



ISED SLPB-002-20

PSBN Innovation Alliance Comments on the proposed
Ministry of Innovation, Science & Economic Consultation on
the Technical and Policy Framework for the 3650-4200MHz
Band and Changes to Frequency Allocation of 3500-
3650MHz Band (SLPB-002-20)

**Release
Version
R01.00**

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Preface & Introduction to this Document

The PSBN Innovation Alliance is pleased to submit this document under its umbrella legal Copyright auspices, to the Ministry of Innovation, Science, and Economic Development (ISED) committee studying 5G Auction Rules for the 3.65-4.20GHz bands (SLPB-002-20), as a peer review by industry professionals, Public Safety communications practitioners, and municipal and industry leaders. This document is a Copyrighted submission for ISED review and may be released for public review pursuant to the terms of the ISED consultation.

We sincerely appreciate this opportunity to comment on SLPB 002-20 to specifically offer perspectives on the needs of First Responders and Critical Infrastructure in this ISED consultation, and we applaud the excellent work of ISED in fostering innovation and high quality, cost effective 5G services for the coming decades in Canada, and in considering creative new policy solutions to bridge the rural and remote digital divide in our country.

We respectfully remain available to respond to any ISED questions, and would like to request to participate in any follow-up actions or oral proceedings related to this solicitation. We sincerely appreciate the opportunity to comment on the future path of broadband telecommunications for First Responders in Canada, in this time of generational change and review of telecom policy.

Yours sincerely,
The PSBN Innovation Alliance

Principal Contact:

C/O Mr. Bill Payne
Director of Information Technology
Halton Regional Police Service
Asst. Dir. Technology – PSBN Innovation Alliance

Email: Bill.Payne@HaltonPolice.ca
Telephone: 905-580-1621

Address: Halton Regional Police Service
2485 North Service Rd W.
Oakville, ON
L6M 0Y3

Lead Author:

Mr. Phil Crnko, M.A.Sc., P.Eng.
Engineering Adviser
Halton Regional Police Service

PSBN Innovation Alliance Executive Director:

C/O Deputy Chief Anthony Odoardi
Peel Regional Police Service
Executive Director – PSBN Innovation Alliance

Email: Anthony.Odoardi@PeelPolice.ca
Telephone: 905-453-2121 ext. 4061

Address: Peel Regional Police Service
7150 Mississauga Rd.
Mississauga, ON
L5N 8M5

Media Communications Contact:

Jennifer Hartman
Coordinator, Corporate Communications
Halton Regional Police Service

Email: Jennifer.Hartman@HaltonPolice.ca
Telephone: 905-825-4747 ext. 4904

Address: Halton Regional Police Service
2485 North Service Rd W.
Oakville, ON
L6M 3H8

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**REVIEW COMMENTS & RECOMMENDATIONS RELATED TO ISED SLPB-001-20:
POLICY AND LICENSING FRAMEWORK FOR SPECTRUM IN THE 3500MHz BAND**

A STUDY BY THE PSBN INNOVATION ALLIANCE

A. OVERVIEW:

1. This document is a set of recommendations prepared by the PSBN Innovation Alliance – an association of Emergency Responder agencies, municipalities and related organizations across jurisdictions covering over 4 million Canadians – providing a response to the ISED consultation SLPB 002-20 regarding the establishment of new licensing terms for 5G services in the 3.65-4.20GHz spectrum bands in Canada.
2. The PSBN Innovation Alliance mission is to advance technologies and to foster the innovative development of wireless communications systems that meet the needs of Emergency Responders and the communities they serve.
3. One of our areas of research relates to the building of a reliable Public Safety Broadband Network (PSBN) for Canada – in an approach founded on the policy principles of Community Safety & Wellbeing (see Reference [A07]) on positive societal partnerships that foster holistic Community growth and benefits for all Canadians).
4. Our aim is to ensure Canadian telecom infrastructure meets the 21st century data interoperability, Cybersecurity and rugged reliability needs for 911 emergency lifesaving operations, and to grow 911 and broadband access alongside critical infrastructure in all the rural, remote, suburban and urban communities we serve.
5. Our Alliance work spans both terrestrial and wireless communications, and across the breadth of narrowband and broadband communications technology - and spectrum - which underpins Canada's digital society. In our response we also highlight the assured communications needs for First Responders in rural and remote communities across Canada, tech trends and new policy models that can help improve access and integration of municipal networks into a more reliable, innovative and affordable telecommunications service for all Canada's diverse communities.
6. In summary, we hope to provide collaborative perspectives and technical considerations to the CRTC, in support of building telecommunications networks that meet the evolving critical data needs of Emergency Responders in Canada's rural and remote communities.
7. This document is aligned with our published six-volume set of whitepapers, studies and reports focused on various key policy and economic aspects for consideration in the design of a flexible and robust Canadian PSBN – available digitally at www.psbnnnovationalliance.ca:
 - a. Volume I – The Evolving Communications Needs of Canadian First Responders;
 - b. Volume II – Qualitative Analysis of Canadian PSBN Models;
 - c. Volume III – Economic Analysis of Canadian PSBN Models
 - d. Volume IV – Business Model Scenario for a Hybrid Model PSBN
 - e. Volume V – TNCO Interim Report Review Comments & Recommendations for a Canadian PSBN;
 - f. Volume VI – Community Safety Broadband Model (CSB) – CRTC 2019-406 Submission
8. Please refer to these related whitepapers for further background pertaining to holistic PSBN policy for Canada – along with added policy linkages to NG-9-1-1 and rural broadband, a needs analysis, future trends discussion and added information on the recommendations in this response on 4G / 5G spectrum allocations in the 700MHz band and beyond (see References [A01] through [A06]).

A1. PSBN Innovation Alliance – Association Membership:

9. The PSBN Innovation Alliance is a not-for-profit Association of Public Safety agencies and Critical Responders in Ontario, partner R&D institutions, universities and commercial advisors, and currently includes a rapidly growing membership covering a population of over 4 million Canadians. Our comments within this document are provided as conceptual and research oriented, and are not intended to imply the endorsement of specific members listed below. The following member agencies are part of our rapidly growing Association:

PSBN INNOVATION ALLIANCE

FULL MEMBERS:



- 7 Regional Agencies that cover more than 4 Million Canadians in common PSBN advocacy
- Combines users from Tri-Services, Transit, Electricity, Municipal Services, Airports & more
- The Nucleus & Foundation of a Province-wide PSBN serving all of Ontario
- Innovative new business model (MVNO / MNO combination) + interoperability focus
- Strong advocate for policies promoting Rural Broadband growth + Rural Business Innovation
- Nexus for University R&D focused on Emergency Responder & Critical Infrastructure Apps → Safer Cities

ADVISOR / OBSERVER MEMBERS:



ASSOCIATION ADVISOR MEMBERS:



Represents the Chiefs of 56 Policing Agencies in the Province of Ontario



Represents all 11,200 career Firefighters in the Province of Ontario



Represents 18,000 sworn and civilian police personnel from 47 police associations across Ontario.

For further information, please visit our website at: www.psbnnnovationalliance.ca

B. COMMENTS & QUESTIONS ON ISED LICENSING FOR 3650-4200MHz SPECTRUM:

10. In terms of high-level principles related to spectrum licensing, until recently ISED has defined 4 types of Spectrum License Areas in auctions and allocations:

- Tier 1: a single national service area covering the entire territory of Canada
- Tier 2: consists of 14 provincial and large regional service areas covering the entire territory of Canada
- Tier 3: consists of 59 smaller regional service areas covering the entire territory of Canada
- Tier 4: consists of 172 localized service areas covering the entire territory of Canada, based on contiguous groupings of Statistics Canada's 1996 census subdivisions – Tier 4 licenses are currently used for Fixed Wireless Access in the 3450 MHz to 3650 MHz spectrum blocks.

11. It is now planned that for 5G deployments, that an approach using ISED's new Tier 5 License Areas will be used and decisions on these new License Areas were issued in July 2019 in document DGSO-006-19¹.

12. ISED made four critically important points for Public Safety Agencies in its July 2019 decision document (see footnote 1) in sections 36, 37, 97 and 108 as follows:

(36) There are also non-commercial uses for spectrum that benefit the public good. This includes spectrum that is used to provide municipal or social services that enhance the capabilities of different public safety entities such as fire, police and other first responders, or that can be utilized for research by public and private institutions.

(37) ISED believes that all of the aforementioned use cases for spectrum are compelling and has designed the Tier 5 service areas with the flexibility in mind to support multiple services and business models. ISED will maintain the design principle to foster demand

(97) The TPS (Toronto Police Service) provided a Tier 5 approach for the heavily populated western end of Lake Ontario based on regional municipal boundaries. These regional municipal boundaries match the CD boundaries defined by Statistics Canada.

13. ISED decided that each Tier 5 service areas would fall into one of four categories as follows:

- (1) Metropolitan Areas (greater Toronto, greater Vancouver and greater Montreal)
- (2) Other Urban Areas
- (3) Rural Areas
- (4) Remote Areas

(108) Therefore, ISED has decided to divide these three large metropolitan areas by municipal or regional municipal boundaries where possible, so that the Tier 5 service areas can align with municipal governments for the delivery of services such as utilities, sanitation and public safety functions to their constituents.

14. The PSBN Innovation Alliance applauds the ISED decision approach of employing more granular Tier 5 licensing in the deployment of future 5G spectrum, and accordingly suggests that for the future allocations of spectrum in the 3650-4200MHz bands under consideration, that ISED should implement the vision of Tier 5 allocations as documented in the ISED July 2019 decision.

¹ [Decision on a New Set of Service Areas for Spectrum Licensing](#)

[Q1]

ISED is seeking comments on the timelines for the development of an equipment ecosystem using 5G technologies in the 3800 MHz band. In particular:

- a) the ecosystem maturity level and readiness of equipment under band classes n77 or n78 for the Canadian market*
- b) the ability of existing or future base station radios to handle multiple technologies and band classes at the same time (i.e. whether all four band classes (B42, B43, n77 and n78) or a subset of these band classes are able to operate on the same base station radio) and how it may affect the adoption of 5G technologies in the 3800 MHz band*

Q1 Response:

- 15. Based on discussions held to date with equipment manufacturers, the PIA suggests that 3GPP based equipment is indeed available and suitable for use with multiple bands (e.g. small cell radio solutions) on the same base radio. We therefore suggest the maturity level and readiness is essentially adequate today or in the very near future for multiple vendors.

[Q2]

ISED is seeking comments on the potential linkages between the equipment ecosystems using 5G technologies in the 3500 MHz and 3800 MHz bands. In particular:

- a) whether contiguity between the 3500 MHz band and 3800 MHz band is preferred given that 3GPP specifications allows for non-contiguous carrier aggregation*
- b) whether there are any technical or operational impediments (e.g. equipment limitations/challenges to support aggregated use of spectrum, or requirements for additional base station radios) that would be incurred if operators have a large frequency separation between frequency blocks in one or both bands, and at what point (i.e. how wide the frequency separation) such impediments would become significant*
- c) whether the equipment ecosystem deployed for the 3500 MHz band will be able to operate in the 3800 MHz band, and whether this equipment could easily be extended to 3800 MHz after being deployed*

Q2 Response:

- 16. Based on discussions held to date with equipment manufacturers, the PIA suggests that 3GPP based equipment is indeed available and suitable for use with multiple bands – covering both Band n77 and n78 in chipsets (e.g. small cell radio solutions) on the same base radio. We therefore suggest the maturity level and readiness is essentially adequate today or in the very near future to support an ecosystem of multiple competing vendors.

[Q3]

ISED is seeking comments on how the difference in technical rules between the U.S. and EU could impact Canada's ability to leverage the economies of scale from the global 3800 MHz ecosystem. In particular:

- a) would the difference in technical rules (such as out-of-band-emission (OOBE) power limits) result in two distinct region-specific equipment ecosystems*

b) which equipment ecosystem would be more suitable in the Canadian environment (noting that Canada has, for the most part, aligned with the U.S. on low- and high-band spectrum for 5G but in the mid-band, Canada is more aligned with the EU in the 3500 MHz band (3450-3650 MHz)) and specifically, whether Canada should generally align its technical rules with the U.S. or the EU in the 3800 MHz band

Q3 Response:

17. In considering the stance of 911 emergency response, and from the stance of disaster preparedness and interoperability in times, we suggest it is advantageous for the interests of Public Safety and cross-border assistance between the US and Canada to maintain closer spectrum assignment coordination with our neighbours in the US. We cite in particular cases of fire crews, electric utility crews, police / military staff from one country crossing the border to assist the other country – in scenarios ranging from wildfires through to ice storms and power outages.
18. For Public Safety interests then, the ability to interoperate seamlessly and with minimal pre-configuration or duplication of devices across neighbouring agencies in particular is essential to lifesaving services of emergency responder organizations. We therefore suggest that it is more suitable in the Canadian environment that we align for the most part with the US technical rules in the 3800MHz band.

[Q4]

ISED is seeking comments on the proposal to add a primary mobile service, except aeronautical mobile, allocation in the 3700-4000 MHz band to the CTFA and the specific changes shown in annex B.

Q4 Response:

19. In considering the stance of 911 emergency response, and the growing capacity needs of new applications for Public Safety responders, such as NG-9-1-1 and the growing use of video calling in public interactions, and Cloud based data for operations, we therefore support ISED releasing new spectrum to be made available for terrestrial primary mobile services (except aeronautical mobile) in the 3700-4000MHz Band.
20. We also concur with the edits shown in Annex B – however we do suggest that in order to maintain a vibrant, innovative and effective Low Earth Orbit (LEO) industry in Canada, and given the unique advantages that LEO services will offer to rural and remote Canadians that are outside the range of economical connectivity to terrestrial services, that ISED make specific considerations and consultation in the near future (2021) to further enhance spectrum options available to LEO satellite communications service providers.
21. Given the chronic issues seen in rural and remote Canada with respect to the broadband digital divide, and the follow-on impacts lack of mobile 911 access causes in cases of emergency response, we suggest it is crucially important that ISED take steps to enable and enhance the provision of LEO services to Canadians, and to provide a framework for innovation in the realm of LEO satellite technology.
22. Furthermore, in the case of rural broadband and remote broadband services, given that incumbent terrestrial MNOs have not been able to bridge the digital divide in rural regions with cellular technology over the past several decades (due in part to economics and profit considerations of large incumbent carriers), we suggest this is all the more reason that Canada should be a leader in LEO technology innovation. Therefore, ISED has a key role to play in providing Canadian commercial ventures with new spectrum tools and policy frameworks to

enable bridging the rural broadband divide (at least in part) with LEO technology, and to foster continued Canadian leadership in the LEO technology arena.

[Q5]

ISED is seeking comments on developing a flexible use licensing model for fixed and mobile services in the 3650-4000 MHz band.

Q5 Response:

23. The PIA concurs with a flexible use approach to licensing 3650-4200MHz spectrum for fixed and mobile usage.
 24. As noted earlier, with the advent of new data related needs and applications for Public Safety emergency responders, it is important that spectrum capacity for digital communications keep pace with the growing demand. Wireless broadband services are an operational efficiency tool for 911 operations in new applications ranging from forthcoming NG-9-1-1 data-based communications for civilians and emergency responders, the growth of video calling as a societal trend, the mobile use of central data repositories via Cloud computing, the growth of the “Internet of Things” (IoT), and more.
 25. In the 21st century, Public Safety agencies will see a explosion in the need for reliable, cost-effective and efficient wireless mobile communications and therefore a flexible use policy will provide the best ability to meet the range of challenges anticipated for Public Safety applications.
-

[Q6]

Given the proposal in section 7.2 on developing a flexible use licensing model for fixed and mobile services in the 3650-4000 MHz band, ISED is seeking comments on the proposal that no new FSS earth stations be authorized in the 3700-4000 MHz band in the future and that the authorization of new FSS earth station licenses be limited to the 4000-4200 MHz band.

Q6 Response:

26. We concur with the ISED proposal to harmonize with the US FCC band plan, and deploy new applications for FSS licenses into the 4000-4200MHz band, and with a grandfathering in of legacy license holders in the 3700-4000MHz band in satellite dependent areas, so that remote and rural regions may continue to use existing equipment deployed in 3700-4000MHz spectrum.
-

[Q7]

ISED is seeking comments on the proposal to implement a 20 MHz guard band between 3980-4000 MHz to protect FSS operations in 4000-4200 MHz band from proposed flexible use operations in the 3700-3980 MHz band.

Q7 Response:

27. We concur with the ISED proposal to harmonize with the US FCC band plan, and to institute a guard band between 3980-4000MHz, and to allocate 3700-3980MHz as flexible use for terrestrial operations, while the 4000-4200MHz band focused on FSS usage.
-

[Q8]

ISED is seeking comments on the proposal to maintain a primary allocation to FSS in the entire 3700-4200 MHz band and the proposal that existing FSS earth stations in satellite-dependent areas remain licensed in the entire 3700-4200 MHz band.

Q8 Response:

28. We concur with the ISED proposal to harmonize with the US FCC band plan, and to institute a guard band between 3980-4000MHz, and to allocate 3700-3980MHz as flexible use for terrestrial operations, while the 4000-4200MHz band be focused to FSS usage.
-

[Q9]

ISED is seeking comments on the future demand for C-band in rural and remote areas such as the North, including the following:

- a) the trend towards using higher frequencies by FSS operations to provide broadband connectivity*
- b) the ability of using higher frequencies to replace current C-band capacity and the potential timelines*
- c) the possibility of a trend towards using 4000-4200 MHz in combination with other connectivity options (e.g. higher frequencies satellites or wireline solutions) and when it would be expected to be available for satellite-dependent areas*

Q9 Response:

29. We concur with the ISED proposal to harmonize with the US FCC band plan, and to institute a 20MHz guard band between 3980-4000MHz, and to allocate 3700-3980MHz as flexible use for terrestrial 5G operations, while the 4000-4200MHz band be focused to FSS usage. The proposed approach allows remote and rural regions the “best of both worlds” by both grandfathering in legacy licenses in the 3650-3980MHz spectrum, and yet offering 5G services in those bands to meet terrestrial communications needs – and 4000-4200MHz for new satellite licenses.
30. We would suggest that in Northern regions, as populations continue to grow, that connectivity to terrestrial networks will in turn grow with those populations (i.e. fiber-optic links to Southern regions and networks that continue to spread Northwards) and that those rural and remote regions can make use of a mix of both LEO / FSS and terrestrial fixed / mobile networks.
31. These remote and rural regions can also leverage 700MHz (Band Class 14) as a part of municipally led Public Safety Broadband Networks (PSBNs) as a nucleus or seed of cellular services in areas where incumbent MNOs continue to refuse to deploy services. PSBNs offer rural Canada a greater wide-area and longer-range service for meeting the needs of both emergency responders on a priority basis, and commercial / civilian access. These municipalities

may also deploy 700MHz as a wide-area technology that can be used as part of a Community Safety Broadband (CSB) model, as proposed by the PIA in our recent submission to the CRTC Rural Broadband consultation TNC 2019-406.²

32. Additionally, over time as remote and rural communities grow and have more access to fiber-based cellular networks, they may also still avail themselves of FSS services in the 4000-4200MHz band for new license deployments, and at the same time for pre-existing deployments in the 3700-3980MHz band in a designated satellite-based jurisdiction, those legacy licenses may be maintained. We suggest this arrangement provides an equitable treatment of rural and remote regions in that:
- a.) they can keep existing spectrum in the lower portion of the 3800MHz band, and
 - b.) gain new licenses in the high portion of the 3800MHz band, while at the same time
 - c.) growing their use of terrestrial 5G services in 700MHz Public Safety bands and beyond in the 3500MHz to 3980MHz bands.

[Q10]

In addition to capacity requirements, ISED is seeking comments on other issues that should be considered in maintaining broadband connectivity in satellite-dependent areas.

In providing comments, respondents are requested to include supporting arguments and rationale.

Q10 Response:

33. The PIA respectfully suggests that from a Public Safety stance – and also from a municipal 5G strategy stance, that remote and rural regions can also leverage 700MHz (Band Class 14) as a part of municipally led Public Safety Broadband Networks (PSBNs), to serve as a nucleus or seed of cellular services in areas where incumbent MNOs continue to refuse to deploy services, or in areas that are underserved from a 4G and 5G technology viewpoint.
34. These rural focused 4G and 5G services may either take the guise of new neutral-host P3 (public-private-partnership) service providers with non-traditional capital investors (i.e. other than incumbent MNOs – such as tower infrastructure ownership firms, capital investors, foreign investors up to appropriate limits), or alternatively as part of municipally-struck partnerships with incumbent MNOs to offer PSBN RAN (radio access network) services.
35. PSBNs offer rural Canada a flexible and better wide-area service through a mix of HPUE (high power user equipment) in 700MHz Band Class 14 spectrum, and with proposed new carve-outs in higher bands such as 3.65GHz to 3.98GHz in more dense suburban / small-town urban regions, to meet the needs of both emergency responders on a priority basis, and yet also provide commercial / civilian access. These municipalities may also concurrently deploy 700MHz alongside 3.65GHz 5G radios as a wide-area technology strategy that can be used as part of a Community Safety Broadband (CSB) model, as proposed by the PIA in our recent submission to the CRTC Rural Broadband consultation TNC 2019-406.³
36. The value of 700MHz spectrum as an allocation to Public Safety is that it can act as a “glue layer” or bridge between shorter-range 5G spectrum in the 3.65GHz to 3.98GHz ranges, and FSS satellite services such as LEO. By taking a “network-of-networks” approach to Public Safety communications, and offering First Responders with spectrum set asides, ISED can offer

² CRTC 2019-406 – PIA Submission - <https://services.crtc.gc.ca/pub/ListeInterventionList/Documents.aspx?ID=292602&en=2019-406&dt=i&lang=e&S=C&PA=t&PT=nc&PST=a>

³ CRTC 2019-406 – PIA Submission - <https://services.crtc.gc.ca/pub/ListeInterventionList/Documents.aspx?ID=292602&en=2019-406&dt=i&lang=e&S=C&PA=t&PT=nc&PST=a>

Northern rural and remote municipalities with a “tool box” of spectrum options to strike partnerships where needed:

- a.) 700MHz Public Safety Broadband Networks (wide area, high power with Public Safety priority);
 - b.) New / future carve-out of a portion of 3.65GHz to 3.98GHz, or at a minimum universal Priority Access Licenses (PALs) in this new spectrum for Public Safety responders;
 - c.) Future carve-outs in future spectrum allocations with either universal priority access for Public Safety responders, or outright carve-outs that may be applied for by municipalities for local 5G services in a P3 partnership arrangement to create new small-scale regional MNOs where incumbent MNOs continue to refuse to invest due to marginal business case;
37. The set-aside of portions of new spectrum allocations for Public Safety and municipal purposes – which serve a critical common good to society, is a longstanding trend historically with ISED in Canada, and should be maintained. The use of reserved spectrum set-asides for municipalities gives both First Responders a key tool to overcome congestion, but also for deployment of radio resources in areas where costs from incumbent MNOs are too high and where there is a regional lack of competition or competitive forces.
38. ISED made four critically important points for Public Safety Agencies in its July 2019 decision document (see footnote 1) in sections 36, 37, 97 and 108 as follows:
- (36) There are also non-commercial uses for spectrum that benefit the public good. This includes spectrum that is used to provide municipal or social services that enhance the capabilities of different public safety entities such as fire, police and other first responders, or that can be utilized for research by public and private institutions.***
- (37) ISED believes that all of the aforementioned use cases for spectrum are compelling and has designed the Tier 5 service areas with the flexibility in mind to support multiple services and business models. ISED will maintain the design principle to foster demand***
39. For these reasons, the PIA strongly suggests that in new allocations for terrestrial 3.65GHz to 3.98GHz bands, that there be a corresponding Public Safety / municipal set-aside of some fraction of the new spectrum allocations, which will continue ISED’s longstanding approach to Public Safety set-asides of radio spectrum, while at the same time assisting with market forces in order to prevent a further concentration of market power in the Canadian telecom market, and a further reinforcement of the chronically high costs that Canadians and Canadian 911 emergency response organizations pay for telecom services.
40. A spectrum carve-out in the 3.65GHz to 3.98GHz bands, or some type of set-aside for municipal emergency responder usage, and/or for municipal Smart-City usage offers a flexible approach to:
- a.) Foster competitive forces in the terrestrial cellular services market to help bring down the chronically high cost of Canadian telecom services, through municipal-based new entrants that may grow regionally and offer new competitive market forces;
 - b.) Offer remote municipalities a tool to deploy a nucleus of cellular service for residents and emergency response, where incumbent MNOs refuse to invest due to marginal business cases;
 - c.) Ensuring Public Safety continues to retain the ability to leverage spectrum carve-outs on a municipal basis, to build partnerships with MNOs for deployment of radio services that are important to the Community Safety and Wellbeing of their residents;

[Q11]

ISED is seeking comments on its proposal to remove the FSS allocation in the 3500-3650 MHz band and to suppress Canadian footnote C20 in the CTFA as detailed in annex B. In addition, ISED is seeking comments on the proposed grandfathering of the existing earth station operations listed in annex C, such

that fixed or mobile stations in the 3500-3650 MHz band will be required to coordinate with these earth stations as specified in SRSP-520.

Q11 Response:

41. We concur with the proposed approach for 3500-3650MHz spectrum, to grandfather in existing earth stations with a requirement for coordination around them, and for removal of Canadian footnote C20 in the CTFA per Annex B.
-

[Q12]

ISED is seeking comments on its proposal to remove the primary FSS allocation from 3650-3700 MHz and suppress Canadian footnote C33 in the CTFA as detailed in annex B.

Q12 Response:

42. In this case we also agree with the proposed ISED approach of removing the primary FSS allocation from 3.65-3.70GHz, and in removal of Canadian footnote C33 in the CTFA per Annex B.
-

[Q13]

ISED is seeking comments on:

- a) *establishing unpaired blocks of 10 MHz for the 3650-3700 MHz band*
- b) *establishing unpaired blocks of 10 MHz for the 3700-3980 MHz band*

Q13 Response:

43. In this case we would suggest there could be some advantage to harmonizing to a 20MHz band spacing plan aligned with the US FCC approach, for ease of cross-border coordination of Public Safety devices and equipment that may use 5G services in the future. Additionally, we note that to achieve maximum throughputs on par with 5G performance projections, that larger aggregated blocks are required, on the order of 100MHz.
44. If ISED is desirous of using an alternative with smaller 10MHz spacing – the advantage in theory is that more MNOs or new entrant service providers could be licensed in the same geographic areas, although with less throughput. Based on real-world testing of PSBNs in the Province of Ontario, it is our observation that a 20MHz allocation within a given region is really the minimum necessary in order to support an adequate quality of service for the anticipated boom of 5G bandwidth heavy broadband services over the coming years, from video calling to Cloud computing, IoT and beyond.
45. However, if ISED does adopt the smaller licensing approach of 10MHz blocks, (aware that ISED could license bundles of said blocks and given that 5G NR and LTE equipment support both sizes), we therefore suggest that a smaller block allocation should therefore include a reservation for Public Safety / municipal use, aligned with the practice of Public Safety carve-outs historically (e.g. 700MHz Band Class 14 and others in the past via LMR bands).
46. The use of reserved spectrum set-asides for municipalities gives both First Responders a key tool to overcome congestion, and for special utilization specific to Public Safety needs (e.g. ad-hoc radio deployables in urban disaster response) but also for deployment of radio resources in areas where costs from incumbent MNOs are too high and where there is a regional lack of competition or competitive forces.

