ISED SLPB-002-20 REPLY COMMENTS

PSBN Innovation Alliance Reply Comments on the 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)

November 30, 2020

Release Version R01.00

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 offer reply comments on the SLPB 002-20 submissions, and to specifically offer perspectives on the needs of First Responders and Critical Infrastructure in this ISED consultation. We also 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

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ISED SLPB-002-20 - Reply Comments
PSBN Innovation Alliance Comments on proposed ISED Policy Framework for the 3650-4200MHz Band

Page 1
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Table of Contents

ISED SLPB-002-20 - Reply Comments
PSBN Innovation Alliance Comments on proposed ISED Policy Framework for the 3650-4200MHz Band

Page 2
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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. <u>OVERVIEW</u>:

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 comments 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.psbninnovationalliance.ca:

    a. <u>Volume I</u> – The Evolving Communications Needs of Canadian First Responders;

    b. <u>Volume II</u> – Qualitative Analysis of Canadian PSBN Models;

    c. <u>Volume III</u> – Economic Analysis of Canadian PSBN Models

    d. <u>Volume IV</u> – Business Model Scenario for a Hybrid Model PSBN

    e. <u>Volume V</u> – TNCO Interim Report Review Comments & Recommendations for a Canadian PSBN;

    f. <u>Volume VI</u> – 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:

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

ISED SLPB-002-20 - Reply Comments
PSBN Innovation Alliance Comments on proposed ISED Policy Framework for the 3650-4200MHz Band

Page 4
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B. **REPLY COMMENTS ON ISED CONSULTATION SLPB-002-20:**

10. We would like to again thank the Ministry of Industry, Science and Economic Development (ISED) for the opportunity to comment and share concepts that may be of use in setting up 5G spectrum band assignments, from the perspective of Public Safety 911 communications needs.

11. For the reader's convenience we briefly summarize key elements of our positions here per our original submission to the ISED SLPB-002-20 consultation in October 2020. We noted in our original submission that from a Public Safety stance:

> 1.) We supported the concept of a "digital right of way" for First Responders in band plans for 5G spectrum, and future Conditions of License for all 5G spectrum, in an approach that provides priority and pre-emption access for 911 emergency responders in their lifesaving mission through a Spectrum Access System (SAS) or other approach, and which would comprise prioritization and potentially pre-emption of data and voice calls in disaster and during 911 emergency or disaster response, where delays of minutes and seconds in gaining timely access to Public Safety data can literally mean life or death. We in turn propose that fair wholesale tariffs for prioritization & pre-emption be set by the CRTC as part of their review ongoing review of mobile broadband pricing.

> 2.) We proposed that ISED should retain the longstanding policy of municipal Public Safety spectrum set-asides to these 3.8GHz allocations in 5G – for at least a portion of the 3.8GHz mid-band allocation, as a means of fostering rural / remote broadband access in acting as a municipal "spectrum asset of last resort" that could be used as a backstop in chronically underserved regions to gain a nucleus of wide-area mobile 4G/5G broadband access where MNOs have declined to invest in the status-quo approach.

> Leveraging the PSBN concept and Public Safety spectrum set-asides in low & mid-band 5G spectrum, could more rapidly bring 5G services to rural regions, by making low-cost / lower bandwidth spectrum available for Public Safety as a nucleus or "patch filler" underlay of broadband access in underserved regions, or regions with spotty access. This lower cost PSBN spectrum, combined with the user base of Public Safety and Critical Infrastructure stakeholders (such as Rail and Utilities) within a rural PSBN business case, can make the ROI feasible for investment, with such a PSBN "neutral host" network also leveraged to provide rural residential / commercial use via prioritization technology.

> Also, Public Safety set-aside spectrum helps ensures that growing Public Safety data needs are met in the long-run for both Next Gen 9-1-1 services and the exploding data usage via societal trends such as common Cloud data platforms, new digital tools and the growth of video-calling as part of a general societal trend. Set-asides in 3.8GHz mid-band 5G spectrum will help guarantee that 911 emergency responders get data connectivity in the minutes and seconds that count in urban areas facing network congestion challenges during disasters.

> 3.) We supported use of SAS (Spectrum Access Systems) concepts aligned with CBRS methodologies as used in the USA – if not for all the exact corresponding frequency bands as in the USA (ie. per FCC regulations CBRS occupies 3550MHz-3700MHz) then potentially for a subset of the overall CBRS assignments in a Canadian band plan, in order to facilitate easier cross-border coordination of US and Canadian Public Safety agencies during mutual aid, and potentially as a means of gaining more efficiency in spectrum use via a prioritization and pre-emption methodology within a SAS model.

> 4.) We supported the use of granular Tier-5 geographic licensing of 5G spectrum, as the best means to meet diverse municipal grass-roots needs for investment and Community Safety and Wellbeing, and as an approach aligned with the principles of the First Mile coalition and the Inuit Circumpolar Council of Canada in looking at the grass-roots

ISED SLPB-002-20 - Reply Comments
PSBN Innovation Alliance Comments on proposed ISED Policy Framework for the 3650-4200MHz Band

Page 5
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community needs and economic development needs as the starting point to building rural and remote infrastructure.

5.) <u>We provided a number of responses to the detailed RF technical questions</u> from the consultation and we refer the interested reader to the original text for the specifics.

6.) <u>We suggested a PSBN using 700MHz "Band Class 14" spectrum provided at low or zero cost to Public Safety on a Tier 5 basis complements 3.8GHz allocations in a holistic 5G spectrum strategy</u>, and that using a P3 investment approach – <u>could act as the first layer in an overall low-band / mid-band / high-band 5G rural enablement strategy in chronically underserved rural and remote communities</u>, or for those municipalities with particular capital investment needs for infrastructure development. Through leveraging adjacent Public Safety 911 communications needs and the adjacent needs of critical infrastructure, we can improve the "ROI gap" in these rural broadband business cases.

Such a PSBN-oriented rural investment approach can also be a catalyst to solve local Community Safety & Wellbeing needs, and at the same time provide municipalities with a valuable long-term stake in regional / municipal monetization of excess PSBN telecom spectrum in those regions, and an approach to garner more co-investors via Critical Infrastructure entities such as Electrical Utilities and Rail. In this regard we note that we also align with the recommendations of the Canadian Electricity Association as submitted to this ISED consultation and applaud their comments.

7.) <u>We also supported the Telesat proposal for 3.8GHz auction terms</u> as noted in the SLPB-002-20 Annex H, as we suggest it is potentially a cost-effective way of paying clearing costs – while yet maintaining ISED oversight on auction terms and band plans, and at the same time providing the benefit of solid Telesat commitments to a smooth transition to new spectrum for all current remote / rural fixed satcom systems in use today (and in particular we note any used by Public Safety agencies and critical infrastructure). In all, the Telesat proposal seems to be the most effective and rapid way to clear the current spectrum, and at a net lower cost than alternatives to paying for the reasonable and expected cost of clearing 3.8GHz as evidenced in the US experience.

8.) <u>We also supported the concept that Telesat has a key role in a strategy for rural broadband enablement in Canada's North and in rural / remote communities</u>, via a Low Earth Orbit satellite communications service layer that could enable fixed Public Safety communications, or as a backhaul layer in support of PSBNs that can also provide commercial mobile services in underserved rural regions. Public Safety Broadband Networks in Canada will consist of 700MHz "Band Class 14" spectrum and could be used in conjunction with Telesat LEO fixed backhaul to provide remote wide-area 4G / 5G commercial mobile access services, or for "First Mile" 5G fixed residential access.

The recent launch and advent of Low Earth Orbit technology also aligns with Public Safety's need to have multiple redundant layers for continuity of operations (i.e. a HetNet or heterogeneous network architecture). Strategic systems redundancy, along with planned technology and service "fall-backs" in the event of disasters or congestion events is key to "assured communications" for 911 emergency responders, and LEO can play a significant role in linking layers of Public Safety communications networks across Canada.

Also, Telesat's LEO technology fully aligns with our proposals on a satcom layer within an overall PSBN "Network of Networks" strategy. In this approach, LEO enables backhaul to mobile PSBN 5G low-band towers providing wide-area mobile broadband services in remote underserved communities in regions that lack fiber links. LEO is also a key component of our PIA model called "<u>Community Safety Broadband</u>" which is a P3 rural broadband enablement strategy relating to the joint commercial & Public Safety use of wide-area 700MHz spectrum PSBNs - as an initial "jump-start" for mobile access in those

ISED SLPB-002-20 - Reply Comments
PSBN Innovation Alliance Comments on proposed ISED Policy Framework for the 3650-4200MHz Band

Page 6
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rural communities that chronically lack 4G or 5G infrastructures and have near-term Community Safety & Wellbeing needs for broadband access, or for regions that lack co-investment partners for mobile broadband today.

9.) We provided details related to a model for remote / rural Wireless mobile broadband enablement – using the Public Safety Broadband Network (PSBN) concept developed by the PIA and called "Community Safety Broadband" – as a rural P3 business model for consideration by the Federal Government. We propose the CSB model could help spur co-investment to bridge the rural broadband "ROI gap" potentially faster in some communities than using only the current status-quo approach in those regions, particularly where "the need is now" for infrastructure in support of the maintenance of Community Safety & Wellbeing (see Reference [A05]).

As examples we cite recent published reports on underserved rural and remote regions in Canada, where a surge in COVID-19 related broadband usage and societal trend to video calling has highlighted broadband access problems seen in the current status-quo approach. Also, we note regions in Eastern and Northern Ontario where reports of 911 calling access problems persist, as but some of the example rural and remote use cases where a where our CSB model could help.
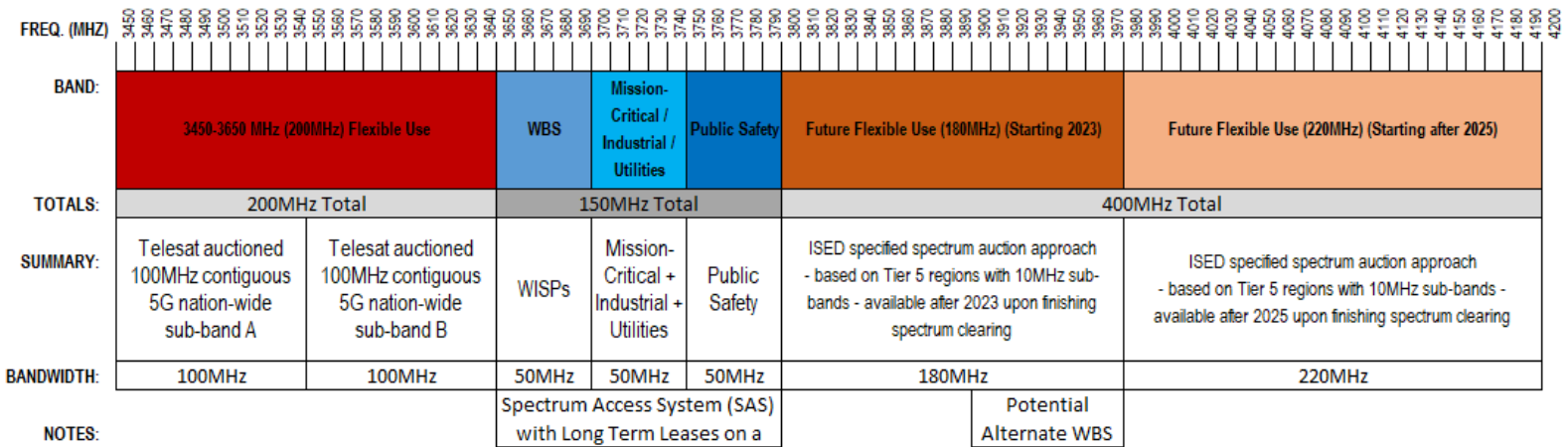
In brief, after our review of the SLPB-002-20 submissions we continue to stand by our original suggestions noted above, as advantageous policy approaches for ISED to consider in development of a 3.8GHz band plan strategy.

