricity for Canadians. This also allows CEU to effectively incorporate regional and specialised MNO into their operating models, furthering reliability, and promoting a stable equalized investment in all MNO.

26. A point that CEA raised it its October 2018 submission to the CRTC was the issue of SIM card lock in whereby it is in no way cost effective to roll a truck to every field device to change the SIM card in each if the CEU changes cellular service provider. CEA members are happy to see that since October some MNOs are at the early stages of offering e-SIMS (over the air re-programmable SIM cards) as a

[10] http://wirelessestimator.com/articles/2018/floridas-governor-calls-out-verizon-and-atts-poor-service-in-hard-hit-bay-county-florida/
[11] https://www.cbc.ca/news/canada/new-brunswick/bell-aliant-cellphone-landline-1.4235279

partial solution to SIM card lock in. CEA stresses that e-SIMs while good and address service provider lock-in concerns they are not a solution to CEUs reliability and security concerns.

PVNO - Needed Because of Market Challenges that can be Overcome

27. To make the Smart Grid a reality CEUs want to purchase, at negotiated rates, significantly more wireless services in the years ahead but will only do so if there are large improvements in commercial cellular service reliability (where it is recognized that reliability is both system resiliency and operational redundancy/diversity) and security.

28. Because CEUs are not willing to rely on a single MNO service contract and they do not have the cost-effective ability to access multiple RANs CEU investments are diverted to non-LTE private networks (LTE system are much more preferable than non-LTE systems and this is discussed in more detail later), and other more costly solutions to meet the reliability and security needs for critical Smart Grid communications. While a given MNO could improve their network, a more efficient approach will be to leverage the combined strength of all Canadian network assets (i.e PVNO, a network of networks). We consider the absence of this option and other ongoing gaps between needs and services offered as market challenges that can be overcome with regulatory change.

Security Needs Not Being Met

29. Examples of CEUs needs not being met can be found in the publicly available SLAs and/or Terms & Conditions (see Appendix B for Rogers[12] clause 11 & 16, Bell[13] clauses 11 & 21, Telus[14] clauses 28 & 30) from the major national MNOs. These clauses illustrate that with their standard and cost-effective service offerings, the MNOs are either unwilling or unable to provide service level guarantees around security or availability. For a comparison, banks are an excellent place to store money, in no small part because deposits are insured by the Canadian Deposit Insurance Corporation. No such consumer protection exists for CEUs in their MNOs commercial cellular services; this represents a market challenge which CEUs want to help solve.

30. While CEUs could bolster the security and redundancy of self deployed and operated wireless connections, the options represent a significant additional and unnecessary cost that would flow to electricity customers if enacted. Instead CEUs would prefer to use economically efficient solutions, i.e. PVNO, that would not see cost increases flow to the customers. Also, of importance is that CEUs who operate their own HSS (home subscriber server) and PGW (packet gateway) will do so with Smart Grid security and privacy optimizations purpose built into the design of the network. This optimization is cost effective in part due to their more limited scope of traffic and use.

[12] https://www.rogers.com/cms/pdf/en/Enterprise-Customer-Terms-and-Conditions.pdf
[13] https://www.bell.ca/styles/wireless/en/all_regions/pdf/caaterms.pdf
[14] https://www.telus.com/en/bc/support/article/service-terms-between-you-and-telus#your_warranties

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31. The alternative to the PVNO could be for the CRTC to require that MNOs retain liability for damages caused by cybersecurity breaches to their clients. The PVNO is however a simpler and more economically efficient solution whereby CEUs can chose to be responsible and liable for their own cybersecurity, a choice they do not currently have as show in figure 2.

32. Additionally, the security of the PVNO system is maintained by not offering service to the public. Because the main purpose for PVNO is for resilient and cost-effective critical-infrastructure connections. Offering a 3rd party services on top of the internal use case would be contrary to that purpose as it would compromise the security of the CEU network. Cybersecurity of CEU critical networks is now becoming part of the regulatory framework[15] that regulators are applying to the business of energy distribution. Therefore, any potential mixing of CEU cyber assets and a 3rd party business venture, would by its very nature degrade security and thus would be untenable.

Reliability Needs Cannot be Met by a Single MNO

33. Telecommunications reliability is of paramount importance to CEUs because they must connect significant number of field devices that are used to control and monitor the electrical system (also called machine to machine communications or industrial internet of things a.k.a IIOT). A critical consideration in the placement of these devices is the ability to reliably communicate with them because they are what enable CEUs to ensure the safe and reliable delivery of electricity.

34. Again, please see Appendix A for an example of a significant service disruption that CEUs routinely must deal with. CEA has also collected other evidence of reliability concerns the electrical utilities have with regards to wireless service providers please see Appendix C for our collected examples. In general, there is a significant gap between the reliability currently offered by commercial cellular and what is needed to meet CEU requirements to operate the Smart Grid.

35. Telecommunication reliability it is not just a Canadian concern but an electrical industry concern. As an example, a major study from the United States published by UTC last month (Utilities Network Baseline – April 2019 Update)[16] shows that generally MNOs (the study calls them carriers) do no prioritize the restoration of cellular service to electrical infrastructure (page 19) despite that a "lack of reliable telecommunications impedes a utility's ability to perform disaster recovery".

36. Furthermore, the UTC report notes that

[15] http://www.ieso.ca/Powering-Tomorrow/Technology/IESO-ramps-up-stakeholder-outreach-with-new-cybersecurity-role
[16] https://utc.org/wp-content/uploads/2019/04/UTC-Utility-Network-Baseline-Final.0419.pdf

> "Utilities do things their own way. Telecoms carriers build their networks to maximize return on investment and therefore their networks are profit centers. By contrast, utilities design and engineer their networks to maximize reliability even in the face of natural disasters, and therefore utilities' networks are cost centers, not profit centers. Both industries take a logical approach to building their networks, based on their differing objectives."

37. Which is a statement that CEA agrees with. CEUs, as critical infrastructure, must have the highest reliability that can be reasonably expected but that level of reliability is not required by commercial cellular providers, nor does CEA believe that carriers should be mandated to have such reliability. CEA understands that such a mandate would represent significant expense on their behalf to harden assets and build redundant backups, the cost of which would be passed to consumers. A PVNO model allows allow electrical system reliability to be increased, by being able to seamlessly switch from down networks to operating ones to maintain control of field devices, without mandating significant expenditures by MNOs and so the PVNO is an economically efficient solution to CEU reliability needs.

38. CEUs want to improve the control and monitoring of the field devices but can only do so with increased ability to reliably communicate with their field devices. For an example of how improved communication would benefit Canada please consider that if a neighbourhood loses power in a lightning storm CEUs know the safest way (for both the CEU workers and the public) is to bring the power back is in stages because it does not cause a difficult to manage load spike (from zero to 100%). Currently this is difficult because the scale at which re-energization occurs can be coarse. But re-energization could be much more easily accomplished in the future by having field devices in the Smart Grid talk to the CEU network to bring individual transformers online one at a time. Or, at an even more granular level, smart homes could talk to the CEU network to prioritize the energization of medical equipment before the whole home. In this way the community can be re-energized faster and more safely, as smaller individual pieces of the grid can be brought online before the whole neighbourhood.

39. CEUs need for increased reliability comes both from customer demands for new and better services, as well as the awareness that both the frequency and occurrence of power disruptions from extreme weather are increasing because of climate change, please see figure 3.