47. ISED made four critically important points for Public Safety Agencies in its July 2019 decision document (see footnote 1) in sections 36, 37, 97 and 108 as follows:

(36) There are also non-commercial uses for spectrum that benefit the public good. This includes spectrum that is used to provide municipal or social services that enhance the capabilities of different public safety entities such as fire, police and other first responders, or that can be utilized for research by public and private institutions.

(37) ISED believes that all of the aforementioned use cases for spectrum are compelling and has designed the Tier 5 service areas with the flexibility in mind to support multiple services and business models. ISED will maintain the design principle to foster demand

48. For these reasons, the PIA strongly suggests that in new allocations for terrestrial 3.65GHz to 3.98GHz bands, that there be a corresponding Public Safety / municipal set-aside of some fraction of the new spectrum allocations, which will continue ISED's longstanding approach to Public Safety set-asides of radio spectrum, while at the same time assisting with market forces in order to prevent a further concentration of market power in the Canadian telecom market, and a further reinforcement of the chronically high costs that Canadians and Canadian 911 emergency response organizations pay for telecom services. This 3800MHz band allocation for Public Safety can be seen as a next-generation component for the coming growth of PSBNs in Canada in the coming decade.
49. Therefore, if ISED were to move to a smaller allocation block size than the US FCC approach, we would suggest the greater number of licenses provides even more of a rationale to ensure Public Safety and municipalities receive 5G spectrum set-asides for common societal / 911 emergency response needs, with the reservation of an appropriate spectrum block for First Responders on a Tier 5 municipal basis.
50. These 5G spectrum set asides in the 3.65-3.98GHz band could be licensed by municipalities via new entrant MNO ventures, in new P3 neutral-host business arrangements, or via partnerships with incumbent MNOs where advantageous to First Responders and local municipalities.
51. At a minimum we would suggest that two (2) of these 10MHz blocks be set aside for a total of 20MHz of reserved spectrum for Public Safety in the 3.65-3.98GHz range, with a preference for up to 50MHz of spectrum for municipal and Public Safety use, given the explosion of 5G applications and the growing need for reliable access to mobile data for emergency response. These "Public Safety / municipal" set asides could be held for dedicated private use by Public Safety and critical infrastructure entities in sensitive areas with critical infrastructure, or used in partnership with critical utilities (e.g. via "closed" cell sites in the vicinity of nuclear power plants or energy / fuel infrastructure) and yet also afford access to the general public through 4G / 5G prioritization and pre-emption services, or where private sites are "opened up" to the general public in times of disaster or societal need.
52. The use of set-asides can be also beneficial to society through offering municipalities a spectrum tool to engage in P3 or commercial partnerships with new entrants in areas that are currently underserved by incumbent MNOs, or as leverage in negotiating services to civilians in small municipalities to ensure a net lower cost of telecom for residents.
53. Spectrum policy as set by ISED plays a key role in addressing or potentially reinforcing the chronic high cost of telecom services in Canada, and so therefore we suggest municipal and Public Safety set-asides are an approach to both inject new-entrant and innovative new municipal neutral-host models, which foster new competitive market forces. For this reason, we suggest it very important that ISED continue its longstanding tradition of allocating spectrum for non-commercial uses that benefit the public good, with a PSBN allocation of 20MHz to 50MHz in size, within the 3.65-3.98GHz spectrum band.

[Q14]

Subsequent to changes to the spectrum utilization described in section 7 and recognizing the need to change the current WBS licensing model, ISED is seeking comments on its proposal to displace the existing WBS licensees and designate 80 MHz of spectrum available for the development of a new shared licensing process in the 3900-3980 MHz band as described in Option 2. Specifically, ISED is seeking comments on:

a) the amount of spectrum proposed (80 MHz) under a shared spectrum licensing process

b) whether there should be a provision that allows certain users (e.g. existing WBS licensees) priority licensing (e.g. an initial application window before accepting applications from others)

Q14 Response:

54. In this case, we suggest that from a Public Safety viewpoint, it would be important that all 5G spectrum in the 3.65 to 3.98GHz band that is deployed for commercial wide-area / general usage, include a Priority Access License (PAL) arrangement, which permits Public Safety a “digital right of way” to gain access to spectrum on a priority basis for fair-rate remuneration of services. This “digital right of way” for 911 emergency responders on 5G spectrum is a societal life-saving benefit, where in times of crisis or disaster, that Public Safety personnel responding to an emergency obtain top-of-queue access to wireless broadband, using prioritization and pre-emption services.
55. We would therefore strongly suggest to ISED that this approach to a prioritization & pre-emption concession in the 3.65-3.98GHz band (at fair market rates for such service) is critical for the needs of Public Safety access to data communications has rapidly grown where the current state has data now essentially as important as voice-only communications in the provision of effective 911 emergency services – due to operational efficiencies and growing use of Cloud computing, video-based calling, access to patient records and other next generation applications which all improve 911 response times and health outcomes for injured civilians.
56. We propose this prioritization & pre-emption capability for Emergency Responders be enshrined in the band plan for 5G services when final plans are written by ISED, and that this prioritization & pre-emption capability be in addition to spectrum carve-outs for municipalities and Public Safety due to the benefit of having spectrum for non-commercial uses, as agreed by ISED in its July 2019 decision and statements (see Footnote #1 above).
57. Regarding existing WBS users of the band, there is no ideal solution as unfortunately these users would be inconvenienced in either proposed recourse, however we suggest that Option 2 is the better arrangement for those existing WBS users. We defer to those users for a view on the economic impact of ISED’s decision on their business and services offered.
58. We agree with the suggestion in Option 2 related to a designation of frequencies from 3900-3980MHz as a shared-use band (presumably similar in manner to the PAL approach used in CBRS in similar bands in the USA) – in alignment with the success seen by the innovative CBRS tiered approach to spectrum sharing in the US, and as a means of offering more net competitive market forces, while balancing the need for prioritization for First Responder users in times of disaster or 911 emergency need.
59. Therefore, in summary, regarding item a.) we suggest that a PAL or prioritization scheme apply to at least a portion spectrum – similar in concept to that used in the CBRS PAL approach by the US

FCC for similar band allocations in the US, and that regarding item b.) that provision for priority and pre-emption services should be made for First Responders.

[Q15]

Given the proposal to implement Option 2, ISED is seeking information on potential costs such as upgrading equipment, which may be incurred by WISPs that are displaced from 3650-3700 MHz to provide services using the 3900-3980 MHz band.

Q15 Response:

60. We respectfully defer this question to incumbent WBS license holders for discussion.
-

[Q16]

Based on the proposal to implement Option 2, ISED is seeking comments on the proposed displacement deadlines, with WBS operations in urban areas being displaced by December 2023 and all others by December 2025. Respondents are invited to propose other protection and displacement options for consideration, provided they include a strong rationale.

Q16 Response:

61. We respectfully defer this question to incumbent WBS license holders for discussion as to an appropriate and reasonable timeframe for migration.
62. However, we suggest for consideration that a 5-year displacement timeframe as conducted in the US, is a fair period of time for businesses to prepare contingencies, but in the ISED proposal for a lesser 3-year period for Canadian urban centers, that such an approach essentially penalizes urban centers with a lesser 3 year period and seemingly relies on a rationale that “urban centers can handle the faster economic disruption better” – but this may not necessarily be the case.
63. In turn, setting the rural transition period to 5 years does not really provide a significant additional period to prepare for economic impacts, and really is simply aligned with the baseline timeframe provided to US rural regions.
-

[Q17]

ISED is seeking comments on the Tier 4 service areas that would be considered urban as defined above and as listed in annex D.

Q17 Response:

64. We suggest that the current ISED list designating Tier 4 service areas is adequate for the sake of timelines of grandfathered deployments. However, for the purpose of future licensing within the 3.65-3.98GHz spectrum, we suggest that a Tier 5 approach to more granular licensing – is more effective for Canada, and proven possible in the recent US experience.
65. As an example of the feasibility of conducting a Tier 5 style auction, we would suggest ISED refer to the FCC approach of auctioning PAL (Priority Access License) access to 3550-3650MHz spectrum – which constitutes a license auction with a similar number of counties that the

equivalent Tier 5 auction would require in Canada. ISED may refer to the FCC auction terms surrounding at the following URL – FCC Document 20-18 related to procedures for Auction 105:

<https://docs.fcc.gov/public/attachments/FCC-20-18A1.pdf>

66. As an illustrative quote from the FCC sample auction terms for their county based (i.e. essentially Tier 5 level equivalent) auction in FCC 20-18, we cite from the above URL – on page 5:

“C. Description of Licenses to Be Offered in Auction 105

*7. Auction 105 will offer seven PALs in each county-based license area. Each PAL consists of a 10-megahertz unpaired channel within the 3550-3650 MHz band. **The auction will offer a total of 22,631 PALs.** PALs are 10-year renewable licenses. A Priority Access Licensee may hold up to four 10-megahertz channel licenses (out of a total of seven) within the band in any license area at any given time”*

67. This county-based PAL auction for 3550-3650MHz spectrum is slated to begin this year – delayed by 1 month due to the Coronavirus pandemic to July of 2020.
68. Therefore, we respectfully suggest that a Tier 5 approach to auctions for 3500MHz-4200MHz spectrum is indeed feasible, and a more granular approach would offer advantages in terms of greater access to spectrum for new entrants and municipalities.

[Q18]

ISED is seeking comments on whether the moratorium should be extended to include all Tier 4 service areas.

Q18 Response:

69. Given the need to prevent new WBS deployments that may be grandfathered shortly in conjunction with outcomes from this consultation, and given the potential for economic loss by any new entrant that inadvertently licenses WBS spectrum to only have it removed or grandfathered in the very near future, we would suggest it is in the interest of all market participants to be aware of the moratorium, and so suggest the moratorium should be extended to all Tier 4 service areas.

[Q19]

ISED is seeking preliminary comments on the future spectrum licensing process for 3900-3980 MHz, including the following:

a) what type of applications are envisioned for this spectrum

b) what type of shared licensing process ISED should consider (e.g. database approach, licensee to licensee coordination)

c) what additional measures ISED should consider employing to manage access to the band in high demand areas, such as major metropolitan centres

d) what technical restrictions should be considered (e.g. technical rules similar to adjacent 3500 MHz flexible use band with reduced power levels, a guard band between new flexible use systems below 3900 MHz, shared use above 3900 MHz, etc.)

e) what type of eligibility criteria, if any, should be established

Q19 Response:

70. We applaud ISED's thoughts of considering other international jurisdictions with a shared access regime for at least a portion of the 3.65-3.98GHz spectrum under discussion. In particular we suggest that the innovation seen in the CBRS technology approach by the US FCC is a role model for ISED to consider for at least part of the band, and indeed if Canada were to align with the CBRS approach successfully being auctioned and deployed by the US FCC, we would have a ready ecosystem of viable equipment, which would provide cost savings and synergies to Canadian service providers and First Responder users / civilian users, without a need to invent new markets and products.
71. In this case, we suggest that from a Public Safety viewpoint, it would be important that all 5G spectrum in the 3.65 to 3.98GHz band (i.e. not just 80MHz from 3.90-3.98GHz) that is deployed for commercial wide-area / general usage, include a Priority Access License (PAL) arrangement or a "prioritization & pre-emption concession for emergency services", which permits Public Safety a "digital right of way" to gain access to spectrum on a priority basis for fair-rate remuneration of services. This "digital right of way" for 911 emergency responders on 5G spectrum is a societal life-saving benefit, where in times of crisis or disaster, that Public Safety personnel responding to an emergency obtain top-of-queue access to wireless broadband, using prioritization and pre-emption services.
72. We would therefore strongly suggest to ISED that this approach to a "prioritization & pre-emption concession" in the 3.65-3.98GHz band (at fair market rates for such service) is critical for the needs of Public Safety access to data communications has rapidly grown where the current state has data now essentially as important as voice-only communications in the provision of effective 911 emergency services – due to operational efficiencies and growing use of Cloud computing, video-based calling, access to patient records and other next generation applications which all improve 911 response times and health outcomes for injured civilians.
73. We propose this prioritization & pre-emption capability for Emergency Responders be enshrined in the band plan for 5G services when final plans are written by ISED, and that this prioritization & pre-emption capability be in addition to spectrum carve-outs for municipalities and Public Safety due to the benefit of having spectrum for non-commercial uses, as agreed by ISED in its July 2019 decision and statements (see Footnote #1 above).
74. In response to the specific sub-questions:
75. a.) From a public safety stance, we would see use cases ranging from the advent of high bandwidth video calling as a societal trend and a necessity for Public Safety and 911 emergency responders to communicate with the public, the use of data heavy Cloud computing services, the use of shared desktop and shared whiteboards for emergency response, access to health records (e.g. paramedics en-route to a hospital with a patient), the use of Internet of Things (IoT) sensors on a growing scale, the use of Augmented Reality (e.g. overlay of data for Fire-fighters' visors while operating in a building), and added data-heavy applications that will certainly be conceived of and deployed in the future.
76. b.) Given the ready ecosystem, the successful market paradigm and technology, we respectfully suggest a CBRS style approach that leverages the existing CBRS technology, distributed database management approach, and ability to mix PAL licenses with General Access users, and

a highest tier for possibly military or First Responder users as seen in the US FCC deployment approach.

77. c.) We respectfully suggest that given the possibility of congestion in urban areas, and given the need of First Responders to priority access to data as a part of their non-profit life-saving service and societal benefits gained from reliable 911 access, that prioritization for First Responders (at fair remuneration) be enshrined in all such 3.65-3.98GHz band licenses in the future. Additionally, we suggest that a carve-out of spectrum for municipal Public Safety be included in the band plan.
78. At a minimum we would suggest that two (2) of these 10MHz blocks be set aside for a total of 20MHz of reserved spectrum for Public Safety in the 3.65-3.98GHz range, with a preference for up to 50MHz of spectrum for municipal and Public Safety use, given the explosion of 5G applications and the growing need for reliable access to mobile data for emergency response. These "Public Safety / municipal" set asides could be held for dedicated private use by Public Safety and critical infrastructure entities in sensitive areas with critical infrastructure, or used in partnership with critical utilities (e.g. via "closed" cell sites in the vicinity of nuclear power plants or energy / fuel infrastructure) and yet also afford access to the general public through 4G / 5G prioritization and pre-emption services, or where private sites are "opened up" to the general public in times of disaster or societal need.
79. The use of set-asides can be also beneficial to society through offering municipalities a spectrum tool to engage in P3 or commercial partnerships with new entrants in areas that are currently underserved by incumbent MNOs, or as leverage in negotiating services to civilians in small municipalities to ensure a net lower cost of telecom for residents.
80. Spectrum policy as set by ISED plays a key role in addressing or potentially reinforcing the chronic high cost of telecom services in Canada, and so therefore we suggest municipal and Public Safety set-asides are an approach to both inject new-entrant and innovative new municipal neutral-host models, which foster new competitive market forces. For this reason, we suggest it very important that ISED continue its longstanding tradition of allocating spectrum for non-commercial uses that benefit the public good, with a PSBN allocation of 20MHz to 50MHz in size, within the 3.65-3.98GHz spectrum band.
81. ISED made four critically important points for Public Safety Agencies in its July 2019 decision document (see footnote 1) in sections 36, 37, 97 and 108 as follows:

(36) There are also non-commercial uses for spectrum that benefit the public good. This includes spectrum that is used to provide municipal or social services that enhance the capabilities of different public safety entities such as fire, police and other first responders, or that can be utilized for research by public and private institutions.

(37) ISED believes that all of the aforementioned use cases for spectrum are compelling and has designed the Tier 5 service areas with the flexibility in mind to support multiple services and business models. ISED will maintain the design principle to foster demand
82. For these reasons, the PIA strongly suggests that in new allocations for terrestrial 3.65GHz to 3.98GHz bands, that there be a corresponding Public Safety / municipal set-aside of some fraction of the new spectrum allocations, which will continue ISED's longstanding approach to Public Safety set-asides of radio spectrum, while at the same time assisting with market forces.
83. d.) We suggest that in regard to additional technical restrictions that ISED look to the ground breaking work conducted by the US FCC in their CBRS endeavours as indicative of some areas of concern to plan for, and as lessons learned for ISED and Canada in the future.
84. e.) From an eligibility criteria stance, we would suggest for Public Safety PAL or top priority access schemes, that tri-services Public Safety agencies (Police, Fire, EMS) be all considered eligible for such "digital right of way" prioritization within the 3.65-3.98GHz band.

The PIA remains available to ISED for any follow-up questions or discussion desired on these points.

[Q20]

ISED is seeking comments on its proposal that existing FSS earth stations licensed in 3650-3700 MHz after June 11, 2009, be permitted to continue to operate on a no-protection basis with respect to proposed new flexible use operations.

Q20 Response:

85. On this item, we suggest that ISED's proposed approach is a reasonable method to limit the damage to incumbent licensees of FSS earth stations, in particular since a reasonable "warning" was provided over the past 11 years - since 2009 - to such market players, and given the approaches seen in other jurisdictions around the world in support of LEO / FSS services in these bands.
 86. We defer to FSS licensees for a discussion of negative impacts or specific issues they will encounter in such an arrangement.
-

[Q21]

ISED is seeking comments on whether the Tier 4 service areas identified for exemption of certain provisions in GL-10 for mmWave bands as listed in annex E would be appropriate to apply for FSS operations in the 3700-4200 MHz band. ISED invites alternative proposals for areas that would be considered satellite-dependent (e.g. based on Tier 5 categories).

Q20 Response:

87. On this item, we suggest that communities which are satellite dependent be permitted to be exempted from certain provisions, in order to provide sufficient FSS capacity for continued services to those remote communities that continue to be un-connected to terrestrial fiber backhaul or major MNO networks.
88. In these areas, as populations grow beyond a certain threshold (which should be revisited by ISED over time), their primary need for FSS services may be supplanted over time with a need for more terrestrial 5G services. At such time as populations exceed some ISED defined threshold, they may warrant a removal of the exemptions at that time to permit more capacity for 5G spectrum needs.
89. In the interim time until these remote municipalities obtain sufficient population to warrant building of adequate fiber connections and wide area terrestrial / cellular 5G coverage, these municipalities could make use of 700MHz spectrum and the PSBN concepts which our organization – the PIA – have proposed, where the 20MHz of spectrum available in Band Class 14 could be used to provide 4G / 5G services in a neutral-host or P3 partnership between a given municipality and interested MNO partners, or new entrants.
90. The PIA has offered the concept of "Community Safety Broadband", which uses 700MHz Band Class 14 as a kernel or seed of spectrum, which we propose be made available to municipalities

and their local Public Safety entities on a primary and low or zero cost licensing basis, and that these 700MHz network can effectively be a starter spark for 5G in areas that lack the population base for large incumbent MNOs that continue to decline to invest. We further propose that 700MHz spectrum be licensed with HPUE (high power user equipment) mode as is proposed in the US PSBN deployments, to permit greater range in sparsely populated areas.

91. This proposal for 700MHz to act as a “5G bridge” in rural areas could be also used in these satellite dependent communities, where 700MHz coupled with LEO or FSS services can provide a low-cost 4G / 5G experience to smaller populations or sparsely populated areas, with the added benefit of growing 911 call access for civilians, and providing First Responders with cellular access in regions that previously did not have cellular services.
92. The 700MHz PSBN band with HPUE mode is an ideal “glue layer” to permit rural communities to enjoy a level of early access to 4G / 5G and the benefits of improved 911 calling and Public Safety access to data, while at the same time permitting parallel use of 3.65-4.2GHz spectrum for primarily FSS based communications.
93. We have provided an overview of the PIA’s “Community Safety Broadband” concept in Appendix G of this document, for consideration of our proposal in having 700MHz act as an intermediate step in rural areas for a measure of 4G / 5G services and improved emergency responder access, until such time that populations favour the commercial exploitation of 3.65-4.2GHz spectrum for 5G services instead of FSS.

[Q22]

ISED is seeking comments on whether certain remote industry operations, for example offshore oil drilling platforms, should be included in the definition of satellite-dependent areas.

Q22 Response:

94. Yes, we would agree that these cases related to mining operations and off-shore oil drilling entities should be included in the definition of satellite-dependent areas.

[Q23]

ISED is seeking comments on its proposal to modify the existing FSS satellite authorizations to limit FSS operations in 3700-4000 MHz in non-satellite-dependent areas of Canada to a no- interference basis. ISED is also seeking comments on the proposal to adjust the conditions of licence for FSS operations to reflect the proposals as of the FSS transition deadline, including the possible removal of a high expectation of renewal for the 3700-4000 MHz portion of the band.

Q23 Response:

95. Yes, we would agree with the approach to limit FSS operations in non-satellite dependent areas to a no-interference basis.

[Q24]

ISED is seeking comments on its proposed date of December 2023 as the Canadian FSS transition deadline.

Q24 Response:

96. Given the fact that the US will be proceeding with its plans and published deadlines, and that RF interference now appears to be imminent, and given the US intention to proceed – we concur with the RF interference implications that ISED appears to describe in this subsection of the consultation – we’re not certain there is a real choice in timelines at this late juncture.
97. We suggest for consideration that a 5-year displacement timeframe - as conducted in the US - is a fair period of time for businesses to prepare business contingencies. However in this proposal ISED is looking to deploy the proposed changes in less than a 3-year period for Canadian urban centers, and it should be recognized by ISED that such an approach essentially penalizes Canadian urban centers with a lesser 3 year period and seemingly relies on a rationale that telecom service provider businesses in “urban centers can handle the faster economic disruption better” – but this may not necessarily be the case.

[Q25]

ISED is seeking comments on how the U.S. transition will impact the availability of FSS capacity in Canada.

Q25 Response:

98. Given the late date of this consultation vis-à-vis the path and intentions taken by the US government and FCC over the past number of years, namely to proceed with their plans on 3.65-4.2GHz spectrum usage - as ISED has suggested in section 9.4 of this consultation it appears Canadian services will indeed be subject to interference if we transition later than our US counterparts. Furthermore, with an alternate date scheme we potentially incur delays in receipt of such future LEO FSS services beyond the US planned timelines for deployment.

[Q26]

ISED is requesting information to assist with the consequent decision following this consultation. This information includes satellite transponder migration plans, frequencies, and how satellite operators serving the Canadian market will accommodate all Canadian customers, and on which frequencies. Requested information could include, but is not limited to:

- *the names and number of satellites that will need to migrate to the 4000-4200 MHz band*
- *the number of new satellites that may be required to serve the Canadian market*
- *the locations of earth stations communicating with these satellites*
- *the number of antennas and locations of associated earth stations that will need to be returned and/or repointed*

- *the flexibility of existing satellites to modify operations according to the different areas of Canada*

Q26 Response:

99. We defer this response to identified satellite operators, as requested in this question.

[Q27]

ISED is seeking comments on its proposed transition deadline of December 2023 for FSS earth stations, in which existing FSS earth station licenses would be modified to 4000-4200 MHz in the relevant areas.

Q27 Response:

100. As noted previously, we suggest that harmonization for economic and Public Safety interoperability reasons is a desired outcome, and that given the stage of this consultation and stage of US spectrum transition, that we have no real choice but to proceed and meet the December 2023 target.

[Q28]

ISED is seeking comments on making amendments to the relevant conditions of licence and technical rules in the 3700-4200 MHz band as well as the 3450-3700 MHz band in order to implement the following proposals with respect to protection from interference:

a) prior to the transition deadline, existing licensed FSS earth stations may operate in the entire 3700-4200 MHz band in all areas and be protected from interference from flexible use operations both in-band (3700-3980 MHz) and the adjacent 3450-3700 MHz band

b) after the transition deadline, existing licensed FSS earth stations may continue to operate in the entire 3700-4200 MHz band in satellite-dependent areas and be protected from interference from in-band flexible use operations in 3700-3980 MHz, but would not be protected from flexible use operations in the adjacent 3450-3700 MHz band; however, ISED also proposes that flexible use licensees deploying stations in the 3450-3700 MHz band within 25 km of an existing licensed FSS earth station in the 3700-4200 MHz band be required to provide a notification to these operators, one year prior to the deployment of fixed or mobile stations

c) after the transition deadline, FSS earth stations would only be licensed to operate in the 4000-4200 MHz band in non-satellite-dependent areas and would be protected from flexible use operations in the adjacent 3700-3980 MHz band

d) after the transition deadline, FSS earth stations operating in 3700-4000 MHz, in all areas, which are not eligible for licensing could continue to operate as a licence-exempt station without protection from flexible use operations both in-band and adjacent band(s)

Q28 Response:

101. We concur with ISED's proposed plan on amendments to the relevant conditions of license and technical rules, as outlined by points a) through d) of this question.
-

[Q29]

ISED is seeking comments on the proposed change to the CTFA to add the new footnote CZZ proposed above and shown in annex B.

Q29 Response:

102. We concur with ISED's proposed plan on amendments to the relevant conditions of license and technical rules, as proposed in Question 28, and we also concur with the proposed change to the CTFA and new footnote as proposed in Annex B.
-

[Q30]

ISED is seeking comments on how to ensure the continued operation of gateways that support the provision of services in satellite-dependent areas, specifically:

a) how much spectrum would be required at these gateway sites

b) if these stations could be consolidated into two sites, away from major population centres, and where the best locations for those sites would be

Q30 Response:

103. We concur with ISED's proposed plan to consolidate FSS gateways.
104. We defer in a.) to FSS service providers to propose appropriate spectrum to meet demands.
105. In b.) we suggest that consolidation is appropriate – however from a continuity of operations and disaster proofing stance, that 2 sites may be inadequate to provide the level of statistical protection from failure modes. There should be strong consideration that given the geographic size and the statistical potential for man-made and natural disasters essentially on par with the USA, (i.e. similar disaster failure modes as the USA) that instead of 2 gateway sites there could in fact be a similar need for 4 gateway sites as a prudent measure to guarantee up-time and Public Safety communications. Geographic location of these 4 (or 2) gateway sites should be spaced across the Canadian geography (e.g. Western Canada, Ontario, Quebec, and Atlantic Canada) and with appropriate inter-site redundancy and capacity provisioned for re-routing of traffic in the event of failures at a given site.
-

[Q31]

ISED is seeking comments on its proposal to issue interim authorizations for certain existing licence-exempt earth stations in the 3700-4200 MHz band.