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12. Also, after having reviewed all the excellent submissions and responses to the SLPB-002-20 consultation, we had the following summary observations and suggestions:

1.) We stand by our original suggestions and comments related to the original SLPB-002-20 consultation, and as summarized above.

2.) We would like to particularly note that we agreed with and supported the concepts and principles outlined in the Canadian Electricity Association (CEA) submission – and the common needs of both our Public Safety agencies and Critical Infrastructure utilities and firms across Canada, as we collaborate in Emergency 911 Response and in saving lives during natural disasters.

3.) We would like to particularly note that we agreed with and supported the concepts and principles outlined in the Telesat submission, and suggest Telesat's effective approach and proposal to clearing and auctioning the band is worthy of consideration by ISED and the Federal Government. We suggest the Telesat approach could have advantages for continuity of operations and a more seamless transition for fixed satcom services in Canada's remote and Far Northern communities.

4.) We also appreciated and supported the comments from the Toronto Police Service and MobilExchange with alignment on aspects of telecom policy that can help save lives. Considering the needs of 911 emergency responders up-front during initial spectrum policy decisions, is essential to crafting holistic telecom policy that ensures 911 lifesaving response and telecom field operation are effective in all municipalities across Canada.

13. Lastly, as related to our review of the many SLPB-002-20 submissions, we would like to compliment all of the excellent comments by our counterparts within this consultation - we sincerely applaud the work of all submitters, and note that through the collegial spirit of exchanging ideas and concepts in this distinctly Canadian and democratic fashion, that we ultimately build better telecom policy for Canadians, and models that most effectively address the diverse telecommunications needs of Canadians from coast to coast. We appreciated reading all

submissions and views from other intervenors to the SLPB-002-20 process, and look forward to continued exchange of ideas in the future.

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14. Therefore, in considering the various positions submitted to the consultation and their merits, and from our stance the long-term telecommunications needs of Public Safety agencies – for resilient, reliable, Cybersecure, and cost-effective wireless communications – and in consultation with counterparts, we would respectfully submit the following "sketch" or spectrum band-plan design concept for consideration by ISED, and which we suggest provides key spectrum tools in support of Critical Infrastructure private network operations and Public Safety 911 emergency response operation, while balancing the allocation of commercial spectrum for incumbent and new entrant regional MNOs.

FREQ. (MHZ)	3450–3650		3650–3700 WBS	Mission-Critical / Industrial / Utilities	Public Safety	Future Flexible Use (180MHz) (Starting 2023)	Future Flexible Use (220MHz) (Starting after 2025)
BAND:	3450-3650 MHz (200MHz) Flexible Use		WBS	Mission-Critical / Industrial / Utilities	Public Safety	Future Flexible Use (180MHz) (Starting 2023)	Future Flexible Use (220MHz) (Starting after 2025)
TOTALS:	200MHz Total		150MHz Total			400MHz Total	
SUMMARY:	Telesat auctioned 100MHz contiguous 5G nation-wide sub-band A	Telesat auctioned 100MHz contiguous 5G nation-wide sub-band B	WISPs	Mission-Critical + Industrial + Utilities	Public Safety	ISED specified spectrum auction approach - based on Tier 5 regions with 10MHz sub-bands - available after 2023 upon finishing spectrum clearing	ISED specified spectrum auction approach - based on Tier 5 regions with 10MHz sub-bands - available after 2025 upon finishing spectrum clearing
BANDWIDTH:	100MHz	100MHz	50MHz	50MHz	50MHz	180MHz	220MHz
NOTES:			Spectrum Access System (SAS) with Long Term Leases on a			Potential Alternate WBS	

Figure B1: __Proposed Spectrum Band Plan for the 3800MHz Band__ – "Sketch" accounting for the needs of Public Safety & Critical Infrastructure in Canada, and aligned with the Telesat proposal from ISED SLPB-002-20.

Benefits of the approach used in this proposed spectrum allocation "sketch" include:

1.) Preserving the longstanding precedent of municipal Public Safety set-asides of spectrum by reserving spectrum from 3750 to 3800MHz for a PSBN 5G "mid-band" extension, which represents a 50MHz allocation within the 3.8GHz band, thereby supporting municipal public-works, municipal services and municipal Community Safety needs. This spectrum will be key in developing innovative municipal private networks and/or prioritized Public Safety use of such spectrum through business collaborations with incumbent MNOs, in a manner that suits the unique and diverse economic development and field operations needs of municipalities across Canada. Spectrum is a valuable tool for municipalities in terms of economic development and support of essential local services, such as 911 emergency calling services;

2.) Allocation of a 50MHz allocation of spectrum from 3700 to 3750MHz for private networks in support of Critical Infrastructure and industrial users, thereby fostering Canadian industrial innovation and meeting the needs for mining, heavy industry, electrical and gas utilities, energy, rail, transit and public transportation, and related Critical Infrastructure entities;

3.) Provision of 50MHz of WBS spectrum for WISPs from 3650 to 3700MHz (or optionally per the ISED consultation a parallel or alternate WBS band from 3900 to 3980MHz.);

4.) Sufficient time to address interference issues in higher band, and time to complete clearing the spectrum in those upper band reaches later in the timeline, so as to permit the

3GPP N78 market for equipment to mature and catch up in terms of vendor options and competitive radio chipset that support this upper portion of the band.

5.) A balance between the need to foster set-asides for Critical Infrastructure and municipal Public Safety, while at the same time meeting the need for 100MHz contiguous bands of spectrum to afford incumbent national MNOs with enough spectrum to achieve among the highest throughputs possible in 3GPP standards – for a better 5G experience across Canada, and balancing the needs of MNOs with other stakeholders.

15.   As additional general comments of this "sketch" or draft spectrum band plan linked to the comments of other submissions we note:

1.) Per the submission from Transport Canada on the potential for harmful interference between portions of the 3.8GHz band, we agree with their recommendation that the upper portions of the band merits further study by ISED on the possible safety impacting interference that 5G can cause of radar altimeters and essential aeronautical equipment operating in the 4200-4400MHz bands. We accordingly suggest the upper portions from 3980MHz through to 4200MHz be assigned for Flexible Use later (after 2025) to permit ISED to resolve this potential catastrophic impact on aeronautic equipment at airports. The use of geographic exclusion zones could be an option, and we also agree with Transport Canada's recommendation that specific impacts of the 3700-3980MHz band segments should be studied and quantified, with a corresponding search for potential mitigation approaches. We suggest the proposals from the Nokia submission as pertaining to existing US research into the radar altimeter and other 5G interference issues may potentially resolve some if not all of the issues noted by Transport Canada, and should be considered by ISED in this regard.

2.) Also, in relation to the comments of the Rural Municipalities of Alberta (RMA) we suggest our proposed draft band plan could provide existing WISPs with 50MHz of reserved WBS spectrum via an SAS (Spectrum Access System) approach that would utilize longer-term leases on the order of 5 years or more, and the ability to use SAS prioritization licenses to provide longer term spectrum access and a layered approach to Priority Access License and General Access License within this 3.8GHz band.
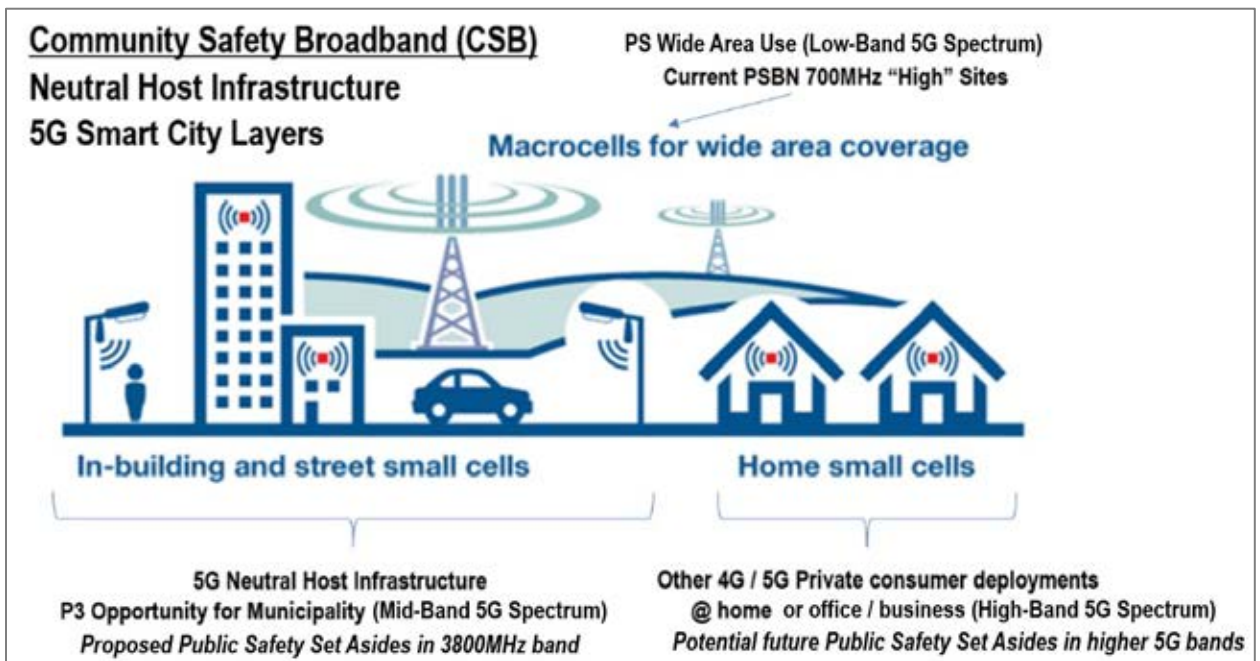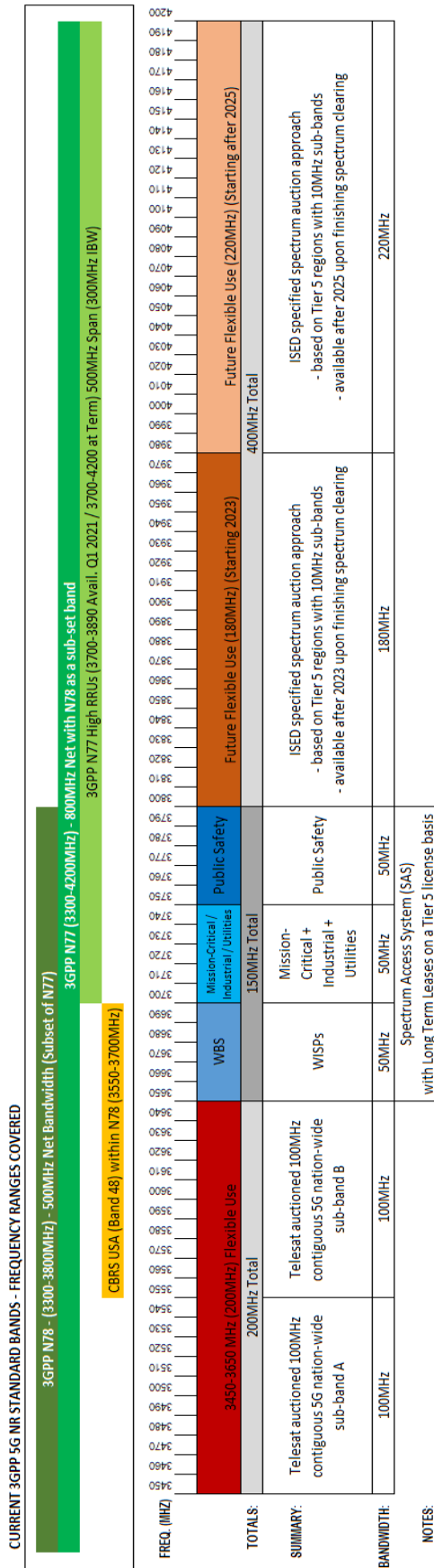

Figure B2: Conceptual view - CSB and the 3.8GHz Band – Low- / Mid- / High-band PSBN spectrum set-asides.

