



# Black Castle Networks

Mission-Critical design that goes Further Beyond

REPORT TO:  
THE TOWN OF ORANGEVILLE

# TELECOMMUNICATIONS REVIEW

REPORT: CONSULTING SERVICES FOR A TELECOMMUNICATIONS REVIEW – RFQ-2021-004

JANUARY 31, 2022

EXTENDED SUMMARY REPORT

Version 1.0

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## CONTACT INFORMATION

Black Castle Networks would like to thank the Town of Orangeville for this opportunity to provide recommendations and suggestions related to technology issues and emergency preparedness posture of the telecommunications systems used in lifesaving 911 response.

It is our sincere hope that our suggestions and recommendations within this telecommunications report will help improve the overall communications reliability, resiliency, Cybersecurity and interoperability posture of the Municipality, and further the lifesaving efforts of all your 911 Emergency Responder organizations.

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## FULL REPORT VS. EXTENDED SUMMARY REPORT VERSIONS

Please note that this document is an “extended summary” version (referred to as the “extended summary” within this document) of the detailed analysis and design work conducted by Black Castle Networks (BCN) during the course of the telecommunications review project for the Town of Orangeville (Town Project Contract: RFQ 2021-004).

The “full report version” of BCN’s work (referred to as the “full report” within this document) includes added details and has been provided to the Town in parallel to this document - and is available from the Town for readers that would like to see full details of the analysis, costing, findings and technology evaluations conducted.



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# I. DESIGN & BUSINESS CASE OVERVIEW

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# 1 INTRODUCTION & OVERVIEW

The Black Castle Networks (BCN) consultancy team is pleased to present this report to the Town of Orangeville (the Town), as a roadmap study of Public Safety & Community Safety Telecommunications investment options for the next 15 years.

Public Safety & Community Safety communications options are considered in this report, with both a qualitative survey of options, and a financial analysis of costs and benefits as part of an overall business case for the solutions considered.

Aspects of Digital Transformation were also considered, along with the holistic commercial and societal benefits related to rural broadband enablement, disaster preparedness risk mitigation, and commercial / economic development benefits.

The report begins with an overview of the current state of the Orangeville and Dufferin County (the County) Emergency Communications infrastructure + interoperability processes, followed by a view to future state telecommunications options available to the Town and County. BCN concludes with a complete business case including financial analysis of finalist options in order to determine the best benefit to the Town and County.

## 1.1 **Primary Areas of Focus:**

- LMR (Land Mobile Radio) replacement or upgrade options for Public Safety voice communications.
- Municipal PSBN (Public Safety Broadband Network) opportunities leveraging reserved Band Class 14 (700Mhz) spectrum earmarked for Public Safety data and voice use.
- PS-LTE (Public Safety LTE) and Private 5G services for municipal utilities, municipal government and emergency services users – leveraging a PSBN alongside an LMR network to create further value for a municipality.
- Cost analysis of investment options for Emergency & Municipal wireless services across a 15 year lifecycle.
- Rough-order-of-magnitude evaluations of RF coverage options for the town on both LMR and PSBN technologies.
- Suggested next-steps for the Town and County.
- Digital Transformation and IoT opportunities and benefits, given the above proposed Municipal telecommunication infrastructure upgrade via PSBN services.

## 1.2 **Financial Basis of Analysis:**

A lifecycle view across 15 years for a CAPEX and OPEX models is provided, considering an Internal Rate of Return (IRR) of 7% for all Net Present Value (NPV) amortizations.





### 1.3 Serious Liabilities, Problems & Failure Modes in Current LMR Status:

The current state of the LMR network in Orangeville, and the corresponding interoperability posture with Dufferin County and Caledon Fire Departments and other tri-services organizations – is in a serious and poor state that could be a liability to the Town and to Dufferin County.

We note in particular that the County and Town have a number of potential unhandled disaster scenarios and hazards from a communications stance, (including disaster scenarios that have happened historically), where several of the noted telecommunications problems have existed on a chronic multi-year basis without remedy.

Based on an analysis of issues reported by County-wide First Responders and stakeholders, BCN accordingly suggests that Line of Duty Death (LoDD) liabilities are a serious possibility for the Town and County to promptly mitigate, where failures in telecommunications could account for Line of Duty Death or civilian death liabilities due to mis-communication, RF coverage holes, or due to inability to coordinate effective response.

These potential LoDD risks due to communications system problems are a serious possibility that the Town of Orangeville and Dufferin County should both appropriately remedy as soon as possible.

In particular, BCN highlights the following summary findings per our Failure Modes and Effects Analysis (FMEA), 911 technology gap analysis, and Stakeholder Meetings conducted (all documented in our accompanying main / full report document), as but some examples of the many problems at play in the Town & County systems:

- Over 36 serious gaps and serious concerns in infrastructure performance or preparedness posture, including single-points of failure in various telecommunication elements per the Failure Modes Analysis and Gap Analysis of 911 communications elements;
- Widely known chronic RF coverage issues in the Dufferin County system that interoperates with the Town of Orangeville system, which have been ignored for years, with no remedy in sight and which potentially risks the safety and wellbeing of First Responders due to missed LMR calls or spotty RF coverage in areas;
- Some of the RF coverage issues noted above exist in
  - key emergency response facilities in the Town (i.e., Headwaters Hospital),
  - cover areas that are at noted “human-made hazards locations” across the County (e.g., windfarms, quarries, energy storage locations);
  - at critical AED and Health Care locations, which per best practices should have assured coverage;
- Un-encrypted wireless communications used by Orangeville Hydro and various Dufferin County agencies which is a potential liability related to disclosure of data;
- Unlicensed wireless communications in HAM (Amateur) radio bands that are used for field operations which can be jammed without legal recourse for denial of service;



- Absence of documentation and manuals, an inability to present Industry Canada official licenses for spectrum by executive staff and the system maintainer, and a lack of basic knowledge within Orangeville and Dufferin County agencies on telecom system elements deployed, their function, and configuration;
- Lack of critical on-site spares of key telecom components of LMR radio infrastructure (not a best practice in industry), which in the event of failure of key components could bring down Orangeville and/or Dufferin County wireless LMR communication for potentially days (or weeks) until replacement parts are ordered and shipped;
- Commercial cellular voice & data services are at risk during emergencies for reduced 911 capacity for both civilians and First Responder during disasters or events that cause congestion, which will worsen with new data-heavy NG-9-1-1 services in the future;
- A lack of communications integration of new de-escalation services such as Social Work agencies & other NGOs and community providers that are now engaging in 911 response;
- Incompatibility of radio equipment between County and Orangeville Fire agencies, and neighbouring agencies, which necessitate physical use of “donor radios” which is prone to error, missed calls - and if radios are forgotten in a call - total lack of communications;

Therefore, in summary the interoperability / telecom preparedness posture of the Town of Orangeville and Dufferin County is in the lowest tier of the Department of Homeland Security (DHS)/ Safecom™ Interoperability Spectrum methodology for determining the relative maturity of telecommunication systems, processes and agency governance for Public Safety, with the following evaluated status:

***“Limited Leadership, Planning and Collaboration among areas, with minimal investment in the sustainability of systems and documentation”.***

For more information on this above DHS methodology evaluation, and the reasons for this specified maturity level, refer to Section 3.8 of this report.

Out of a concern to liabilities due to possible Line of Duty Deaths, or due to reduced capacity to coordinate among agencies during 911 calls, BCN strongly advocates that immediate action be taken to fix the chronic RF and system interoperability problems.



## 1.4 Town of Orangeville Accountability for Change:

In terms of accountability to secure the proper functioning and resiliency of 911 emergency communications, given the above problems BCN suggest:

- Responsibility for the current LMR systems involved lies with the Town of Orangeville & Dufferin County - each accountable to establish effective emergency telecommunication services for 911 operations in their jurisdictions, and to assure interoperability with neighbouring agencies for coordination of lifesaving actions in the event of disaster.