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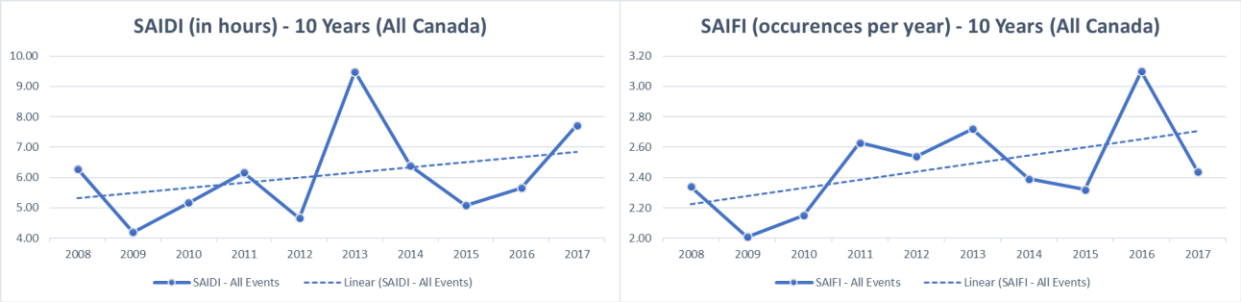

Figure 3. System Average Interruption Duration Index (SAIDI) & System Average Interruption Frequency Index (SAIFI) for all CEA members 2008 to 2017. Both datasets are trending upwards for increased durations of outages as well as increased frequency of outages.

40. CEUs need innovative solutions to improve grid reliability because the alternative is decreasing services to customers, which is not acceptable to CEUs or individual Canadians. The increased ability to communicate in real time with field devices for the monitoring and control of the grid (the Smart Grid) granted by a PVNO is one of the innovations necessary.

41. If a PVNO is not granted, and as the major carriers are unable to provide a service level guarantee (see above example), CEUs will have to take other measures to provide additional redundancy in order to ensure that there is reliable connectivity to their field devices. Unfortunately, these measures involve additional cost for devices (e.g. the addition of specialized multi-SIM modems) and significant additional cost for ongoing subscriptions (redundant wireless plans for each separate SIM card) or building non-LTE (again non-LTE systems are not ideal the reasons for which are discussed in the next section) utility only dedicated networks at significant expense. These mitigations improve diversity without PNVO but are expensive and still don't bring efficiency of operations, and security controls afforded by PVNO.

Coverage/Geography and Interoperability Needs Not Currently Supported

42. Commercial cellular is a good telecommunications solution for CEUs, if reliability and security can be improved, for areas of Canada with coverage, because it is an affordable and accessible service, see figure 4. However, outside established commercial service areas CEUs use, and will continue to deploy, a suite of technologies and spectrum assets to connect their field devices with private telecommunications systems.

43. CEUs would strongly prefer to be able to deploy private LTE systems, which are excellent because they are purpose built, robust, secure and very affordable, but to do so requires an MNC (i.e. PVNO) to enable data routing between networks. CEUs could sub-contract service from an existing wireless carrier but this would not solve the reliability challenge.

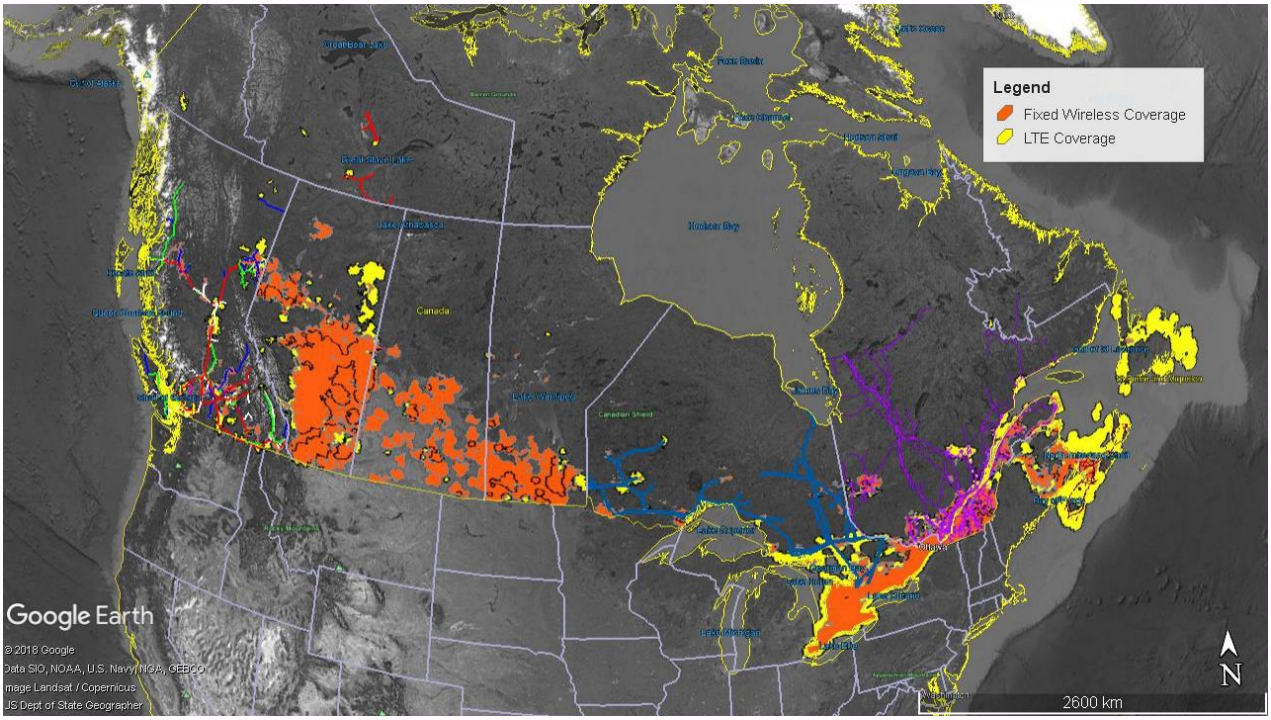

Figure 4. LTE and fixed wireless coverage of Canada compared to CEU generation and transmission assets, depicted as long linear features of various colours while the wireless coverage is depicted as fields of orange and yellow. Coverage data is taken from [2014 CRTC data](https://crtc.gc.ca/eng/internet/internetcanada.htm)[17]. CEU generation and transmission assets often outside existing coverage areas with coverage areas only falling over areas of Canada with towns and cities (please see Appendix D for Province/Territory scale maps).

44. Private LTE is the dominant market trend for private network solutions because of a robust device ecosystem, high effectiveness, and reasonable cost[18]. As such, the commission should generally take greater regulatory notice of the expansion, price reductions, and improved quality of private LTE for industrial machine to machine communication; this [technology is something that is already](http://na.experiences.ericsson.net/utilities/utilities-final)[19] in place.

45. The PVNO would allow CEUs to use 3GPP compatible equipment, including private LTE, from suppliers and much more easily interconnect the different networks including commercial cellular, 1.8 GHz,

[17] https://crtc.gc.ca/eng/internet/internetcanada.htm

[18] To expand, private LTE technology is the most efficient solution because it is non-proprietary and widely available from many suppliers, with proven interoperability, long term market support commitment and upgrade paths such as 3GPP systems. In this way CEUs will avoid vendor lock-in which is most often the case with proprietary technology. Other benefits are device cost reduction, large technical support base and numerous skilled/trained technicians.

[19] http://na.experiences.ericsson.net/utilities/utilities-final

public safety broadband (LTE Band 14) and any other LTE band by reusing some proven core functions (ex: PGW, HSS). The result will be a robust and interoperable communications solution for Critical Infrastructure Operators, that maximizes the value of existing spectrum and infrastructure.

46. A shared RAN approach between multiple partners is an economically efficient way to expand wireless services because it allows multiple parties to share costs and avoid duplication of work. The PVNO is critical to this vision of a shared RAN system because it allows multiple diverse parties to each use 3GPP and LTE standards to communicate but cannot occur if CEUs do not have an MNC.