Q31 Response:

106. We concur with the proposal from ISED on this question.

[Q32]

ISED is seeking comments on the proposed deadline of up to 90 days after the publication of a decision for submitting applications for these interim authorizations of existing licence-exempt FSS earth stations in the 3700-4200 MHz band.

Q32 Response:

107. We concur with the proposal from ISED on this question.

[Q33]

ISED is seeking comments on its proposal that receive-only earth stations that are not eligible for an interim authorization or whose operators do not seek authorization, could continue to operate as a license-exempt earth station on a no-protection basis.

Q33 Response:

108. We concur with the proposal from ISED on this question.

[Q34]

ISED is seeking comments on its proposal that in non-satellite-dependent areas, existing earth stations that operate under interim authorizations receive in-band protection from flexible use operations in the 3700-3980 MHz band until the transition deadline.

Q34 Response:

109. We concur with the proposal from ISED on this question.

[Q35]

ISED is seeking comments on its proposal that in satellite-dependent areas, existing earth stations that operate under an interim authorization receive in-band protection from flexible use operations in the 3700-3980 MHz band before and after the transition deadline.

Q35 Response:

110. We concur with the proposal from ISED on this question.

[Q36]

ISED is seeking comments on its proposal that in all areas, existing license-exempt earth stations that operate under an interim authorization receive no protection from adjacent band WBS stations and flexible use stations operating below 3700 MHz before and after the transition deadline.

Q36 Response:

111. We concur with the proposal from ISED on this question.

[Q37]

ISED is seeking comments on whether the interim authorization process should also apply to new receive-only FSS earth stations in the 4000-4200 MHz band.

Q37 Response:

112. We concur with the proposal from ISED on this question.

113. We respectfully submit a possible option for consideration, given the quick-turn timelines associated with this consultation, that in the event an existing licensee for the noted “enterprise” networks that may be seeking an interim authorization is a Public Safety entity – or offers critical services to Public Safety entities with lifesaving missions, and if such entity reasonably requires additional time for transition or application for interim authorization, that ISED consider such requests and where reasonable and given a justified rationale where there is direct impact on lifesaving services and continuity of operation for Emergency Responders. In such circumstances that could impact 911 Emergency Services personnel we request that ISED consider such extension requests where reasonable and appropriate.

[Q38]

ISED is seeking comments on the proposed conditions for interim authorizations for license-exempt FSS earth stations in 3700-4200 MHz and new receive-only FSS earth stations in the 4000-4200 MHz portion of the band as detailed in annex G.

Q38 Response:

114. We respectfully submit a possible option for consideration, given the quick-turn timelines associated with this consultation, that in the event an existing licensee for the noted “enterprise”

networks that may be seeking an interim authorization is a Public Safety entity – or offers critical services to Public Safety entities with lifesaving missions, and if such entity reasonably requires additional time for transition or application for interim authorization, that ISED consider such requests and where reasonable and given a justified rationale where there is direct impact on lifesaving services and continuity of operation for Emergency Responders. In such circumstances that could impact 911 Emergency Services personnel we request that ISED consider such extension requests where reasonable and appropriate.

[Q39]

ISED is seeking comments on the proposed eligibility of license-exempt stations that could apply for an interim authorization.

Q39 Response:

115. We respectfully submit a possible option for consideration, given the quick-turn timelines associated with this consultation, that in the event an existing licensee for the noted “enterprise” networks that may be seeking an interim authorization is a Public Safety entity – or offers critical services to Public Safety entities with lifesaving missions, and if such entity reasonably requires additional time for transition or application for interim authorization, that ISED consider such requests and where reasonable and given a justified rationale where there is direct impact on lifesaving services and continuity of operation for Emergency Responders. In such circumstances that could impact 911 Emergency Services personnel we request that ISED consider such extension requests where reasonable and appropriate.
-

[Q40]

ISED is seeking comments on its proposal to no longer issue new licenses for fixed services to operate fixed point-to-point applications in the 3700-4000 MHz band.

Q40 Response:

116. We concur with the proposal from ISED on this question. It should be noted that “Fixed” operations can continue under the guise of stationary use of a mobile licensing regime, for potential future use of static 5G IoT sensors in these bands (e.g. bridge load sensors for Public Safety, static roadway sensors, etc.).
-

[Q41]

ISED is seeking comments on whether to allow new licenses for fixed services to operate fixed point-to-point applications in the 4000-4200 MHz band.

Q41 Response:

117. We respectfully suggest that the new orientation / goal of the 4000-4200MHz band is for FSS (satellite) communications per the re-farming proposals of this consultation, and as such to the furthest degree possible (except potentially for any grandfathered fixed links) this band should be

retained for FSS communications. We consider it could be counter-productive to FSS communications if new licenses for fixed services were permitted, and that there are other bands that could suffice for such fixed point-to-point backhaul requirements.

118. We respectfully submit a possible option for consideration, given the quick-turn timelines associated with this consultation, that in the event an existing licensee for the noted fixed links that may be seeking an interim authorization is a Public Safety entity – or offers critical services to Public Safety entities with lifesaving missions, and if such entity reasonably requires additional time for transition or application for interim authorization, that ISED consider such requests and where reasonable and given a justified rationale where there is direct impact on lifesaving services and continuity of operation for Emergency Responders. In such circumstances that could impact 911 Emergency Services personnel we request that ISED consider such extension requests where reasonable and appropriate.

[Q42]

ISED is seeking comments on the proposal to grandfather existing point-to-point operations in the 3700-4000 MHz band under existing licenses for fixed service (as identified in annex A), such that flexible use systems in these two tiers may not claim protection from, nor cause interference to these fixed service stations.

Q42 Response:

119. We respectfully suggest that the new orientation / goal of the 3700-4000MHz band is for mobile 5G communications per the re-farming proposals of this consultation, and as such to the furthest degree possible (except potentially for discrete period of time for any grandfathered fixed links) this band should be retained for mobile 5G communications. We consider it could be counter-productive to 5G mobile communications if new licenses for fixed services were permitted, and that there are other bands that could suffice for such fixed point-to-point backhaul requirements.
120. We respectfully submit a possible option for consideration, given the quick-turn timelines associated with this consultation, that in the event an existing licensee for the noted fixed links that may be seeking an interim authorization is a Public Safety entity – or offers critical services to Public Safety entities with lifesaving missions, and if such entity reasonably requires additional time for transition or application for interim authorization, that ISED consider such requests and where reasonable and given a justified rationale where there is direct impact on lifesaving services and continuity of operation for Emergency Responders. In such circumstances that could impact 911 Emergency Services personnel we request that ISED consider such extension requests where reasonable and appropriate.

[Q43]

ISED is seeking comments on the proposal to rely on technical limits and coordination procedures rather than mandate specific technology solutions (e.g. TDD synchronization between systems) to address interference issues between TDD flexible use systems in the 3650-3980 MHz band.

Q43 Response:

121. In the United States, the CBRS is the Citizens Broadband Radio Service that opens up 150 MHz of spectrum in the 3.5 GHz band for commercial use in the US. This is spectrum traditionally used

by the military and commercial satellite operators and wireless internet service providers (WISPs). In order to take advantage of CBRS, a network must employ a spectrum access system (SAS) and have access to an Environmental Sensing Capability (ESC) network to dynamically manage the spectrum use.

122. We respectfully suggest that this innovative approach to spectrum management and interference mitigation, as proven out and adopted by the FCC in the USA could be used in Canada on some portion of the 3.65-3.98GHz spectrum in order to effectively increase access to new mobile network operator (MNO) entrants, municipalities and others – and in an effort to maximize the potential spectral efficiency of 5G spectrum, given the anticipated growth of uses by society over the next 20 – 30 years (e.g. Cloud computing, augmented reality, video calling growth, IoT, etc.). Given the high cost of telecom services in Canada, creative new approaches that have been proven in other nations (e.g. CBRS) should be considered by ISED.
123. Furthermore, the Priority Access License (PAL) approach inherent to the CBRS model could provide a mechanism to both handle Public Safety and military applications in Canada, as well as incumbent MNOs and new entrants, and unlicensed users such as municipal neutral-host networks, in regions that are underserved by incumbent MNOs, etc.
124. The SAS is an automated frequency coordinator that manages spectrum sharing on a dynamic, as-needed basis across three tiers of access:
125. Tier 1 is incumbent users such as the federal government and fixed satellite users.
126. Tier 2 is Priority Access License (PAL) users. These are licensed wireless users who acquire spectrum through an auction. The SAS will ensure PAL users do not cause harmful interference to Tier 1 users and will protect PAL users from interference by General Authorized Access (GAA) users.
127. Tier 3 is GAA users who will deploy “lightly-licensed” devices. The SAS will ensure GAA users do not cause harmful interference into Tier 1 incumbents and Tier 2 PAL users.
128. If spectrum is not being used by one tier it can be accessed by another via the SAS—securely and without harmful interference. By definition, PAL is licensed and is afforded interference protection from GAA. PAL licenses will be purchased at auction. There will be up to 70 MHz of PAL spectrum available in any area, which can be chosen from 100 MHz of the CBRS band (3550–3650 MHz).
129. Many refer to GAA tier users as unlicensed users. However, although GAA users do not require a license, they must meet the FCC’s technical, financial, character, and citizenship qualifications to be eligible as a GAA user. Use cases may differ slightly between PAL and GAA.
130. In general, we suggest that the success seen in the CBRS approach to auction and efficient spectrum utilization is an approach that should be considered by ISED, given its potential for equally lucrative spectrum auction fees, but also due to the ability to open spectrum resources for non-traditional telecom players in Canada, which can help to alleviate the high cost of telecom services and promote new Canadian service provider entrants into the market.

[Q44]

ISED is seeking comments on whether any additional measures should be taken to limit potential interference issues between flexible use systems in the 3650-3980 MHz band.

Q44 Response:

131. CBRS is the Citizens Broadband Radio Service that opens up 150 MHz of spectrum in the 3.5 GHz band for commercial use in the United States. This is spectrum traditionally used by the military and commercial satellite operators and wireless internet service providers (WISPs). In order to take advantage of CBRS, your network must employ a spectrum access system (SAS) and have access to an Environmental Sensing Capability (ESC) network to dynamically manage the spectrum use.
132. We respectfully suggest that this innovative approach to spectrum management and interference mitigation, as adopted by the FCC in the USA could be used in some portion of the 3.65-3.98GHz spectrum in order to effectively increase access to new mobile network operator (MNO) entrants, municipalities and others – in an effort to maximize the potential spectral efficiency of 5G spectrum, given the anticipated growth of uses by society over the next 20 – 30 years (e.g. Cloud computing, augmented reality, video calling growth, IoT, etc.). Given the high cost of telecom services in Canada, creative new approaches that have been proven in other nations (e.g. CBRS) should be considered.
133. Furthermore, the Priority Access License (PAL) approach inherent to the CBRS model could provide a mechanism to both handle Public Safety and military applications in Canada, as well as incumbent MNOs and new entrants, and unlicensed users such as municipal neutral-host networks, in regions that are underserved by incumbent MNOs, etc.
134. In general, we suggest that the success seen in the CBRS approach to auction and efficient spectrum utilization is an approach that should be considered by ISED, given its potential for equally lucrative spectrum auction fees, but also due to the ability to open spectrum resources for non-traditional telecom players in Canada, which can help to alleviate the high cost of telecom services and promote new Canadian service provider entrants into the market.

[Q45]

ISED is seeking comments on whether specific technical measures should be adopted to address potential interference issues between flexible use systems and WBS systems until the displacement deadline.

a) For co-channel flexible use and WBS operations in the 3650-3700 MHz band, what specific measures may be needed to protect WBS? For example, should new flexible use stations be required to coordinate with WBS stations within a specified distance prior to deployment? Alternatively, should a technical parameter such as a power flux density (pfd) trigger for coordination measured at the WBS receive antenna be adopted? Are there other more appropriate measures that ISED should consider? Should multiple measures, such as a combination of distance and pfd trigger for coordination, be adopted? How would these requirements impact the deployment of new flexible use stations?

b) For adjacent band flexible use systems, is there a need to adopt any additional measures, beyond what is currently specified in RSS-192 and SRSP-520, to further address coexistence between these flexible use and WBS systems? If so, what should they be? How many flexible use frequency blocks (or MHz) immediately adjacent to the 3650-3700MHz band could potentially affect WBS systems? How would these requirements impact the deployment of flexible use stations?

Q45 Response:

135. In regard to item a.) on interference mitigation for the interim period until displacement, we suggest that coordination between WBS and new flexible use stations occur within an appropriate range (e.g. 30km) Additionally, we suggest that use of both PFD measures and distance be used as a two-criteria approach to trigger coordination. We suggest that the deployment of new base stations would not be impacted given that all parties are expected to use diligent calculation, commissioning, measurement and preparatory engineering work in advance of field deployments – and so such conditions could reasonably be anticipated.
136. In turn, for item b.) we propose that the terms specified in RSS-192 and SRSP-520 are sufficient.
-

[Q46]

Until the transition deadline, in all areas for flexible use in the 3650-3700 MHz band: ISED is seeking comments on the proposal that until the transition deadline, those flexible use licensees deploying stations in 3650-3700 MHz within 25 km of a licensed FSS earth station (not including interim FSS authorization) in the 3700-4200 MHz band will be required to coordinate with the operators in these earth stations.

Q46 Response:

137. We concur with the proposal from ISED on this question.
-

[Q47]

After the transition deadline, in all areas for flexible use in the 3450-3650 MHz band: ISED is seeking comments on its proposal that the current SRSP-520 coexistence requirements for flexible use operations in the 3450-3650 MHz band to protect FSS operations in the adjacent band 3700-4200 MHz be removed.

Q47 Response:

138. We concur with the proposal from ISED on this question.
-

[Q48]

For FSS earth stations licensed in the 4000-4200 MHz band and flexible use in the 3800 MHz band, in all areas: ISED is seeking comments on adjacent band coexistence measures, taking into account the coexistence measures adopted by the EU (i.e. a stringent OOB limit) and the U.S. (i.e. a combination of guard band, a typical OOB limit, pfd limits, and baseline minimum filter specifications for earth station operations) and the current Canadian requirements (i.e. a typical OOB limit and coordination distance):

- a) What are the benefits and technical limitations associated with the above coexistence measures?*

b) Which set of coexistence measures above (i.e. EU, U.S., Canada) is preferred? If applicable, comments are sought on the values of the limits in relation to the supported measures.

c) Given the proposal in section 9.1 to displace WBS in 3650-3700 MHz and identify 3900-3980 MHz for shared use, are there any additional considerations that may impact the response to a) and b) above?

d) Which portion of the 3800 MHz band should the above measures be applied to in order to protect FSS in the 4000-4200 MHz band (i.e. how many frequency blocks or MHz)?

Q48 Response:

139. In response to item a.) we suggest that the advantage of harmonization with the US and the multiple measures will help mitigate interference, given the pragmatic reality that our one contiguous land border is adjacent to the US and will encounter cases of interference with US based users. Additionally, the US approach represents a bit of a middle-road in terms of complexity and rigidity – between the Canadian and European models.
140. In response to item b.), as in a.) above we suggest the US approach is a middle of the road strategy that provides some added considerations beyond the current Canadian model, but does unduly not clamp down on OOBES.
141. We defer a response to item c.) due to time constraints in submitting this response document, but would welcome the opportunity to respond in follow-on discussions with ISED.

[Q49]

ISED is seeking comments on what technical requirements should be imposed to ensure co-channel protection of FSS earth stations from flexible use systems, in the relevant scenarios and timeline as stated in sections 9.5 and 9.6. For example, could the pfd limit of -124 dBW/m2/MHz measured at the earth station antenna proposed by FCC above be used to protect co-channel FSS earth station? Alternatively, should other measures be adopted, such as a separation distance as described in section 7.3? Or should a combination of measures be adopted? If applicable, what are the specific values that should be adopted?

Q49 Response:

142. We propose that as noted in section 7.3, up to a 60km radius around FSS earth stations may be required. As a conservative approach to reducing the probability of interference, we propose a combination of distance specification (e.g. 60km) and a PFD limit per the FCC work in this domain.

[Q50]

ISED is seeking comments on whether the assumptions made by the FCC about earth stations, including baseline minimum filter specifications for earth station operations as stated above, are applicable to Canadian operations. Is there any additional information that ISED should consider in the development of appropriate technical rules to enable coexistence both co-channel and in adjacent bands?

Q50 Response:

143. We suggest that the FCC specifications are indeed applicable to the Canadian case for operations.
-

[Q51]

ISED is seeking comments on its proposal to not implement any technical requirements for the coexistence between flexible use operation in the 3650-3980 MHz band and radionavigation operations in the 4200-4400 MHz band, noting the 220 MHz frequency separation between the bands of operation. If this is not sufficient for coexistence, what other measures would be appropriate?

Q51 Response:

144. We suggest that the proposed ISED separation of 220MHz is adequate.
-

[Q52]

ISED is seeking comments on the use of an auction as the licensing process for the flexible use spectrum that would be considered as the 3800 MHz band, noting a separate consultation process would be issued, if required, to determine the licensing framework for the range 3900-3980 MHz.

Q52 Response:

145. In the event that the Telesat proposal in the last portion of this submission is not accepted by the ISED and the Canadian government, then yes, we suggest that an auction approach with a set-asides for a municipal / Public Safety use, permitting remote and rural regions that have shown a lack of incumbent MNO interest – have the set-aside as a last recourse to “jump start” 5G deployments in their regions.
146. In the event that the Telesat proposal is in fact accepted, we suggest that a municipal / Public Safety set aside is compatible with the Telesat proposal, potentially in the 3900-4100MHz portion that Telesat proposes ISED would govern for licensing.
147. The use of reserved spectrum set-asides for municipalities gives both First Responders a key tool to overcome congestion, and for special utilization specific to Public Safety needs (e.g. ad-hoc radio deployables in urban disaster response) but also for deployment of radio resources in areas where costs from incumbent MNOs are too high and where there is a regional lack of competition or competitive forces.
148. ISED made four critically important points for Public Safety Agencies in its July 2019 decision document (see footnote 1) in sections 36, 37, 97 and 108 as follows:
149. ***(36) There are also non-commercial uses for spectrum that benefit the public good. This includes spectrum that is used to provide municipal or social services that enhance the capabilities of different public safety entities such as fire, police and other first responders, or that can be utilized for research by public and private institutions.***

150. ***(37) ISED believes that all of the aforementioned use cases for spectrum are compelling and has designed the Tier 5 service areas with the flexibility in mind to support multiple services and business models. ISED will maintain the design principle to foster demand***
151. For these reasons, the PIA strongly suggests that in new allocations for terrestrial 3.65GHz to 3.98GHz bands, that there be a corresponding Public Safety / municipal set-aside of some fraction of the new spectrum allocations, which will continue ISED's longstanding approach to Public Safety set-asides of radio spectrum, while at the same time assisting with market forces in order to prevent a further concentration of market power in the Canadian telecom market, and a further reinforcement of the chronically high costs that Canadians and Canadian 911 emergency response organizations pay for telecom services. This 3800MHz band allocation for Public Safety can be seen as a next-generation component for the coming growth of PSBNs in Canada in the coming decade.
152. Therefore, if ISED were to move to a smaller allocation block size than the US FCC approach, we would suggest the greater number of licenses provides even more of a rationale to ensure Public Safety and municipalities receive 5G spectrum set-asides for common societal / 911 emergency response needs, with the reservation of an appropriate spectrum block for First Responders on a Tier 5 municipal basis.
153. These 5G spectrum set asides in the 3.65-3.98GHz band could be licensed by municipalities via new entrant MNO ventures, in new P3 neutral-host business arrangements, or via partnerships with incumbent MNOs where advantageous to First Responders and local municipalities.
154. At a minimum we would suggest that two (2) of these 10MHz blocks be set aside for a total of 20MHz of reserved spectrum for Public Safety in the 3.65-3.98GHz range, with a preference for up to 50MHz of spectrum for municipal and Public Safety use, given the explosion of 5G applications and the growing need for reliable access to mobile data for emergency response. These "Public Safety / municipal" set asides could be held for dedicated private use by Public Safety and critical infrastructure entities in sensitive areas with critical infrastructure, or used in partnership with critical utilities (e.g. via "closed" cell sites in the vicinity of nuclear power plants or energy / fuel infrastructure) and yet also afford access to the general public through 4G / 5G prioritization and pre-emption services, or where private sites are "opened up" to the general public in times of disaster or societal need.
155. The use of set-asides can be also beneficial to society through offering municipalities a spectrum tool to engage in P3 or commercial partnerships with new entrants in areas that are currently underserved by incumbent MNOs, or as leverage in negotiating services to civilians in small municipalities to ensure a net lower cost of telecom for residents.
156. Spectrum policy as set by ISED plays a key role in addressing or potentially reinforcing the chronic high cost of telecom services in Canada, and so therefore we suggest municipal and Public Safety set-asides are an approach to both inject new-entrant and innovative new municipal neutral-host models, which foster new competitive market forces. For this reason, we suggest it very important that ISED continue its longstanding tradition of allocating spectrum for non-commercial uses that benefit the public good, with a PSBN allocation of 20MHz to 50MHz in size, within the 3.65-3.98GHz spectrum band.
-

[Q53]

ISED is seeking general comments on the proposal submitted by Telesat found in annex H, including whether such an approach would be in the best interest of Canadians and more specifically, whether it would result in the faster deployment of 5G services in the affected frequencies; more efficient use of spectrum and what the implications of this repurposing plan would be for other users of the band.

Q53 Response:

157. We support the Telesat proposal. We suggest the proposal is worthy of consideration for many reasons, including the fact it is an innovative approach to paying for the reasonable costs to be expected relating to spectrum re-farming and clearance. Per published accounts from the US experience as an estimate - is a high cost exercise that the government would ordinarily need to provide compensation for to the tune of several billion dollars, in fairness to the incumbent licensee.
158. The Telesat proposal provides government and ISED with several advantages:
- 1.) A private mechanism to pay for the clearance and repacking costs, and preparation of the band
 - 2.) A means to foster a new telecom service provider entrant potentially
 - 3.) A means to still retain ISED control over auction of 200MHz of spectrum (i.e. 3900-4100MHz) which would be under ISED's governance, and further through agreement on license terms and final secondary owner in the 3700-3900MHz portion, and effectively the entire band for that matter.
 - 4.) A means to still provide Public Safety and municipalities with a spectrum carve-out of between 20MHz and 50MHz to help foster new entrants and access in regions where incumbent MNOs continue to decline to invest.
 - 5.) A means to still mandate a Public Safety "digital right of way" in flexible use spectrum terms as discussed earlier in our submission, with a prioritization and pre-emption requirement for Public Safety users that may be roaming onto the band, at fair rates to be established by the CRTC.
 - 6.) A potential savings of public funds – and a net lower cost of spectrum which in turn translates to lower costs for rate payers, by avoiding the traditional "mega auction" approach that tends to generate huge government revenues, but with a corresponding need to charge high costs to end consumers to recuperate these high spectrum costs over time – feeding into the issue of Canada's chronic high cost of telecom services.
 - 7.) More net contiguous 100MHz blocks of spectrum – which are potentially enabling of higher net throughput rates for Canada's 5G deployments than smaller blocks.
 - 8.) An economic strategy to gain a national and international leader in satellite communications, and viable long-term satcom services for Canadian critical infrastructure and Public Safety agencies.
159. Therefore, we suggest the Telesat proposal should be strongly considered by ISED and the Federal Government, and contingent on obtaining some form of Public Safety / municipal set-aside of spectrum along with priority & pre-emption capability in new flexible use spectrum within the band, we in turn strongly support the Telesat proposal.

[Q54]

ISED is seeking comments on whether the Telesat proposal meets ISED's policy objectives outlined in section 3, including:

- a) supporting rural/remote connectivity
- b) promoting competition in mobile services
- c) making more mid-band spectrum available to support 5G services

Q54 Response:

160. In response to item a.) we suggest that yes, the Telesat proposal does meet ISED's policy objectives in relation to supporting rural / remote connectivity. The proposal will bolster both a LEO network for Canada with rural benefits, permit the re-farming of 400MHz of spectrum, and yet still permit a carve-out of spectrum for Public Safety and rural municipalities in alignment with our earlier proposal for such a set-aside. The Telesat proposal also provides added advantages as noted in our response to Question 53.
161. In regard to item b.) we propose that competitive forces would still be fostered in the Telesat proposal, as it would sell off 200MHz of the band (i.e. 3700-3900MHz), and also permit ISED run auctions with set-asides for the balance of 200MHz (i.e. 3900-4100MHz). New entrants could be mandated in set-asides, as well as a set-aside for municipalities and Public Safety.
162. Per our earlier response on the value of municipal set-asides, which can be co-deployed in P3 or neutral host arrangements in communities where incumbent MNOs have refused to invest, there is significant value in retaining a set-aside to support Public Safety and municipal partnerships for both 911 emergency services need, and in a shared spectrum approach to commercial services in remote communities.
163. The use of reserved spectrum set-asides for municipalities gives both First Responders a key tool to overcome congestion, and for special utilization specific to Public Safety needs (e.g. ad-hoc radio deployables in urban disaster response) but also for deployment of radio resources in areas where costs from incumbent MNOs are too high and where there is a regional lack of competition or competitive forces.
164. ISED made four critically important points for Public Safety Agencies in its July 2019 decision document (see footnote 1) in sections 36, 37, 97 and 108 as follows:
- (36) There are also non-commercial uses for spectrum that benefit the public good. This includes spectrum that is used to provide municipal or social services that enhance the capabilities of different public safety entities such as fire, police and other first responders, or that can be utilized for research by public and private institutions.***
- (37) ISED believes that all of the aforementioned use cases for spectrum are compelling and has designed the Tier 5 service areas with the flexibility in mind to support multiple services and business models. ISED will maintain the design principle to foster demand***
165. For these reasons, the PIA strongly suggests that in new allocations for terrestrial 3.65GHz to 3.98GHz bands, that there be a corresponding Public Safety / municipal set-aside of some fraction of the new spectrum allocations, which will continue ISED's longstanding approach to Public Safety set-asides of radio spectrum, while at the same time assisting with market forces in order to prevent a further concentration of market power in the Canadian telecom market, and a further reinforcement of the chronically high costs that Canadians and Canadian 911 emergency response organizations pay for telecom services. This 3800MHz band allocation for Public Safety can be seen as a next-generation component for the coming growth of PSBNs in Canada in the coming decade.