### Short-Term Proposed Actions (within 6 months):

- Assigning a Communications Coordination Officer or Town Executive member to be responsible and accountable for short & long term actions to improve the Public Safety Communications issues.
- A multi-agency review and update of standard operating procedures per the US Department of Homeland Security's SAFECOM™ interoperability guidelines, a process which will help the Town and County to benchmark and codify best practices and interop. methodology for Public Safety communications across Town and County stakeholders, to help optimize emergency and disaster response.
- Advocate with the PSBN Innovation Alliance (PIA) and within Federation of Canadian Municipalities (FCM) and Rural Ontario Municipalities Association (ROMA) organizations in Ontario in favour of PSBN policies for Public Safety spectrum aligned with a municipal option to subordinate spectrum for municipal needs (e.g., Private 5G deployments of this spectrum for First Responders and municipal critical infrastructure / municipal monetization)
- Apply for infrastructure grant funds for rural and municipal broadband initiatives in the timespan leading up to a tender to prepare a submission where Orangeville and Dufferin County may be eligible for government incentive programs for rural broadband enablement in Canada and Ontario.

### Long-Term Proposed Actions (within 1-2 years):

- Tender and implement the deployment of a renewed infrastructure and a new Hybrid LMR+LTE Public Safety communications system. See details outlined in section 1.6 below. Including:
  - Tendering for a proposed design making use of a Hybrid combination of a baseline Conventional LMR system plus a PSBN wireless broadband overlay RAN.
  - Adoption of a proposed strategy for a hybrid PSBN-LMR technology posture within the Town and County – with a Private 5G approach to PSBN spectrum and service.



## 1.5 Key Themes in the Project Recommendations:

Regarding over-arching themes in this report, the case for change in the business case is founded on the following 3 pillars, with PSBN & Private 5G infrastructure as primary driver behind this positive change, and helping in turn to address many of the problems noted above in section 1.3. We refer the interested reader to our accompanying full report for additional details and background on our recommendations.

The three main pillars of the proposal help drive the positive business case, developed for a combined LMR replacement & deployment of Private 5G PSBN primarily for Critical Infrastructure, using new PSBN RF spectrum reserved for Public Safety in the 700MHz band.

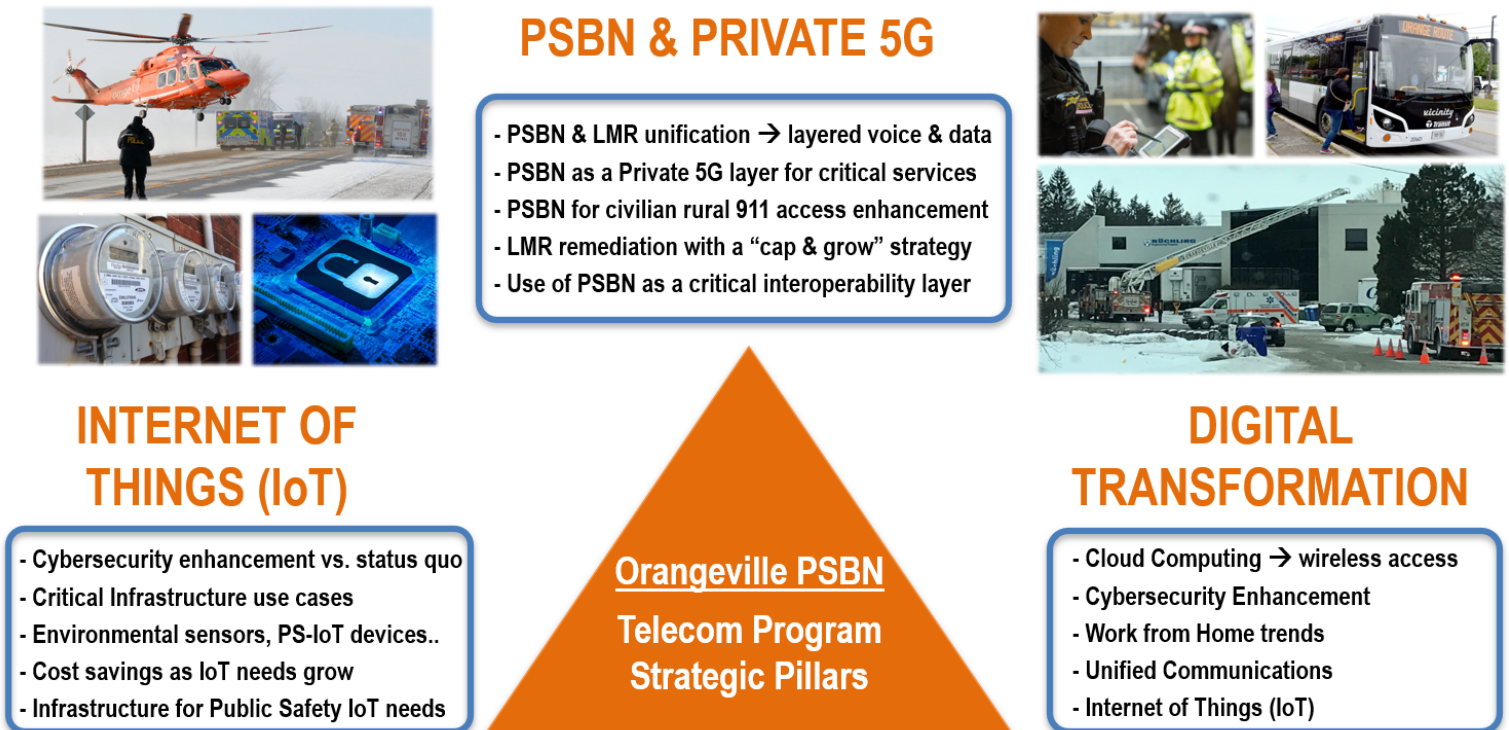


Figure 1 - Key themes in the Orangeville Telecom Report and potential solution areas for current issues & gaps.

The long-term replacement infrastructure includes a Hybrid LMR+LTE approach with:

1. A new Project 25™ Digital Conventional LMR System covering Orangeville (2 sites)

+ Optional case for including Dufferin County (6 sites) to solve all County voice communications interoperability problems for local agencies.

2. A new Orangeville Public Safety Broadband Network (PSBN) radio access network (2 sites)

+ Optional case for including Dufferin County (6 to 9 sites) to secure data communications for 911 First Responders, fold in new response organizations (e.g., Social Services) and build a cybersecure digital communications layer for critical infrastructure (future Smart Grid electrical control needs, water metering, etc) PSBN sites would be located on municipal infrastructure, or co-located at the LMR sites with the local Radio Access Network (RAN) plugging into a Provincial neutral-host core service.

## 1.6 Proposed Long-Term Strategy & Next Step Actions

Therefore given all the noted concerns with the current Public Safety LMR communications posture in the Town and County, and the generational communications technology advances in LMR and LTE / PSBN communications technology, BCN proposes that for in the case of both the Town of Orangeville and Dufferin County, that a “Cap and Grow” or “Hybrid model” strategy of communications renewal & investment is optimal. The proposed design & costing in this document demonstrates just such a Hybrid combination of a baseline Conventional LMR system + new PSBN wireless overlay.

In this “Cap and Grow” strategy legacy LMR systems are strategically “capped” at a baseline of lower-cost - yet effective - Conventional VHF LMR technology given the small user base in the region, and then “growing” toward a new replacement technology (PSBN LTE or PSBN 5G services) for enhanced capacity and new data services not available with LMR alone. A hybrid PSBN-LMR technology posture is therefore the proposed strategy.