47. Furthermore, with a PVNO, CEUs will be inclined to contribute to RAN expansion in remote areas. Either through Shared RAN or by incentivizing MNOs to expand their network to accommodate CEUs (e.g. around dams and substations). By doing so, the general public will have access to that expanded coverages zones, including support for 911 services. MNOs will have an incentive to make their coverage areas large enough to cover nearby communities because the initial infrastructure development cost to improve coverage has already been covered by the CEU business.

Public Safety Broadband Network is a Good Tool but Not a Silver Bullet

48. In general, CEUs are looking forward to the release of the public safety broadband network (PSBN) governance structure. On the surface the needs of the PSBN match closely to the needs of CEUs. Should CEUs be able to access Public Safety reserved LTE band 14 they will be able to solve some reliability, and coverage challenges. Of particular interest is the robustness of the envisioned dedicated and deployable systems where the core components are local to the base stations and towers. In this environment even if a remote Critical Infrastructure facility (ex: a Dam) is isolated from other networks due to backhaul failure, local personnel, and warning systems can remain operational. However, it must be noted that PSBN is still under development, with no certainty it will serve all CEUs well or equally and as such CEUs are cautious about PSBN and will reserve their final opinion until the governance structure is finalized.

49. Since the PVNO for CEUs will make it much easier for CEUs to interoperate with the PSBN and other PSBN users, the PVNO will add reliability and security to telecommunications for not just CEUs. Australian public safety's ongoing trial is a good example of this combined approach (detailed later in this consultation). But the PVNO (network of network approach) is required to optimize the system and so the regulatory changes required to allow a PVNO to occur should be recognized for furthering public safety (a significant public good).

PVNO Benefits to non-CEUs

50. While the PVNO will be good for CEUs we are happy to say that we believe it is also a regulatory development that would positively impact Canada's telecommunications markets, rural broadband

deployments as well as improving Canada's global competitiveness for innovative high-tech industries.

PVNO Will Help Enable the 5G Network

51. CEA members expect the 5G rollout to occur in stages over the course of multiple years but those timelines will ultimately be up to MNOs to determine the business case for. CEUs are happy to work with telecom companies so long as the reliability of the grid is not negatively affected and that electricity customers do not cross-subsidize MNOs.

52. In fact, CEUs are excited for the prospect of 5G technology for much the same reasons that other industries are, low latency automation, and efficient data transfer. Furthermore, 5G increasingly enables interoperation with private LTE and even license exempt systems if numbering resources are available (i.e. PVNO) making it potentially of great use to CEUs and other critical infrastructure operators. The emerging 5G technology promises to make utility private LTE even easier[20] which is another reason CEUs are excited for 5G

53. The caution CEUs want to bring to the CRTC's attention with the 5G network is that because its densely deployed small cells will probably have short, or non-existent, battery backup, the network is only as reliable as the power grid supporting it. CEUs are aware that extreme weather is increasing outage duration and frequency (see figure 3). If the power grid goes down because extreme weather has knocked out the CEU's wireless control systems, then the 5G network would also go down. So, in order to maximize the reliability of the 5G network, MNOs and the CRTC should want to maximize the reliability of the power grid and that can be achieved by CEUs using PVNO. In this regard the PVNO is an enabler of the 5G rollout because the alternative would be to require that all small cells have multi hour battery storage which would add significant cost and engineering effort of each device, but PVNO is a more economically efficient solution.

PVNO Will Help Support MNO Providers, Especially Rural and Remote

54. Another way the PVNO supports MNOs, as well as Canadians in rural/remote parts of Canada is through the contract structure that a PVNO requires. Because CEUs using PVNO need multiple diverse Radio Access Networks (RAN) to ensure reliability, contracted volume agreements would be spread among multiple parties. This means that multiple MNOs can have large anchor customers (i.e. CEUs), especially small MNOs in rural and remote parts of Canada where Critical Infrastructure Operators (CIOs) such as Electricity and Rail are. PVNO is an enabler for the commercial wireless market because current contracts for commercial wireless service are winner take all or said another way, feast or famine. Going forward the contracts would be more stable because no longer would the market promote a commercial model where 1 bid winner gets the whole contract on a long-term basis.

[20] https://5g.co.uk/guides/what-is-a-private-5g-network/

Instead the CEU could allocate traffic to the best service provider in any given area and, for the reasons discussed throughout, allocate second and third providers as well.

55. In this way, even if during contract re-negotiations, an MNO drops from 1st to 3rd place they retain a portion of the contract revenue. This spreading of contracts for cellular services will allow all MNOs, large or small, to make investments with greater surety, especially in rural and remote parts of Canada. In this way the PVNO indirectly supports rural broadband programs by reducing some of the financial risk to MNOs to provide services in remote areas.

Innovation Benefits the Canadian Economy

56. The benefits to Canada from a PVNO are not just restricted to the telecommunications section. In general, and affirmed by government, Canada needs to innovate to be globally competitive. Given that the economy is powered by electricity and increasingly operated with wireless technology it is in Canada's best interest to improve both. The conflux of electricity and telecommunications innovation is best seen in emerging new high-tech industries and their demand for high levels of electricity service reliability, power quality and low greenhouse gas emissions (served by Canada's already 82% non-emitting grid). All of which are competitive advantages that Canada already has but ones which we cannot let go. The Netherlands, Italy, Belgium and Australia are all making significant strides in advancing their electrical utility wireless telecommunication technology, via PVNO, and if Canada does not act we will be left behind.

57. The following are high level summaries of PVNO activities in other countries.

Netherlands

58. In 2014, after a consultation[21] the Netherlands changed how they assigned MNCs[22] to that they could be issued for private networks. This paved the way for the utility Enexis to create its PVNO. Importantly the decree notes on page 4 that

> "This Decree expands the possibilities for using MNCs, and thus also those for using IMSIs. This Decree was prompted by two developments in the public electronic communications services ("PECS") market, which created a need for broader possibilities for using MNCs. The first development was the increased use of local wireless networks with low capacity for internal business applications. The second development more generally involved the increased use of mobile networks for business applications, with the emphasis on computerised applications, also referred to as Machine-to-Machine (M2M) applications. Incentives for innovation and market forces relating to both developments can be developed by expanding the possibilities for using

[21] https://www.ecodocdb.dk/download/8b9d79d3-ab26/ECCREP212.PDF
[22] https://www.government.nl/binaries/government/documents/annual-reports/2016/02/16/decree-change-of-imsi-number-plan-for-private-networks/decree-change-of-imsi-number-plan-for-private-networks.pdf

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MNCs. Expanding this use means that MNCs will also be assigned to non-public electronic communication networks for the purposes of wireless communication."

Australia

59. The Australian Public Safety Mobile Broadband network, which is comparable to Canadas Public Safety Broadband Network (PSBN) put out a request for proposal in October 2018[23] for a new broadband delivery model that meets the following criteria

- A Mobile Virtual Network Operator (MVNO) model with multi-carrier roaming in metro and regional areas, which will benefit from the overlapping coverage and redundancy of multiple carrier networks and avoid the cost of hardening a single network.
- A Radio Access Network (RAN) sharing model would be used to address areas that require an expansion of existing coverage and would generally apply in rural and remote areas.
- The potential use of deployable base stations in areas beyond the coverage footprints of conventional networks

60. The above requirements are a PVNO model, even if the term is not used. It also highlights how a Canadian PVNO would be able to interoperate with the forthcoming Public Safety Broadband Network.

Italy

61. In 2015 the Italian utility ENEL entered into an agreement with TIM[24], a major MNO, to securely transmit smart meter data while avoiding the risk of SIM card lock in.