Figure B3: <u>Proposed Spectrum Band Plan for the 3800MHz Band</u> – Account for the needs of Public Safety & Critical Infrastructure and including WBS. This approach is aligned with Telesat's Annex H proposal.

16.   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.

17.   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-006-19[1] .

18.   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.

19.   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.

20.   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.

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

21. <u>In terms of 5G business models that can improve the Rural Broadband Divide and in turn foster rural and remote access for Public Safety 911 response</u> – we respectfully suggest that ISED, the CRTC and the Government consider the PIA's Community Safety Broadband (CSB) Rural Investment Model. Public Safety communications often act as a lifeline remote communications access for Public Safety in times of emergency or disaster, and for consideration the deployment of PSBNs to meet Critical Infrastructure needs plus Community Safety needs could act as just such an investment spark in remote regions.

22. The CSB model is an approach to further investment in municipalities that have unfortunately struggled to date to garner MNO investment interest, or where traditional MNOs have simply declined to invest. We have provided a copy of our original summary of the CSB model in Appendix F of this document, copied per our original submission.

23. In the CSB model, in using a neutral-host or MOCN RAN approach, and through fostering co-investment opportunities to more institutional capital investors with a longer-view to ROI than perhaps traditional MNOs (i.e. in business consortia that span multiple major MNOs, major investment funds, or via a neutral-host PSBN model) we suggest that we could solve the "ROI gap" which today prevents building infrastructure in many of currently underserved municipalities in Canada.

24. In our original submission we provided an overview of the PIA's Community Safety Broadband concept - and in essence it the model we use a Public-Private Partnership (P3) approach, aligned to meet the needs and public safety benefits related to essential 911 emergency calling access and Public Safety communications needs for efficiency and 911 field operations (e.g. digital tools, Next Generation 911 services for digital interaction with 911 callers, health records, new data / cloud tools, soon-to-com 911 video calling, etc.). We also suggested that the needs of Public Safety and the needs of Utilities and Rail transportation entities are aligned, and that together these needs could help tip the scales of a decision based on market principles and return on investment. The CSB model may not solve all community investment challenges, but it could help a number of them – essentially a variant of "the Starfish Principle".[2]

25. By combining the needs and benefits for Rail, Utilities and Public Safety (PSBN) stakeholders, aligned with the economic development needs of remote and rural communities - that a CSB model could help resolve the "Rural Broadband Divide" for a good number of municipalities that lack access today. Further, with the advent of Low Earth Orbit networks – a PSBN with a "Network of Networks" vision can help tip the scales for investment decisions in a good percentage of underserved communities across Canada's Far North and rural / remote regions.

26. Incumbent MNOs are winners with the CSB model as well, since in those regions where a marginal business case prevented a large incumbent MNO from investing and gaining customers, by instead now partnering with other co-investors and stakeholders we can reach the investment thresholds – and bridge the investment "gap". There are a number of international examples and precedent related to this P3 "neutral host" approach, as we had noted in our original response, in the building of infrastructure held by multiple MNOs in 5G deployments in underserved UK Rural Regions. We also see these P3 themes and co-investment / neutral-host approaches being used in the UK SRN[3] and now recently also considered in the nation of Ireland via a national 5G municipal-based policy & strategy[4], and in a number of other international examples of using neutral-host or commonly held systems to bridge telecom access gaps that can arise.

27. We also feel our Community Safety Broadband (CSB) model aligns with the principles of the First Mile coalition (www.firstmile.ca) and we applaud their work and approach. The First Mile model builds infrastructure considering the local community needs first, and as the <u>basis</u> for design and not as an afterthought, as seen in the corresponding "Last Mile" concept in traditional telecom design. We suggest the First Mile approach and model holds significant merit for consideration by

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[2] The Star Fish Foundation - https://www.thestarfishchange.org/starfish-tale
[3] Mobile UK - https://www.mobileuk.org/
[4] CONNECT - https://connectcentre.ie/wp-content/uploads/2020/08/5G-and-Future-Connectivity_Full-Document-FINAL.pdf

ISED in considering future approaches to auctioning / granting spectrum that can mitigate the current disparity in rural and remote access, and via using granular Tier 5 geographic regions to align with First Nations needs. Further, in using Spectrum Access Systems we have a means for First Nations municipalities to monetize access in neutral-host models with co-investors that take a longer-term view, or via Public Safety and Utilities / Rail co-investors.

28.   We also noted policy alignments between our policy recommendations and the submission of the Inuit Circumpolar Council of Canada, in regard to rural and remote spectrum access for First Nations. Also, we suggest that 5G co-investment and spectrum strategy models which favor co-investment with First Nations communities is essential, and this concept of co-investment by community stakeholders in a regional telecom system investment is one of the tenets of our CSB model. In summary, we suggest that ISED consider inclusion of a grassroots aspect or approach within overall spectrum licensing strategy. By considering the First Mile and Community Safety and Wellbeing (Reference [A06]) needs within underserved municipalities as the first step in any spectrum licensing approach, we can better help communities with co-investment options and new approaches to solving the rural broadband divide.

29.   At the very least then, we propose that a CSB style telecom investment approach, combining utilities, transportation and Public Safety business cases and common interests, within a P3 municipally oriented model of telecom investment with long-term institutional capital investors – could help tip the investment case within many of today's underserved Canadian communities, Using the PIA model and Public Safety Broadband Networks (PSBNs) could provide ISED and the Federal government with a "backstop" model to "bridge the Rural Broadband Divide" faster than relying on granular / evolutionary spread with the current status-quo approach today.

30.   In many municipal cases where "the need is now" for urgent or critical Community Safety and Wellbeing needs, that the PSBN concept and PIA's CSB model approach could act as "the kernel or spark of co-investment" to get investment started faster in a given region that is currently struggling with Rural Broadband access using Canada's current status-quo paradigm for rural grants and incumbent MNO oriented investment.

31.   We would again like to re-iterate that we do not currently see a single solution to the Rural Broadband divide, but that by using multiple models as "tools within a toolbox" – but that our suggestions here could perhaps allow Canada to use PSBNs as a "backstop" rural broadband enablement approach, or a "connection approach of last resort" so that we can get net more communities connected faster than the status-quo. The Federal government could use the impetus behind the licensing of 700MHz spectrum and near-term deployment of regional Public Safety Broadband Networks (PSBNs) – alongside 3.8GHz spectrum allocations with Public Safety spectrum set-asides, as a way to jump-start or bridge the broadband gap in many of Canada's underserved communities.

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32.   To conclude our reply comments, we once again appreciate ISED's diligent work on spectrum policy in Canada, and we respectfully note that our submission is simply intended to provide potential technical and business model considerations for ISED, based on our experiences in Public Safety infrastructure and telecommunications.

33.   The telecom related needs of Public Safety agencies are crucially important to ensuring the continuity of lifesaving 911 calls and 911 field operations in Canada, and we therefore suggest ISED should consider our proposals on PSBNs and their potential role within current and future 5G band plans, and as related to a long-term 5G spectrum allocation strategy and PSBN strategy in low-, mid- and high-bands.

34.   We would like to offer to attend any in-person or virtual discussions arising from this consultation, and we are available to ISED to answer any questions or review aspects of our proposals.

C. **SIGNATURES:**

35.   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.

36.   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.

37.   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.

38.   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.

39.   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
**Executive Director PSBN Innovation Alliance**

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

40. 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.

41. 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;

42. 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.

43. 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.

44. 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.)

45. 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 <u>not</u> 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.

46.   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.

47.   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 <u>all</u> municipalities within that jurisdiction, and for "public" commercial lease of Band Class 14 spectrum on behalf of those municipalities that <u>elect to forfeit</u> their Tier 4 / Tier 5 license (see Sub-License Variant #2 below);
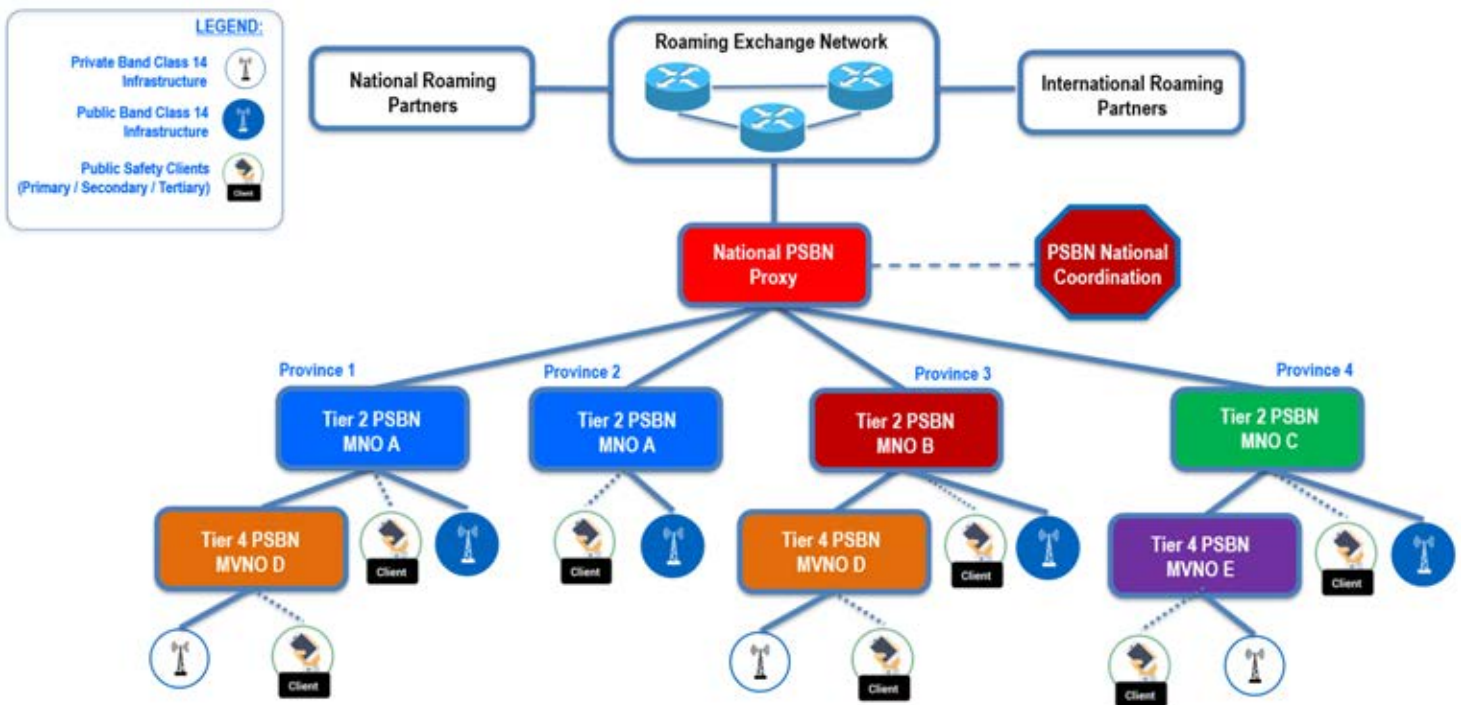
Figure D1: <u>Hybrid PSBN Model – DRDC Delivery Model "Option D"</u> - Service delivery model with Tier 2 PSBN MNO Sub-lessees and Tier 4 / future Tier 5 PSBN MVNOs with sub-licensed private PSBNs.