This approach to “Cap and Grow”, as opposed to “rip and replace” or “increased legacy investment” strategies, allows for leveraging the advantages of both LMR & LTE technologies at a reasonable cost, while preparing the way for a future transition to the new replacement technology (PSBN). Then when final technical issues related to direct-mode LTE communications are resolved the Town and County will be in a position to complete or further enhance the transition to PSBN with a baseline system already in place.

Given the concerning state of problems with the current Orangeville and County LMR networks, the justification for replacement of the LMR system is considered de-facto justified in terms of cost, due to open-ended liabilities at play. The current state of maintenance & interoperability of the system could potentially cost lives or contribute to negative outcomes for civilians during 911 response due to lack of effective communications and reliable field coordination. The LMR business case is therefore considered justified.

In turn, regarding justification or business case for second element of the strategy – the parallel the Hybrid PSBN overlay element – BCN’s Financial and Economic Analysis has determined that a PSBN deployment will pay for itself on cost savings of voice & data for Town government and Public Safety usage vs. the chronically high-cost telecom market in Canada – in a Private 5G style economic model which has been proven internationally as a viable business model in precedent business cases (e.g., Sunderland, Tucson, etc).

The overlay PSBN proposed in the Hybrid design also provides “bonus value” due to reduction of disaster liabilities, and also through value-add synergies related to growing mission-critical Internet of Things (IoT) and industrial device needs for reliable, private & secure wireless access, and given new Water / Electric Metering projects on the horizon.

### **Therefore, in terms of long-term strategy & next steps actions, the following 4 steps are recommended:**

1. Begin an RFP process immediately to prepare a tender for replacement of the current Orangeville (and Dufferin County) LMR systems.
2. Complete preparatory steps for the tender, including an RF site survey, and computerized RF coverage design, and further tower + RF site inspections to help develop final tendering terms.



3. Complete the municipal procurement tendering process and award for a Hybrid LMR+PSBN system. Advocate for PSBN spectrum in upcoming Industry Canada public consultations for final spectrum terms alongside First Responder associations.
4. Complete the deployment and commissioning of a new Town of Orangeville LMR+PSBN system (or County-wide Hybrid system) with a 15-20 year lifecycle.

## 1.6.1 Technology Strategy – Infrastructure

The proposed strategy consists of two technology concepts combined into a common Hybrid LMR+LTE solution design, for unified voice & data communications and improved interoperability:

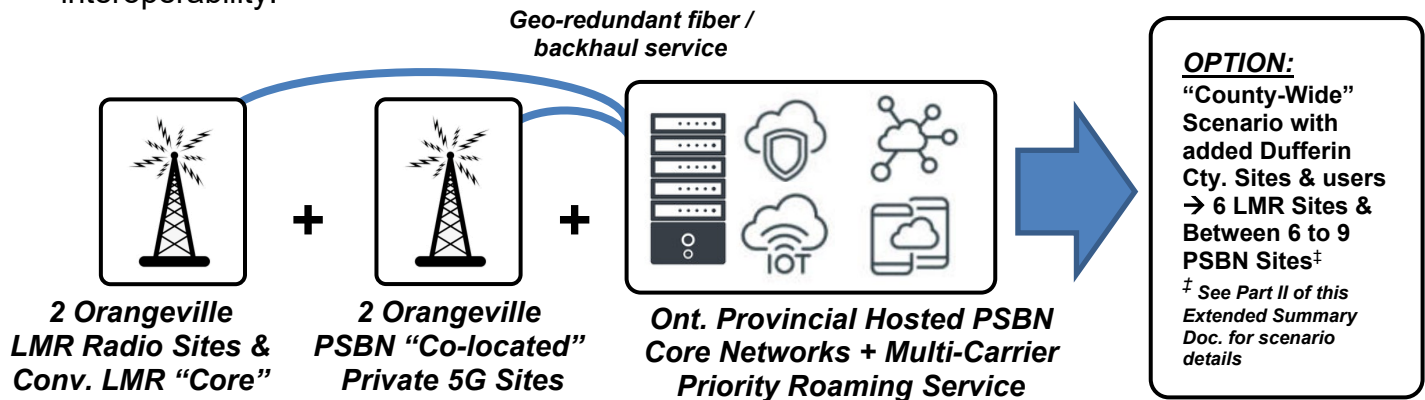


Figure 2 - High Level Conceptual view of the proposed Hybrid Model LMR+LTE system infrastructure / key elements.

## 1.6.2 Technology Strategy – Hybrid LMR & LTE User Devices

In terms of user devices – existing Town of Orangeville agency device replacement cycles and existing budgets would be used to transition to new Hybrid mode equipment. Thanks to the economies of scale and volume of devices in the USA FirstNet™ network, a growing ecosystem of LMR and LTE compatible devices for 700Mhz PSBN Band Class 14 spectrum have been developed – and which are planned to be offered in Canada via a national PSBN starting the 2022 to 2023 timeframe. The following list provides a summary of the viable device ecosystem for these Hybrid LMR+LTE devices and LTE / 5G enabled devices that support 700MHz Band Class 14.

### **Hybrid LMR+LTE PSBN Ecosystem** (fostered via FirstNet commercial market)

**# of Handsets:** 9+

**# of Vehicular Modems:** 7+

**Example vendors:** Harris, Tait, JVC Kenwood, iCOM, Motorola Solutions..

### **LTE / 5G PSBN Ecosystem** (fostered via FirstNet commercial market)

**# of SmartPhones / Tablets:** 74+

**# Vehicular Modems / Devices:** 16+

**# of Laptops:** 61+

**Example vendors:** Samsung, Apple, Sierra Wireless, Cradelpont, Sonim, Motorola Solutions, Kyocera, Google, LG, Panasonic, others..

### 1.6.3 Project Costing & Timeline

In terms of major project elements, the Hybrid Model scenario encompasses two main elements – the LMR system, and the PSBN system.

An overall procurement phasing that can either combine the tender or run the procurement as two separate tenders:

1. **LMR System** - First, the project approach includes capital investment and operations for 15 years of an LMR VHF Conventional digital simulcast core network and 2 radio sites, as a replacement and upgrade of the current Orangeville system. This will include the potential for hosting an integrated “County-Wide” scenario with additional LMR sites to create a holistic and interoperable solution for all Dufferin County first responders, utilities, public works and municipalities (please refer to “Part II – County-Wide Scenario” within this report for details on that design scenario.)

#### Infrastructure

##### K Core Scenario (Digital or Analog Conventional LMR)

	CAPEX Grand Total	OPEX 15yr Grand Total	TOTAL (CAPEX + OPEX 15 yr)
LIST	\$616,418.00	\$1,072,400.00	\$1,688,818.00
Est. DISCOUNT (20%)	\$533,134.40	\$647,920.00	\$1,181,054.40

Figure 3 – Summary of the “winning” lowest cost scenario for a Town of Orangeville Conventional LMR system.

2. **PSBN System** - The approach also includes a second PSBN component providing Private 5G voice and data communications for Emergency Responders, municipal users and critical infrastructure. The solution also includes multi-carrier prioritized roaming via a hosted 5G PSBN core provided by Halton Regional Police Service, as a secure PSBN core hosting service for a future expanded Provincial PSBN in Ontario. A 15 year cycle is used as in the LMR case. Details of this and all scenarios are included in our accompanying full report.

#### Infrastructure

##### PSBN Halton-Peel Scenario (PIA / Ontario PSBN Open Core Concept w. 4G/5G Wireless RAN)

	CAPEX Grand Total	OPEX 15yr Grand Total	TOTAL (CAPEX + OPEX 15 yr)
LIST	\$566,661.60	\$2,835,000.00	\$3,401,661.60
Est. DISCOUNT (20%)	\$493,329.28	\$2,808,000.00	\$3,301,329.28

Figure 4 – Summary of the “winning” lowest cost scenario for a Town of Orangeville PSBN system.