Belgium

62. Belgium is using a PVNO network architecture[25] to improve broadband coverage for police

"A single SIM card gives priority access within a secure environment to three Belgian operators, as well as eleven operators in four neighbouring countries. This gives the service provider the best coverage in Belgium and in the border regions (there are 49 police zones along Belgium's borders). In locations where the coverage of one network is too low, the user's tablet or laptop will automatically switch to a network with greater coverage."

[23] https://tenders.nsw.gov.au/dfs/?event=public.RFT.downloadSummary&rftuuid=A0BFBFF0-B999-6717-A0F1D3320BD7DBAF

[24] https://www.enel.com/media/press/d/2015/08/enel-and-tim-sign-agreement-for-technological-development-of-electricity-data-transmission-infrastructure-

[25] https://tcca.info/astrid-launches-blue-light-mobile-an-innovative-broadband-data-service/

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Conclusion

63. CEA thanks the commission for this opportunity to present our views on how to improve Canadas wireless market. We iterate that **CEA requests to appear at the public hearing** where CEA policy experts as well as telecommunications experts from CEA's membership look forward to answering the commission's questions regarding PVNO be they policy or technical.

Signatures

Sol Lancashire, Manager Telecom Engineering, BC Hydro

Chair, CEA Operating Technology & Telecommunications Committee

Francis Bradley
Chief Operating Officer, CEA

Justin Crewson
Director, Transmission and Distribution Policy, CEA

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Special Acknowledgements

Special thanks to members of CEA's Operating Technology & Telecommunications Committee (OTTC) for their invaluable efforts in developing this submission. The OTTC includes representatives from the following CEA member companies.

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Appendix A – Service Outage Notification and Unexpected Affects

Rogers Enterprise Service Assurance has been advised of the following planned outage.

Notification Type: Planned(New)

Service Affected: MPLS,VPN,GRE,TO5
Area Affected: National with Toronto Egress

Start Date: Wednesday, April 03, 2019
Start Time: 12:00 AM EDT
End Date: Wednesday, April 03, 2019
End Time: 6:00 AM EDT
Duration: 3 Hours and 0 minutes

Work Summary: Rogers Network Operations will be doing maintenance on our Core Network Node "Toronto MPG". There will be 3G and LTE service impact for customers using custom APN with egress from Toronto for approximately 180 minutes during the specified time frame.

Additional Comments/Update:

We suffered an outage with the MNO APN's in Feb 2019.
Exact start and end times:
Start: 02/xx/2019 time [s]
End: 02/xx/2019 time [s]

There were two issues here. So the original outage was due to an APN outage, and compounded by some issue on our own equipment.

1) There was a planned change on the MNO side that caused problems. MNO reverted their changes to restore the APN.
2) The outage with the MNO APN's caused our router to have issues with IPSEC tunnels. So when the APN connectivity restored, we were unable to connect to sites using IPSEC. We had to reboot our router to restore full services.

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Appendix B – Limited Liability Clauses in Public Rogers, Bell, and Telus Terms and Conditions

Rogers

11. Privacy of Communications. Rogers makes no representation, warranty or covenant that Customer's use of the Services will be entirely secure and private. Customer acknowledges that it may be possible for third parties to monitor communications while Customer uses the Services. Customer assumes full responsibility for the establishment of appropriate security measures to control access to its equipment and to the information transmitted by Customer. In addition, Customer acknowledges and agrees that Customer is solely responsible for taking the necessary precautions to protect its networks and systems, and all software, data and files stored on or otherwise forming part of its network and the Customer's System, against unauthorized access by its employees or any third party, and that such responsibility includes, without limitation, protection against unauthorized access through the Services. Rogers will not be liable for any claims, losses, actions, damages, suits or proceedings whatsoever resulting from, arising out of or otherwise relating to Customer's failure to take appropriate precautions to protect its networks and systems and all software, data and files stored on or otherwise forming part of its network and systems, against unauthorized access by its employees or any third party or any other breach of customer's security or privacy.

16. No Warranty. CUSTOMER ACKNOWLEDGES AND AGREES THAT THE SERVICES AND ALL DEVICES, OTHER EQUIPMENT AND THIRD PARTY SERVICES ARE PROVIDED BY ROGERS "AS IS" AND "AS AVAILABLE" AND, TO THE EXTENT PERMITTED BY LAW, WITHOUT WARRANTY BY ROGERS OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABLE QUALITY, FITNESS FOR A PARTICULAR PURPOSE, INFRINGEMENT, OR THOSE ARISING FROM A COURSE OF DEALING OR USAGE OF TRADE. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, ROGERS SHALL HAVE NO LIABILITY WHATSOEVER TO CUSTOMER FOR: (I) ANY INTERRUPTIONS OR DISRUPTIONS OF THE SERVICES, THE INTERNET OR THE THIRD PARTY SERVICES OR ANY OTHER DAMAGES SUFFERED BY CUSTOMER WHICH ARE CAUSED BY DIRECTLY OR INDIRECTLY BY ANY FAILURES OF THE DEVICES, OTHER EQUIPMENT, THE SERVICES, THE ROGERS FACILITIES, THE INTERNET OR THE THIRD PARTY SERVICES; (II) ANY POWER FAILURES; (III) ANY ACTS OR OMISSIONS OF CUSTOMER OR ITS OFFICERS, EMPLOYEES, AGENTS OR CONTRACTORS INCLUDING, WITHOUT LIMITATION, DEFAMATION OR COPYRIGHT INFRINGEMENT; (IV) ANY DISRUPTION OF ANY PART OF THE EQUIPMENT USED TO PROVIDE THE SERVICES BY PARTIES OTHER THAN ROGERS; (V) ANY INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS ARISING FROM OR IN CONNECTION WITH CUSTOMER'S USE OF THE DEVICES, OTHER EQUIPMENT, THE SERVICES OR THE THIRD PARTY SERVICES; (VI) ANY EVENT OF FORCE

MAJEURE, AS DEFINED IN SECTION 26 OF THIS AGREEMENT; OR (VII) ANY SUSPENSION OR TERMINATION OF THE SERVICES.

Bell

11. Updates. Bell may update the software, features and settings on Client's Device (including Non-Bell Devices with a Bell SIM card) including through "Over-The-Air" means as necessary, without notice, and Client acknowledges such updates may be required in order to ensure continuity of Services.
21. LIMITS ON LIABILITY. EXCEPT FOR A VIOLATION BY BELL OF SECTION 3 OF THESE GENERAL TERMS AND CONDITIONS, OR FOR PHYSICAL INJURIES OR DEATH, OR DAMAGE TO PROPERTY CAUSED BY BELL'S GROSS NEGLIGENCE, FOR WHICH, IN EACH CASE, BELL'S LIABILITY SHALL NOT BE LIMITED, BELL IS NOT LIABLE TO CLIENT OR ANYONE USING THE DEVICE OR THE SERVICES, OR ANY THIRD PARTIES, FOR THE FOLLOWING:

    I. DEFECTS, FAILURES OR INTERRUPTIONS IN SERVICE, INCLUDING TRANSMISSION;

    II. ANY DAMAGES, including LOSS OF PROFITS, LOSS OF PROPERTY, LOSS OF EARNINGS, LOSS OF BUSINESS OPPORTUNITIES, OR ANY OTHER LOSS, HOWEVER CAUSED, ARISING DIRECTLY OR INDIRECTLY FROM USE OF THE SERVICES OR THE DEVICE;

    III. ANY CONTENT TRANSMITTED ON OR RECORDED BY BELL'S FACILITIES, INCLUDING CONTENT THAT MAY BE ILLEGAL, DANGEROUS, DEFAMATORY, OFFENSIVE OR ANNOYING OR WHICH MAY INFRINGE UPON OTHERS' INTELLECTUAL PROPERTY, PRIVACY OR OTHER RIGHTS, OR ANY CONTENT, APPLICATION OR SERVICES PROVIDED TO CLIENT BY A THIRD PARTY FOR USE WITH THE DEVICE OR THE SERVICES, EVEN IF BELL BILLS CLIENT FOR SUCH CONTENT, APPLICATION OR SERVICES ON BEHALF OF SUCH THIRD PARTY;