[Q55]

ISED is seeking comments on what elements from sections 7 to 10 of this consultation would still apply or need to change if ISED were to implement the Telesat proposal, in particular:

- a) the proposal for maintaining the primary allocation for FSS in the 3700-4200 MHz band
- b) the proposed implementation of an exemption to transition for satellite-dependent communities and the proposed changes to satellite licenses to apply it
- c) the proposal for treatment of WBS incumbents
- d) the proposal to issue interim authorizations for certain existing licence-exempt earth stations in the 3700-4200 MHz band
- e) technical considerations for coexistence between FSS and flexible use
- f) technical considerations for coexistence between flexible use and aeronautical radionavigation systems
- g) the overall impact on existing users in the 3700-4200 MHz band

Q55 Response:

166. In response to the above items:

- a.) In this case the allocation would be modified in the Telesat plan to just 4100-4200MHz.
- b.) In this case the exemptions would be reasonable accommodations that could still apply in a negotiated final approach with Telesat.
- c.) On this item, the WBS incumbents could still be equitably treated with the Telesat proposal.
- d.) In this regard, we propose that such interim authorizations could still be used.
- e.) In this regard the technical coexistence terms could still be used.
- f.) In this item we suggest that these technical considerations could still apply also.
- g.) Lastly, we suggest that the Telesat proposal would actually provide a lower impact and better / more organized and realizable transition plan for the spectrum.

[Q56]

If ISED were to implement the Telesat proposal, ISED would need to consider the licensing framework for the 3700-3900 MHz band. Thus, ISED is seeking comments on:

a) whether it should, as proposed by Telesat, issue flexible licences in the 3700-3900 MHz band using the same conditions of licence as those contained in [annex H](#) of the 3500 MHz Framework, noting that some conditions may need to be adjusted to reflect the differences in the two bands and the decisions resulting from this consultation process

b) whether it should issue a single Tier 1 flexible use licence as proposed by Telesat or align with the 3500 MHz band and issue Tier 4 licences

c) what deployment conditions should apply to these licences including Telesat's proposal that the deployment requirements would only come into force after the Minister approves a transfer

d) any additional conditions of licence that should apply given the nature of the proposal

Q56 Response:

167. In response to the above items:

- a.) We suggest that ISED should use the terms per Telesat's proposal in Annex H – with the caveat that we propose spectrum set-asides for Public Safety and Municipalities per the benefits to municipal set-asides and historical precedent for such carve-outs for Public Safety, as we note in this submission.
- b.) We concur with Telesat's approach of a Tier 1 license that in turn can be sold via secondary auction to smaller blocks as per final ISED license specifications (e.g. 10MHz)
- c.) We concur with the proposal from Telesat, and suggest that a deployment condition be made requiring a 20MHz to 50MHz set-aside for Public Safety and municipalities per the benefits to municipal set-asides and historical precedent for such carve-outs for Public Safety, as we note in this submission.
- d.) We also suggest a mandated term in licenses or sub-licenses for terrestrial operation, that Public Safety obtain a "digital right of way" for prioritization and pre-emption within the bands, as we expand upon in the balance of this submission.

[Q57]

In its proposal, Telesat indicates that it takes no position on ISED imposing a pro-competitive measure such as a spectrum cap or set-aside on the 3700-3900 MHz licences. ISED would review any request for transfer in accordance with provisions related to commercial mobile spectrum through section 5.6 of CPC-2-1-23, Licensing Procedure for Spectrum Licences for Terrestrial Services. However, ISED would also consider the competitive implications on the 3500 MHz and 3800 MHz bands and consider pro-competitive measures in accordance with the Framework for Spectrum Auctions in Canada. As such, ISED is seeking comments on:

- a) the need for a pro-competitive measure (e.g. spectrum cap or set-aside)
- b) the type of competitive measure that should be applied
- c) the amount of spectrum that should be considered under any such competitive measure

Q57 Response:

- 168. Per our earlier response on the value of municipal set-asides, which can be co-deployed in P3 or neutral host arrangements in communities where incumbent MNOs have declined to invest, there is significant value in retaining a set-aside to support Public Safety and municipal partnerships for both 911 emergency services need, and in a shared spectrum approach to create a seed or starting nucleus of commercial services in such underserved remote communities.
- 169. We respectfully suggest that given the possibility of congestion in urban areas, and given the need of First Responders to priority access to data as a part of their non-profit life-saving service and societal benefits gained from reliable 911 access, that prioritization for First Responders (at fair remuneration) be enshrined in all such 3.65-3.98GHz band licenses in the future. Additionally, we suggest that a carve-out of spectrum for municipal Public Safety be included in the band plan.
- 170. At a minimum we would suggest that two (2) of these 10MHz blocks be set aside for a total of 20MHz of reserved spectrum for Public Safety in the 3.65-3.98GHz range, with a preference for up to 50MHz of spectrum for municipal and Public Safety use, given the explosion of 5G applications and the growing need for reliable access to mobile data for emergency response. These “Public Safety / municipal” set asides could be held for dedicated private use by Public Safety and critical infrastructure entities in sensitive areas with critical infrastructure, or used in partnership with critical utilities (e.g. via “closed” cell sites in the vicinity of nuclear power plants or energy / fuel infrastructure) and yet also afford access to the general public through 4G / 5G prioritization and pre-emption services, or where private sites are “opened up” to the general public in times of disaster or societal need.
- 171. The use of set-asides can be also beneficial to society through offering municipalities a spectrum tool to engage in P3 or commercial partnerships with new entrants in areas that are currently underserved by incumbent MNOs, or as leverage in negotiating services to civilians in small municipalities to ensure a net lower cost of telecom for residents.
- 172. The use of reserved spectrum set-asides for municipalities gives both First Responders a key tool to overcome congestion, and for special utilization specific to Public Safety needs (e.g. ad-hoc radio deployables in urban disaster response) but also for deployment of radio resources in areas where costs from incumbent MNOs are too high and where there is a regional lack of competition or competitive forces.
- 173. ISED made four critically important points for Public Safety Agencies in its July 2019 decision document (see footnote 1) in sections 36, 37, 97 and 108 as follows:
- 174. ***(36) There are also non-commercial uses for spectrum that benefit the public good. This includes spectrum that is used to provide municipal or social services that enhance the capabilities of different public safety entities such as fire, police and other first***

responders, or that can be utilized for research by public and private institutions.

175. ***(37) ISED believes that all of the aforementioned use cases for spectrum are compelling and has designed the Tier 5 service areas with the flexibility in mind to support multiple services and business models. ISED will maintain the design principle to foster demand***
176. For these reasons, the PIA strongly suggests that in new allocations for terrestrial 3.65GHz to 3.98GHz bands, that there be a corresponding Public Safety / municipal set-aside of some fraction of the new spectrum allocations, which will continue ISED's longstanding approach to Public Safety set-asides of radio spectrum, while at the same time assisting with market forces in order to prevent a further concentration of market power in the Canadian telecom market, and a further reinforcement of the chronically high costs that Canadians and Canadian 911 emergency response organizations pay for telecom services. This 3800MHz band allocation for Public Safety can be seen as a next-generation component for the coming growth of PSBNs in Canada in the coming decade.

[Q58]

ISED is seeking comments on Telesat's proposals for the transition of FSS earth stations and whether any additional measures are required to ensure a smooth transition.

Q58 Response:

177. We concur with the Telesat proposal per Appendix H.

[Q59]

Telesat's proposal includes ISED allocating an additional 80 MHz for flexible use in the 4000-4100 MHz band. ISED is seeking comments on the feasibility of making this extra spectrum available, specifically:

- a) *whether there would be standardized 5G equipment available for this 80 MHz, given that it does not align with the U.S. band plan*
- b) *whether there would be FSS filters available, given the reduced amount of FSS spectrum and that it would not align with the U.S. band plan*
- c) *whether there would be enough capacity to continue FSS services in Canada with the proposal to reduce the amount of FSS spectrum to 100 MHz*
- d) *to what degree would the requirement to protect U.S. FSS earth stations in the border areas have an impact on the ability to deploy flexible use stations near the border and to what degree would this impact the value of this spectrum*

Q59 Response:

On item a.) we propose that 5G chipsets are available that would indeed support the designated frequencies, and that given deviations seen vis-à-vis the USA within other license frameworks in Canada, that this is not necessarily a critical showstopper, given that the 3GPP 5G Band Plan covers this frequency range.

On item b.) we suggest that such filters could be secured.

On item c.) we suggest that with the proposal a good amount of FSS communications will over time transition to LEO operation, and so will transition to higher frequency ranges, and that this will alleviate congestion in re-packing to the 4100-4200MHz range.

On item d.) we propose that US FSS protection could still occur using the due diligence and interference mitigation proposals outlined in earlier sections of this consultation response.

C. SIGNATURES:

178. This submission document is provided for the consideration by ISED in relation to the forthcoming re-deployment of spectrum in the 3.65-4.2GHz bands, and specifically in support of the data communications needs of First Responders and improved 911 services across Canada.
179. Our submission aim is to ensure the creation of a robust, Cybersecure, cost effective and resilient 911 and PSBN infrastructure in Canada to addresses the diverse needs of Public Safety agencies across Canada, and to provide potential ideas and suggestions for areas that may merit further consideration by all tiers of government.
180. Public Safety agencies represent a set of very important stakeholders with regard to the continuity of operations of telecommunications in Canada, and fulfill an important service to society in their lifesaving missions, and through their goal of improving the Community Safety and Wellbeing of Canadians from coast to coast.
181. We respectfully offer to attend and present at any future in-person oral proceedings, or to provide supplemental information as a part of this ISED consultation.
182. We appreciate this opportunity to submit our analysis and findings for review, and remain available for any questions or desired discussions with ISED and Canadian levels of government studying the range of options for future Public Safety telecommunications policy.

Yours sincerely,



By: _____
Deputy Chief Anthony Odoardi
Peel Regional Police Service
Exec. Director PSBN Innovation Alliance

D. APPENDIX – PSBN 4G / 5G HYBRID LICENSING MODEL:

183. With respect to examples of future 5G Conditions of License, the PSBN Innovation Alliance is advocating for flexible terms for Band Class 14 spectrum that would permit national 4G / 5G interoperability and yet meet regional needs for highly reliable and Cybersecure data networks to support the operational needs of First Responders and critical ICT infrastructure (airports, utilities, transit, etc). We provide our proposed Hybrid model as a parallel example for consideration in future ISED 5G auction terms.
184. In general terms, we note - per discussions with stakeholders from across Canada - that there are indeed widely varying needs given different rural / urban requirements. Ultimately, the key needs we have observed tend to fall along largely two main lines:
- a. Rural Regions – Band Class 14 Considerations
 - i. Higher spectrum availability per citizen (ie. far less spectrum deployments);
 - ii. Common carriers are reluctant to invest given low population density;
 - iii. In rural regions, a key benefit of Band Class 14 would be in meeting both Public Safety NG911 requirements for reliable communications in rural regions + fostering rural broadband using priority access on common “public” spectrum available also for rural users;
 - b. Urban Regions – Band Class 14 Considerations
 - iv. Lower spectrum availability per citizen (ie. far more spectrum deployments);
 - v. First Responders & Critical Infrastructure (Transit / Utilities) are priced out of access to dedicated spectrum given high market prices for limited spectrum;
 - vi. In urban regions, given population density, a key need is reliability and resiliency of wireless networks in the face of network surges or disasters, and additionally there is a keen need for private / Cybersecure networks for critical infrastructure;
185. An additional constraint in balancing the diverse needs of Canadians across all regions is the need to extract maximum potential sub-leasing value, through potential sale of spectrum to common carriers. In essence, if urban regions were to reserve spectrum licenses for their private requirements, the thought is the more rural regions would potentially obtain less net revenue from MNOs - due to an overall lower demand at a lease auction for split spectrum.
186. In balancing the urban-rural needs in Canada, a key interest for rural regions would be to tender spectrum assets for sub-lease all at once - in order to extract a maximum share of lease revenues from the value of lucrative urban markets. In this approach the obtained revenues would in theory be higher in the aggregate than if rural regions were sub-leased to common carriers on an individual basis. Rural citizens are essentially “spectrum-rich” given un-used spectrum, however their spectral assets have limited value given low population density.
187. However, in urban regions a need exists for reliable and resilient networks and for the reduction of chronically high Canadian telecommunications costs, given a restricted market with few competitive choices. In urban regions, given higher numbers of RF deployments per capita and thereby less spectrum availability, essentially one can view urban populations as “spectrum-poor” with respect to their rural counterparts. A higher need exists for reserved spectrum in urban areas to facilitate reliable communications systems for critical infrastructure - that ultimately benefit society - and to provide reserved data access for Emergency Response in times of wireless network congestion (eg. disasters, special events, surge data use in emergencies, etc.)
- 188.
189. In making a final determination for a spectrum terms, it is important to revisit the needs of First Responders, which indeed was the original intent for the allocation of Band Class 14. In looking at historical precedent for similar allocations of dedicated spectrum for First Responders, we can

look to the LMR precedent. In allocation of LMR licenses, narrowband LMR licenses were allocated on a regional basis to meet the local needs of First Responder agencies, and were not sold or sub-leased all at once for maximum financial revenue – although admittedly the relative market value of narrowband spectrum assets is quite distinct from broadband allocations. In essence, the LMR model gave municipalities the “right of first refusal” and the ability to deploy private spectrum if deemed cost effective and of value, or forfeit their license to an MNO aggregator for the province.

190. In our proposed Hybrid PSBN approach, we attempt to create a mechanism to simultaneously meet the contrasting needs of rural and urban regions, and therefore we submit a two-part licensing mechanism to permit the needs of more urban municipalities to be considered in parallel to those of larger rural regions.

191. In summary, our suggested Hybrid model approach comprises the following key tenets:

- A national license held by a National Functions Body (ie. per DRDC “Model Option D”, and sub-licensed directly to all Tier 4 / Tier 5 municipalities;
- An optional right for all Tier 4 / Tier 5 municipalities to license Band Class 14 in their jurisdiction, and for those municipalities that see a cost advantage and / or benefit to ICT infrastructure for their municipality, to use a Hybrid / MVNO model (see Sub-License Variant #1 below);
- A Tier 2 based sub-lease shall be tendered to certified MNOs for exclusive provision of prioritized commercial data services for all municipalities within that jurisdiction, and for “public” commercial lease of Band Class 14 spectrum on behalf of those municipalities that elect to forfeit their Tier 4 / Tier 5 license (see Sub-License Variant #2 below);

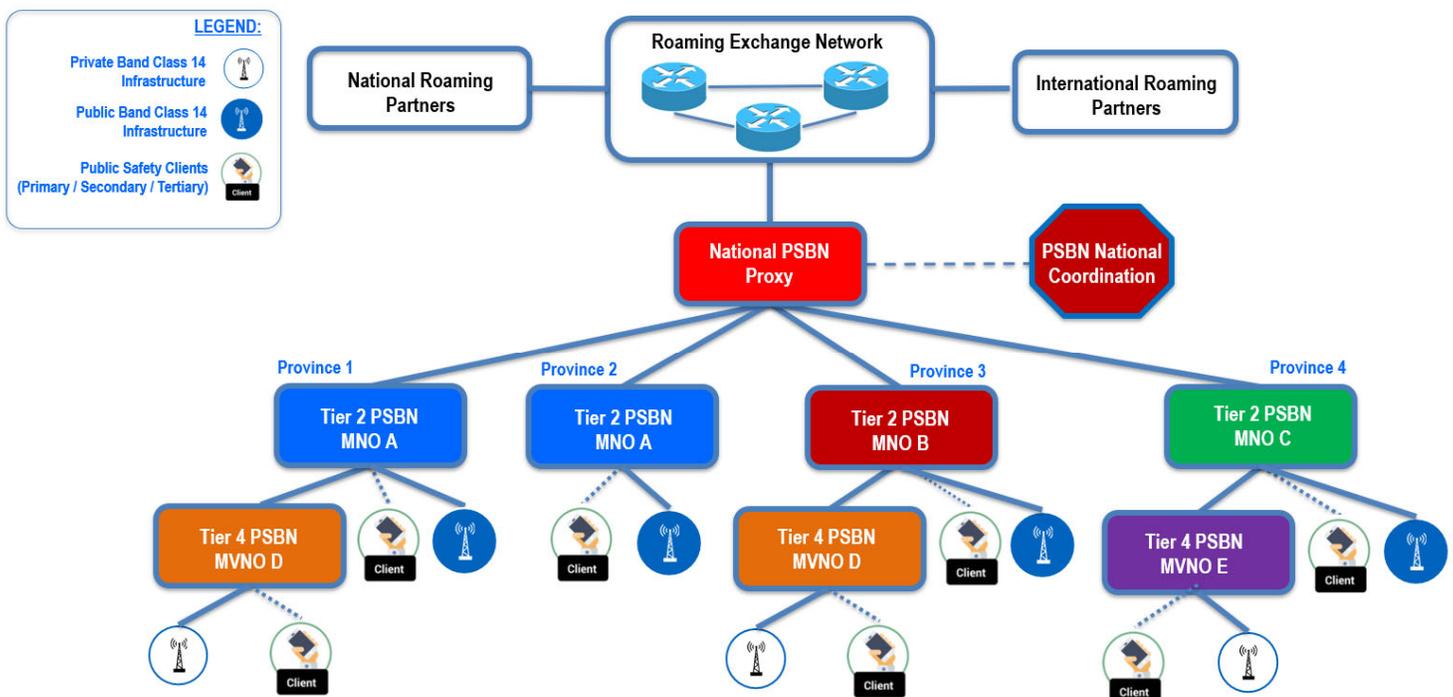
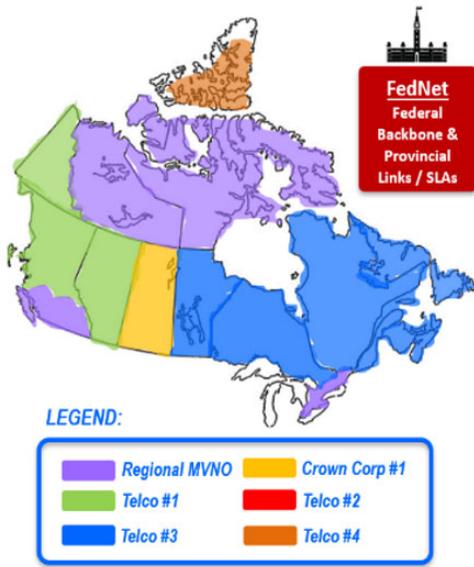


Figure D1: Hybrid PSBN Model – DRDC Delivery Model “Option D” - Service delivery model with Tier 2 PSBN MNO Sub-lessees and Tier 4 / future Tier 5 PSBN MVNOs with sub-licensed private PSBNs.

192. **Tier 4 / Tier 5 Sub-License Holder**: Each Tier 4 / Tier 5 municipality would have the option of deploying one of two sub-license variants for a 20-year term of license via a certified MVNO or MNO, and may engage in cost-sharing partnerships with Secondary and Tertiary Responders and those commercial entities maintaining critical infrastructure (eg. utilities, transit, airports, naval ports, etc).
- a. **Sub-License Variant #1** - Deploy spectrum privately with an approved MVNO or MNO per a list of eligible and approved firms certified to supply PSBN services in Canada. The list of eligible firms shall be maintained by the National Functions Body. The spectrum may be shared with Secondary and Tertiary Responders.
 - b. **Sub-License Variant #2** – Municipalities may forfeit their license to their encompassing Tier 2 jurisdiction, which will add that given Band Class 14 sub-license to the set of those serviced by the designated sub-leasing MNO for that Tier 2 jurisdiction.
 - c. **Commercial Prioritization & Pre-Emption Services** - In both variants, prioritization and pre-emption services shall be offered on all commercial broadband networks held by the designated Tier 2 MNO sub-lessee, with these services exclusively offered by the sub-leasing MNO for that Tier 2 jurisdiction as a concession.
 - d. **National Certification of PSBN MNOs and MVNOs**: All MVNOs and MNOs with sub-leases or contracts for PSBN services shall be required to follow stringent technical requirements (eg. security, resiliency, KPI performance, SLAs, etc.) that are to be established by the PSBN National Functions Body, as a pre-requisite for offering PSBN services in Canada.
193. **Tier 2 MNO Sub-Lesseees**: A national tender for MNO sub-leasing rights of Band Class 14 shall be established, with sub-leasing tendered and allocated by Tier 2 jurisdictions, each for a 20 year term. The tender should simultaneously sell the sub-lease rights for all Tier 2 regions to promote maximum tendered lease value. The designated MNO Tier 2 lessees shall also be granted exclusive wholesale rights for any PSBN MVNOs operating within their given Tier 2 concessions, and further exclusive rights for a Band Class 14 emergency deployable service offered to municipalities and First Responder agencies.
194. This approach to tendering Tier 2 sub-lease with associated concessions also provides the side benefit of motivating the large incumbent MNOs to provide cost effective and competitive PSBN commercial prioritization service rates (along with with quality and high security), in order to entice as many of the Tier 4 / Tier 5 sub-license regions in that province as possible, to forfeit their licenses to the MNO and to elect the Sub-Variant #2 model.
195. This approach of splitting the band into a municipally allocated sub-license and a provincially allocated sub-lease with a nationally held primary license is intended to balance the needs of rural and urban Canadian regions, and also allow for innovation in the regional licensing approach (eg. via allowing MVNOs or smaller provincial or regional MNO collaborations alongside the provincial lease holder).
196. This Hybrid model approach also permits cost sharing for infrastructure – where if a regional municipality has a need and wishes to deploy Band Class 14 privately in support of critical infrastructure and due to economic advantage (eg. for utility needs, or Public Safety access requirements, or for Rural Broadband enablement, or MVNO cost savings), they would have the ability to deploy their infrastructure independently, and also potentially to contract with the provincial lease holder for prioritization services, or for cost sharing of infrastructure deployments.
197. A seamless nation-wide experience for PSBN users is maintained via the standardizing role of the National Functions Body, and via reciprocal roaming agreements between any regional MVNOs and Tier 2 MNOs such that First responders from other jurisdictions may roam onto a

given Tier 4 / regional PSBN infrastructure from the designated Tier 2 sub-lessee MNO, and vice versa.



Hypothetical Example PSBN – Network of Networks Model

2-Tier Licensing → “Municipal Opt-In Choice”

Municipalities can choose what’s best for them..

Variant i) “Tier 5” Muni Opts-in to keep spectrum and deploys Hybrid / MVNO model PSBN

- partners with interested utility / transit firms / P3 VCs
- lower cost, higher reliability, better security
- critical infra. asset for municipality
- Muni uses MNOs for market-driven roaming

- or -

Variant ii) “Tier 5” muni elects to Opt-out to forfeit spectrum license to Provincial MNO (telco.)

- carrier uses spectrum commercially as it wishes
- gives First Responders commercial prioritization

198. Figure D3: Hybrid Model Scenario – Geographic View and two-tier Licensing approach
199. Lastly, in our cost analysis of this Hybrid approach alongside alternatives, although the sub-lease revenue may be slightly lower in value in a tendered bid (given the unknown of which particular regions will forfeit their sub-license rights at time of tendering), other compelling financial advantages in this model make up the difference in potentially reduced lease value, and make consistently make the Hybrid / PS-MVNO model an optimal cost approach for total cost of ownership of telecom services. (See models and detailed financial discussion included below in this document)
200. ***PSBN National Functions Body***: Additionally, a federal contract for a “National Function Body” shall be established to provide oversight of the National license, and also to provide inter-regional coordination and certification of MNOs and MVNOs that may participate in the PSBN. A key role of this National body will be to help provide an integrated and seamless pan-Canadian PSBN experience. All MVNOs and MNOs with sub-lease contracts for services shall be required to follow technical requirements (eg. security, resiliency, KPI performance, etc.) to be established by the PSBN National Functions Body, as a pre-requisite for offering PSBN services in Canada.
201. Given the cost advantage of MVNO wholesale data rates and infrastructure cost-sharing with Secondary and Tertiary responder entities, our proposed Hybrid approach tends to out-perform pure-carrier approaches due to the chronically high cost of data in Canada vis-à-vis other international jurisdictions. A private infrastructure + MVNO approach works due to high carrier costs with respect to the capital cost of standardized and relatively low-cost Band Class 14 infrastructure running in essentially free spectrum with good propagation characteristics.
202. A further advantage of our proposed approach versus other variants studied, is the flexibility to adapt the spectrum allocations to economically meet varying rural and urban needs and yet provide a strong role for MNOs within a “Network of Networks” approach to a PSBN.
203. The following diagrams illustrate the proposed sub-license variants and leasing approaches:

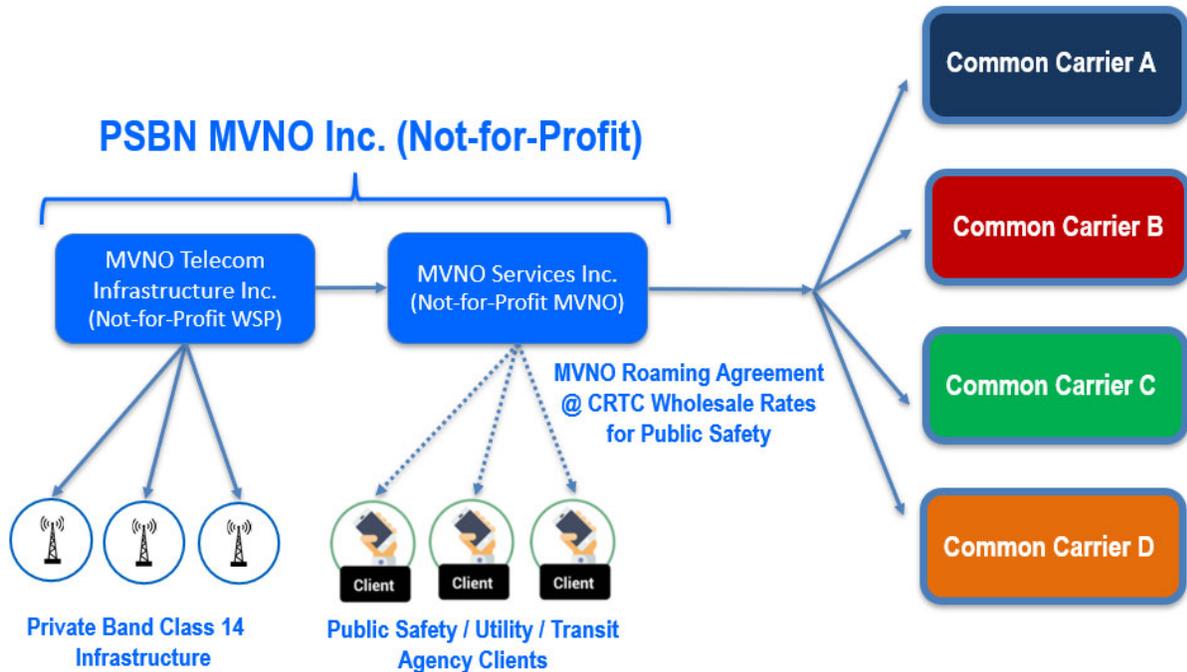


Figure D3: Hybrid Model Scenario – Band Class 14 Sub-License Variant #1 - A consortium of municipalities collaborates in the deployment of a private Band Class 14 PSBN with prioritized roaming onto the designated Tier 2 PSBN MNO (sub-lessee) for the province.