48. ***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.

49. ***Tier 2 MNO Sub-Lessees***: 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.

50. 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.

51. 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).

52. 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.

53. 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

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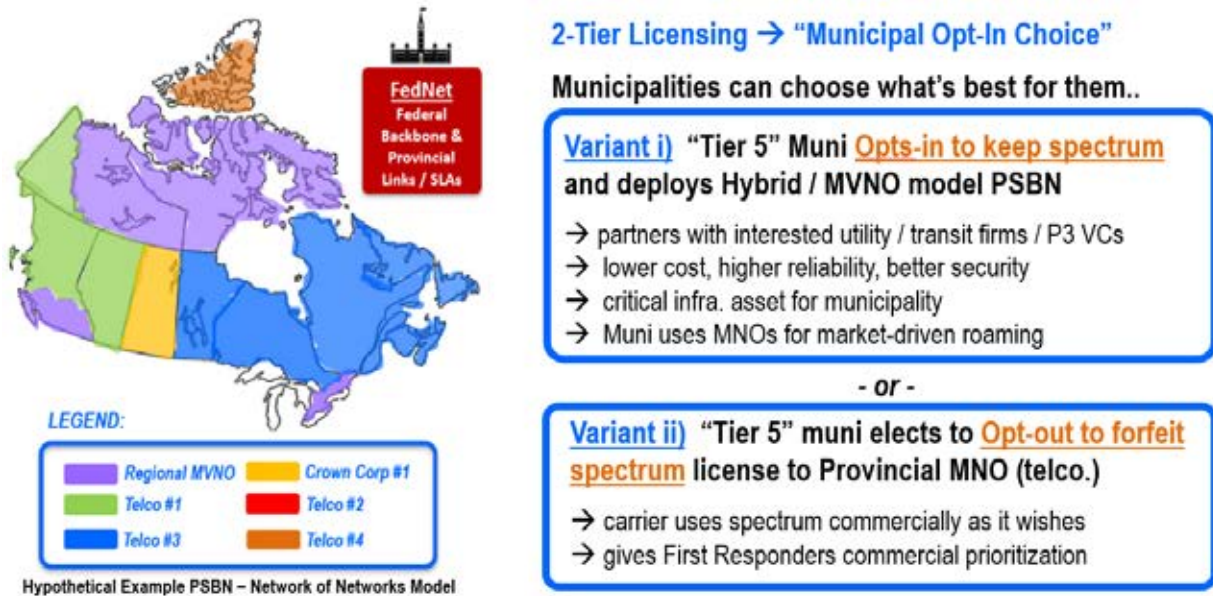

Figure D3: _Hybrid Model Scenario_ – *Geographic View and two-tier Licensing approach*

54.   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)

55.   **_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.

56.   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.

57.   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.

58.   The following diagrams illustrate the proposed sub-license variants and leasing approaches:
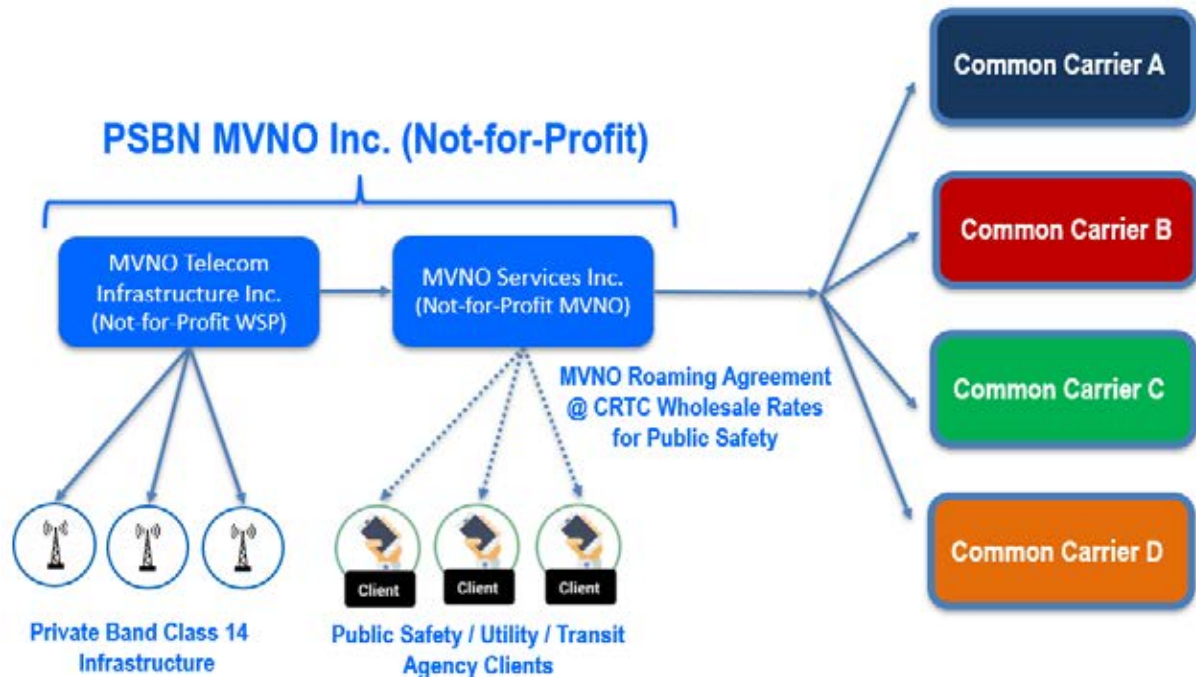
***Figure D3: Hybrid Model Scenario – Band Class 14 Sub-License Variant #1 -** A consortium of municipalities collaborates in the deployment of a private Band Class 14 PSBN with prioritized roaming onto the designated Tier 2 PSBN MNO (sub-lessee) for the province.*
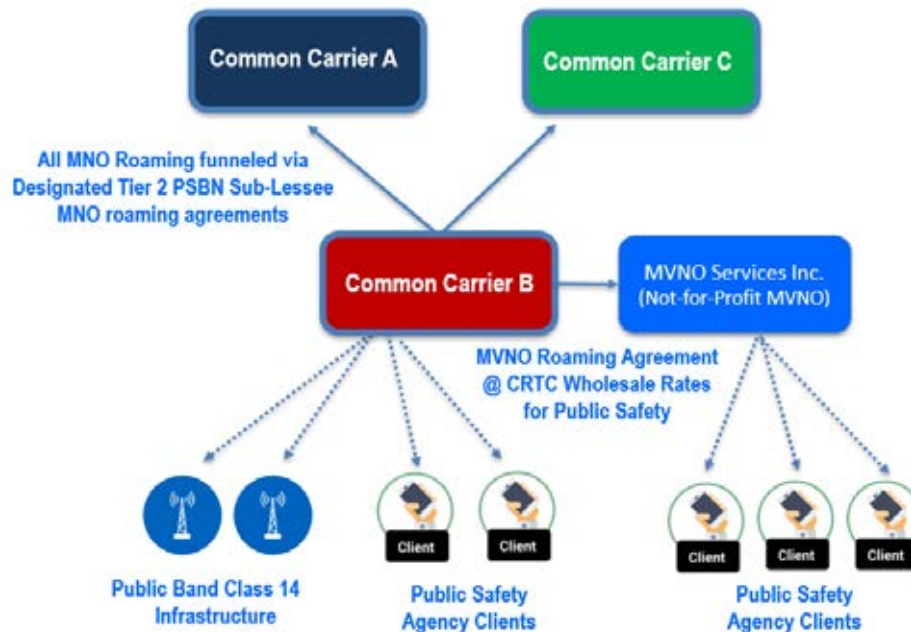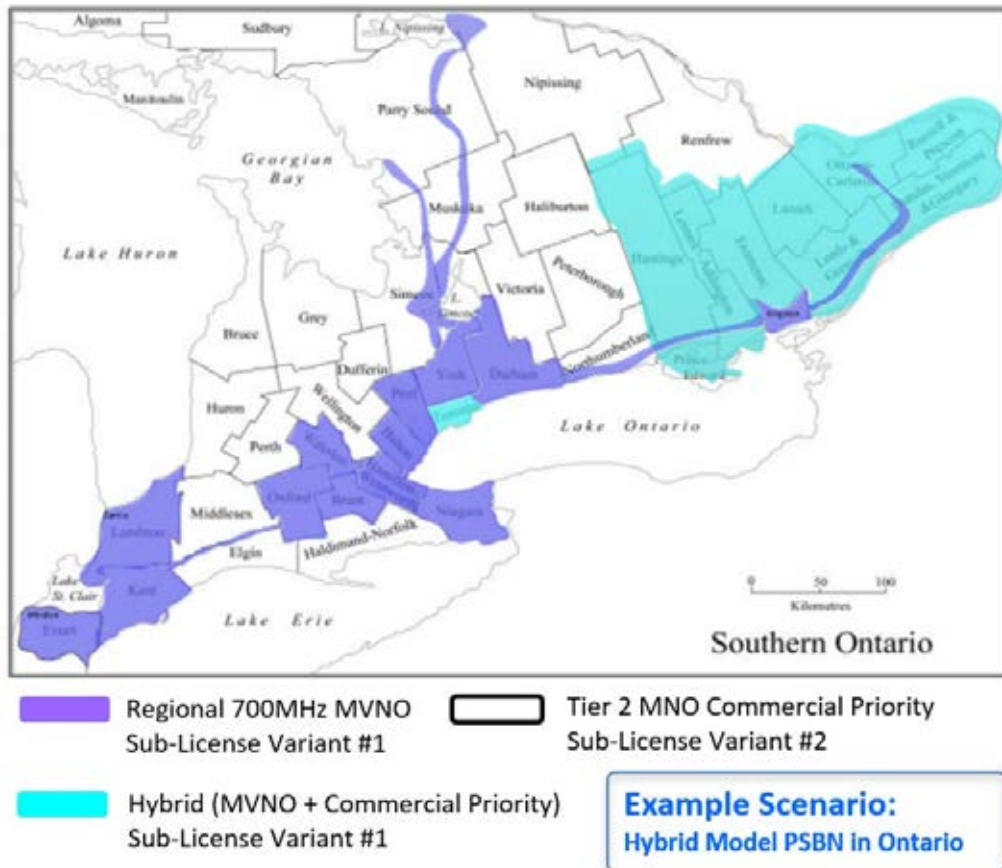

***Figure D4: Hybrid Model Scenario – Band Class 14 Sub-License Variant #2 -** A municipality forfeits its Tier 4 / Tier 5 Band Class 14 license and opts to join the Tier 2 MNO providing PSBN services via prioritized access to commercial carrier spectrum.*

Figure D5: <u>Hybrid PSBN Model – Hypothetical licensing scenario</u> - 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).