    IV. ANY BREACH BY CLIENT OF THE AGREEMENT, CLIENT'S NEGLIGENCE, OR ACTS OR OMISSIONS IN CONNECTION WITH THE SERVICES, OR THE DEVICE;

    V. LOSS, THEFT, DAMAGE TO OR UNAUTHORIZED USE OF THE SERVICES, THE DEVICE, ANY EQUIPMENT, ANY BELL PREPAID CARDS, VOUCHERS, COLLATERAL, ELECTRONIC RECEIPTS OR THE 2 DIGIT PERSONAL IDENTIFICATION NUMBER; AND

    VI. ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES WHATSOEVER ARISING OUT OF OR IN CONNECTION WITH THIS AGREEMENT OR THE PROVISION OF SERVICES (INCLUDING LOST PROFITS, ANTICIPATED OR LOST REVENUE, LOSS OF DATA, LOSS OF USE OF ANY INFORMATION SYSTEM, FAILURE TO REALIZE EXPECTED SAVINGS OR ANY OTHER COMMERCIAL OR ECONOMIC LOSS, OR ANY THIRD PARTY CLAIM), WHETHER ARISING IN NEGLIGENCE, TORT,

STATUTE, EQUITY, CONTRACT, COMMON LAW, OR ANY OTHER CAUSE OF ACTION OR LEGAL THEORY EVEN IF BELL HAS BEEN ADVISED OF THE POSSIBILITY OF THOSE DAMAGES.

EXCEPT FOR A VIOLATION BY BELL OF SECTION 3 OF THESE GENERAL TERMS AND CONDITIONS, OR FOR PHYSICAL INJURIES OR DEATH, OR DAMAGE TO PROPERTY CAUSED BY BELL'S GROSS NEGLIGENCE, FOR WHICH, IN EACH CASE, BELL'S LIABILITY SHALL NOT BE LIMITED, BELL'S TOTAL CUMULATIVE LIABILITY FOR DAMAGES, EXPENSES, COSTS, LIABILITY OR LOSSES (COLLECTIVELY, "DAMAGES") ARISING OUT OF OR

IN CONNECTION WITH THIS AGREEMENT OR THE PROVISION OF SERVICES, IF ANY, WHETHER ARISING IN NEGLIGENCE, TORT, STATUTE, EQUITY, CONTRACT, COMMON LAW, OR ANY OTHER CAUSE OF ACTION OR LEGAL THEORY EVEN IF BELL HAS BEEN ADVISED OF THE POSSIBILITY OF THOSE DAMAGES, IS LIMITED TO DIRECT, ACTUAL, PROVABLE DAMAGES AND WILL IN NO EVENT EXCEED AN AMOUNT EQUAL TO THE TOTAL AGGREGATE MONTHLY FEES (LESS ALL DISCOUNTS AND CREDITS) PAID BY THE CLIENT FOR THE SPECIFIC SERVICE(S) THAT GAVE RISE TO THE DAMAGES, DURING THE ONE-MONTH PERIOD BEFORE THE EVENT GIVING RISE TO THE DAMAGES, LESS AMOUNTS PAID FOR PREVIOUS CLAIMS, IF ANY. THIS SECTION SHALL APPLY EVEN IF THERE IS A BREACH OF CONDITION, A BREACH OF AN ESSENTIAL OR FUNDAMENTAL TERM, OR A FUNDAMENTAL BREACH OF THIS AGREEMENT. CLIENT AGREES THAT THE LIMITATIONS OF LIABILITY SET OUT IN THIS SECTION ARE FAIR AND REASONABLE IN THE COMMERCIAL CIRCUMSTANCES OF THIS AGREEMENT AND THAT BELL WOULD NOT HAVE ENTERED INTO THIS AGREEMENT BUT FOR THE CLIENT'S AGREEMENT TO LIMIT BELL'S LIABILITY IN THE MANNER, AND TO THE EXTENT, PROVIDED FOR IN THIS SECTION.

The following applies when Bell provides e9-1-1 Services (provision of wireless phone number and location information to emergency service providers). (A) Bell's liability is not limited by the limitations set out below in cases of Bell's deliberate fault, gross negligence or anti-competitive conduct or in cases of breach of contract where the breach results from Bell's gross negligence. (B) Except in cases where Bell's negligence results in physical injury, death or damage to Client's property or premises, Bell's liability for negligence related to Bell's provision of e9-1-1 Services is limited to the greater of $20 and three times the amount Client would otherwise be entitled to receive as a refund for the provision of defective service under this Agreement. (C) In addition, in respect of Bell's provision of e9-1-1 Services, Bell is not liable for: (i) libel, slander, defamation or the infringement of copyright arising from material or messages transmitted over Bell's telecommunications network from Client's property or premises or recorded by the Device or Client's or Bell's equipment; (ii) damages arising out of Client's acts, default, neglect or omission in the use or operation of the Device or equipment Bell has provided to Client; and (iii) any act, omission or negligence of other companies or telecommunications systems when facilities of such

other companies or telecommunications systems are used in establishing connections to or from Client's facilities and Device and equipment.

Telus

28. Since wireless telecommunications are delivered by radio waves, they are subject to factors that cannot reasonably be controlled. For this reason, TELUS does not guarantee timely, secure, error-free or uninterrupted service or that you will always receive your messages or data. To the extent permitted by law, legal warranties and conditions (implied or statutory) do not apply to the service.

30. TELUS is not responsible for:

- Libel, slander, defamation or the infringement of copyright arising from material or messages transmitted from your property or premises or recorded by your equipment or TELUS' equipment;
- Damages arising out of your act, default, neglect or omission in the use or operation of equipment provided by TELUS;
- Damages arising out of the transmission of material or messages over TELUS networks on your behalf, which is in any way unlawful; or
- Any act, omission or negligence of other companies or telecommunications systems in relation to the provision of the service to you, when the facilities of such other companies or telecommunications systems are used to establish connections to or from facilities and equipment controlled by you.

To the fullest extent permitted by law, TELUS will not be liable to you or to any other person for any damages or expenses (including loss of profits, loss of earnings, loss of business opportunities, loss of data, economic loss or other similar loss, or punitive damages) arising out of or in connection with the use or failure of the service, whether caused by negligence or otherwise, and whether claimed in contract, tort or otherwise.

These limitations of liability extend to the benefit of third party providers of audio or audiovisual programming services delivered to your device through the service. In the case of the provision of emergency services on a mandatory basis, our liability to you, except in cases where negligence on the part of TELUS results in physical injury, death or damage to your property or premises, is limited to the greater of twenty dollars and three times the amount you would otherwise be entitled to receive as a refund for the provision of defective service under your Agreement.

None of the limitations of liability stated above apply in cases of deliberate fault, gross negligence or anti-competitive conduct on the part of TELUS or in cases of breach of contract where the breach results from our gross negligence.

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Appendix C - Collection of MNO Reliability Events

Compiled on 2018-11-02

Major events causing cellular service interruptions

Contains some press release of major events who impacted the cellular service. The service interruptions where caused by either natural disaster or human factors. They are presented in reverse chronology.

Florida, USA - Hurricane Michael (2018-10-10)

Florida's Governor calls out Verizon and AT&T's poor service in hard-hit Bay County, Florida (2018-10-15)

In Featured News by Wireless Estimator/October 15, 2018

http://wirelessestimator.com/articles/2018/floridas-governor-calls-out-verizon-and-atts-poor-service-in-hard-hit-bay-county-florida/

> "**Now, after clearing the roads, communications are the first priority, and power**. We have an unbelievable problem in Bay County — **Verizon is down and AT&T is up, but the county services are on Verizon. In other places, Verizon is up and AT&T is down**," said Florida Governor Rick Scott.