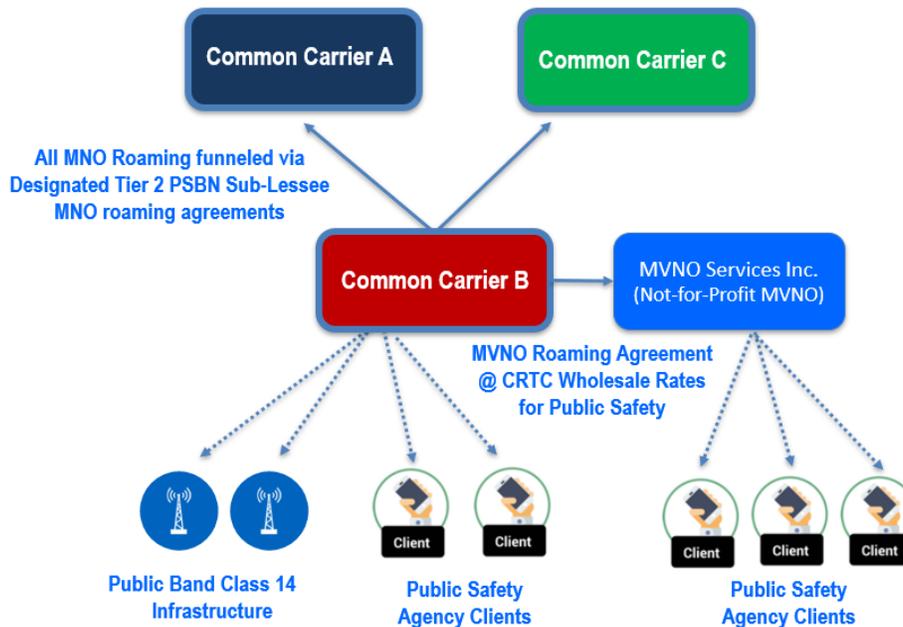


Figure D4: Hybrid Model Scenario – Band Class 14 Sub-License Variant #2 - A municipality forfeits its Tier 4 / Tier 5 Band Class 14 license and opts to join the Tier 2 MNO providing PSBN services via prioritized access to commercial carrier spectrum.

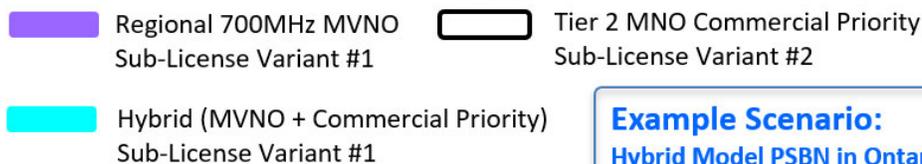
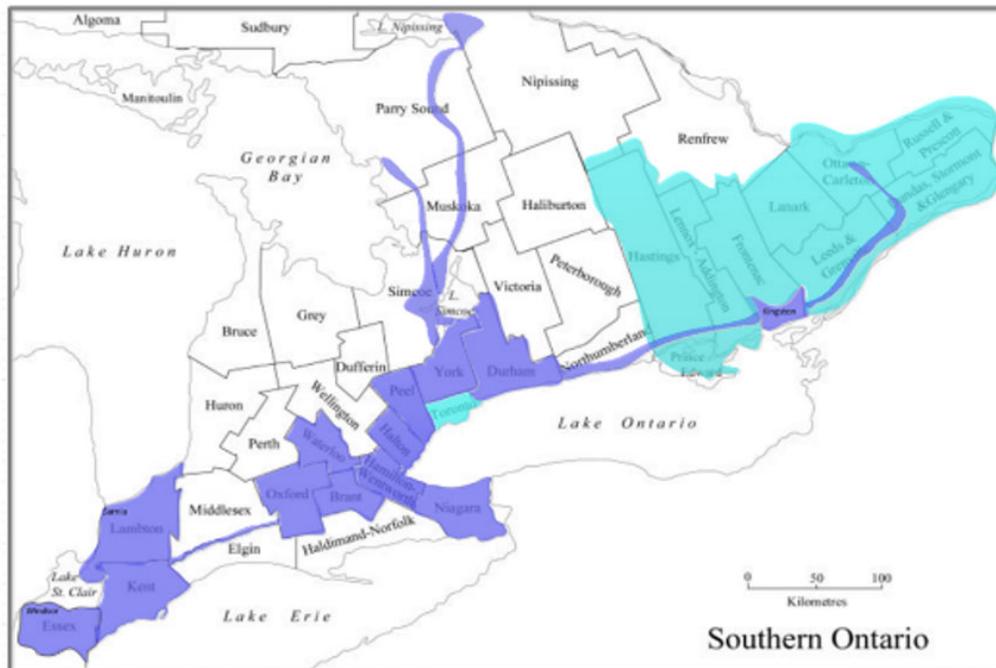


Figure D5: Hybrid PSBN Model – Hypothetical licensing scenario - A view of a scenario with Tier 2 MNO PSBN overlay coverage (white – Sub-License Variant #1) complementing a private Tier 4 / Tier 5 Band Class 14 PSBN with MVNO services (dark blue - Sub-License Variant #2) and regions with a Hybrid approach (cyan – Sub-License Variant #1 with commercial prioritized services).

204. In summary, we propose that our Hybrid model approach to licensing provides the following key advantages over pure carrier approaches:
- a. Provide the most flexibility to meet varying municipal and regional needs and allow those municipal regions that see a benefit and need for Public Safety exclusivity, to so deploy private Band Class 14 networks;
 - b. Allows public-private partnerships and potentially approved regional PSBN MVNOs to foster market competition and provide a cost effective yet secure telecommunications network for First Responders;
 - c. Permits the participation of MVNOs to help bring cost stability to chronically high Canadian telecom rates due to relatively limited competition in the Canadian market;
 - d. Provides a seamless overlay of prioritized Tier 2 MNO commercial services on all commercial bands belonging to the MNO, through a sub-lease approach, where the designated Tier 2 MNO has exclusive rights to prioritization services, deployable services and MNO roaming for First Responder users, and also exclusive rights to commercialize Band Class 14 infrastructure for public access in those particular Tier 4 municipalities that elect to forfeit their sub-license;

- e. Flexibly permit all those Tier 4 municipalities that do not require or see a value in private Band Class 14 access for First Responders, to yield their license and subscribe to the provincial / territorial designated Tier 2 PSBN MNO;
205. In closing, the goal of our proposed Conditions of License is to attempt and balance the needs of those regions desiring to use spectrum to promote Rural Broadband Enablement - along with the extraction of maximum spectral lease revenue - alongside the needs of other urban regions desiring to provide highly secure and highly reliable data networking for First Responders and critical ICT infrastructure entities (ie. utilities, transit, airports, ports, etc.)

E. APPENDIX - PROPOSED BAND CLASS 14 (700MHz) PSBN CONDITIONS OF LICENSE:

206. In order to meet the diverse needs of Canadian regions, and yet provide for the key requirement of interoperability of reliable and resilient data communications for First Responders, we propose the following terms of license for a Hybrid model approach to a Canadian PSBN:
207. **Band Plan:** We propose that the 20MHz Bandclass 14 allocation be harmonized with the US / FCC / band plan to leverage economies of scale with the chipsets of higher volume US FirstNet end-user-devices, and common radio infrastructure.
208. **Term of License:** The term of this licence is proposed as 20 years and allocated on a Provincial basis. At the end of this term, the licensee will have a high expectation that a new licence will be issued for a subsequent term through a renewal process, unless a breach of licence condition has occurred, a fundamental reallocation of spectrum to a new service is required, or an overriding policy need arises.
209. The process for issuing licenses after this term and any issues relating to renewal, including the terms and conditions of the new licence, will be determined by the Minister following a public consultation.
210. Licensing of the 10+10MHz paired block should be aligned to “Model Option D” as described in the DRDC-2017-R038 Scientific Report (See Reference [C72]), with a PSBN National Functions Body as primary license holder, and Tier 4 or future Tier 5 regional municipalities holding secondary or subsidiary licenses to operate the PSBN.
211. Tier 4 or future Tier 5 license holders of the Bandclass 14 spectrum may choose one of two Sub-License variants as follows:
212. **Sub-License Variant #1** - The secondary or subsidiary licenses should be based upon Tier 4 or Future Tier 5 Service Areas. Allocations should be initially to a lead Public Safety entity assigned to maintain spectrum licenses on behalf of municipal governments in given Tier 4 or Tier 5 regions, and shall be for the exclusive use of approved Public Safety entities, and to designated Secondary and Tertiary Responders that maintain critical Canadian infrastructure (eg. utilities, transit, airports, naval ports, transportation, etc.).
213. Access to spectrum in a given Tier 4 or Tier 5 area that elects to retain their license in this first licensing variant shall be fully private and limited to approved Public Safety agencies and commercial entities that maintain critical infrastructure.
214. Broadband prioritization and pre-emption services shall also be made available by the designated MNO for First Responders of the given Tier 4 / Tier 5 jurisdiction, and shall include prioritized access for First Responders on all other available commercial broadband spectrum retained by the designated MNO for that Tier 2 jurisdiction.

215. These prioritized access services on other available broadband commercial spectrum held by the MNO shall be provided as a contracted commercial PSBN service, optionally available for all the Public Safety entities residing within the Tier 4 / Tier 5 licensing district. The prioritization service shall be made available as a service and maintained via the designated MNO sub-leasing spectrum within a given Tier 2 region.
216. ***Sub-License Variant #2*** - As an option, the Tier 4 or Future Tier 5 license-holders may elect to forfeit their Bandclass 14 sub-license to their respective Tier 2 jurisdiction (ie. provincial or territorial government). The given Tier 2 jurisdiction will then in turn add that Tier 4 / Tier 5 license to the overall Band Class 14 sub-lease for that jurisdiction. A designated MNO offering prioritized commercial-grade PSBN services shall add the Tier 4 / Tier 5 license to those serviced within that Tier 2 region.
217. Access to Band Class 14 spectrum in those regions that forfeit their Tier 4 / Tier 5 license shall be fully public with Band Class 14 capacity folded into the network capacity of the designated Tier 2 PSBN MNO, and with prioritization services on all commercial spectrum of that MNO for designated First Responder agencies.
218. ***Exclusive Tier 2 MNO Sub-Leases and Multi-Band Spectrum Prioritization Services***: Exclusive sub-leasing rights for the 20 MHz block, (including all those jurisdictions that forfeit their sub-license per Sub-License Variant #1), would be granted based upon a Tier 2 territorial basis to provide for maximum sub-lease value through a national tendering arrangement.
219. In both variants, prioritization and pre-emption services for designated Public Safety entities shall be offered on all commercial broadband networks that are held by a given Tier 2 MNO, with these services exclusively offered by the sub-leasing MNO for that Tier 2 jurisdiction.
220. ***PSBN National Functions Body***: Additionally, a National Function Body shall be established to provide oversight of the National license, and also to provide inter-regional coordination and certification of MNOs and MVNOs that may participate in the PSBN. All MVNOs and MNOs with sub-lease contracts for PSBN services shall be required to follow technical requirements (eg. security, resiliency, KPI performance, SLAs, etc.) to be established by the PSBN National Functions Body, as a pre-requisite for offering PSBN services in Canada.
221. ***License Transferability & Divisibility***: Licenses are proposed for allocation on a Provincial basis, and transferable in whole or in part (divisibility) on a municipal basis, in both bandwidth and geographic dimensions, subject to ISED's approval. A Subordinate Licence may also be issued in regard to this licence. ISED's approval is required for each proposed Subordinate Licence.
222. The licensee must make the Transfer Request in writing to ISED. The Transfer Request will be treated as set out in Client Procedures Circular CPC-2-1-23, Licensing Procedure for Spectrum Licenses for Terrestrial Services, as amended from time to time.
223. ***Radio Station Installations***: The licensee must comply with Client Procedures Circular CPC-2-0-03, Radiocommunication and Broadcasting Antenna Systems, as amended from time to time.
224. Provision of technical information: The licensee must provide, and maintain, up-to-date technical information on a particular station or network in accordance with Client Procedures Circular CPC-2-1-23, Licensing Procedure for Spectrum Licenses for Terrestrial Services, as amended from time to time.
225. Compliance with legislation, regulation and other obligations: The licensee is subject to, and must comply with, the Radiocommunication Act and the Radiocommunication Regulations, as amended from time to time.
226. ***Technical considerations, and international and domestic coordination***: The licensee must comply on an ongoing basis with the technical aspects of the appropriate Radio Standards

Specifications (RSS) and Standard Radio System Plans (SRSP), as amended from time to time. Where applicable, the licensee must use its best efforts to enter into mutually acceptable agreements with other parties for facilitating the reasonable and timely development of their respective systems, and to coordinate with other licensed users in Canada and internationally.

227. The licensee and any sub-lessees must also comply on an ongoing basis with technical directives and requirements of the PSBN National Functions Body, with interoperability directives, service level agreements and security policies to be established.
228. **Lawful Interception:** The licensee operating as a telecommunication common carrier using the spectrum for voice telephony systems must, from the inception of service, provide for and maintain lawful interception capabilities as authorized by law.
229. **Research & Development:** The licensee or sub-lessee must invest, as a minimum, 2% of its adjusted gross revenues resulting from the use of this license, averaged over the term of the license, in eligible research and development (R&D) activities related to telecommunications.
230. The licensee is exempt from R&D expenditure requirements if it, together with all affiliated licensees that are subject to the R&D condition of license, has less than \$1 billion in annual gross operating revenues from the provision of wireless services in Canada, averaged over the term of the license.
231. **Deployment Requirements:** Licensees will be required to demonstrate to the Minister that this spectrum has been put to use to provide services as specified in a regional table of coverage requirements (to be specified but aligned with licensing framework requirements for the recent 600MHz band) within 5 years of the initial issuance of the license. Additional tables specifying requirements for 10 year and 20-year coverage shall be made, but aligned generally with the requirements of the recent 600MHz band coverage model (See Reference [C73]).
232. Establishment of a final table specifying percentages of population covered for the milestones above shall be made in consultation with the national tri-services Public Safety associations
233. The Department will review licensees' compliance with their deployment conditions at years 5, 10 and 20. Where, at any point in the license term, the licensee is not in compliance with its deployment conditions, the Department may invoke various compliance and enforcement measures.
234. These measures may include warnings, administrative monetary penalties, legal action, license amendments, suspensions, or other measures. In certain cases of non-compliance, the Department may determine that the most appropriate course of action is to revoke the license.
235. Where a license is transferred, the requirement for the new licensee to deploy will continue to be based on the initial license issuance date.
236. **Mandatory antenna tower and site sharing:** The licensee must comply with the mandatory antenna tower and site sharing requirements set out in Client Procedures Circular CPC-2-0-17, Conditions of License for Mandatory Roaming and Antenna Tower and Site Sharing and to Prohibit Exclusive Site Arrangements, as amended from time to time.
237. **Roaming Agreements:** The licensee, being an operator providing exclusive service to Public Safety entities (Primary, Secondary and Tertiary responders as defined by ISED) is not required to comply with the roaming requirements set out in Client Procedures Circular CPC-2-0-17, Conditions of License for Mandatory Roaming and Antenna Tower and Site Sharing and to Prohibit Exclusive Site Arrangements.
238. **Annual Reporting:** The licensee must submit an annual report for each year of the license term per the reporting requirements approach used for the 600MHz spectrum allocation.

F. APPENDIX – COMMUNITY SAFETY BROADBAND MODEL FOR RURAL CANADA:

F1. Overview of a Canadian Hybrid PSBN Model that enables Rural & Remote Broadband

In considering a Canadian PSBN and telecom / industrial strategy for the next 20 years and beyond, it is important for agencies and governments to consider their current levels of telecom service quality, telecom price and pain points as seen in traditional telco carrier data services vs. Land Mobile Radio (LMR) voice-only networks available today for Public Safety agencies - and devise approaches improve these current issues in a final approach for a PSBN.

Key issues of concern for Public Safety in the current MNO paradigm which hinder the establishment of “mission critical” grade broadband services on par (or closer) to the reliability levels seen with LMR today – include:

- **Concerns on Rural Broadband & Rural 911**: Recent news confirming issues in 911 service in rural regions & the continuing Rural Broadband divide via our current MNO-oriented / grant-based approach – which has failed to grow Rural Broadband to the extent required due to a lack of interest in incumbent MNOs to invest in rural regions with low commercial viability;
- **Concerns on Resiliency & Reliability**: Recent large-scale telecom outages (eg. Canada nation-wide mobile service & 911 outage in Jul. 2019, Hurricane Dorian outages, Toronto Raptors parade comms failures, Ottawa Tornado extended mobile service outage, Atlantic Canada mobile service outage in Aug. 2018, noted difference in level of resiliency versus traditional LMR services, etc.);
- **Concerns on Cybersecurity**: Recent and still unresolved concerns regarding exposure to potentially insecure telecom equipment in several of the major Canadian MNOs;
- **Concerns on Chronic High Costs**: Recent international, independent studies have confirmed Canada’s chronic highest telecom costs in the industrialized world;

Please see References [A01] to [A16] & References [D01] to [D51] for a small sampling of articles and reports of the above issues. To resolve these issues, we propose a new “Community Safety Broadband Model”, which is summarized below.

The Corporate & Business Structure

The structure of the proposed “shared investment” PSBN model to help meet these above challenges is showcased below with a fictional firm called “Trillium PSBN Inc., which consists of a Public-Private Partnership (P3) – potentially operating as a Not-for-Profit corporation – with one parent firm for holding and governance (Trillium PSBN Inc.) and two subsidiaries (Trillium Telecom Infrastructure WSP Inc. and Trillium MVNO Inc.).

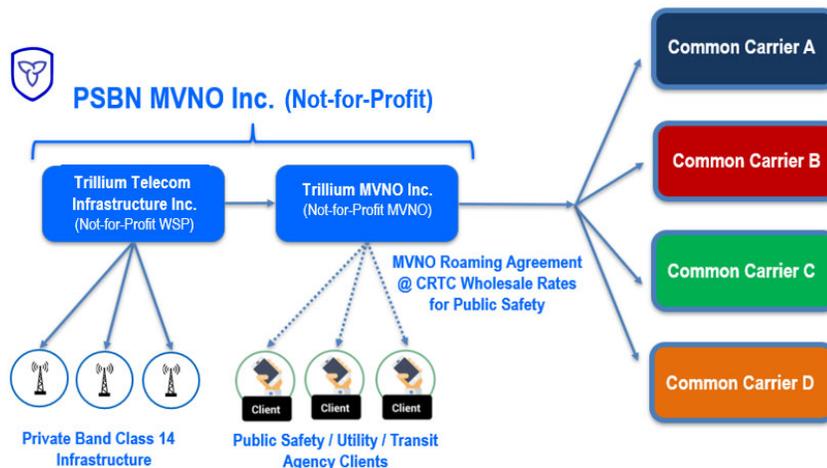


Figure 1: High-level conceptual view of business model, corporate components and relationships with common carriers / MNOs.

A “network-of-networks” RAN approach with a distributed set of core networks across the province will be used to improve network resiliency in disaster scenarios, over the more centralized incumbent MNO architectures that we have seen are prone to wide-scale province-wide failures (see References [D01] through [D51] for examples). A new generation of ruggedized PSBN RANs will be built on a regional municipality scale and internetworked via SLAs to common distributed cores held by Critical Infrastructure partners & the Trillium PSBN infrastructure WSP.

In a given region, a municipality may contract and tender for 700MHz RAN services (according to defined technical RAN SLA requirements) from among a pre-qualified P3 partnership pool of PSBN investors. Once established, the RAN is “plugged into” a shared PSBN common core system for Ontario (or potentially other provinces in this fictional example), providing roaming and integration across all the PSBN RANs – and with roaming services to regional / national carriers.

Community Safety Broadband (CSB)

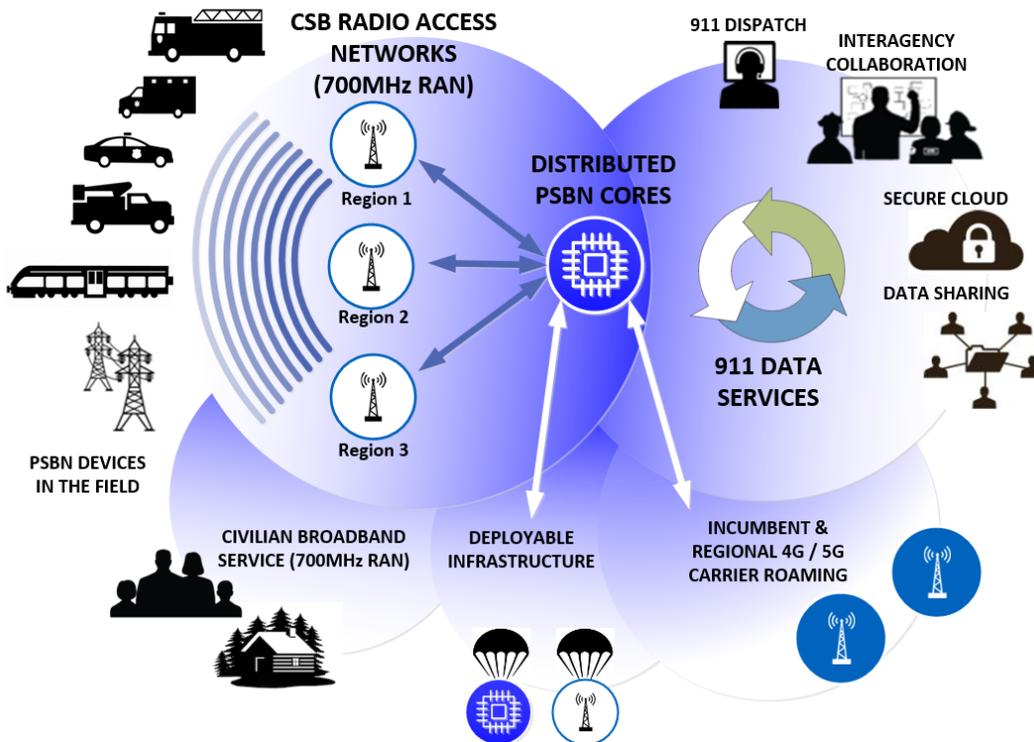


Figure 2: Conceptual view of a municipal Community Safety Broadband Service Model (CSBM), built around a 700MHz PSBN RAN & core, and with the ability for regions to tender, partner, deploy and “plug into” the central Community Safety Broadband Model (CSBM) core networks – for both municipal consumer use and improved 911 service coverage for civilians. Consumer services are supplied via MVNO services on the CSB infrastructure. Public Safety & Critical Infrastructure obtain priority access on the 700MHz network (white circles). Roaming onto commercial MNO services is also included for Public Safety users. The CSB Model enables 911 access for the community and Next-Gen 911 operational data for First Responders – helping to bridge Canada’s digital divide now in areas with poor or zero MNO service.

Technology

The technology used by the proposed PSBN will consist of 3GPP™ standards based 4G infrastructure (Release 13 and higher) along with associated 4G user equipment, providing Public-Safety LTE services to users on 700MHz Band-Class 14 spectrum. A decision on equipment suppliers for the network will be made via public tender to 4G infrastructure vendors (eg. Ericsson, Nokia, Samsung, Redline, others) and the network-of-networks will be built via a set of pre-qualified equipment vendors to ensure compatibility in the Ontario PSBN.

An evergreening approach to 3GPP Core and RAN infrastructure shall be included in tendering requirements for infrastructure suppliers, such that any future transition or integration from 4G to

5G releases in the 3GPP roadmap will be incorporated - to ensure the network remains current for the 20 year+ operational life of the network. Trillium engineering will be responsible for coverage design and roaming integration for seamless MVNO and PSBN services.

The Market

The PSBN market in Ontario and Canada will be enabled via key decisions to be made by Public Safety Canada and the Ministry of Innovation, Science and Economic Development in 2020.

Anchor target market segments when deploying in a new rural greenfield region include:

- Public Safety Wide-Area Operations Staff – amortized & CAPEX-based infrastructure
- Provincial Government / Municipal Staff – amortized & CAPEX-based infrastructure
- Critical Infrastructure Wide-Area Operations (utilities, energy, rail, transit, airports, etc)
- Critical Infrastructure Secure IoT (Internet of Things)

These anchor use cases and clients provide a baseline population to help amortize costs on 700MHz PSBN “seed sites” that have marginal business cases in rural regions – helping deploy access to RAN and spectrum sooner, where otherwise these regions would languish until national-scale business models break profit-thresholds for larger-scale MNOs.

Anchor use cases include 911 operational use, train control on remote rail links and utility control signals for wide-area bulk electricity and generation purposes – as but a small example of uses.

Piggy-backing off these anchor users, general broadband wireless internet services may be optionally offered to the same municipality’s population in the 700MHz band’s spare capacity, for service to commercial and general users in the rural / remote population where there was no MNO coverage or option prior. Besides helping spur economic development with access to digital tools and efficiencies, these wireless PSBN sites also offer 911 emergency call access in rural & remote regions that otherwise would have had poor to zero emergency calling coverage.

Direct customer-facing consumer service on this common rural network would be provided via roaming contracts and services with major MNOs (eg. Bell, TELUS, Rogers and Freedom) – and via new anticipated consumer MVNOs riding on top of rural and remote Community Safety Broadband infrastructure (eg. see the Red Compartida MVNO model for an analogous approach – See References [A49] through [A52]). Consumer MVNOs would provide general population users with service offerings, and also provide market competitive forces to ensure a short-term single infrastructure PSBN deployment does not inhibit fair-market competition on price.

As the spare capacity at rural PSBN sites fills over the lifetime of the network, and with population growth plus the long-term historical tech trend of ever-more data-hungry broadband applications – the business model (once marginal at the outset of a site deployment) becomes viable and permits the municipal P3 partnership stakeholders to monetize the assets via sale, or sub-lease for access to a regional MNO that wants to grow their network.

The Investment Model

Capital investment in RAN and Core infrastructure shall be comprised of provincial-based P3 (Public-Private-Partnership) 4G/5G PSBN core-network service organization, with individual municipal contracts for local 700MHz RAN deployments that connect into the common core via SLAs. Each of the local RANs can be structured as municipal shared services corporations, with P3 shares – and where each of the seeded rural / remote RANs is “plugged into” the provincial PSBN core framework. Alternatively, RANs may be optionally built by the central PSBN core service operator for those smaller rural municipalities that don’t have the tendering ability due to municipal size or wish to aggregate their RAN with other adjacent regions for scale.

In this manner, via the P3 shared approach, the local municipalities and Public Safety agencies retain a share and say in a valuable local asset – wireless broadband services – for eventual asset monetization via asset sale or recurrent revenue service model, which brings funds back into the local community.