59. 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;

60. 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:**

61. 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:

62. **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.

63. **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.

64. 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.

65. 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.

66. Tier 4 or future Tier 5 license holders of the Bandclass 14 spectrum may choose one of two Sub-License variants as follows:

67. *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.).

68. 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.

69. 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.

70. 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.

71. *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.

72. 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.

73. *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.

74. 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.

75. *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.

76. **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.

77. 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.

78. **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.

79. 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.

80. 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.

81. **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.

82. 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.

83. **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.

84. **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.

85. 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.

86. **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]).

87. 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

88. 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.

89. 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.

90. Where a license is transferred, the requirement for the new licensee to deploy will continue to be based on the initial license issuance date.

91. **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.

92. **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.

93. **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.

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 F1: 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.
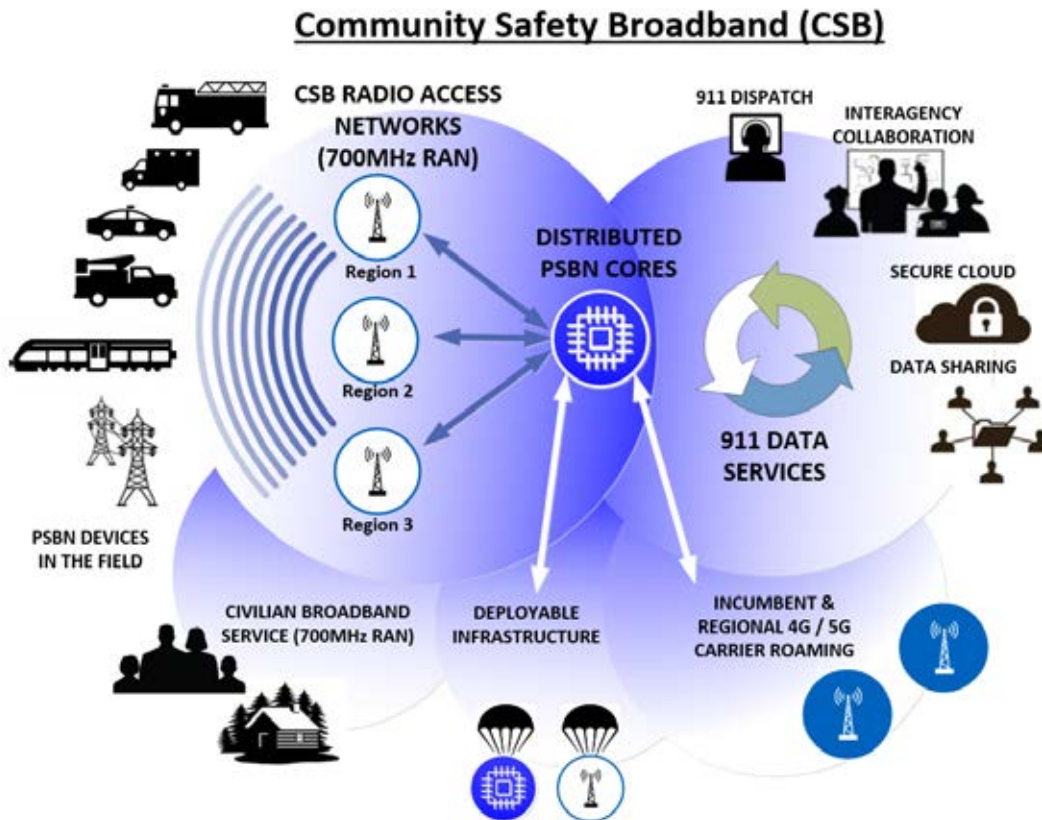
Figure F2: Conceptual view of a municipal Community Safety Broadband Service Model (CSBM), built around a 700MHz PSBN RAN & core, and with the ability for regions to tender, partner, deploy and "plug into" the central Community Safety Broadband Model (CSBM) core networks – for both municipal consumer 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.
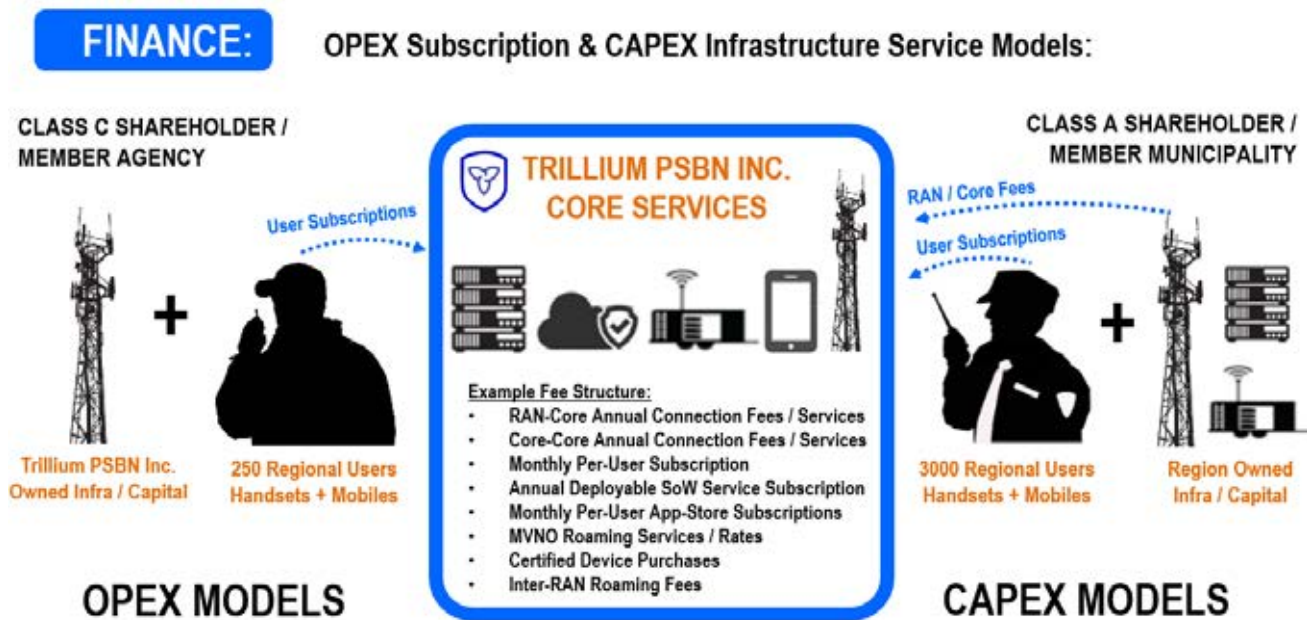

Figure F3: Overview of two CAPEX and OPEX cost model and bundling options for Public Safety, municipal and Critical Infrastructure users.

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).

Figure F4: 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.

ISED SLPB-002-20 - Reply Comments
PSBN Innovation Alliance Comments on proposed ISED Policy Framework for the 3650-4200MHz Band

Page 28
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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 <u>flexible range of models</u> 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.

F2. 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.
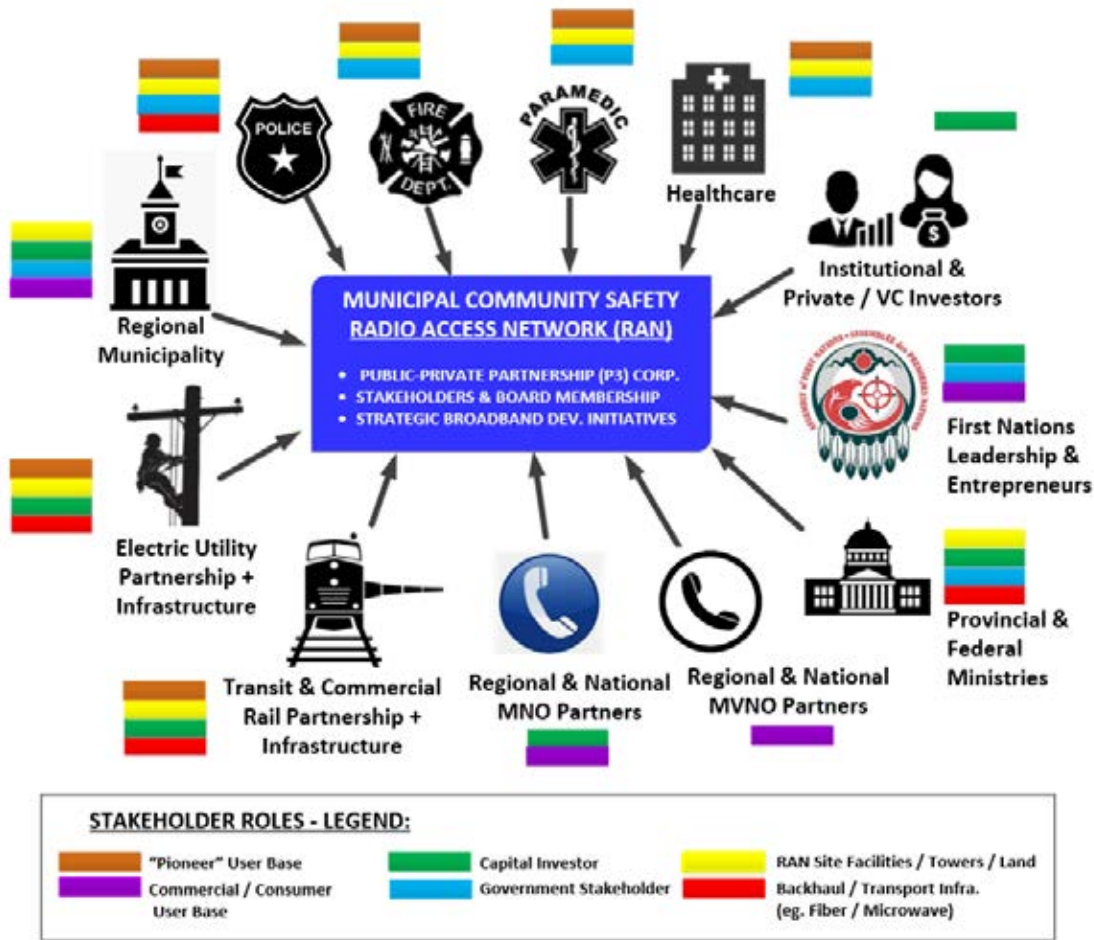
The balance of this document highlights the advantages of flexible CRTC policy and provides a new targeted grant templates for Community Safety Broadband Model (CSBM) projects in the North, with an aim to creating PSBN deployment cases that make economic sense – using the right telecom tool (eg. MNO 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.