## 1.6.4 Federal & Provincial Grant Programs for Rural Broadband

A number of Federal and Provincial financial grant programs are available to municipalities to help build out wireless and terrestrial broadband infrastructure, in order to bridge the “digital divide” between Canadian urban and rural + First Nations regions.

Several billion dollars have been made allocated in the following listed grant fund programs, and which are available to municipalities via application processes which evaluate designs and needs, and assign annual “winners” for funding allocations.

### **Examples of Grants Orangeville & Dufferin County could apply to for funding:**

1. **CRTC Broadband Fund** – [\$750M over 5 yrs.]
2. **CIRA (Canadian Internet Registration Authority) Community Investment Program** [Up to \$1.25M per year in \$250k / \$100k grants]
3. **Govt. of Canada Universal Broadband Fund (UBF)** – [\$6B over 10 yrs.]
4. **Govt. of Canada / Prov. of Ontario – Rural & Northern Infrastructure Stream of Investing in Canada Infrastructure Program** – [\$2B over 10 years; up to \$5M per selected project]
5. **Prov. of Ontario ICON Fund** – [\$4B over 4 yrs.]
6. **PIA / PSBN Accelerator Program (Being Setup) – P3 Accelerator Fund** – [\$28B over 7 yrs.]

The above programs have varying requirements & annual deadlines / application cycles.

BCN recommends that the Town (and County in the event the “County-Wide” optional scenario is selected for the project) apply for a number of the above grants in 2022 and 2023, as a mechanism to help reduce overall capital expenditures for the project.

Each grant application process is slightly different, with rules governing submission requirements, and different proposal submission windows for new applicants. Many dates for the above programs have shifted or been delayed due to the COVID-19 pandemic.

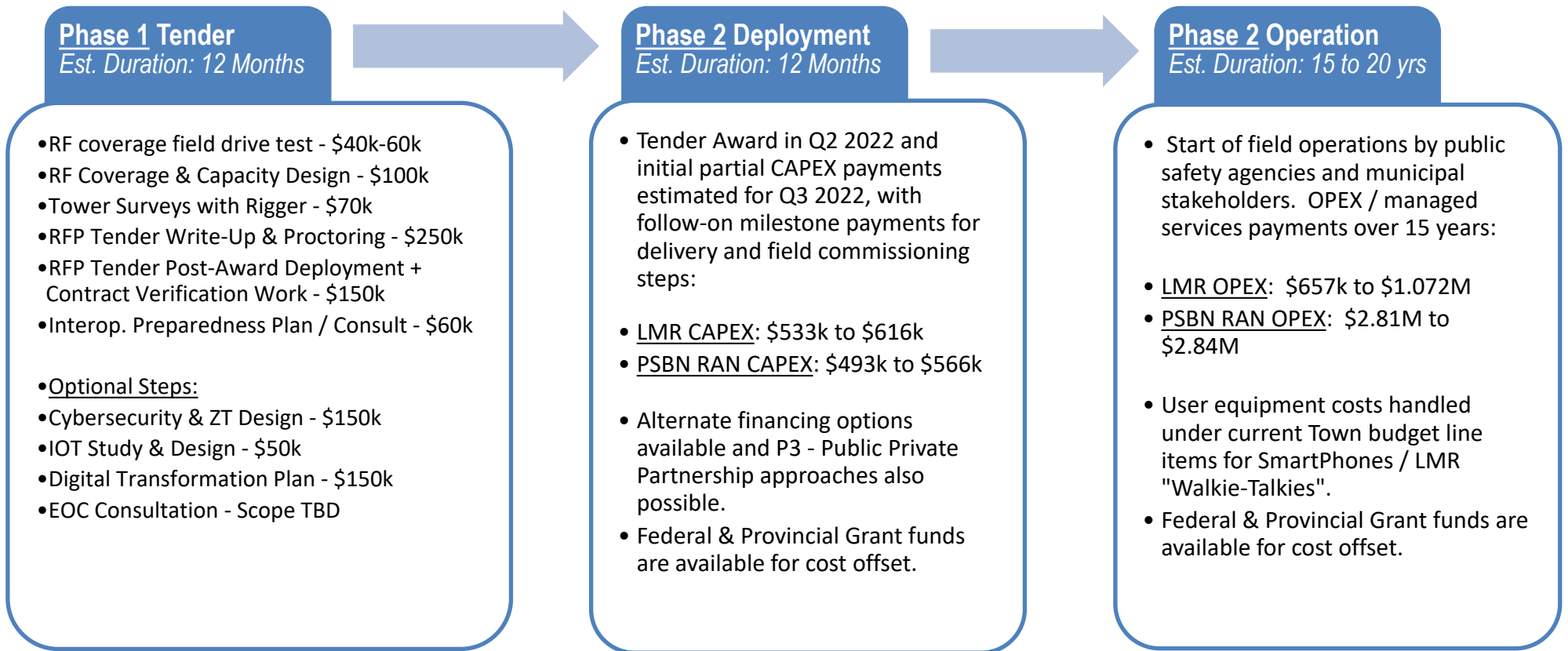
In summary, BCN would recommend in particular that any future announced rounds of the CRTC Broadband Fund be considered for applications (two rounds have closed with second round applicants from the 2021 deadline being presently considered), and also the next potential round of the ICON fund also be considered - once announced.

Lastly, BCN suggests it would be worthwhile to enter into negotiations with the above noted PIA / PSBN Accelerator Fund which is a P3 investors consortium – or to consider permitting such similar capital investment consortia to bid in any final tender conducted by the Town or County.