Comment: Even FirstNet would greatly benefit from a PVNO approach.

FCC Chairman: Pace of network recovery post-Hurricane Michael is "unacceptable"

By Sean Kinney, Editor in Chief on October 18, 2018

https://www.rcrwireless.com/20181018/network-infrastructure/fcc-chairman-pace-of-network-recovery-post-hurricane-michael-is-unacceptable

FCC asks industry to report on network resiliency

By Kelly Hill on November 7, 2018

https://www.rcrwireless.com/20181107/policy/fcc-asks-industry-to-report-on-network-resiliency

> "The voluntary framework approved by the FCC in April 2016 laid out a five-part strategy to enhance coordination among wireless carriers during emergencies. According to the FCC, those parts included:
> -providing reasonable roaming when technically feasible
> -fostering mutual aid among wireless providers

-developing best practices with local public safety officials and establishing a provider/911 call center contact database
-working to increase consumer readiness and preparation
-improving public awareness and stakeholder communications on service and restoration status with county-by-county information.

The FCC asks that carriers report back by Nov. 26."

Ottawa-Gatineau Tornado (2018-09-21)

Opposition calls for probe of cellphone services in emergencies (2018-10-02)

https://www.cbc.ca/news/politics/cellphones-tornado-disaster-emergencies-1.4846296

MPs say they want to know how reliable cellphone services are during prolonged power failures.
…

New Democrat MP Brian Masse called on Public Safety Minister Ralph Goodale, Industry Minister Navdeep Bains and the CRTC to take stock of the strengths and weaknesses of the current system.

"The minister needs to really address this. The CRTC should by playing a leadership role."

Masse said **the government should do an inventory of the cellphone system's performance in emergencies and share those results with Canadians "within a matter of weeks."**

Industry minister responds
Bains' office said the department works with cellphone providers.

"Cellphones play an important part in our everyday lives, and become ever more critical in times of emergencies. Innovation, Science, and Economic Development (ISED) has an ongoing working relationship with the telecommunication service providers focused on business continuity, especially in emergency situations, when the department works with the impacted service providers to offer the requested support.

"We will continue to work with cellphone service providers to ensure the system is prepared in case of emergencies, including extreme weather events."

Cellphone companies say their networks did work — albeit more slowly — in the aftermath of the tornadoes and they dispatched teams with portable generators to keep critical parts of their networks running.

The calls for the government to examine the reliability of Canada's cellular phone networks in an emergency come after six tornadoes touched down in the Ottawa-Gatineau area on Sept. 21. One

tornado hit an electrical substation and high winds downed power lines, knocking out electricity to an estimated 170,000 customers.

As the electrical outage dragged into the following day, many Ottawa-area residents found their cellphone service had slowed to a crawl, with signal strength at only one bar or with no service at all.

No minimum standard
There is no minimum standard set by the government for how long for cellphone networks should be able to keep working in the event of a prolonged power outage.

Albas said reporting by CBC News has shed light on a problem.

"It's raising awareness that there is a growing dependence on our electronic devices and how they may work — or not work — in a public safety emergency," he said.

"The government should always be looking for ways to improve the safety of Canadians, especially in relation to new and changing technology. It would be my hope that Minister Goodale and Minister Bains would already be reacting to these kinds of things, asking questions."

Masse said he also wants the government to look into the question, particularly since those who coordinate public safety responses in emergencies also rely, at least in part, on cellphone networks.

Masse said the government should compile an inventory of the existing system to determine its strengths and weaknesses in an emergency.

"The minister needs to convene a meeting with the CRTC to get a handle on what the different operators in Canada are capable of and what they are expected to do with those capabilities, where are the weaknesses and gaps, and to have a public discourse about that."
…

Ontario, Quebec and Maritime Telus Outage (2018-04-26)

Telus and Koodo network outage restored
https://mobilesyrup.com/2018/04/26/telus-koodo-network-outage/

By Sameer Chhabra **APR 26, 2018** 12:25 PM EDT
Update: Telus has issued the following statement, noting, “Mobility services are currently experiencing intermittent interruptions of service in Ontario, Quebec and Maritimes. Clients will have no service in the affected area. We are working to resolve the issue as quickly as possible but do not have an estimated time of resolution.”

…

Update 3: Telus has issued the following statement: “Service is fully restored after some TELUS wireless customers in parts of Ontario, Quebec and Atlantic Canada experienced intermittent or disrupted service earlier today. The disruption was caused by an unusual hardware issue that was quickly resolved by our network technicians. We apologize to our customers for the inconvenience.”
….

The outages briefly affected a Telus-enabled device at the MobileSyrup offices, but 3G service has since resumed on that device. While the phone is still capable of sending and receiving phone calls — as well as accessing 3G data services — the device is unable to connect to Telus’s 4G LTE network.

New Brunswick and Atlantic Telus and Bell Outage (2017-08-04)

CBC News article

Bobbi-Jean MacKinnon · CBC News · Posted: Aug 04, 2017 11:48 AM AT | Last Updated: August 4, 2017
https://www.cbc.ca/news/canada/new-brunswick/bell-aliant-cellphone-landline-1.4235279

Bell Aliant service was restored to customers late Friday afternoon after a **"major" outage affected cellphone** and landline services, internet and TV across **New Brunswick and the rest of Atlantic Canada for several hours**.

Bell had to reroute and repair network infrastructure, spokesperson Nathan Gibson said in a statement around 4 p.m. AT.

The outage, which started shortly before 11 a.m., was caused by "accidental damage to multiple fibre network links," Gibson said. "Bell apologizes to our customers for the disruption."
Late Friday, Bell said on Twitter that two major fibre links had been cut during third-party construction work.

Telus, which shares cell towers with Bell, said earlier in the day the damage happened in Drummondville, Que.

The interruption affected 885 cell sites across New Brunswick, Nova Scotia, P.E.I. and Newfoundland and Labrador and disrupted everything from 911 service to banking machines and flights.

Similar outage in 2011

Bell Aliant faced a similar outage in New Brunswick in September 2011, after a fibre optic cable was cut in the northern city of Campbellton.

Users of Virgin and Koodo, which also use Bell's towers, were also affected. **Rogers customers were not.**

….

Bell says Atlantic services restored following damage to fibre network

https://mobilesyrup.com/2017/08/04/bell-aliant-telus-kood-virgin-telus-phone-service-down-atlantic-canada/

http://www.cbc.ca/news/canada/nova-scotia/bell-telus-phone-service-atlantic-provinces-1.4235224

Calgary flood Telus Outage (2013)

Document mentioning the event

https://www.jbs.cam.ac.uk/fileadmin/user_upload/research/centres/risk/downloads/riskprize2015-rajan.pdf

New Brunswick Bell Aliant outage (2011)

Bell Aliant service restored in New Brunswick after fibre line cut
https://globalnews.ca/news/160515/bell-aliant-service-restored-in-new-brunswick-after-fibre-line-cut-2/