F3. Community Safety Broadband Model (CSBM) - "Concept at a Glance" Diagrams

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

MUNICIPAL COMMUNITY SAFETY RADIO ACCESS NETWORK (RAN)
- PUBLIC-PRIVATE PARTNERSHIP (P3) CORP.
- STAKEHOLDERS & BOARD MEMBERSHIP
- STRATEGIC BROADBAND DEV. INITIATIVES

Police — Fire Dept. — Paramedic — Healthcare — Institutional & Private / VC Investors

Regional Municipality — Electric Utility Partnership + Infrastructure — Transit & Commercial Rail Partnership + Infrastructure — Regional & National MNO Partners — Regional & National MVNO Partners — First Nations Leadership & Entrepreneurs — Provincial & Federal Ministries

STAKEHOLDER ROLES - LEGEND:

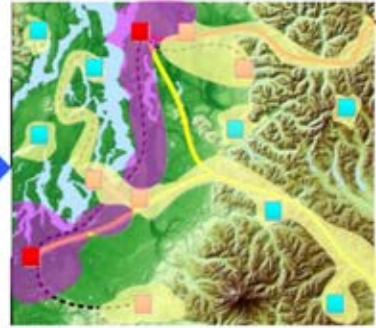|		
"Pioneer" User Base	Capital Investor	RAN Site Facilities / Towers / Land
Commercial / Consumer User Base	Government Stakeholder	Backhaul / Transport Infra. (eg. Fiber / Microwave)

PSBN - Year 0 — Initial State

PSBN - Year 3 — + Utility & Rail 700MHz RAN coverage

PSBN - Year 5 — + LEO Links to standalone RAN Sites

LEGEND:
- City
- Rural Township
- First Nation
- Provincial Highway
- Hydro Utility Power Lines
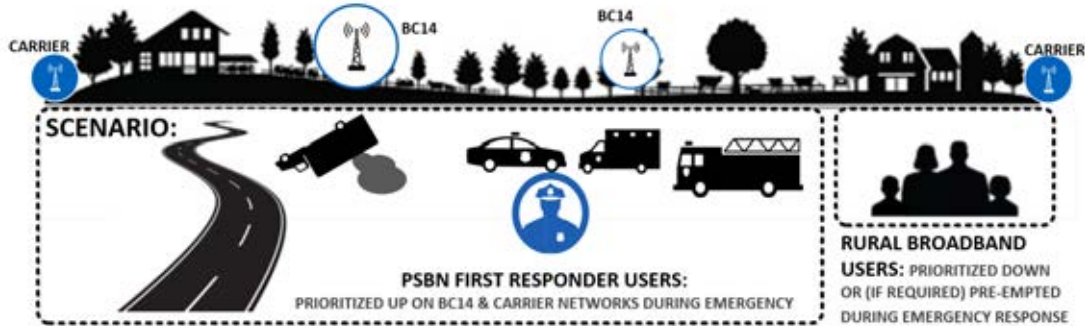- Freight Rail Line
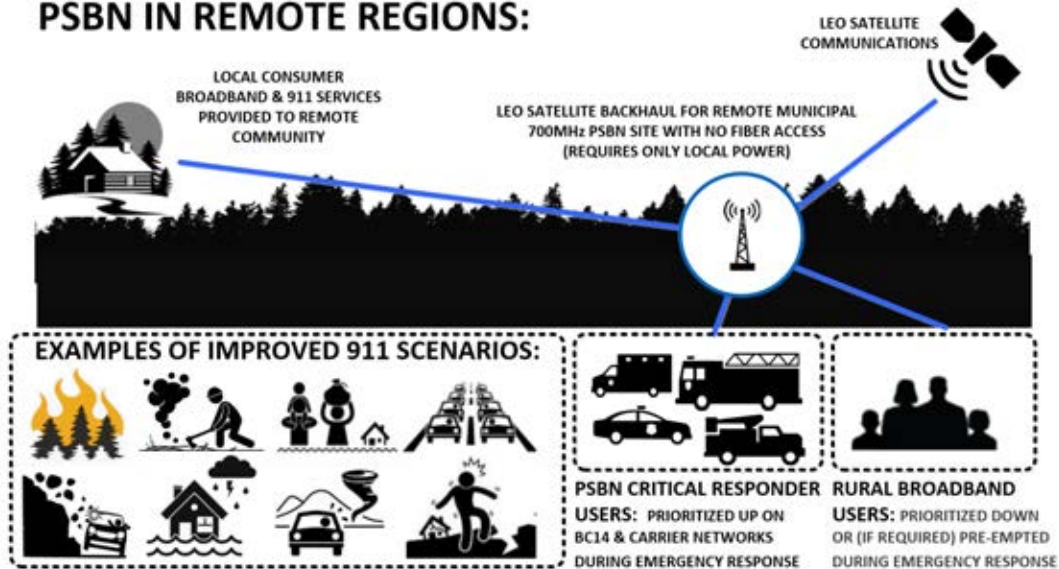- Community Safety PSBN Coverage
- National MNO
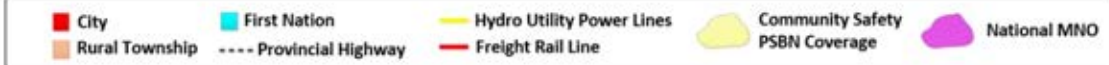
Figure F5: (Top) - Conceptual of PSBN Stakeholder P3 collaboration and key roles within a P3 corporate PSBN RAN municipal partnership. (Bottom) - Community Safety Broadband Model growth of coverage access over time in a region, showing leverage of rail and utility infrastructure in a hypothetical scenario 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.

ISED SLPB-002-20 - Reply Comments
PSBN Innovation Alliance Comments on proposed ISED Policy Framework for the 3650-4200MHz Band

Page 30
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F4. Community Safety Broadband Model (CSBM) - Conceptual View - Deployment Scenarios
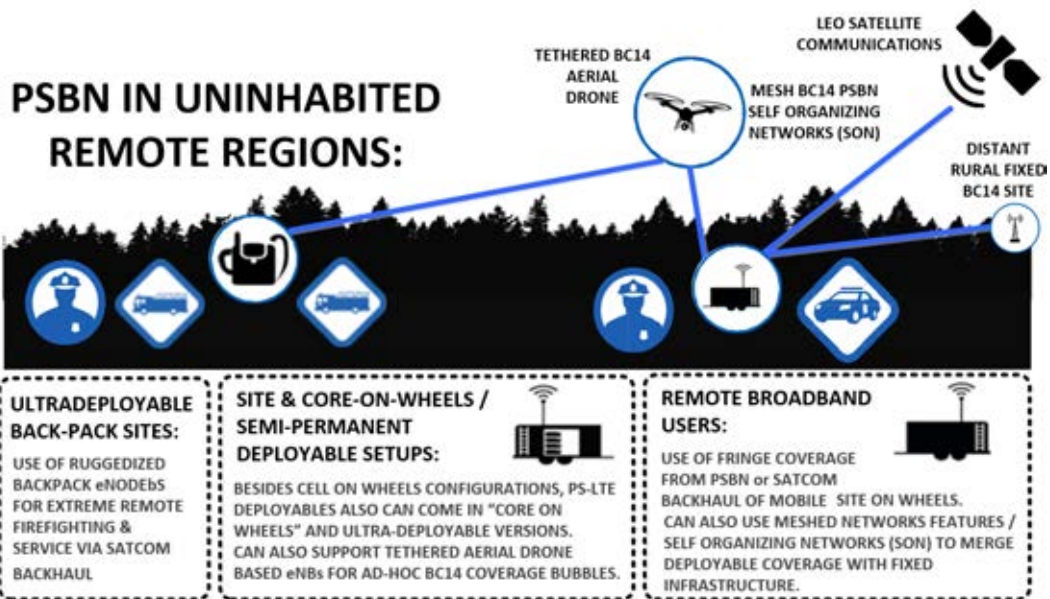
Figure F6: Conceptual view of Community Safety Broadband Model in Rural, Remote, and uninhabited regions. Commercial carrier spectrum sites shown in blue circles, with PSBN 700MHz (BC14) sites shown in white site circles.

ISED SLPB-002-20 - Reply Comments
PSBN Innovation Alliance Comments on proposed ISED Policy Framework for the 3650-4200MHz Band

Page 31
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F5. Benefits of a Hybrid PSBN for Rural Canada – and the Community Safety Broadband Model

94. 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 <u>multiple</u> 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 "spectrum 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 or 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 <u>faster</u> and <u>freer</u> 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 <u>use</u> 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-spriority 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.
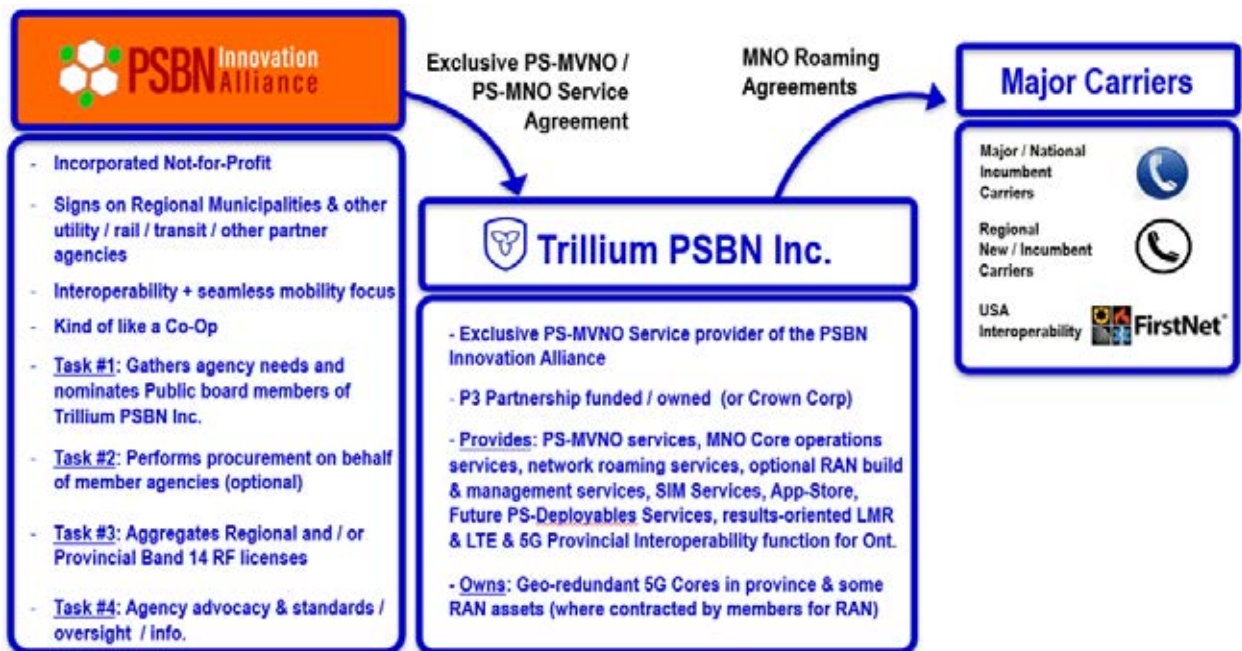

Figure F5: Conceptual view of Community Safety Broadband Model stakeholders and P3 public-private partnership approach for PSBN infrastructure.