## Example Project Phases



## Example Phased Timeline

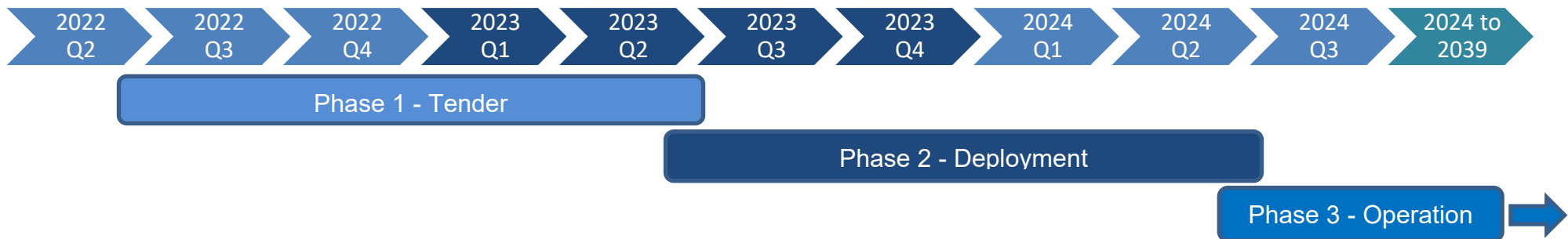
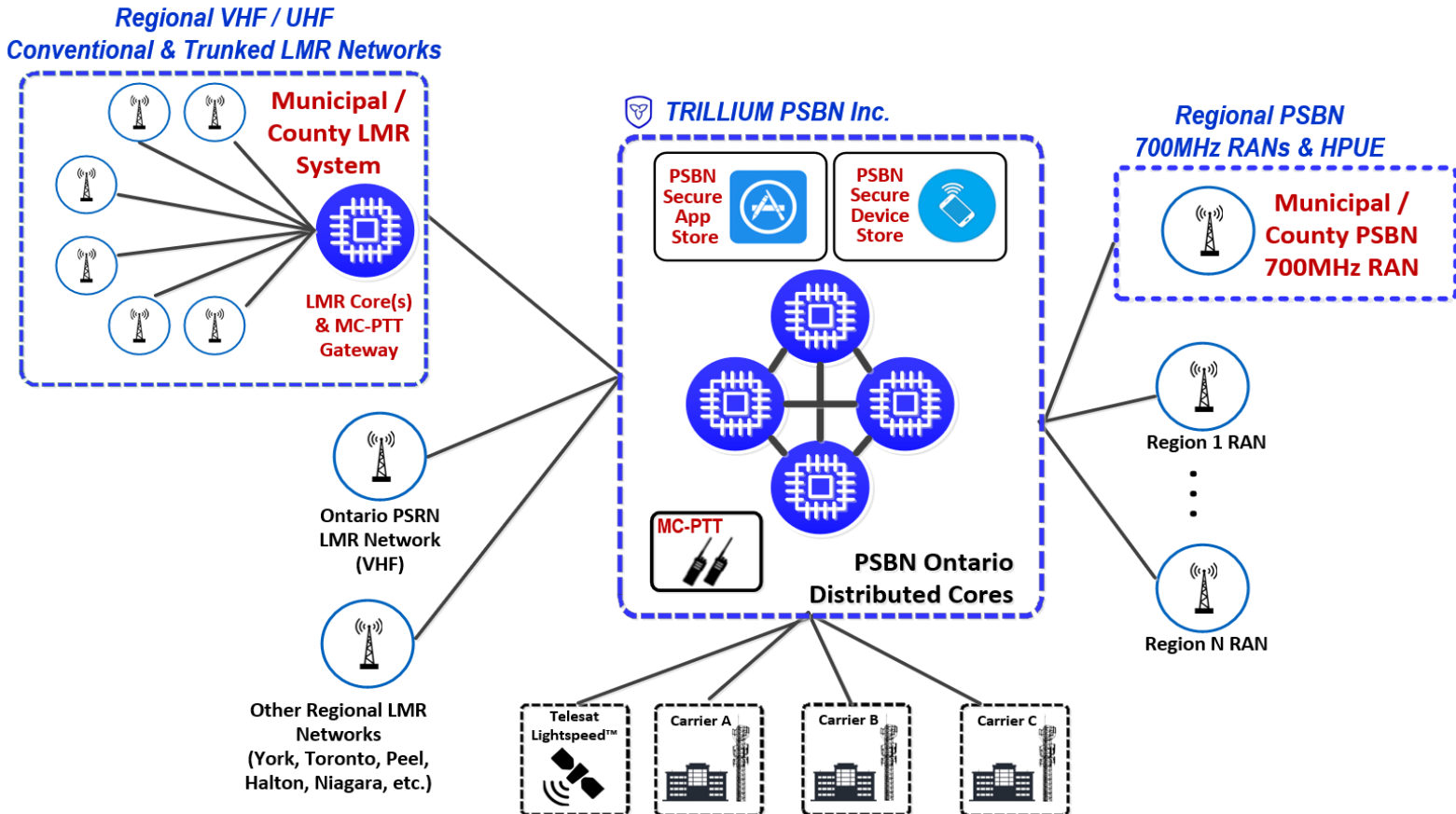


Figure 5 - High Level Time-Line View of the program and deployment phases, showing timing of preparatory, CAPEX & OPEX amounts + an example GANTT Chart for timing.

## 1.6.5 Hybrid LMR+LTE System Design & Provincial PSBN Integration

The proposed “Hybrid” design creates an integrated regional LMR system alongside a dedicated PSBN wide-area network as a Private 5G Public Safety cellular access network, combined with seamless multi-carrier roaming services. The PSBN network in this case provides both Private 4G / 5G data service benefits for Public Safety and municipal critical infrastructure stakeholders, while at the same time offering a lower cost wireless service.



**Key Hybrid Design Advantages – Summary:** (Please refer to the accompanying full version of this report - “The Town of Orangeville Telecommunications Review” - for added details on design advantages.)

1. Multi-Carrier Networks & QPP Priority Access across multiple national & regional carriers
2. Flexible Use Spectrum for rural vs. urban needs & PSBN Spectrum Monetization Option
3. PSBN Provides a Better Backup / Resiliency Enhancement to LMR
4. PSBN Provides a Capacity Enhancement to the LMR system
5. PSBN Provides North America’s 700MHz “RF Interoperability Layer” for Disasters
6. PSBN 700MHz Provides New Wireless Cybersecure Broadband Data, Apps & Devices
7. Digital Divide – New “Private 5G” Broadband Service tailored to rural & urban municipal needs for open access, or improved civilian 911 access or private capacity for critical infrastructure