-

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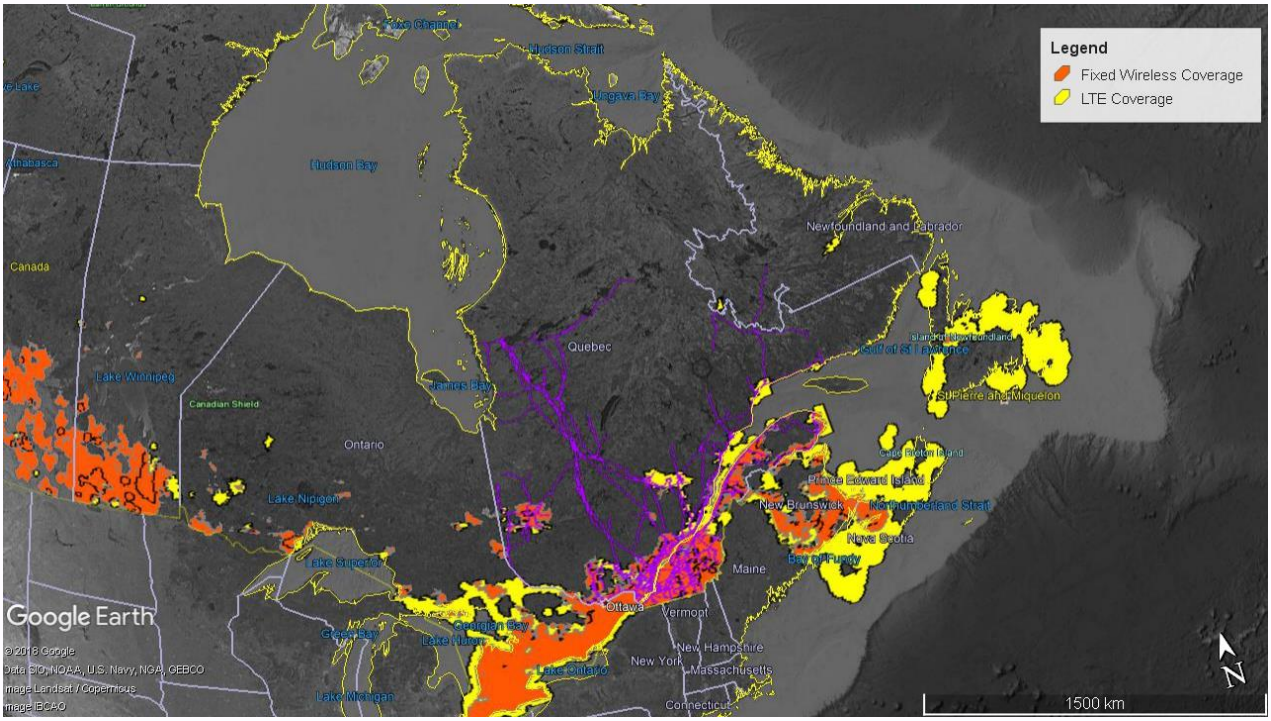
Appendix D – Provincial/Territorial Wireless Coverage Vs. CEU Infrastructure Maps

In all maps the lines, of various colours depict CEU infrastructure, the yellow areas are LTE coverage and the orange areas are fixed wireless coverage. In all cases CEU infrastructure falls outside existing coverage areas.

Quebec



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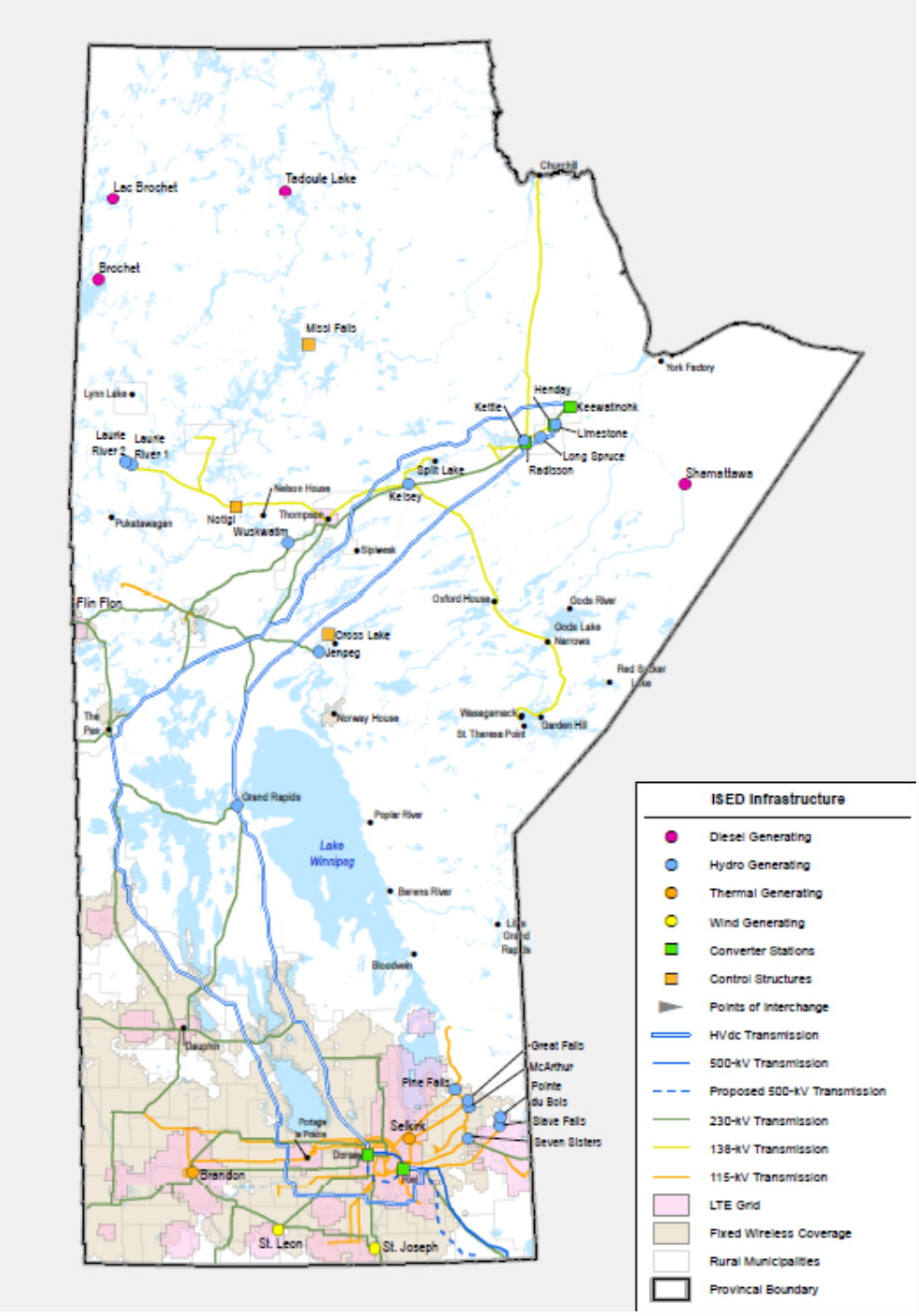
Manitoba