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 critical near-term 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 invest, 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.
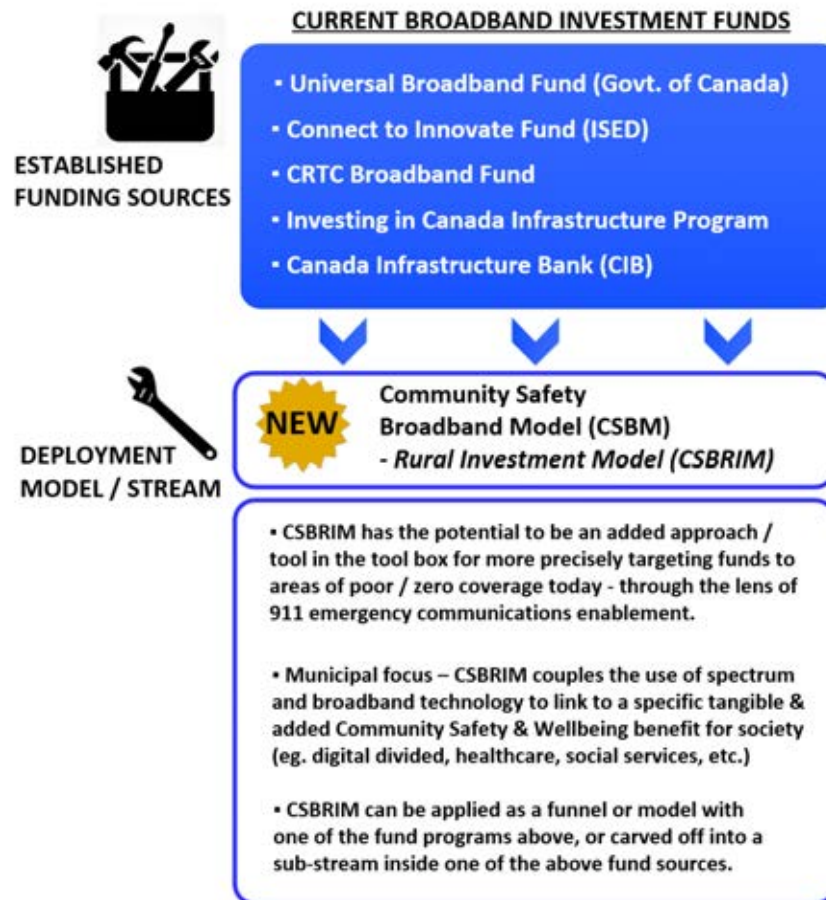

CURRENT BROADBAND INVESTMENT FUNDS

ESTABLISHED FUNDING SOURCES
- Universal Broadband Fund (Govt. of Canada)
- Connect to Innovate Fund (ISED)
- CRTC Broadband Fund
- Investing in Canada Infrastructure Program
- Canada Infrastructure Bank (CIB)

DEPLOYMENT MODEL / STREAM

NEW Community Safety Broadband Model (CSBM) - *Rural Investment Model (CSBRIM)*

- CSBRIM has the potential to be an added approach / tool in the tool box for more precisely targeting funds to areas of poor / zero coverage today - through the lens of 911 emergency communications enablement.

- Municipal focus – CSBRIM couples the use of spectrum and broadband technology to link to a specific tangible & added Community Safety & Wellbeing benefit for society (eg. digital divided, healthcare, social services, etc.)

- CSBRIM can be applied as a funnel or model with one of the fund programs above, or carved off into a sub-stream inside one of the above fund sources.

Figure F6: 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.
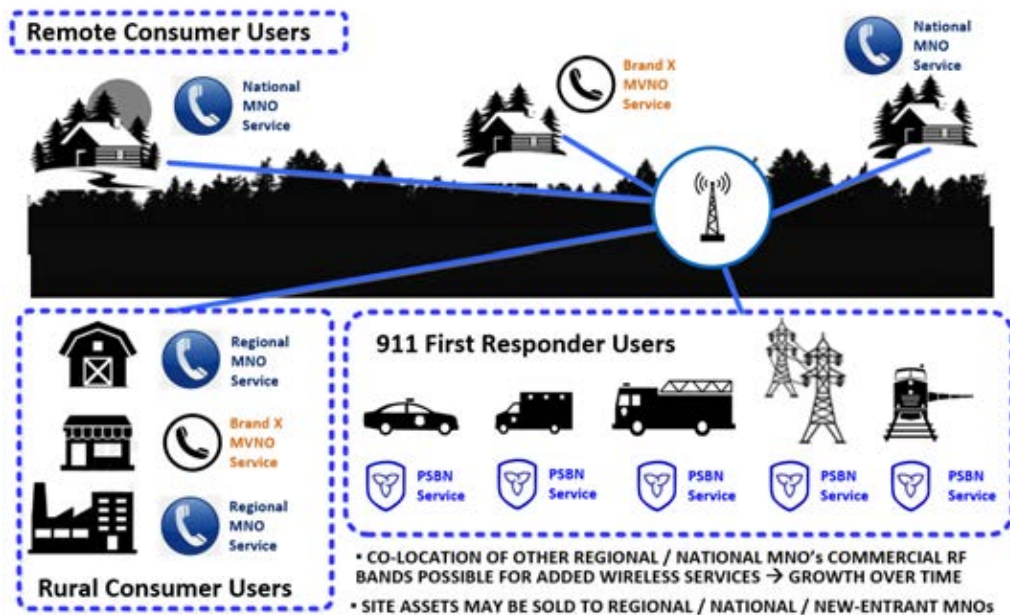
Figure F7: Illustration of MVNO services running on QPP (prioritized & pre-emptable) PSBN infrastructure in the Community Safety Broadband Model (CSBM) – along with potential paths to monetization for rural and remote municipalities.

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 $5 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 <u>more market entry points via Tier 5 granular geographic licenses</u>, <u>and via municipal spectrum grants to help in turn foster more local players and more local entrepreneurship</u>, <u>alongside partnerships with current + new sources of capital investment</u>.

k. **<u>Het-Net architecture for multiple Public Safety fall-back systems in disasters</u>** – 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.
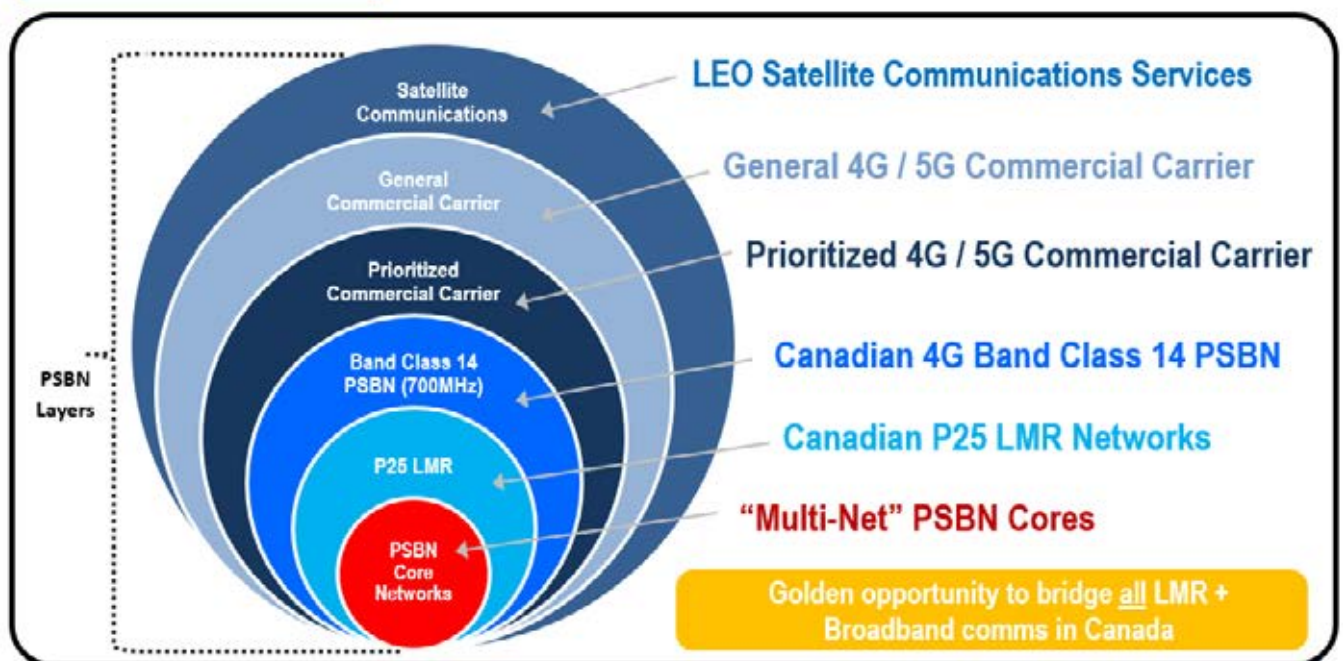

<u>Figure F8</u>: Diagram showing the PSBN Innovation Alliance "Network of Networks" and Het-Net concept for a holistic Canadian PSBN solution.

ISED SLPB-002-20 - Reply Comments
PSBN Innovation Alliance Comments on proposed ISED Policy Framework for the 3650-4200MHz Band

Page 41
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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.
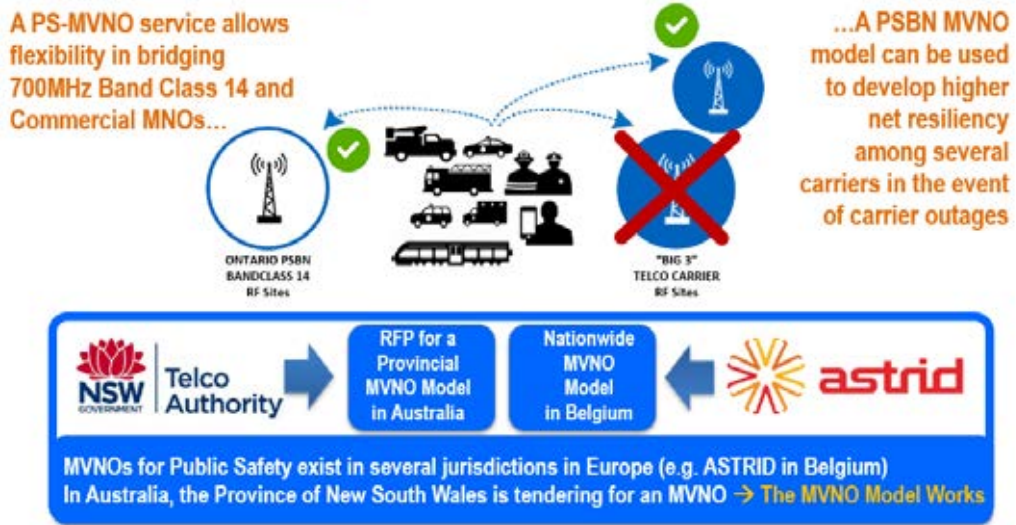

Figure F9: Diagram showing the Public Safety MVNO concept running across multiple roaming MNO partners + PSBN 700MHz sites.