# FUTURE STATE SYSTEM OVERVIEW

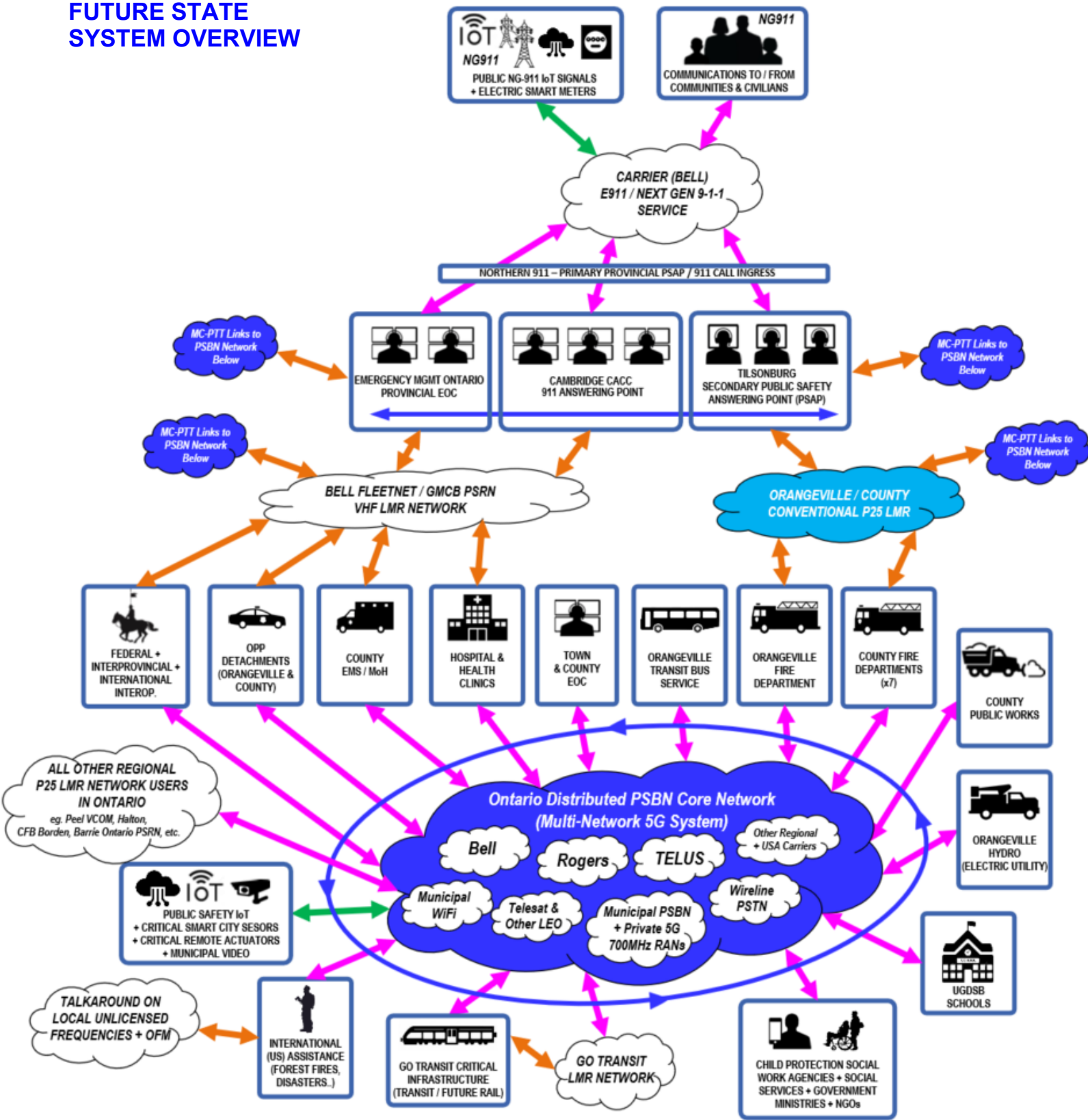


Figure 7 – Future *evolved* flows of voice & data during emergency response in the proposed future state - with the Hybrid LMR-LTE model system. This future state addresses the Orangeville & Dufferin County interoperability problems noted in evaluation of current state Emergency Response (see Sect. 3 of the accompanying full report). *Clouds*: Dark Blue = New PSBN; Light Blue = New LMR; *Links*: Pink = voice & data; Green = data-only; Orange = voice-only; Blue = new inter-agency interoperability made possible.

## 2 FINANCIAL CASE - OVERVIEW

### 2.1 Cost Summary – Orangeville LMR Infrastructure

A detailed evaluation of the CAPEX and OPEX for a number of Land Mobile Radio (LMR) upgrade or replacement scenarios was conducted for the Town of Orangeville. A two-site LMR network that covers the geographic area of the Town of Orangeville was considered and determined optimal in this Town of Orangeville LMR scenario. County-wide scenarios were evaluated separately, and results for those evaluated County-wide scenarios are provided within Section 8 of this extended summary report. ROM (Rough Order of Magnitude) costs were used which are typically accurate to within +/- 25% of final cost.

In the scenarios studied for the Town, an LMR regional core was considered in the candidate solutions, with cost estimates including equipment and features to “pre-enable” the Orangeville LMR core network to possibly later accommodate “add-on” Dufferin sites. Both Conventional and Trunked scenarios were considered.

In this flexible and expandable "add-on" strategy, if the Town wished it could deploy a “solo” LMR system to start now for only the Town’s coverage needs, and at a future time attach additional Dufferin County LMR sites through a negotiated agreement with the County (e.g., via partnership on shared core and RAN ownership, or a hosting approach where an annual attachment fee is charged to Dufferin county to attach sites to the Orangeville core, or other desired hosting models.)

The summary estimated cost table for the winning LMR design in this Orangeville-only scenario is provided below. Please refer to our accompanying full report document for details on the scenarios and design iterations used in our analysis.

#### Infrastructure

#### K Core Scenario (Digital or Analog Conventional LMR)

	CAPEX Grand Total	OPEX 15yr Grand Total	TOTAL (CAPEX + OPEX 15 yr)
LIST	\$616,418.00	\$1,072,400.00	\$1,688,818.00
Est. DISCOUNT (20%)	\$533,134.40	\$647,920.00	\$1,181,054.40

Figure 8 – Summary of the “winning” lowest cost scenario for a Town of Orangeville Conventional LMR core network with two LMR sites providing coverage over the service area.

### 2.2 Cost Summary – Orangeville PSBN Infrastructure

In turn, a design and costing evaluation was conducted for a Public Safety Broadband Network (PSBN) to be deployed as an overlaid network on top of the above LMR design. In summary the PSBN design is an add-on element to the LMR design, and provides both additional Private 5G municipal data services as well as seamless voice backup for the LMR system, and a potential spectrum monetization option for the Town as well.



The following summary tables provide the evaluation of the CAPEX and OPEX elements of the various PSBN scenarios considered for the Town of Orangeville. In this grouping there are costs for a 2 site PSBN network covering the geographic area of the Town of Orangeville. An option is included at the end of this extended summary document, for a Dufferin County PSBN add-on scenario, due to the advantages of cost-sharing and interoperability synergies which come with deployment of a County-wide LMR & PSBN system.

As above in the LMR scenario, where standalone regional cores are involved in the given solution, the cost is priced to “pre-enable” the Orangeville PSBN core network to be able to later accommodate and “plug-in” (add-on) Dufferin PSBN RAN sites. In the cases involving hosting on the Halton Regional Police Service PSBN core preliminary core fee costs have been considered that are currently used to estimate a municipal RAN attachment onto the Halton PSBN core network.

**Infrastructure**

**PSBN Halton-Peel Scenario (PIA / Ontario PSBN Open Core Concept w. 4G/5G Wireless RAN)**

	CAPEX Grand Total	OPEX 15yr Grand Total	TOTAL (CAPEX + OPEX 15 yr)
LIST	\$566,661.60	\$2,835,000.00	\$3,401,661.60
Est. DISCOUNT (20%)	\$493,329.28	\$2,808,000.00	\$3,301,329.28

Figure 9 - Summary of the “winning” lowest cost scenario for a Town of Orangeville PSBN system with two 4G / 5G PSBN radio sites providing coverage over the Town’s service area.

It is important to note that during the work on the full business case analysis, a large number of variant “sub-scenarios” stemming from these finalist solutions were also considered within the financial and costing work, in order to provide the Town with a rigorous evaluation of options and cost.

BCN’s accompanying full report contains detailed information pertaining to the design & architecture of the scenarios considered, financial estimates, strategic case, and the full formal business case level of analysis and depth. The formal business case methodology used in BCN’s report is aligned with the Ontario Ministry of Infrastructure Ontario formal case analysis process for investment decisions.

The following sub-sections provide a summary of the business case evaluations for each of the main finalist business scenarios, which further validate the scenarios noted above have adequate positive attributes - in addition to the cost advantages noted - to justify proceeding as an investment by the Town of Orangeville.

**2.3 ROM Cost Summary – Potential Spectrum Revenue & Financial Gain**

Potential benefits from a PSBN model accrue from several sources, as discussed in our Economic Case within this report. We consider these revenue possibilities in our following Economic Case, including:

- Cost savings from deferral or elimination of monthly telecom fees
- Potential revenue from monetization of 700MHz spectrum via roaming agreements with incumbent national / regional carriers through sale of unused bandwidth



### 3 ECONOMIC CASE - OVERVIEW

The need to remedy the existing serious and chronic problems with the Town and County's current LMR systems is a matter of critical liability and Public Safety need, and is understood to be a necessary and justified investment from the stance of being able to provide essential 911 municipal service. The LMR investment justification is therefore excluded from the following summary economic narrative which focuses on the incremental cost justification for a PSBN overlay on top of a remediated LMR system.

The PSBN 5G Business Model is a moderate initial capital investment for the Town of Orangeville (approx. \$493k to \$566k for a 100% stake, and options for smaller shares in P3 scenarios) but with substantial benefits to the business climate, to Community Safety & Wellbeing, and to overall Town & County telecom quality in support of up-coming Next Gen 911 services.