The main core network investment and individual municipal RAN contract underwritten and funded-in-part by Critical Infrastructure entities participating in a consortium, alongside private venture capital, regional and national MNO investment, and institutional investors. Private and corporate P3 capital in the municipal RAN entity can be augmented with use of Federal and Provincial grant funds to help drive site deployments.

FINANCE:

OPEX Subscription & CAPEX Infrastructure Service Models:



Figure 4: Overview of two CAPEX and OPEX cost model and bundling options for Public Safety, municipal and Critical Infrastructure users.

Another benefit of the model is that rural, remote and First Nations municipalities can retain a degree of municipal independence in selecting P3 partners as they wish in the model to help build local RAN sites in the manner best suited for their Community Safety, in alignment with local economic development projects, Smart City / Smart Rural projects, and with enhancing local 911 emergency communications access, via a tendering approach that is handled at the municipal level.

This more distributed approach to offering municipal-based “Tier 5” geographic licensing – provides more competitive vectors in the telecom market than a single large-scale tendering of 700MHz spectrum on a province-wide or national scale, thereby further improving competitive forces in Canada’s high-cost telecom market.

Strategic & Member Service Alliances

An additional interesting advantage to the Trillium PSBN business model is in the role of Critical Infrastructure entities in the overall “network of networks” hybrid PSBN approach.

A key value proposition for Critical Infrastructure entities to participate and invest in the Trillium PSBN is in market demand for private LTE networks for rail, utilities, energy, transit and airport applications – as examples of some Critical Infrastructure entities that could be participants.

The worldwide trend driving private LTE and cellular IoT growth (see Reference [C67]) is that these Critical Infrastructure entities generally have serious concerns over the reliability, resiliency and

Cybersecurity of the commercial MNOs – where loss of critical control signals on lower-reliability incumbent MNO networks can in turn open these Critical Infrastructure firms to significant liabilities and risk for loss of life in relation to their mission-critical operations.

The Hybrid PSBN model allows these Critical Infrastructure entities to participate in a highly secure network and share costs – own capital assets – and also participate as potential infrastructure maintenance service provider partners to help maintain the PSBN network across the province.

The Services

Trillium PSBN offers a set of focused high-quality wireless broadband services, including:

- Wide Area Private PSBN services (Prioritized Data + VoLTE services + NG-911 Services)
- MVNO Roaming Services on incumbent MNOs (Data & Voice) for Public Safety users
- Emergency Deployable Site-on-Wheels Services for ad-hoc hot spot coverage in disasters
- Hosted PSBN Core & Hosted PSBN RAN Services for municipal 700MHz RANs to plug in
- Secure App-Store – Cybersecure App Sales Portal & App Certification on PSBN
- Secure Device-Store – Secure SIM Cards & Device Certification on PSBN
- Cybersecurity / network security monitoring
- Optional - Municipal neutral-host infrastructure services, to permit monetizing 700MHz spectrum capacity for both Public Safety & general commercial users
- Optional – Municipal neutral-host roaming tariffs for MNOs, RF co-location site access fees and services for larger MNOs with users roaming onto PSBN sites.

Prioritization and pre-emption services are provided to these Critical Infrastructure and 911 First Responder agencies on the PSBN network. Additionally, services are offered to Public Safety agencies and utilities on a “Public Safety MVNO” (PS-MVNO) which passes wholesale rate savings onto Public Safety and CI partners – and also offers prioritized and pre-emption services on regional or nation-wide MNO roaming partner(s).

PSBN Suite of Services:

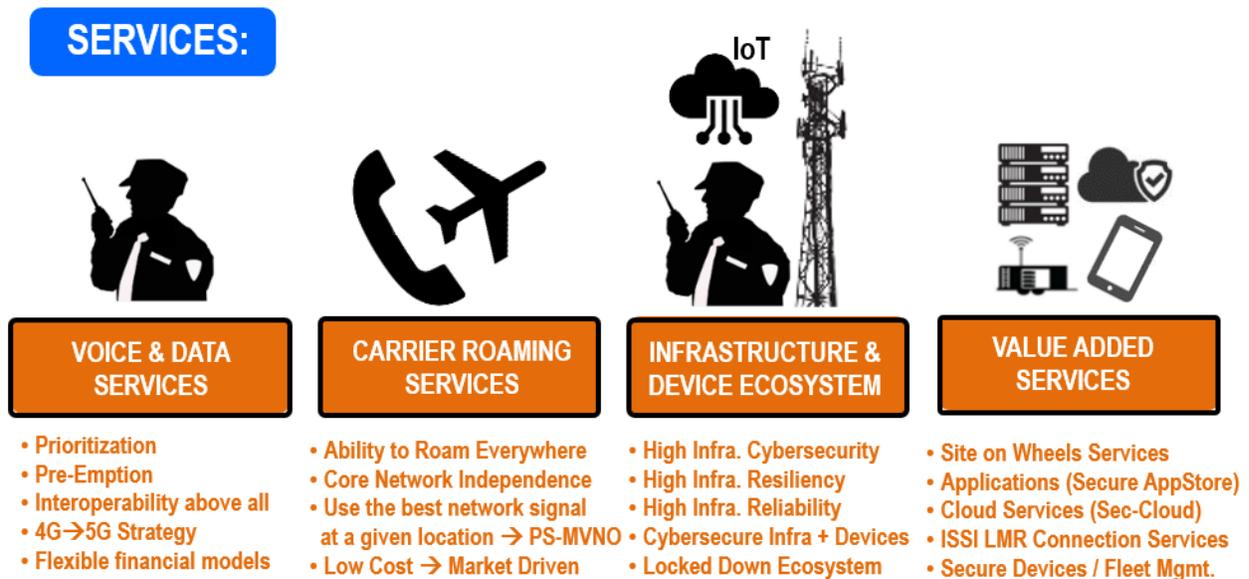


Figure 3: Overview of Public Safety direct service offerings proposed for PSBN emergency and Critical Infrastructure users. General population users are serviced on the infrastructure via MVNO partners that contract for roaming agreements onto PSBN site infrastructure.

Pricing Model

In alignment with the varying agency financial needs as seen across Ontario, an over-arching theme in pricing strategy for Trillium PSBN will be a flexible range of models to meet the unique needs of each unique municipality. Both OPEX, CAPEX and pure MVNO approaches shall be provided as options to select from, and the sales effort will assist in the establishment and negotiation of public-private partnerships in each municipality – to provide maximum value while meeting the needs of Critical Infrastructure partners.

In turn wholesale pricing for general MVNO and MNO access onto PSBN sites shall be established to provide commercial / consumer-grade services in the same rural regions covered – via CRTC mandated and pre-negotiated MVNO rates for PSBN systems to ensure fair market pricing and fair cost recovery for commercial users at the rural PSBN sites.

Community Safety Broadband Rural Investment Model – Summary

In summary, a Hybrid PSBN Model that includes Critical Infrastructure entities and Public-Private-Partnerships is a viable business model that can help reduce chronic high telecom costs for Public Safety agencies, Critical Infrastructure entities, plus rural and remote consumers.

The model also establishes policy hooks for helping local / rural economic development, creates more net competitive forces in the Canadian telecom marketplace – and essentially offers an “infrastructure model of last resort” to more rapidly deploy both 911 services and consumer grade broadband wireless access in underserved regions with delayed or no MNO investment to date, or during disasters.

A Community Safety Broadband Model – the business model described in this document – is simply one of several permutations / variant scenarios to a Public Private Partnership model to enable a community-based spectrum asset for essential emergency services and a further expansion of RF coverage where it’s needed – for community safety as well as for social and economic development, and commercial / consumer broadband services.

This rough rural investment framework is a model is a model that can be refined, built upon and customized by Canadian provincial and regional governments that are working on digital development projects an consider spectrum and 911 service enhancement as possible ways help deploy sites and drive rural development forward.

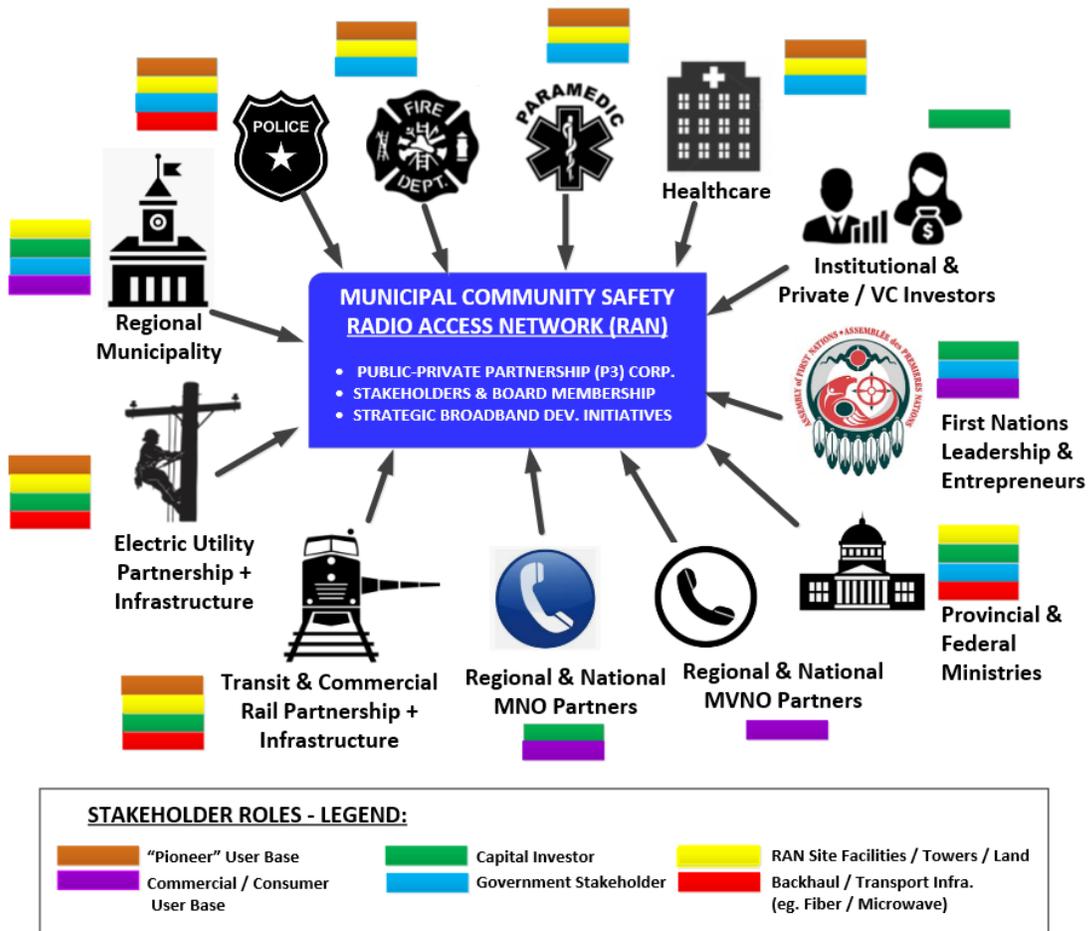
The balance of this document highlights the advantages of flexible CRTC policy and provides a new targeted grant templates for Community Safety Broadband Model (CSBM) projects in the North, with an aim to creating PSBN deployment cases that make economic sense – using the right telecom tool (eg. MNO vs. MVNO vs. PSBN infra. build vs. auction vs. LEO satellite communications) and societal sense for bridging the digital divide for all First Nations, rural and remote Canadians.

In summary, alternative municipal-based spectrum allocation models and network growth strategies for 700MHz PSBN spectrum do exist, and could be used as a parallel tool to national auctions to help speed up deployments via growing “seed infrastructure” in underserved rural areas – and at the same time as a way to foster new sources of competition in the Canadian telecom marketplace.

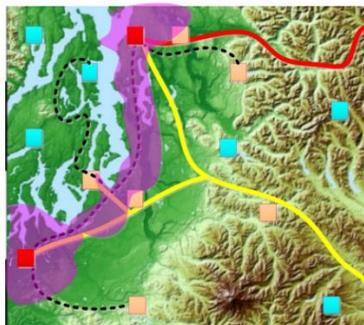
The drive to accelerate rural development will build many new digital-business success stories across rural Canada, and net economic growth for current and future generations. We hope that the CRTC and government may consider some of the ideas in this rough framework and spectrum model, in their decisions on the path ahead for enabling rural and remote Canada with essential digital services. The PSBN Innovation Alliance remains available to review and any questions in a support of a viable, cost-effective, reliable and Cybersecure PSBN model for Canada.

B3. Community Safety Broadband Model (CSBM) - “Concept at a Glance” Diagrams

**Community Safety Broadband (CSB) Stakeholders
Rural Investment Model (CSBRIM)**

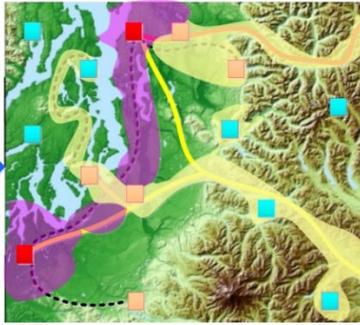


PSBN - Year 0



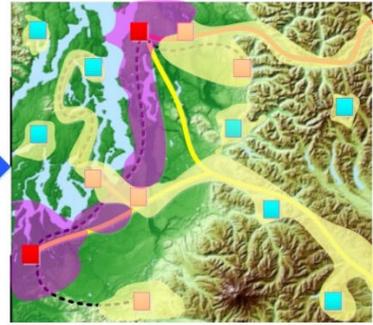
Initial State

PSBN - Year 3



+ Utility & Rail 700MHz RAN coverage

PSBN - Year 5



+ LEO Links to standalone RAN Sites

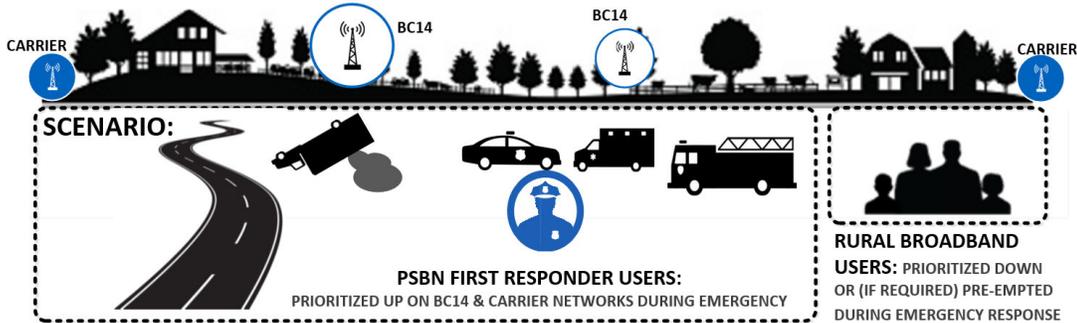
LEGEND:

■ City	■ First Nation	— Hydro Utility Power Lines	■ Community Safety PSBN Coverage	■ National MNO
■ Rural Township	- - - Provincial Highway	— Freight Rail Line		

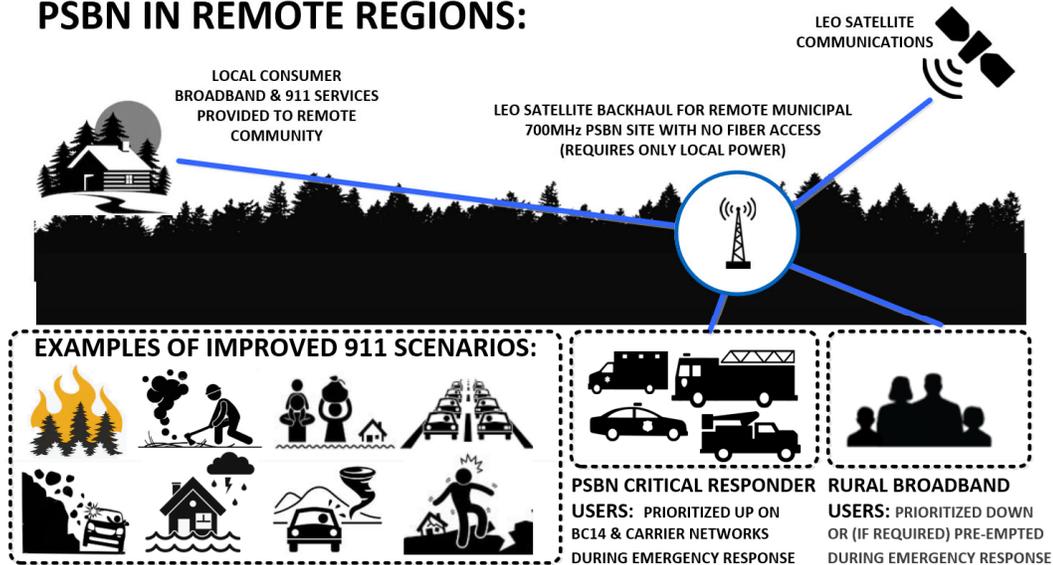
Figure 3: (Top) - Conceptual of PSBN Stakeholder P3 collaboration and key roles within a P3 corporate PSBN RAN municipal partnership. (Bottom) - Community Safety Broadband Model growth of coverage access over time in a region, showing leverage of rail and utility infrastructure in a hypothetical scenario with rural, urban and First Nations communities. New PSBN coverage in yellow may be sold by the municipal P3 corporation to a regional or national MNO to bring revenue, or may continue on as a municipal service.

B4. Community Safety Broadband Model (CSBM) - Conceptual View - Deployment Scenarios

PSBN IN RURAL REGIONS:



PSBN IN REMOTE REGIONS:



KEY 700MHz PSBN ADVANTAGE: "HPUE" RANGE EXTENSION FEATURE AVAILABLE ON 700MHz BAND FOR BETTER VEHICULAR / FIXED RURAL RANGE THAN COMMERCIAL CELLULAR 5G SPECTRUM SPECTRUM

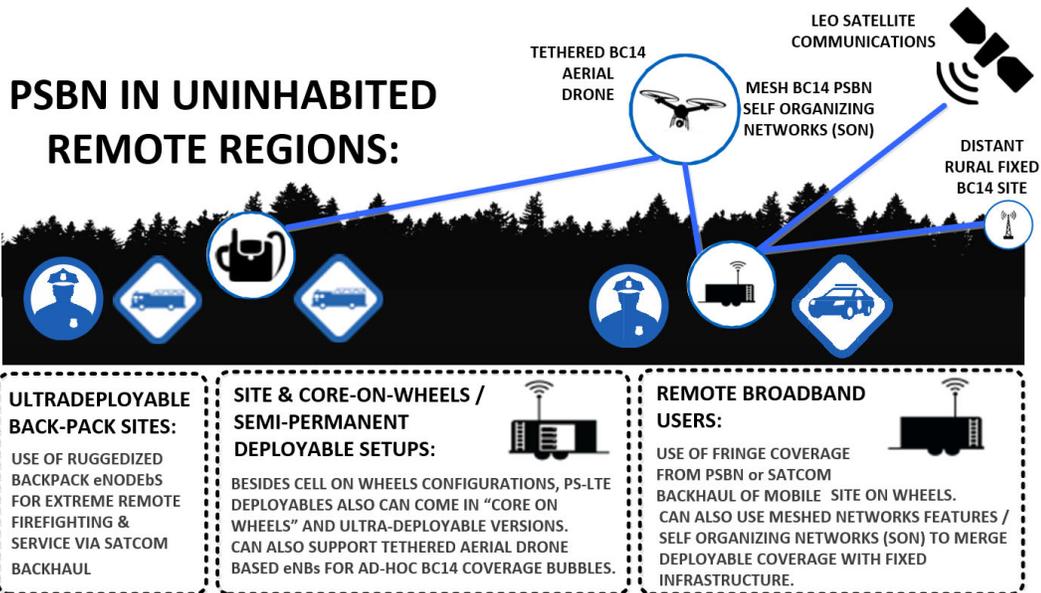


Figure 4: Conceptual view of Community Safety Broadband Model in Rural, Remote, and uninhabited regions. Commercial carrier spectrum sites shown in blue circles, with PSBN 700MHz (BC14) sites shown in white site circles.

B5. Benefits of a Hybrid PSBN for Rural Canada – and the Community Safety Broadband Model

239. The benefits of our overall new Community Safety Broadband Model (CSBM) as a new avenue for fostering rural and remote infrastructure investment include:

- a. **Municipally-Focused Business & Grant / Investment Approach** – by tailoring investments and rural broadband grant-funds to the specific needs of regions via use of multiple tools and business models, as opposed to a more “one-size fits all” policy approach. By hitting the rural broadband access problem from multiple angles – and permitting alternative investment models that may be better suited to some regions where incumbent MNOs have been slower to invest – we can more effectively and rapidly bridge the divide than with a single policy approach.

The PSBN focused CSBRIM approach also gives municipalities a key asset – license sublease control for 700MHz 4G/5G spectrum access in their jurisdictions (based on new Tier 5 ISED license regions for 5G networks) – giving municipalities a bargaining chip and tool to build emergency 911 service infrastructure for First Responders, and also at the same time an ability to overlay commercial services in partnerships with industry.

There is precedent for such an approach which can be seen in several international examples of holistic and tailored Smart City and Smart Rural wireless projects with multi-band 5G radios - that initially could deploy 700MHz PSBN radio modules for high-power and long-range PSBN use, and retain open slots for future expansion of commercial bands for general users when market conditions warrant turn-up of new spectrum and new services (please see References [C01] through [C72] for examples).

By giving municipalities a Tier 5 spectrum license for Smart City and Smart Rural development projects, government can give rural Canadians a key asset to leverage in tendering for municipal services and use of this spectrum. Retaining 700MHz spectrum as a special set-aside for municipal Public Safety also ensures the benefit and control of this key and valuable spectrum resides locally, to support the needs of local communities.

- b. **A more pragmatic view to “spectral efficiency” in spectrum assignment** – In the current regulatory philosophy of Canadian telecom spectrum assignment – and fostered by the current Telecommunications and Radiocommunications Acts, the concept of “spectral efficiency” is often raised as one of the overarching guidelines in assignment of spectrum in Canada and a justification for auction-based sale of spectrum. Indeed, a whole spectrum efficiency framework has been established based on complex information theory, population density studies and mathematical formulae involved in determining a “dollars per bit per Herz” (\$/bit/Hz) result to confirm whether a spectrum auction was “a success” or not for the coffers of the Federal government. Auction rules are effectively structured to promote maximum revenue for government – while attempting to promote new entrants with some fractional set asides.

However, as we see in the chronic high-costs per capita for telecom services in Canada, (see References [B01] through [B48]) and the relative issues that still remain in broadband access rural Canada - such national-scale “mega-auction” policies have had only mixed success to date. Indeed, besides the mixed results in percentages of rural Canadians served, we have also seen recent public threats from some MNOs enabled with spectrum and powerful business leverage in this national auction model - to threaten to withdraw already-committed co-funding for rural broadband if certain market conditions are not met (see References [B49] through [B50] on threats to withdraw rural broadband funding).

Besides high auction costs that the rate payers must ultimately bear, and the barrier to participation for competitive new telecom entrants, we also end up with large amounts of rural spectrum un-used and locked in large incumbent MNOs’ stable of licenses, dormant

and awaiting the rural business cases to improve enough over time and through population growth, to meet the high-threshold barriers to business profitability (indeed the irony is the high thresholds are partially due to the high auction costs to begin with).

The CSBRIM approach flips this paradigm and instead of a national or macro-scale / “top-down” focus with high auction costs and offset grants as a remedy to solving rural broadband - our model looks to a more granular “bottom-up” approach. The CSBRIM looks to provide an “anchor” local benefit with P3 capital investment and grant funds (i.e. Community Safety and wireless 911 data operations in rural communities) and in meeting societal needs for 911 communications and Critical Infrastructure (electricity, rail, etc.) as a “bottom-up” approach to building a monetization strategy and seeding initial coverage in underserved rural areas for specific rural goals and developmental benefits. By lowering entry barrier costs (i.e. to essentially free or nominal cost levels for 700MHz Public Safety spectrum), we provide a powerful catalyst to lower the business model cost in rural Canada and help permit commercial co-investment in rural regions.

Where investment from big incumbent MNOs has been slow or non-existent in rural Canada – the 700MHz PSBN anchor investment approach can help lower costs for new entrants or smaller regional MNOs to jump in and co-invest for more commercial coverage across a region. This use of 700MHz spectrum is effectively a catalyst that in an economic sense lowers and re-values the cost of spectrum from artificially high levels due to national high cost auctions, and provides new cost-sharing options with freer access to new infrastructure capital sources. At the same time the model also bolsters new competitive market forces in rural regions to ensure we have a diversified and robust competitive market in Canada (see References [B01] through [B50] on the chronic high cost of wireless broadband in our country).

We submit that in the special case of Public Safety and “common good” set-aside spectrum such as the 700MHz Public Safety band, that by giving rural and remote municipalities a powerful say in the optimal use and tendering of this spectrum - or alternatively the ability to contract and deploy neutral-host networks of said spectrum – that we end up with a solution better tailored at a granular level to local Canadians’ diverse needs – and potentially more rapid than relying on national-scale auctions alone.

By allowing the rural municipality to tailor telecom infrastructure investment at a more granular level, and granting municipalities a say in 700MHz spectrum allocation, we can argue there is a net “better spectral efficiency” in meeting specific local development needs - than in a national-scale auction for spectrum that ultimately often does not get used in rural regions, as we see in levels of dormant spectrum in remote regions.

It should also be noted that the definition of what is “spectrally efficient” in the rural milieu differs from the context in urban centers – and so we suggest that actual real-world / tangible community development results, and actual successful use of broadband access from that spectrum in rural regions, is the true measure of a spectrally efficient policy and model.

Dormant spectrum in rural regions is a symptom of a problem in the typical national-scale auction paradigm, where in the process, once large national MNOs purchase and pay for spectrum at auction, the spectrum often lies dormant in rural regions awaiting artificially high-breakeven business conditions to trigger a build of infrastructure RF sites, due in part to the initial high auction costs. These high-breakeven conditions in the resultant rural telecom business model often take a long time to reach - or never occur - due to slower growth of lower-population rural centers.

Yet while the business case is delayed by national-scale MNOs, the spectrum is still nevertheless reserved by those major MNO investors that win the auctions, and thus lies un-used. This tie-up of high-cost spectrum seen in today’s generally national-scale

approach to Canadian spectrum auctions in effect hinders using the spectrum in rural Canada. Although there are mechanisms to force larger carriers to relinquish un-used spectrum in a “use it or lose it” requirement in certain cellular and broadband licenses, the current paradigm nevertheless entails delays, administrative complexities and one-sided negotiations with large MNO carriers for access and agreed rates before the spectrum can be applied sub-licensed – and so the current approach still represents a significant delay and net barrier to market entry.

The CSBRIM approach to get spectrum directly in the hands of rural governments (as in the 700MHz Tier 5 license approach proposed for PSBNs) provides a tool to re-balance spectrum access conditions in rural regions where high-cost national-scale auctions are impeding the rural broadband infrastructure cost model.