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.


Figure F10: 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.
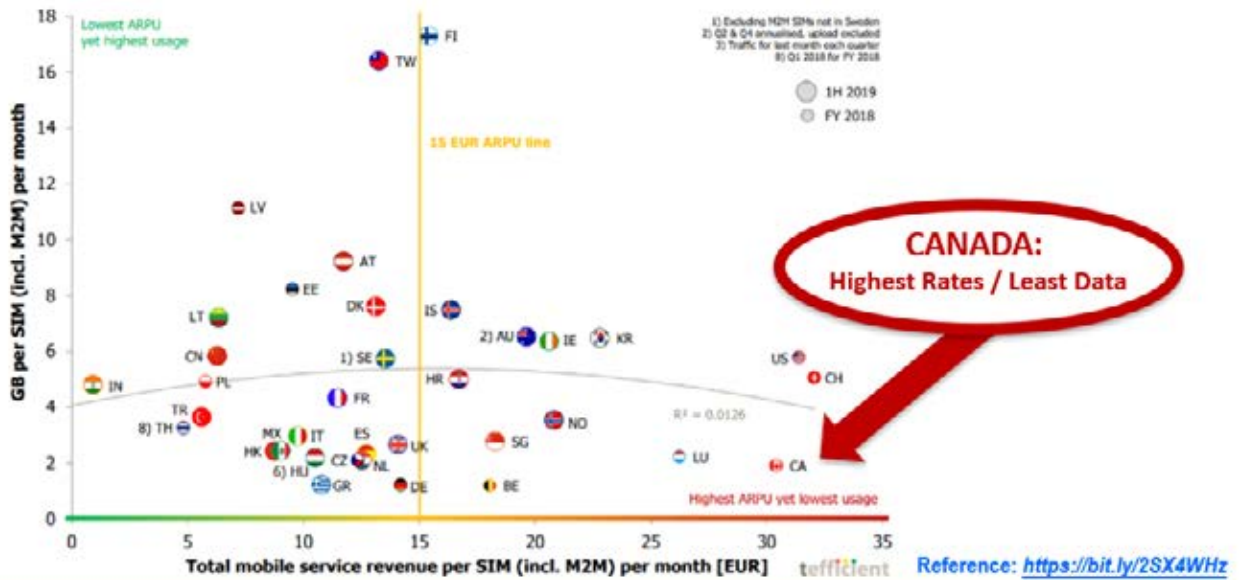
Figure F11: Chart from the latest tefficient™ (see Reference [B01] and [C07]) on worldwide price points contrasting competitiveness and market conditions in benchmark nations from around the world. Canada is located in the lower right quadrant with the highest rates for the least data.

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 netural-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:
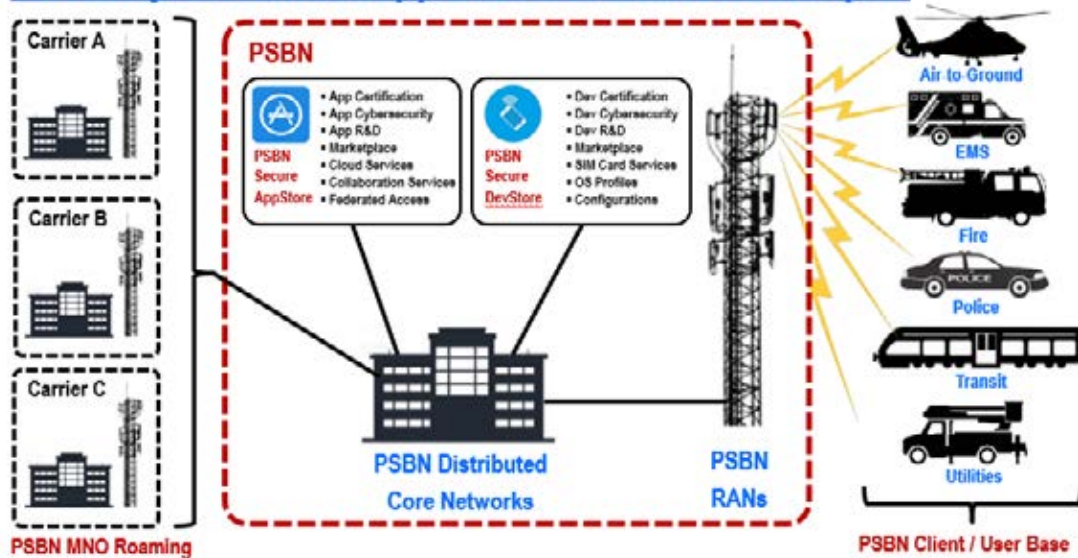
Figure F12: Within the CSB Model, the PSBN is a secured network that encompasses both a Public / Consumer domain and a more highly secure Private / Critical infrastructure domain. All devices and applications in the Critical domain are locked down and certified for Cybersecurity purposes via the PSBN 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.

ISED SLPB-002-20 - Reply Comments
PSBN Innovation Alliance Comments on proposed ISED Policy Framework for the 3650-4200MHz Band

Page 46
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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).
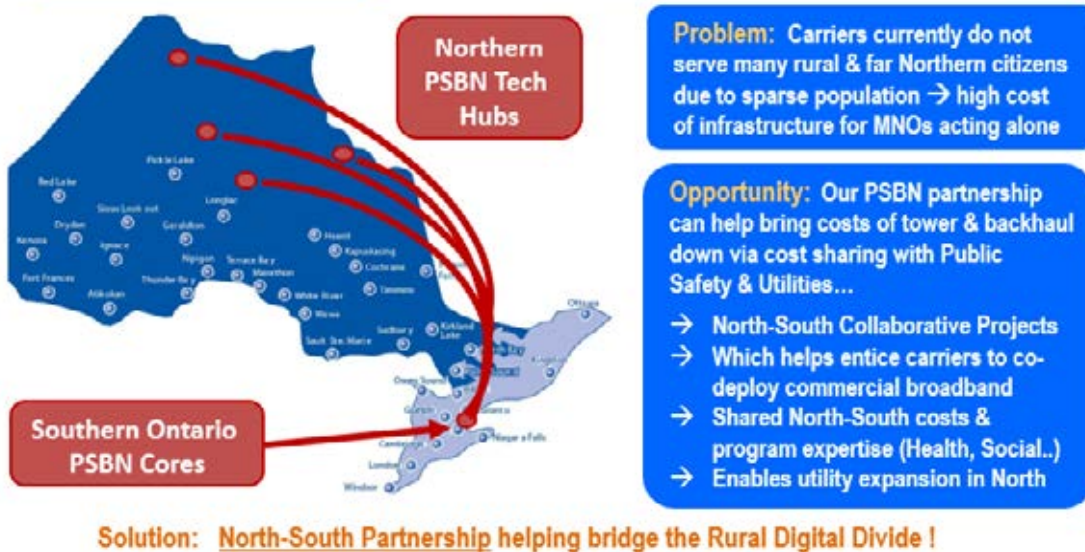
Figure F13: Conceptual diagram showcasing the joined nature of the PSBN and Next-Gen 911 dossiers. Upstream service enablement for

F6. 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.

F7. High Level Needs Analysis for Public Safety & Critical Infrastructure Broadband:

95. 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).
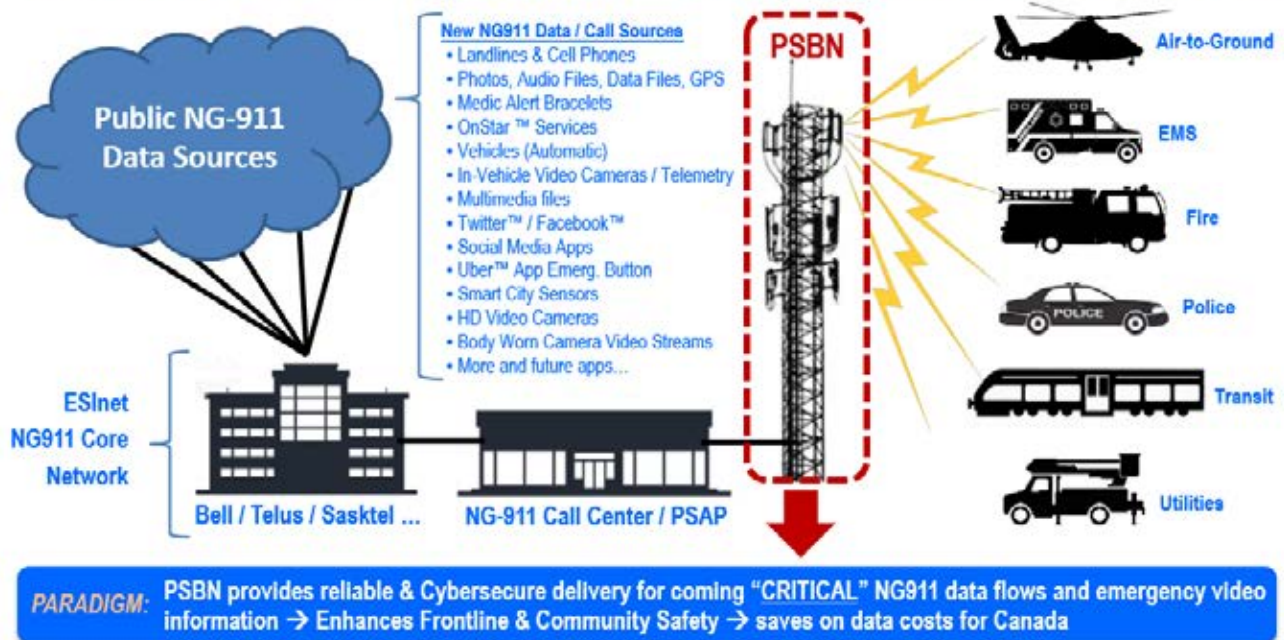
Figure F14: Conceptual diagram showcasing the joined nature of the PSBN and Next-Gen 911 dossiers. Upstream service enablement for civilians with new digital based NG-911 services will need to reliably reach downstream field operations staff – with the PSBN as the key.

ISED SLPB-002-20 - Reply Comments
PSBN Innovation Alliance Comments on proposed ISED Policy Framework for the 3650-4200MHz Band

Page 48
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G. APPENDIX – ADDITIONAL REFERENCES:

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/MCSCSSSOPlanningFramework.html#Section2

ISED SLPB-002-20 - Reply Comments
PSBN Innovation Alliance Comments on proposed ISED Policy Framework for the 3650-4200MHz Band

Page 49
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