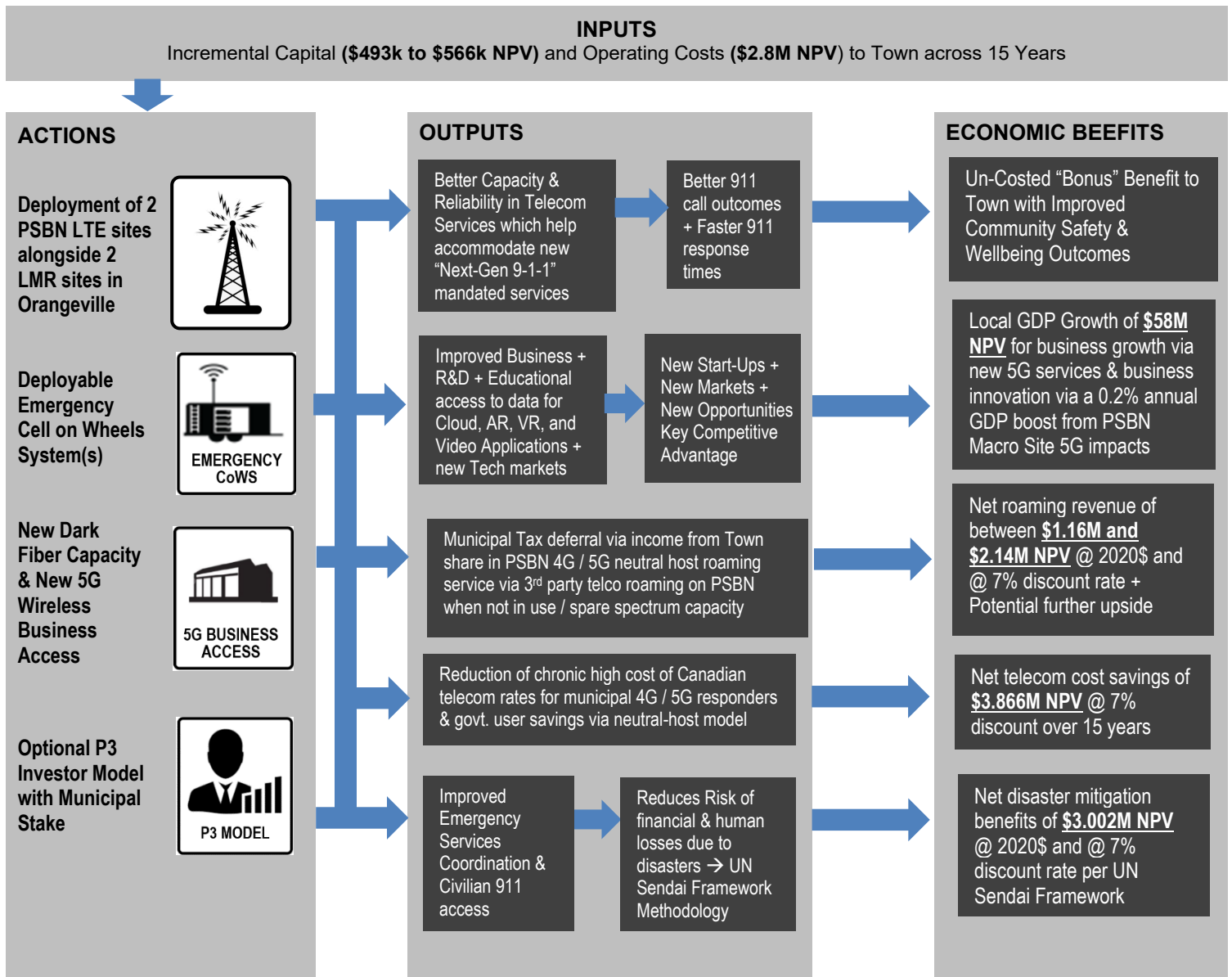


Figure 10 – Summary Economic Case – Overview of Key Inputs, Actions, Outputs & accrued benefits for the Town of Orangeville case.

The analysis included in this Economic Case illustrates how the PSBN project's benefits exceed the costs to deliver it. The Economic Case and Benefit-Cost Ratio for a number of project scenarios were calculated and found to all be above a ratio of 1.0, which is the threshold for a positive decision. Conservative estimates of costs and gains were used throughout the model.

In summary, a Benefit-Cost Ratio score of 2.174 was obtained for the Orangeville Private PSBN scenario, 2.516 for the Orangeville Neutral Host Scenario, versus 2.027 for the County-wide Private System scenario and 2.866 for the County-wide Neutral Host scenario. Therefore, the proposed scenarios are viable from a municipal investment stance given a 7% IRR for investments used, obtaining a healthy buffer margin above the 1.0 Benefit-Cost Ratio decision threshold.

### 3.1 CAPEX & OPEX Payback Period Calculation

In terms of a payback period for the capital investment, the following simplified view summarizes the payback. Given an annual cost savings for broadband telecom costs via use of the Private 4G / Private 5G network, we can calculate:

#### **Town of Orangeville PSBN RAN Scenario – Cost Savings vs. Status Quo**

Net Annual Cost Savings (Due to removed monthly fees):	\$257,760.00
Annual OPEX Costs:	<u>-\$189,000.00</u>
Net Annual OPEX Cost Savings via Investment:	\$ 68,760.00
Total CAPEX Costs Estimate:	<u>\$566,661.00</u>
Payback / Breakeven Period for CAPEX (Years)	8.24 Years

### 3.2 Additional Economic Benefits from Disaster Risk Mitigation

Beyond the covering of raw CAPEX and OPEX costs above, there are added financial benefits accrued due to disaster mitigation effects of the new infrastructure. Through use of the UN Sendai Framework model – (which is a United Nations driven and internationally accepted approach to costing financial benefits from disaster mitigation)<sup>1</sup> we may legitimately estimate economic savings to help frame up the true estimated Return on Investment (ROI) for Public Safety and disaster mitigation investments.

Our preliminary UN Sendai Framework estimates indicate amortized disaster mitigation savings for Orangeville on the order of \$3.002 Million per year. Please refer to the full report for details of the calculation methodology and included elements.

### 3.3 Additional Economic Benefits from Potential Spectrum Monetization

Additionally, there are other intangible benefits that accrue from potential spectrum monetization (i.e., "leasing" out spectrum to a carrier partner) and possible cost reductions for Town residents due to use of a municipal Private 4G style model. These benefits have been estimated accordingly. Please refer to the full report for details.

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<sup>1</sup> <sup>1</sup> United Nations Sendai Framework Program - <https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>



Table 1 - Orangeville Economic Case Summary – Financial Benefits to Town via proposed PSBN design