As an example of this re-balancing of high national-scale spectrum auction costs via granular spectrum assignments, we can refer to the advent of 3.5GHz CBRS unlicensed spectrum in the USA as a harbinger of using creative spectrum policy via a mix of unlicensed and licensed priority access. CBRS will reside alongside traditional national-scale auctions – to provide alternate business models to the telecom market, foster new-entrants and healthy disruptive / dynamic market competitive forces, and also provide municipalities, start-ups and commercial interests with new tools for offering wireless data services to Canadians.

Therefore, our thesis is that by allowing a mix of current “national-scale” auctions, but also including a stronger role for “set-aside” auctions that reserve municipal-level 4G and 5G spectrum for Public Safety or Critical Public Infrastructure (like the case of 700MHz spectrum) – we achieve a policy balance that allows faster and freer access to spectrum.

By fostering lower-cost or freer access to spectrum in rural regions – through economically valuing the spectrum on a more granular Tier 5 geographic basis – we help free-up access to spectrum at a municipal level and give the municipalities a say in the best way to grow wireless infrastructure, and what type of contracts or P3 initiatives or MNO collaborations serve to best meet regional development goals.

As a conclusion on this policy aspect, we suggest that this more granular / distributed approach of giving municipalities a spectrum asset and an avenue to support specific common-good / societal projects – such as rural broadband growth and Public Safety 911 services in 700MHz PSBN set-aside spectrum – is a complementary tool for the CRTC, ISED and government to use alongside National Auctions for nationwide MNOs.

Unleashing the true “value” of spectrum and efficiency of spectrum assignment lies in enabling local Communities with use of that very spectrum in a timely fashion, and in enabling measurable real-world digital projects that can help advance tangible improvements in the quality of life for rural and remote Canadians.

- c. **Public-Private Partnership (P3) for cost sharing and new capital** – The CSBRIM fosters new institutional and corporate investment sources beyond MNOs (but also includes incumbent MNOs as valued partners in our proposed P3 model), and aligns new collaborative partnerships with Public Safety, and Critical infrastructure partners – such as utilities and transportation / rail / commercial firms. This collaboration results in shared costs, and net savings on infrastructure backhaul and facilities – which helps further bring down the high-breakeven thresholds of current rural telecom business models.

This collaborative partnership between municipalities, Public Safety needs, and Critical Infrastructure needs (eg. utilities, healthcare, rail, transportation, transit and energy) can provide an initial “neutral host infrastructure” approach that more rapidly seeds wireless access, fiber and microwave network transport – to meet urgent Community Safety and 911 service needs – but which at the same time acts as a spark to “get the business

model going” until commercial investors’ business cases improve sufficiently due to population growth or other market demand factors.

Public Safety and Critical Infrastructure entities – some with their own assets and infrastructure, such as electric utility fiber links in Northern Ontario – can together provide both a “pioneer” user-base, a key productivity / efficiency value proposition and real-world operations need, plus data applications to help monetize the investment in the short term (e.g. IoT for utilities and train control, Smart Grid control signaling, Public Safety data and civilian 911 needs can help monetize the infrastructure investment in the short term).

In turn, this short-term monetization yields an added longer-term investment benefit with the potential resale of commercial spectrum access on the 700MHz P3 infrastructure as a revenue stream – (using QPP differentiated services for Public Safety) – permitting lower-priority civilian commercial use as well on the rural neutral-host infrastructure. Lastly, these P3 infrastructure assets created may also be monetized by the municipalities and investors through outright sale of the infrastructure, when the local market and private capital interest has grown sufficiently for new entrants, regional MNOs or national MNOs to be interested in acquiring the infrastructure and facilities.

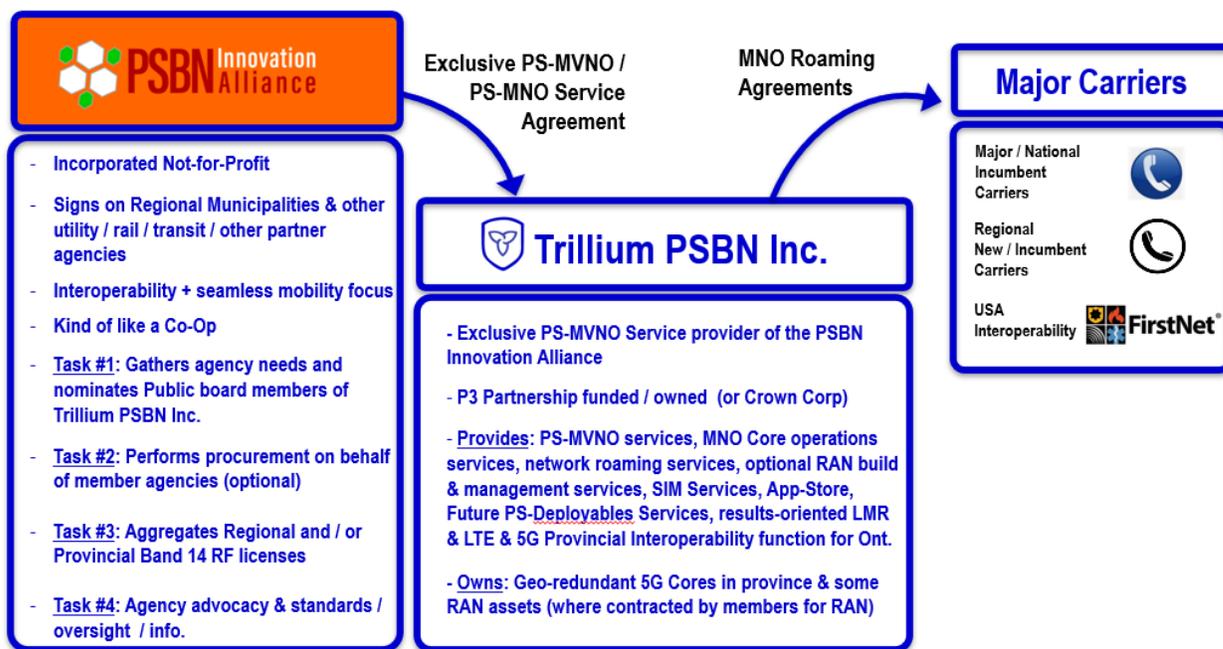


Figure 5: Conceptual view of Community Safety Broadband Model stakeholders and P3 public-private partnership approach for PSBN infrastructure.

In the end, the most valuable proposition of the CSBRIM approach and P3 collaboration aspect is in the “win-win-win” for all parties involved. Municipalities win with tangible Community Safety and targeted Community Wellbeing benefits and improved access to 911 services and new digital services for all rural communities involved. The Critical Infrastructure win is the enablement of wide-area utility / rail operations and critical signaling, and in renewal of rural fiber backhaul assets. Lastly, there is in turn a win for private enterprise through a lowering of the business breakeven thresholds to facilitate new sources of private capital co-investors to participate with acceptable profit margins.

As users, spectrum holders, infrastructure holders and capital investors align together to provide improved Community Safety and Wellbeing partnerships and new infrastructure - with rural, remote and First Nations municipalities – it’s the people and communities that benefit most with support of a “P3 option” among supported Canadian rural telecom business models.

- d. **“Starter-Spark” Approach to Help Pave the way for Commercialization** – by paving the way for access via short-term investment in Community Safety needs for 911 data services and First Responders, and using the CSBRIM’s flexible neutral-host infrastructure concepts (see References [A01] through [A05]), we have a means to foster new ventures via municipal-focused rural or regional MNOs - where incumbent large MNOs cannot or decline to invest today.

Through a neutral-host infrastructure approach, with collaborative P3 investment options including Critical Infrastructure investors (eg. rail, electricity) municipalities have another avenue to invest in their long-term communications needs for Community Safety purposes – to blaze a path for building infrastructure sites and data transport links that improve wireless services for all civilian, commercial and societal interests in a remote or rural community.

This Community Safety Broadband approach in turn provides a valuable municipal asset as communities and telecom / commercial markets mature and grow in a rural region – where the infrastructure deployed for the PSBN in a rural region can eventually be monetized by resale of commercial access to civilians and community businesses on 700MHz spectrum, along with infrastructure co-deployment rights for other commercial ventures (e.g. by providing roaming services and selling access rights to regional MNOs, shared un-licensed MNOs, Public Safety agencies, incumbent large MNOs, or collaborative commercial spectrum holdings).

Alternatively, as market conditions improve in a municipality using the 700MHz Community Safety based broadband access approach, the CSBRIM also permits outright sale of developed telecom assets to new regional operators once market conditions and business case have grown sufficiently to permit other private or large incumbent MNOs to further invest and partner in a given region. The funds secured from optional sale of these assets in turn also ultimately directly of benefit to the local Canadians within the Community using the CSBRIM model.

- e. **An added flexible tool to fill current gaps in the Telecom Policy Toolbox** – By using multiple investment approaches to advance municipal economic development in rural and remote Canada, we provide policymakers with multiple complementary tools in the policy toolbox to try to overcome the diverse challenges of the Rural Digital Divide.

Through offering a niche funding / grant model that focuses on leveraging Public Safety and collaborating with Critical Infrastructure on spectrum, capital and assets – the CRTC and Canadian governments have another flexible economic and social development option in the deck, to enable municipalities and provinces to find the fastest means – and best tailored to diverse local needs – in getting 4G and 5G services plus high quality terrestrial and satellite communications to rural populations.

The CSBRIM approach includes a framework that permits incumbent MNOs to invest alongside new consortiums of investment partners (including critical infrastructure entities such as utilities and rail / transportation) and both national and international Smart City capital funds and long-term growth investors. The CSBRIM approach is collaborative and supports a “better together” investment model to meet the needs of rural and remote communities, along with their economic development and Community Safety needs.

By broadening the number of investment models and choices available to municipalities and government, we can foster more market alternatives, that will in turn help more rapidly bring rural broadband to those communities that have not yet bridged the divide using today’s standard set of funding approaches.

A CSBRIM approach can provide the CRTC investment toolbox with an added flexible tool to address remote economic model circumstances - (i.e. PSBN co-investments with liberal access to 700MHz using QPP in partnership with Public Safety) - while affording fair market choice, consumer alternatives, and fair-market competition. The ultimate benefit is that the model channels new capital sources, and builds a long-term infrastructure asset for municipalities and Canadians as a whole.

These “stay-behind spectrum” benefits for local municipalities within the CSBRIM also provide an asset that can help foster new competitive market forces – in support of lower cost broadband for all Canadians.

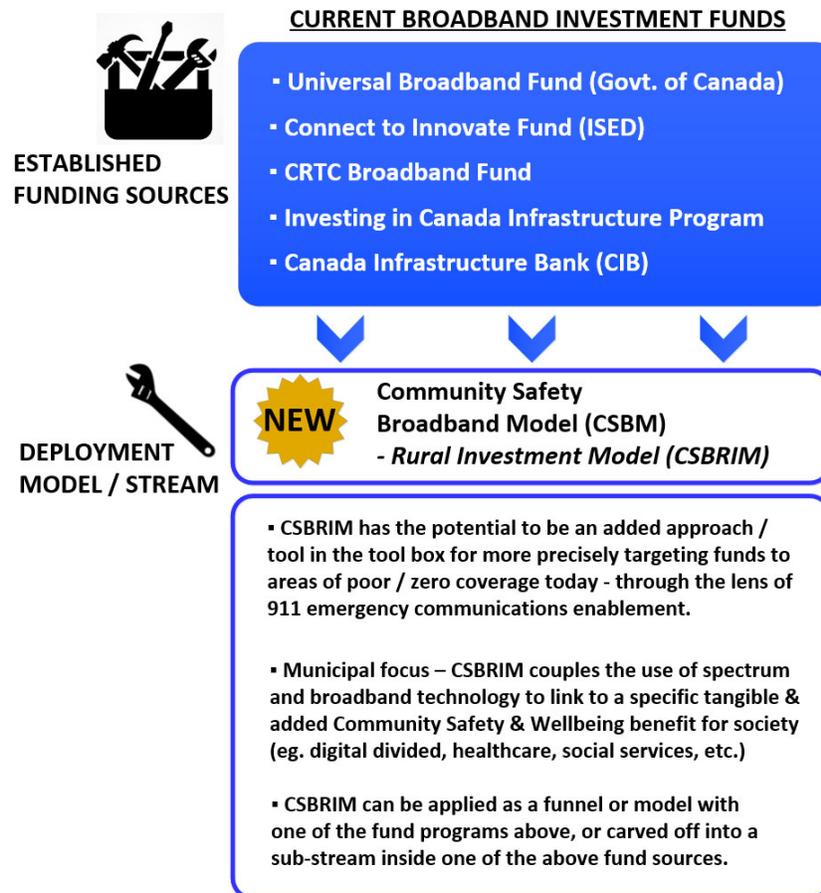


Figure 6: Conceptual view of how the Community Safety Broadband Model (CSBM) can fit into a government policy toolbox for rural broadband.

- f. **Neutral-Host Infrastructure + MVNO Innovation** – The CSBM model uses an approach of deploying neutrally held host infrastructure, as seen in various countries (e.g. see the experience in Mexico with Red Compartida / ALTAN Redes and the MXLINK SMVNO for Public Safety, and use of neutral-host infrastructure in Smart City programs – please refer to References [C48] through [C52] for examples).

The Neutral Host infrastructure concept is just one of several flexible approaches to funding Radio Access Network (RAN) investment within the CSBRIM approach for 700MHz spectrum, and is intended as a short- or mid-term stop-gap to get 911 emergency communications services in critical areas where “the need is now”. These Community Safety infrastructure and sites pave the way for a graduated move to commercial re-sale of access on sites or QPP-based 700MHz commercial access over the infrastructure lifetime in rural and remote communities – to help monetize the initial Community Safety investment.

The ideal and ultimately successful end-state of these Community Safety infrastructure sites is for commercial re-sale and take-over when market conditions permit - to new-entrant MNOs, regional MNOs, or large incumbent MNOs. In the end the neutral-host infrastructure approach is a catalyst to build infrastructure in collaboration with private capital – and which is intended to eventually graduate to full commercial ownership and monetization when market forces and population base permit.

A key point to note is that once infrastructure is built – it is important for a rural broadband model to ensure fair and competitive market rates are achieved for rural Canadians. There is a risk that a single set of infrastructure from a single service provider (neutral-host or otherwise) in a given rural / remote geography could put local consumers at the mercy of that firm for potentially high access rates as “the only game in town” for wireless services. Recent price analysis of Canadian MNO costs has shown strains of this behavior in regions with less than a certain number of MNO competitors (see Reference [B01] to [B50])

To solve the rural competition issue on neutral-host infrastructure, CSBRIM uses essentially the same approach as suggested by the Quebec Rural Municipalities consortium during the CRTC 2019-57 proceedings. In the early phase of building rural connectivity where a given rural or remote municipality does not have multiple competing infrastructure services from multiple MNOs, and where the CSBRIM infrastructure is the only set of wireless services in a rural region, a commercial MVNO approach provides the necessary competitive forces riding on top of municipal P3 / CSBRIM infrastructure from multiple MVNO service providers.

**Community Safety Broadband (CSB)
Neutral-Host Infrastructure
(MVNO & MNO Over-the-Top Services)**

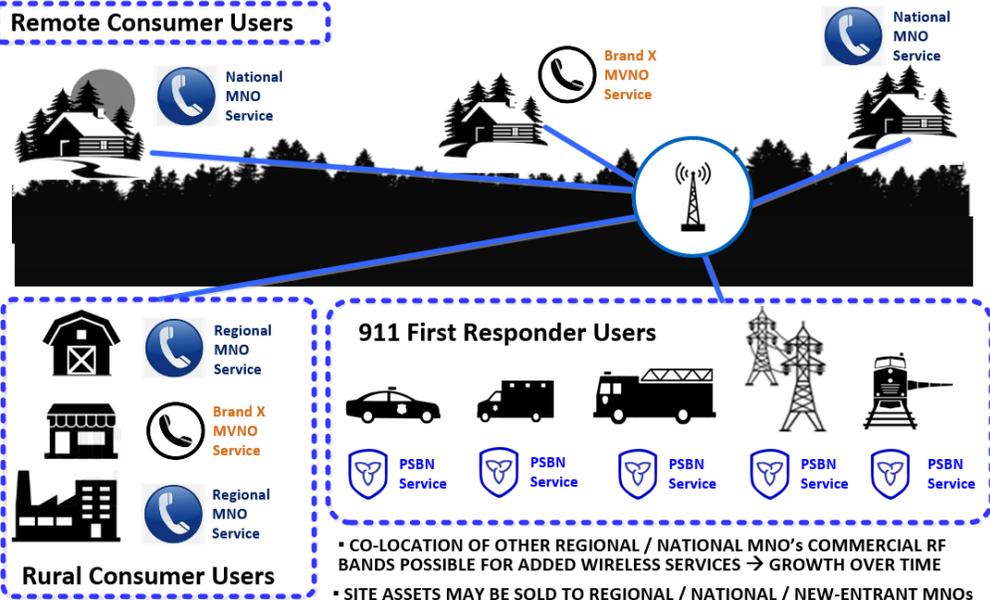


Figure 7: Illustration of MVNO services running on QPP (prioritized & pre-emptable) PSBN infrastructure in the Community Safety Broadband Model (CSBM) – along with potential paths to monetization for rural and remote municipalities.

Therefore, the CSBRIM concept, coupled with the anticipated opening of future full-MVNO services in Canada, can help ensure rural consumers obtain fair market

broadband rates on 700MHz neutral-host operators within a given rural region (or alternatively on an assigned-commercial infrastructure holder as in the Quebec Rural Municipalities conceptual model from the CRTC 2019-57 hearings).

- g. **Significant Economic Savings with the CSBRIM Pro-Market Choice Approach** – The CSBRIM is a vendor agnostic approach to fostering new market entrants, and enhances market choice for Canadian rural and remote consumers of broadband services.

As an example of our model outcomes - in our policy and economic case studies to date on the creation of a PSBN in Ontario using our Community Safety Broadband Model, we conservatively estimate government agency net 20 year operational cost savings on the order of \$2 Billion to \$4 Billion for Ontario agencies as compared to the current national incumbent MNO options for a PSBN build (normalized to 2019 Canadian Dollars) from just the cumulative savings on emergency telecom operations costs. In turn, added benefits accrue via timelier rural and remote community economic enablement, and cost savings to utilities and Critical Infrastructure firms by using a holistic Community Safety Broadband Investment Model (CSBRIM).

Please see References [A01] and [A05] for details on our economic modelling.

- h. **Aligned with rural approaches proposed in CRTC 2019-57 Hearings** - We would like to note that our proposed CSBRIM approach aligns with views noted by the Quebec Rural Municipalities in the recent CRTC 2019-57 proceedings related to the Review of Mobile Wireless Services, in using PS-MVNOs, PVNOs and MVNOs on commonly held P3 infrastructure to foster competition in those regions where multiple incumbent national or regional MNOs decline to invest.

Additionally, the CSBRIM approach to fostering rural investment aligns with the Competition Bureau of Canada's proposed MVNO model, and several other MVNO models suggested during those proceedings. Our proposed MVNO model is a full-MVNO for Public Safety, as a differentiated and niche market case for wholesale rates.

Lastly, we are firm supporters of the PVNO model proposed by the Canadian Electricity Association and Rail Association of Canada, and include the use of PVNOs as features within our CSBRIM investment framework, and as a complementary adjunct to PSBN RAN deployments in 700MHz spectrum.

- i. **Promoting First Nations participation in telecom services entrepreneurship** – Another benefit with the CSBRIM model for 700MHz spectrum is that it focuses on leveraging the spectrum a local asset – and attaches regional and local development targets surrounding wireless broadband access and Community Safety initiatives – at a targeted local level. This approach is ideal to help foster new entrant First Nations businesses and start-ups in the telecom and ancillary high-tech market – with ownership, staffing and operations run by First Nations people.

As noted above, the CSBRIM model flips the investment dynamic around to a grass-roots + bottom-up approach, and refocuses the investment dynamic on “the First Mile” and needs of the local community – with spectrum as an enabling force for specific Community Safety & Wellbeing projects grown via spectrum set-asides such as Band Class 14 in the 700MHz band.

We contrast this “First Mile” approach with the typical afterthought of rural and remote geographies being “the Last Mile” in the broadband marketplace equation in Canada.

On these lines we applaud and strongly support the policy work of the First Mile Connectivity Consortium (FMCC - see www.FirstMile.ca) – which is an innovative Canadian First Nations policy and technology development association, and we feel there

are synergies in the concepts put forth by the First Mile Consortium, and our proposed CSBRIM approach for specifically using 700MHz PSBN spectrum as a municipal development tool for rural and remote communities.

Additionally, we would like to note that the CSBRIM approach aligns with all the key tenets of the First Nations Broadband Infrastructure and Operations Policy (see www.firstmile.ca) for equitable and community-based broadband infrastructure. CSBRIM also aligns with the First Nations broadband policies as noted by the First Mile consortium and the Operations Policy document:

“Broadband as a utility, an essential community and regional public infrastructure that supports and enables First Nation community services such as health, education, economic development, governance, public security and emergency services”.

We suggest the CRTC, ISED and Federal government can assist First Nations development through a more grass-roots / bottom-up approach to spectrum and telecom business models. By giving First Nations a say on use of new 4G and 5G regional-scale RF assets within their jurisdictions, (i.e. at or below ISED’s new Tier 5 level license size for 5G auctions to accommodate licenses covering First Nations reserve territories) and in lowering barriers to market entry at the local level in rural Canada, and by using spectrum (eg. PSBN 700MHz spectrum) as a tool for both Public Safety and local development at the same time – we can provide a market opening to foster greater First Nations entrepreneurship and ownership within the telecom marketplace.

The CSBRIM approach for 700MHz PSBN spectrum – coupled with a focus on local growth through more granular Tier-5 based spectrum allocations to rural municipalities, can be an opening to build more local First Nations businesses and MNO / MVNO start-ups, as documented by the many success stories and initiatives of the First Mile Connectivity Consortium.

- j. **A model that enables new MNO and MVNO entrants and a pro-competition market** – A key tenet of the CSBRIM approach is in using pro-competition policies, to ensure we avoid outright regional monopoly conditions or single-vendor / single service-provider lock-in. Fair-market competition is healthy for markets, consumers and ultimately drives economic growth and technological innovation from market participants and society.

The CSBRIM approach permits building P3 neutral-host infrastructure using 700MHz spectrum in rural regions where MNOs currently decline or are delayed in investing. However, the important caveat is that where these neutral-host infrastructures exist and are the sole carrier in a given geography, we propose that MVNO services be permitted on these municipal-P3 held infrastructures for consumer services, to ensure fair and competitive broadband costs for rural and remote civilians.

In the recent Quebec Rural Municipalities submission at the CRTC 2019-57 hearings – they proposed an approach using MVNOs to ensure competitive rates on rural geographic concessions or time-based / tendered rural infrastructure monopolies – as a way to entice private capital to invest in underserved rural regions. In turn, in the CSBRIM approach, MVNOs foster competitive consumer rates on top of P3-owned neutral-host municipal infrastructure on 700MHz spectrum. In using MVNOs to foster competition on concession-based or municipal-P3 infrastructure, our model is in alignment with many of the MVNO related tenets in the proposal from the Quebec Rural Municipalities.

Additionally, the CSBRIM approach for the 700MHz PSBN band fosters conditions that are optimal for new entrants and regional MNOs to participate – with an ability to gain freer access to spectrum via municipal P3 builds. By giving local municipalities spectrum sub-licenses for 700MHz, we create more opportunities for new entrants and regional MNOs to gain a foothold in the Canadian telecom market – than by relying solely on

national-scale auctions with partial set-asides, as these national auctions often have very high-cost barriers to spectrum and market entry for smaller MNOs, MVNOs and start-ups – even in the case of set-aside spectrum.

Therefore, we suggest that the CSBRIM model aligns with government and CRTC policy objectives to ensure a healthy marketplace with balanced competitive forces in Canada, by facilitating more market entry points via Tier 5 granular geographic licenses, and via municipal spectrum grants to help in turn foster more local players and more local entrepreneurship, alongside partnerships with current + new sources of capital investment.

- k. **Het-Net architecture for multiple Public Safety fall-back systems in disasters** – In looking at building telecom networks that underpin a digital society, building-in resiliency and “graceful fall-back modes” from the start of design is a key tenet for Public Safety and mission-critical networks.

Graceful fallback modes and pre-planned interoperability – via a provincial or multi-regional agency or arms-length operational corporation (e.g. the E-Comm model in British Columbia – see www.ecomm911.ca) provides a coordination function and added layer of network operations / services that ensure interoperability is pre-planned, with defined multi-layered coverage availability throughout a service region, and with seamless roaming across a hierarchy of networks.

In the PSBN Innovation Alliance proposal for a Canadian Public Safety Broadband Model – a Heterogeneous Network (or “Het-Net”) architecture is used as a part of the pragmatic reality of living in an era of intense technology evolution, with several concurrent generations of technology in the market all at the same time. For example, in the Canadian market in the 3GPP standards space we have 3G, 4G and 5G infrastructure generations currently co-existing in MNO infrastructure, and with future advanced Low Earth Orbit (LEO) satellite network services (e.g. Telesat) coming within the next 5 years.

WHAT IS A PSBN? → “A NETWORK OF NETWORKS”

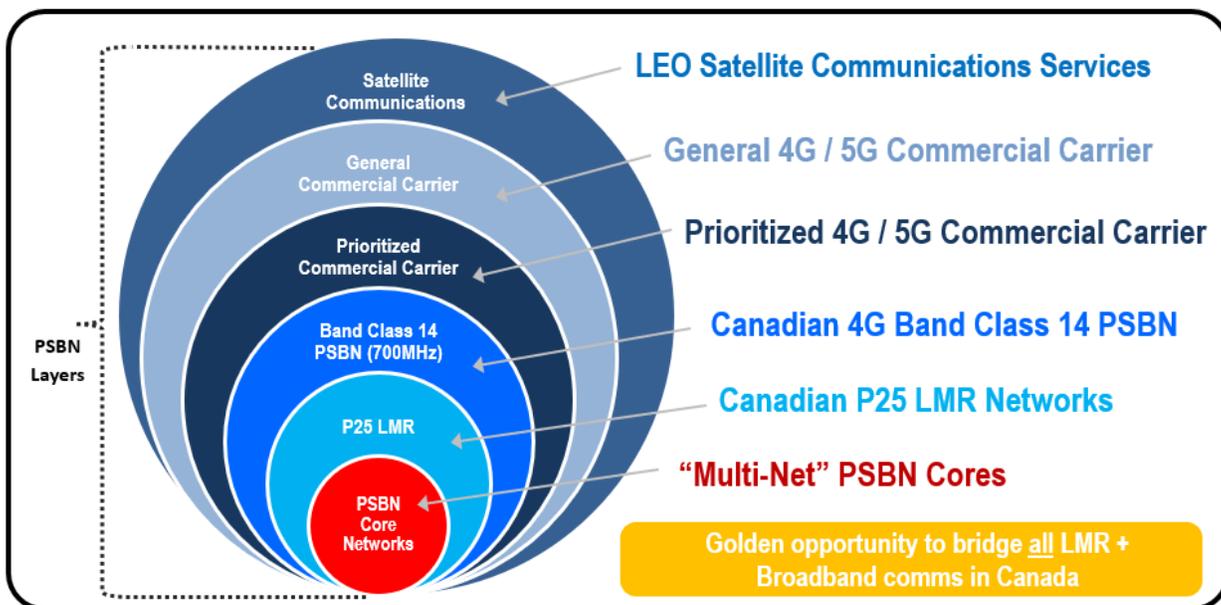


Figure 8: Diagram showing the PSBN Innovation Alliance “Network of Networks” and Het-Net concept for a holistic Canadian PSBN solution.