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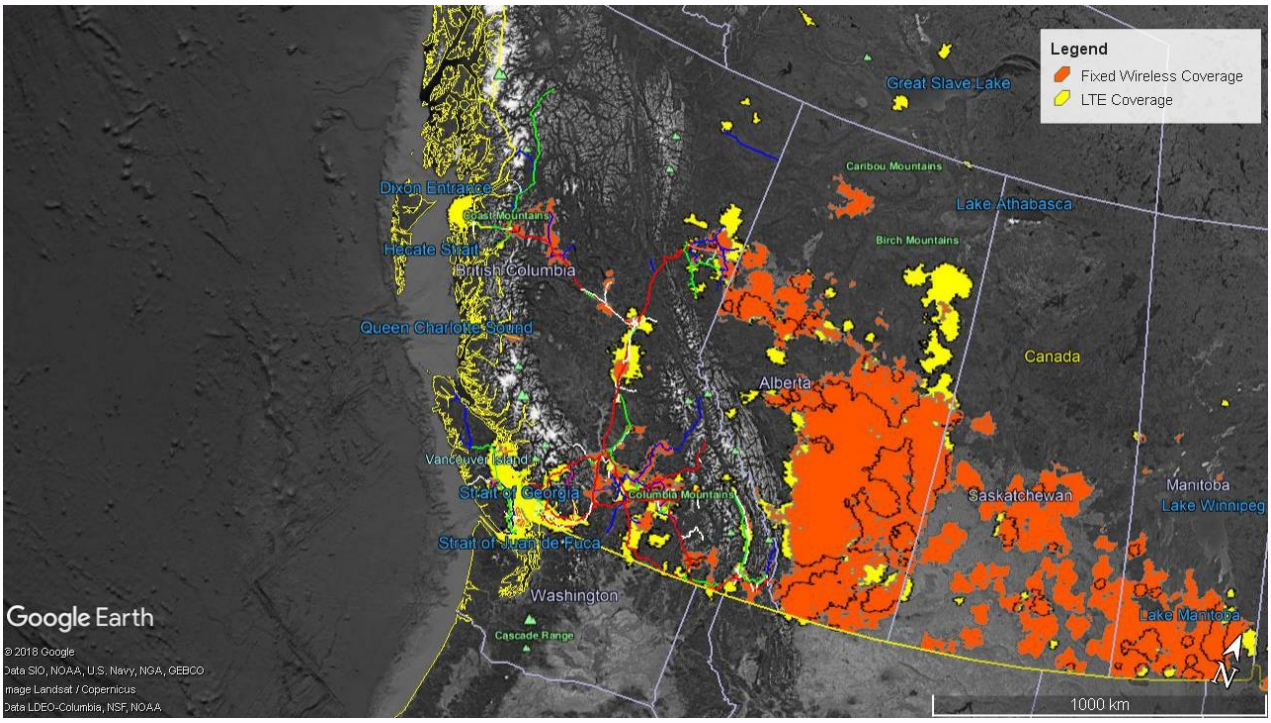
British Colombia



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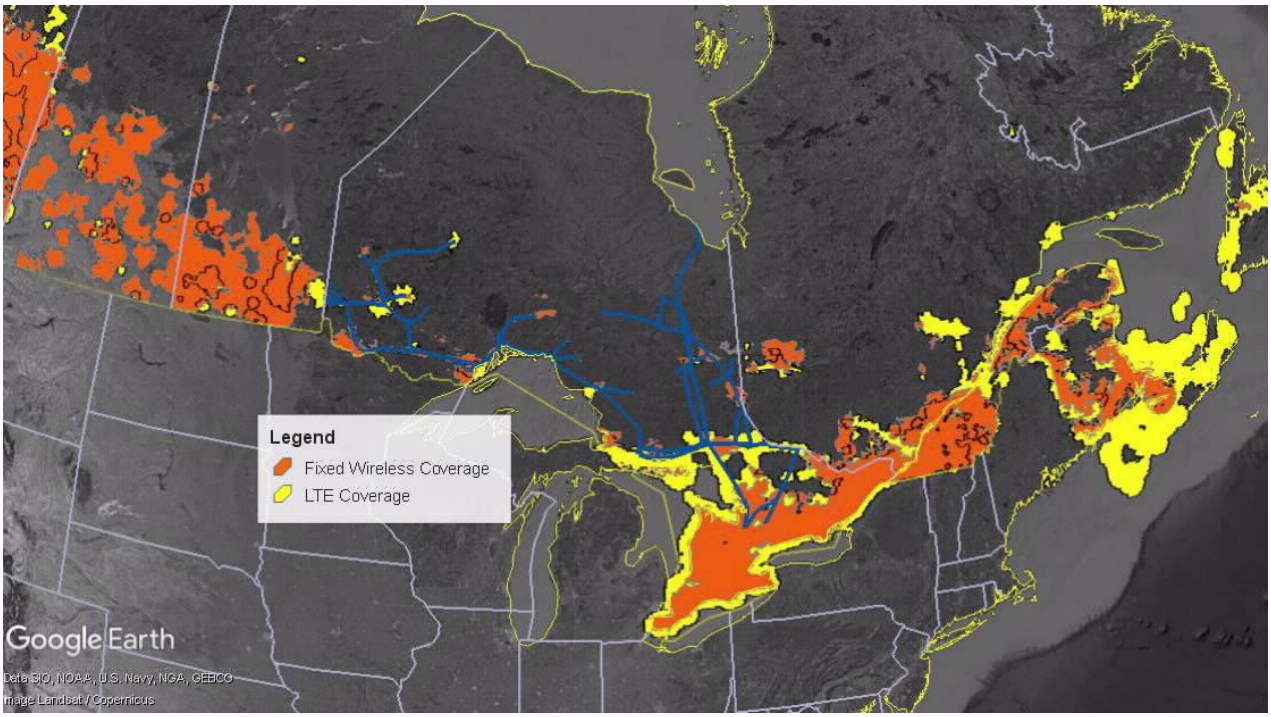
Ontario



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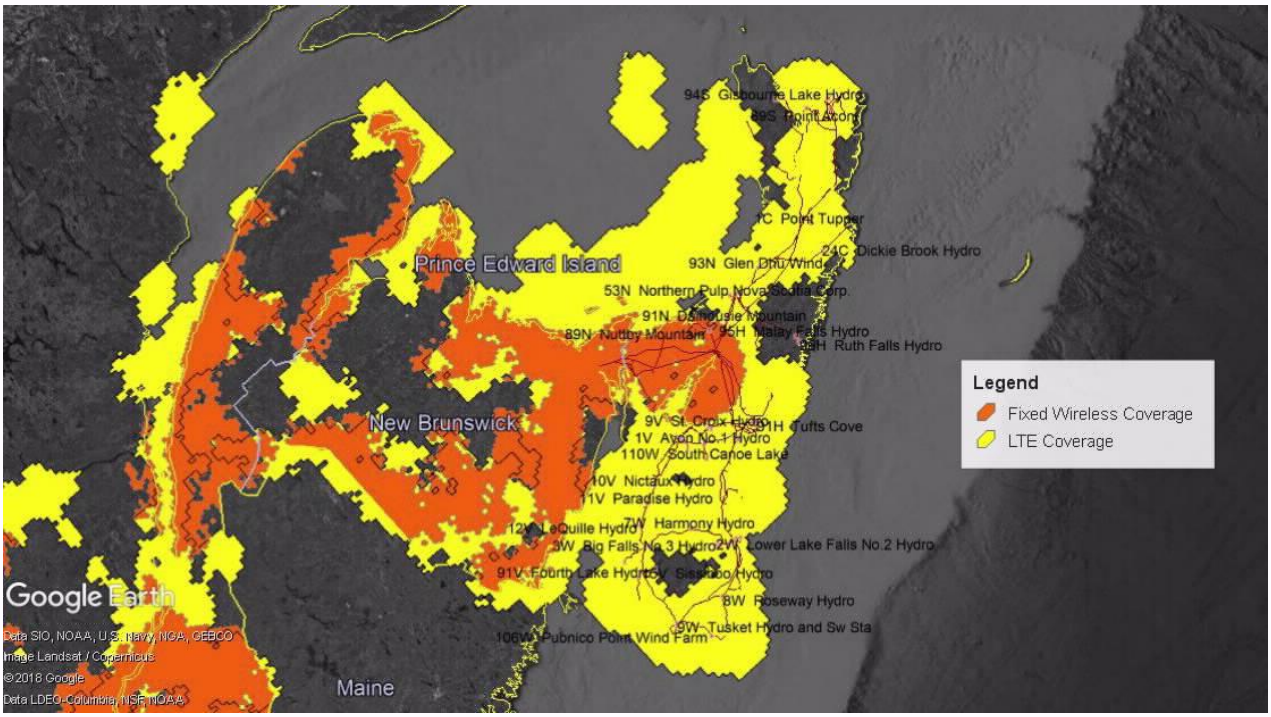
Nova Scotia



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Northwest Territories