In turn, these current broadband technologies co-exist with legacy Land Mobile Radio (LMR) and Geosynchronous satellite technologies, and in some countries even 2G legacy cellular networks – which each have a niche value proposition which is propping-up and driving their extended lifecycles and respective market longevity. (See Reference [C52] for a discussion on lifecycle overlap).

To compound the issues related to network evolution - future 5G network technologies are already arriving – with the advent of “quasi un-licensed” CBRS (3.5GHz spectrum) services in the USA, with near-term plans for the auction of portions of the 3.5GHz spectrum to proceed in Canada in late 2020.

Other early harbingers of more exotic 6G technologies (such as drone-based 4G/5G wide-area hotspots for disaster contingency, or nomadic blimps that can ride over top of a damaged city to provide a ubiquitous blanket of 5G coverage) – are already arriving in working proof-of-concepts that are available for purchase today.

Enhanced municipal Wi-Fi networks also appear to be making a come-back in markets, with growth in saturation and boost in broadband speeds, making WiFi a viable option to support VoIP based calls for Emergency Responders as a network of last resort via PTT-over-cellular applications, in a hierarchy of “graceful failover” options.

This Het-Net PSBN philosophy – “where the service is not the underlying physical technology” - can be thought of in some respects as analogous to the recent rise and evolution of concepts as the “virtualization” of hardware (e.g. VMWare), and service-oriented architectures (e.g. SD-WAN technology in transport networks) – where the underlying physical layers are abstracted from the fundamental service via a presentation layer.

In short – in our data-oriented future in Public Safety communications, with video as an ultimate societal trend for 911 Emergency Responders to interact with civilians and society at large, the use of unlicensed and semi-licensed technologies such as CBRS will potentially have a role to play in a multi-layered network design for Public Safety – and in turn also helps necessitate using a “Network of Networks” or Het-Net design approach in building a PSBN model that can last the long-term and provide the resiliency needed for data services.

Over time, various technologies among these communications layers will fade and become obsolete, and be replaced by other future generations and innovations – but the key tenet behind our PSBN model is that the reliable Public Safety (PSBN) service in Canada is thought of as a service that straddles multiple networks – and multiple spectrum classes – in a “Network of Networks” model.

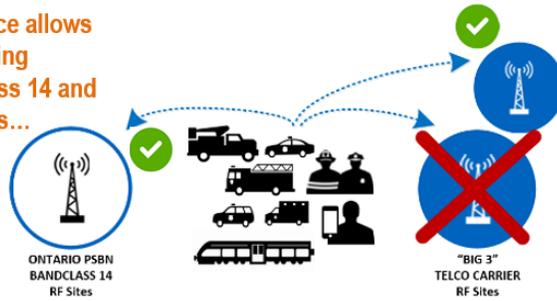
In the case of PSBNs, a “Network of Networks” model builds in resiliency with multiple layers that each provide a degree of failover in rural settings with a single layer of Radio Access Layer infrastructure sites (e.g. Broadband 4G/5G failover to LMR - - or potentially in the future - - Wide-Area 4G/5G Broadband failover to LEO Satellite services - - or LEO Satellite services fallback to LMR).

- I. **A “Digital Right of Way” for Emergency Responders** – Public Safety MVNOs – or PS-MVNOs – can be a new innovative business & technology model that enables better reliability of communications for Emergency Responders. PS-MVNOs effectively create a “digital right of way” – to help 911 lifesaving services in times of need. As noted in our written submission, and also in the submissions of the Canadian Electricity Association and the Rail Association of Canada, MVNOs offer a technical architecture that is better able to withstand outages of individual MNOs, by providing an abstraction layer above

network operators to allow First Responders to jump from one MNO to another in the event of core or RAN outages on a given carrier.

PS-MVNO ADVANTAGE – RELIABILITY IMPROVEMENT VIA 2-3 CARRIERS:

A PS-MVNO service allows flexibility in bridging 700MHz Band Class 14 and Commercial MNOs...



...A PSBN MVNO model can be used to develop higher net resiliency among several carriers in the event of carrier outages

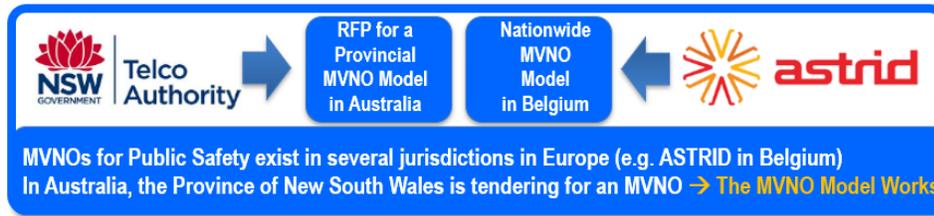


Figure 9: Diagram showing the Public Safety MVNO concept running across multiple roaming MNO partners + PSBN 700MHz sites.

Put simply, MVNOs permit stacking the reliabilities and availability of several carriers – one on top of the other – to get a net better level of signal strength and system reliability than any individual MNO. The PS-MVNO model is an effective concept that has been proven and implemented in other jurisdictions in the world.

Indeed, a recent study on MVNO performance in the US market has confirmed this concept of “stacked reliability”, where Tutela™ has reported in their October 2019 State of the MVNO paper that MVNO performance measured across all 50 states have shown an ability to be as good – and even better than major Tier 1 MNOs.

MVNOs OUTPERFORM MNOs... AN OPERATIONAL ADVANTAGE FOR PUBLIC SAFETY

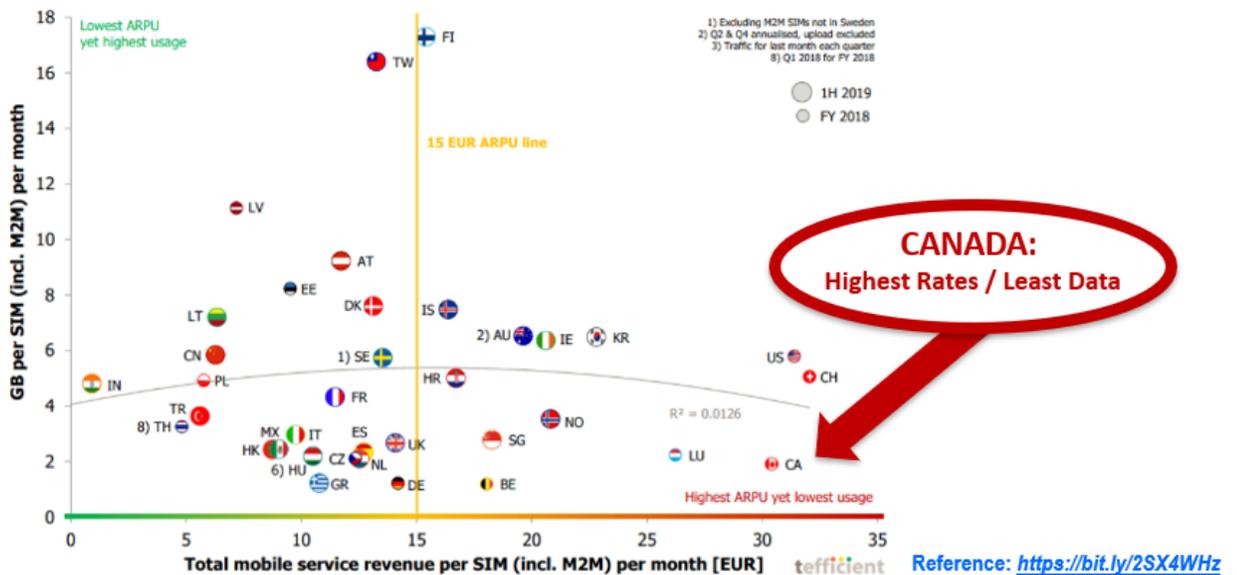


Figure 10: Chart from Tutela (see Reference [C63]) on US MVNO vs. MNO performance findings in their 2019 survey of US broadband service.

This superior performance stems from an ability of MVNO users with multiple network roaming agreements to effectively jump to the best signal level, and the best network in any given location – thereby always maintaining the best level performance for their users. This MVNO concept of providing First Responder access to the best signal in any given location, effectively amounts to a “digital right-of-way”, in a similar manner that an Emergency Responder vehicle’s sirens and lights provide a right of way in the real-world on our highways and roads.

Beyond the performance advantages that a pro- PS-MVNO policy has for First Responders, the relative high cost of telecom in Canada – shown over years of international studies – also impacts the operational budgets of First Responders. Chronic high costs due to competitive skew in the Canadian telecom marketplace in turn draws valuable operational budget dollars away from critically needed 911 field resources, staff and equipment. A pro-PS-MVNO policy, and pro-market-driven model for Canada will in turn generate cost savings that can benefit First Responders in their lifesaving service.

ADVANTAGES OF A PS-MVNO → A HYBRID MODEL PSBN:



Results from latest tefficient™ international study in 2019 shows Canadian telecom rates are still #1 most expensive among major industrialized countries → this chronic high cost impacts Public Safety budgets

Figure 11: Chart from the latest tefficient™ (see Reference [B01] and [C07]) on worldwide price points contrasting competitiveness and market conditions in benchmark nations from around the world. Canada is located in the lower right quadrant with the highest rates for the least data.

We therefore suggest that PS-MVNO Prioritization and Pre-Emption concepts should be strongly considered in future Conditions of License and auction for future spectrum set-asides, in order to permit Public Safety differentiation of services given their lifesaving mission in 5G bands, and as an example we cite the FCC licensing approach to CBRS spectrum prioritization as a creative model for ISED to consider in the 3550 MHz to 3700 MHz block. The FCC approach is focused on two key advances that foster more efficient use of radio spectrum: small cells and prioritized spectrum sharing (ie. Incumbent / Reserved, Priority Access (PA) and General Authorized Access (GAA) levels).

In similar fashion, we advocate for ISED to consider the concept of a “digital right of way” for Public Safety in future auctions, and in the ability of PS-MVNO concerns to contract with national MNO carriers for these differentiated services for Emergency Responders, where the ability for Public Safety to obtain prioritization services with licensees (where a

appropriate) in 5G spectrum, or for the ability to co-deploy reserved services in appropriately-sized Public Safety “set-aside” portions of 5G spectrum allocations (eg. for Critical Infrastructure or reliability / resiliency / Cybersecurity needs or National Security needs) – would be beneficial for emergency communications needs and a societal benefit as well.

In the attached Appendix to this document, we provide an illustrative example (purely for future consideration by ISED and Government) - of a potential framework of Conditions of License for Band Class 14, with a simple yet flexible two-tier licensing framework that would meet the needs of both rural and urban municipalities in Canada. Our Hybrid PSBN model uses the Tier 5 concepts as illustrated in recent proposed ISED 3500MHz auction terms under review, and preserves municipal choice in determining the optimal manner that Band Class 14 spectrum is deployed in order to best meet their grassroots community needs and broadband connectivity challenges.

- m. **An improved focus on interoperability and eliminating coverage gaps for 911 operations** - The CSBM has a key aspect related to core management that is in a fashion similar to the “E-Comm Model” for Public Safety LMR and 911 dispatch services in the Province of British Columbia. E-Comm provides infrastructure services among multiple regional entities in the Lower Mainland of BC, and provides a multi-regional + multi-agency level of coordination as well.

In similar fashion the CSBM in our fictional example (i.e. with the Trillium PSBN Corp. for Ontario above) can act as a P3 (public-private partnership) enterprise at arms-length from government, to provide core network services for municipalities that connect into the PSBN, and to help provide “gap filling” coordination for areas with poor or spotty coverage.

The PSBN service provider function also serves to refine coverage across both PSBN sites and 3rd party incumbent MNOs to help disaster-proof emergency communications for “surge conditions” (such as parades and concerts via deployable devices and sufficient MNO capacity on-hand) and for primary use by Public Safety for additional coverage within special events or disaster regions (e.g. Raptors parade, Hurricane Dorian, and other disasters where MNOs have not provided the level of reliability for data required for Next Gen service delivery.) See References [D01] through [D51] for a review of recent MNO performance in surge and corner-case disaster conditions.

Therefore, the PSBN concept in the CSB framework provides a “glue” layer to help smooth out coverage issues between MNOs in cities and rural areas, and to fill-the-gap in coverage where MNOs refuse to invest but where there is a dire community need. 700MHz spectrum is considered one of several RF-layer interoperability bands for Canada – and the band for data interoperability, and so having a corporate focus on obtaining seamless interoperability across PSBN & MNO infrastructure in our provinces, including rural regions, is critical to success in 911 emergency services.

In this respect, the CSB and CSBRIM models additionally provide a value-add in bolstering the resiliency of aggregate Canadian MNO infrastructure for disaster preparedness – with a “strong-point” philosophy of communications infrastructure.

No such service exists today, and with the increasing frequency of disasters anticipated due to climate change, coupled with man-made disasters – there is a need for a focused effort to provide assured communications across aggregate Canadian telecom infrastructure.

- n. **A suite of unified 911 responder communications tools for seamless roaming across networks** – In addition to interoperability of infrastructure (ie. 700MHz as the common connectivity layer for Public Safety) we also need interoperability of applications

and software. To this end, the proposed CSB model PSBN business model also includes a Cybersecure “AppStore” and “DeviceStore” concept to permit vetting and locking-down of Public Safety apps in the “PSBN domain” of the network.

On the consumer side of the network (ie. serviced by MVNOs and MNOs riding “over the top” of the natural-host infrastructure), civilian and business users will be able to run any Band Class 14 product approved for Canadian market deployment to run on the 700MHz PSBN sites.

PSBN Cyber-Secure AppStore / DevStore Concepts:

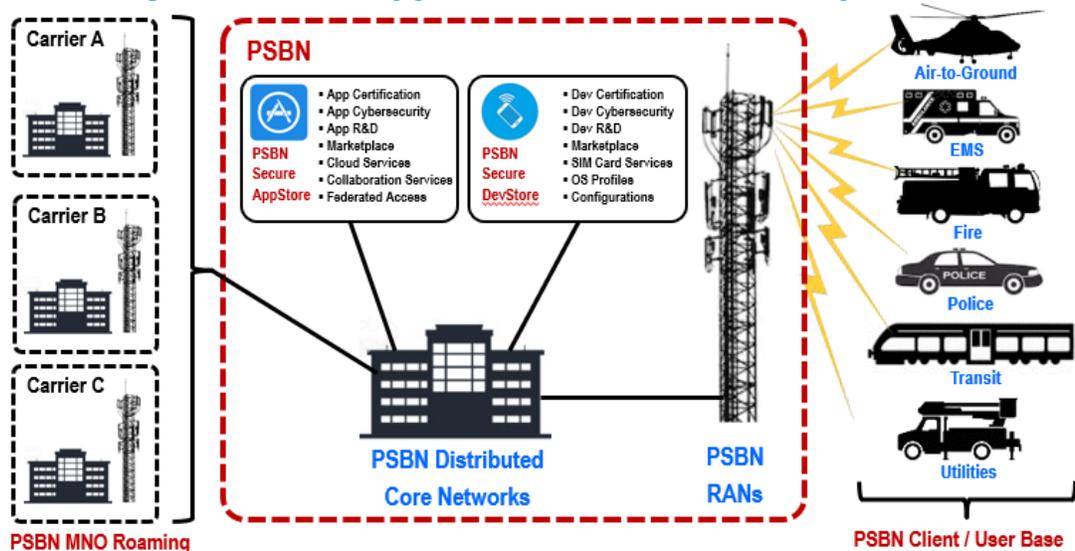


Figure 12: Within the CSB Model, the PSBN is a secured network that encompasses both a Public / Consumer domain and a more highly secure Private / Critical infrastructure domain. All devices and applications in the Critical domain are locked down and certified for Cybersecurity purposes via the PSBN App-Store and Device-Store, for all First Responder and Critical Infrastructure devices and software (eg. utility, transit, rail, airport, etc.)

- o. **Concrete Rural Community-driven Development Projects tied to technology - where the need is now** - As a final advantage in the CSBRIM approach, the model includes a special component related to including the delivery of concrete Community Driven Investment Projects tied to telecom spectrum & infrastructure.

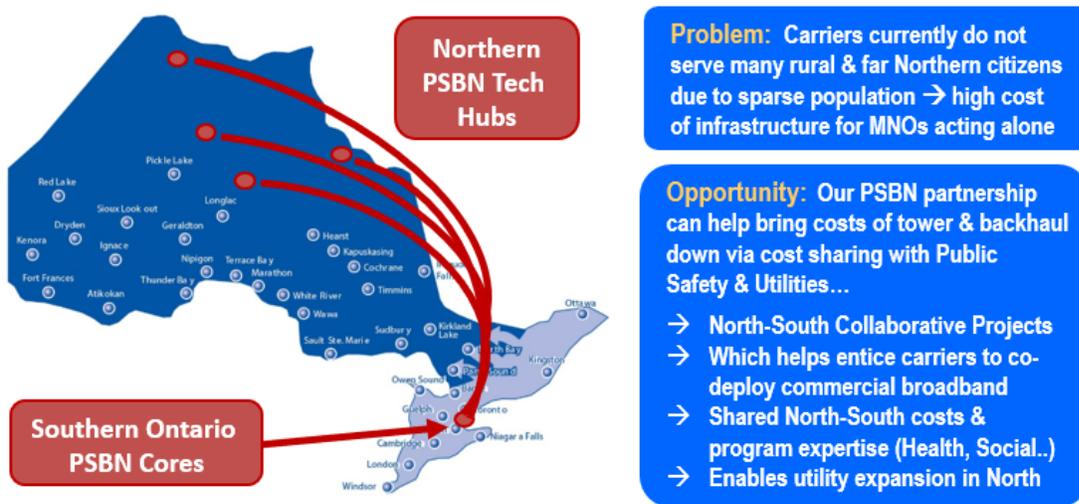
The CSBM approach twins technology enablement in a society with resources for virtual social services - like telehealth, access to e-learning and education, and targeted economic / business start-up programs.

Therefore, the CSB approach does not just focus on the technology – but couples the delivery of new broadband infrastructure, with the delivery of specific new digital social services, as a part of the corporate charter. By helping rural regions achieve both a technology win + a specific and measurable social benefit, we ultimately get more focused benefits for rural Canadians, and create anchor uses for the new broadband spectrum in a given region, so that our new investments do not sit dormant.

Another key tenet of CSB is in fostering North-South tie-ins with advanced University R&D links and the business incubator programs (eg. the Innovation Factory – see <https://innovationfactory.ca/>) in a “North-South” collaboration, so that we can actively foster linkages to tech R&D and societal benefit + technology in our remote and rural communities.

The paradigm of combining societal benefit with engineering technology is not new, and we gain inspiration from the likes of Canadian precedents in Engineering & Society programs of McMaster University's School of Engineering, where technical design is treated as a holistic joining of societal benefit with technology policy (see Reference <https://www.eng.mcmaster.ca/engineering-society-program>).

CSB MODEL VALUE PROP: SMART-RURAL – BRIDGING THE DIGITAL DIVIDE:



Solution: North-South Partnership helping bridge the Rural Digital Divide !

Figure 13: Conceptual diagram showcasing the joined nature of the PSBN and Next-Gen 911 dossiers. Upstream service enablement for

Conclusions on Benefits of the CSBRIM Approach to Rural & Remote Broadband Enablement:

In conclusion, the CSBRIM approach can provide the CRTC and Canadian governments a new tool to address those regions that have currently lagged or fallen behind in rural broadband enablement as a result of today's set of available policy options. By adding a new CSBRIM grant and investment approach to the set of available funding options for municipalities and regional governments – we can more effectively target those communities where incumbent MNOs have currently refused investment for strategic or commercial reasons.

An added financial advantage of the Hybrid or MVNO approach is related to possible cost sharing of telecom infrastructure costs with key “secondary and tertiary” Public Safety entities, such as utilities and transit agencies, that have a keen need for highly Cybersecure infrastructure due to the critical nature of their infrastructure and may be interested given synergies of access needs.

These critical infrastructure agencies have synergies in wireless communications requirements due to the potential for large-scale loss of life in the event of security breaches (eg. nuclear plants, wide-area electrical and natural gas grid-control equipment, automated train control applications, heavy industry plants, etc..), and given the key fact that they interoperate with First Responders during emergency response to disasters and crises.

Lastly, the hybrid model proposed also has an avenue for incumbent national MNO participation and co-investment in neutral-host infrastructure – alongside other investors – in order to help bring down the “break-even threshold” and provide shared profits to all investment partners.

In many respects this approach mimics some of the aspects of the UK Home Office / ESN rural shared infrastructure approach which brings together several carriers to help share costs and profits for more marginal rural business cases.

B6. High Level Needs Analysis for Public Safety & Critical Infrastructure Broadband:

240. In turn, as a very brief summary of needs analysis, the key telecom technology themes and characteristics of mission-critical grade communications systems that are important to First Responders, and which policymakers should consider in developing new policies for rural and remote broadband include:

- Broadband enabled rural communities & First Nations with reliable Next-Gen 911 access
- Unified Communications for data access anywhere on any network
- Better Interoperability via Focused Pre-Disaster-Event Planning & Network Preparation
- Improved Reliability of Communications Infrastructure via PSBN Standards
- Improved Resiliency – Including on-demand Rapid Deployable Communications Systems
- Improved Cybersecurity as a key focus for all PSBN participant networks
- Reduction of the High Cost telecom model as compared to other nations
- “Digital Right of Way” prioritized and preemptable access to data on commercial MNOs
- A “Het-Net” Future for First Responder 911 Communications
- Meeting Diverse Municipal / Societal Needs & Alternative Forms of Investment
- 5G High-Band Spectrum & Long-Term Spectrum Evolution Plans for Public Safety
- Unified Communications & Cloud Data Access for Emergency Responders

As an example of the key near-term Public Safety challenges which illustrates all the above themes we refer to the conjoined “up-stream content” and “downstream delivery” issues inherent in Next Gen 911 data driven requirements from the CRTC (including new / future digital interactions with civilians, which eventually are anticipated to include video) – and the advent of Public Safety Broadband Network spectrum and system deployments (providing the reliable virtualized data pipe across multiple networks, agencies, geographies and contingencies).

PSBN & NG911 ARE TECH CHALLENGES THAT ARE TIED TOGETHER:

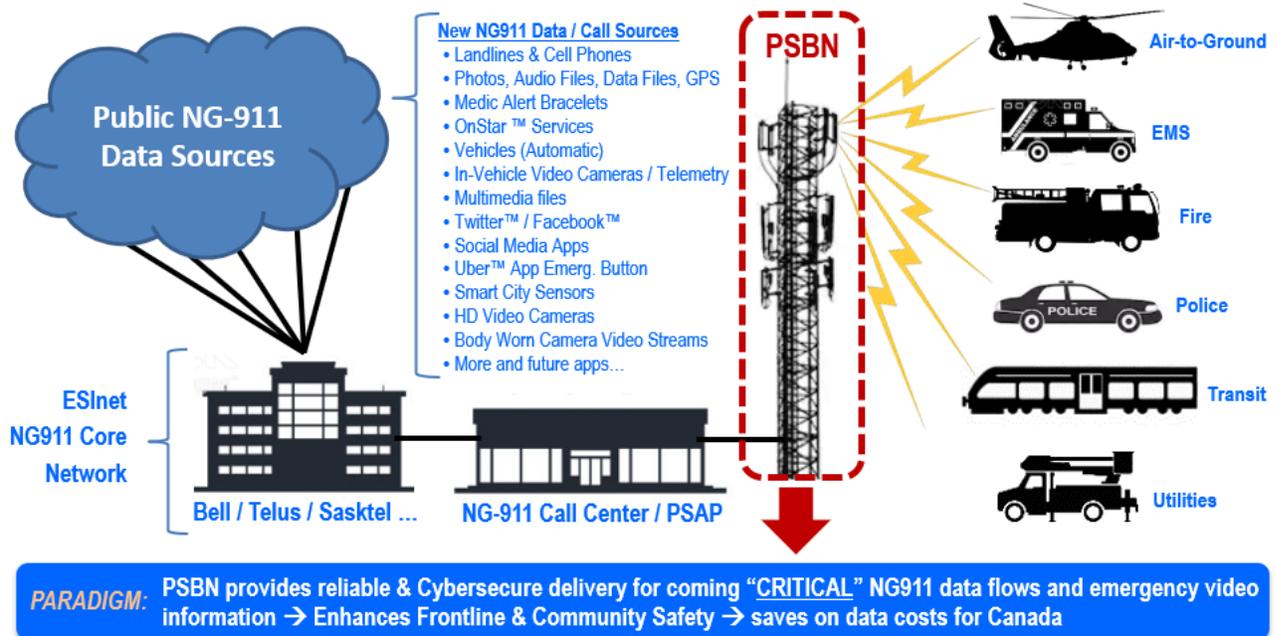


Figure 14: Conceptual diagram showcasing the joined nature of the PSBN and Next-Gen 911 dossiers. Upstream service enablement for civilians with new digital based NG-911 services will need to reliably reach downstream field operations staff – with the PSBN as the key.

G. APPENDIX - REFERENCES:

Section A – Canadian PSBN Policy & Economics Whitepapers

[A01] Halton Regional Police Service, “PSBN Whitepaper Volume I: The Evolving Communications Needs of Canadian First Responders”, March 2019

[A02] Halton Regional Police Service, “PSBN Whitepaper Volume II: Qualitative Analysis of Canadian PSBN Models”, March 2019

[A03] Halton Regional Police Service, “PSBN Whitepaper Volume III: Economic Analysis of Canadian PSBN Models”, March 2019

[A04] Halton Regional Police Service, “PSBN Whitepaper Series – Executive Summary: A Comprehensive Study on the Establishment of a Canadian PSBN”, March 2019

[A05] [Ontario Ministry of Justice, “CSWB Planning Framework – A Shared Commitment for Ontario”, <https://www.mcscs.jus.gov.on.ca/english/Publications/MCSCSSSOPanningFramework.html#Section2>]

[End of Document]