	Town of Orangeville PSBN Private Scenario	Town of Orangeville PSBN Neutral Host Scenario	Dufferin County PSBN Private Scenario	Dufferin County PSBN Neutral Host Scenario	Business as Usual Scenario Telco Services
<b>Economic Case – PSBN Municipal Revenue Benefits</b>					
Total Economic Benefits (2021\$, Net Present Value) (NPV)	\$7.396M NPV @ 7% discount rate over 15 yrs.	\$8.562M NPV @ 7% discount rate over 15 yrs.	\$8.454M NPV @ 7% discount rate over 15 yrs.	\$11.953M NPV @ 7% discount rate over 15 yrs.	\$0 – no PSBN infrastructure
Estimated PSBN Dividends / Roaming Revenue (NPV) Assuming a 100% stake for PSBN model scenarios	\$0 - No roaming / Fully Private infrastructure scenario and so no local income from 5G	Between \$1.166M and \$2.041M NPV Dividends from roaming fees over 15 years	\$0 - No roaming / Fully Private infrastructure scenario and so no local income from 5G	Between \$3.499M and \$6.124M NPV Dividends from roaming fees over 15 years	\$0 – no PSBN infrastructure
Estimated 5G infrastructure asset stake value in an asset sale scenario in Year 10	NPV = \$528k NPV @ 7% discount rate in a year 10 sale scenario	NPV = \$528k NPV @ 7% discount rate in a year 10 sale scenario	NPV = \$1.586M NPV @ 7% discount rate in a year 10 sale scenario	NPV = \$1.586M NPV @ 7% discount rate in a year 10 sale scenario	\$0 – no PSBN infrastructure
Estimated UN Sendai Framework Value of Risk Mitigation Benefits over 15 years	\$3.002 Million NPV over 15 yrs. @ 7% Discount Rate.	\$3.002 Million NPV over 15 yrs. @ 7% Discount Rate.	\$3.002 Million NPV over 15 yrs. @ 7% Discount Rate.	\$3.002 Million NPV over 15 yrs. @ 7% Discount Rate.	\$0 – no PSBN infrastructure
Estimated value of Government Agency Cost Savings via use of PSBN over High-Cost carriers over 15 years of operations	\$3.866 Million NPV over 15 yrs. @ 7% Discount Rate	\$3.866 Million NPV over 15 yrs. @ 7% Discount Rate	\$3.866 Million NPV over 15 yrs. @ 7% Discount Rate	\$3.866 Million NPV over 15 yrs. @ 7% Discount Rate	\$0 – no PSBN infrastructure
Net CAPEX & OPEX Costs	\$567K CAPEX & \$2.835M OPEX over 15 years NPV @ 7% Discount Rate	\$567K CAPEX & \$2.835M OPEX over 15 years NPV @ 7% Discount Rate	\$1.132M CAPEX & \$3.038M OPEX over 15 years NPV @ 7% Discount Rate	\$1.132M CAPEX & \$3.038M OPEX over 15 years NPV @ 7% Discount Rate	\$0 – no PSBN infrastructure
Benefit-Cost Ratio from Project Revenue (NPV)	= \$7.396M benefits / \$3.402M cost = 2.174	= \$8.562M benefits / \$3.402M cost = 2.516	= \$8.454M benefits / \$4.17M cost = 2.027	= \$11.953M benefits / \$4.17M cost = 2.866	= \$0.00M / \$0.0M costs = 0.00



## 4 STRATEGIC CASE - OVERVIEW

The Strategic Case summarizes the performance of the proposed options against the organization's strategic objectives, to indicate if the investment supports the opportunity and broader policy and objectives.

The following sections articulate how the various options perform against each of the official strategic outcome / goals of the Town of Orangeville, as well as how each option supports Town progress toward the given strategic output.

The following list is a summary of Orangeville's "Vision & Values" per the latest Strategic Action Plan for the municipality, coupled with with a short overview of the direct benefits fostered by the Hybrid Model LMR+LTE / PSBN Business Case, and the corresponding outcomes:

- **A barrier-free community**

→ Outcome: Growth of wireless and fiber broadband in underserved areas of the Town and within Dufferin County, for addressing both the urban & rural digital divides, and in ensuring high quality 911 emergency calling access for residents throughout the Town for both day-to-day 911 emergency calls and in disaster scenarios.

- **Spending taxpayers' money wisely and responsibly**

→ Outcome: Cost savings over the higher-cost status quo approach, given that Canada has among the highest cost telecom markets in the world. These chronic high-cost telecom rates paid in Canadian municipalities are an unnecessary excess cost borne by taxpayers.

- **Enhancing the Town's environment**

→ Outcome: Deploying Private 5G infrastructure which is more environmentally friendly in terms of energy consumption versus legacy 4G wireless data technologies.

- **Encouraging business growth**

→ Outcome: Deployment of new 5G wireless access technology helps foster growth of new organic local businesses in markets leveraging wireless communications, both in offering new services and products locally, fostering innovation with 5G by local firms that gain access, and by providing key infrastructure that promotes outside investment by companies looking to locate in a well connected community in Ontario.

- **A safe and secure environment**

→ Outcome: Support of new Next Gen 9-1-1 (NG-9-1-1) services for support of Orangeville resident health and Community Safety, and in offering new efficiency tools to First Responders for improved call operations, better interoperability & disaster preparedness.

- **Well-maintained infrastructure**

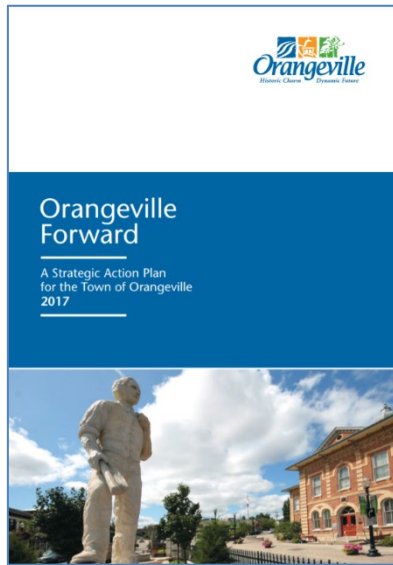
→ Outcome: Sufficient broadband capacity for the projected 26% population growth of Orangeville over the 20 year period between 2016 and 2036. PSBN also can be used to provide a Cybersecure "data pipe" for critical Town infrastructure control signalling.



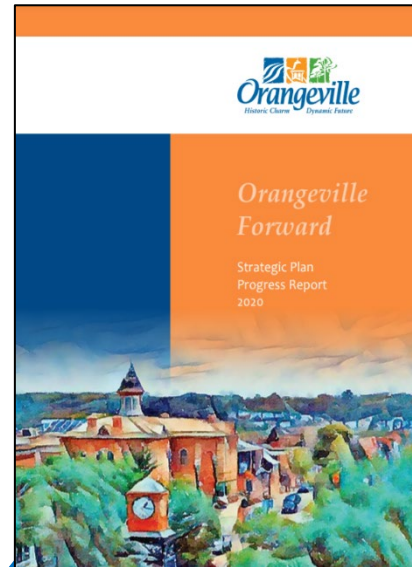
# 4.1 Policy Alignment – Town of Orangeville Planning Documents

In evaluating strategic alignment with the Town's priorities, the following two key strategic planning documents and corresponding targets from the Town, and benchmarked the business case against these strategic plans were considered.

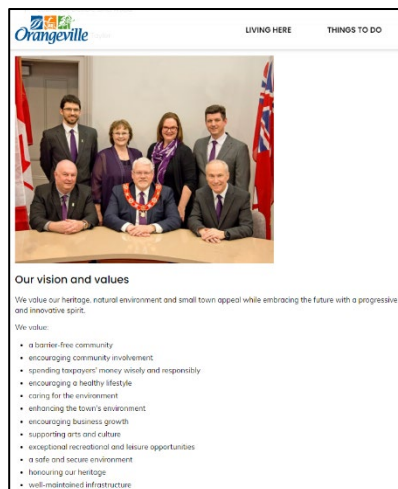
## 1. Orangeville Foreward – A Strategic Action Plan for the Town of Orangeville [2017]



## 2. Orangeville Foreward – Strategic Plan Progress Report [2020]



Town of Orangeville Council Vision & Values [2021]



Town of Orangeville 5 Key Areas [2020]



Figure 11 – Trace of the report's strategic case alignment to current strategy documents of record adopted by the Town of Orangeville. (Strategic Action Plan, Vision & Values & Five Key Strategic Focus Areas)

## 4.2 Policy Alignment – Strategic Action Plan [2017]

The PSBN “Private 5G” model scenarios evaluated in this Business Case both bring advanced new 5G wireless broadband services to the Town of Orangeville, with outcomes that are aligned with Orangeville’s strategic plans as follows:

### Orangeville Strategic Action Plan - 2017<sup>2</sup>:

“**Our Vision:** Orangeville is an inclusive community that respects its heritage, natural environment and small town appeal while embracing the future with a progressive and innovative spirit.”

### **“Why only the Hybrid LMR+LTE Model uniquely fits the Town’s Vision”**

- Cost savings on exploding First Responder data usage needs (due to coming NG911, Cloud, video and data apps) versus high-cost incumbent carriers through use of a Private 5G approach to 700MHz PSBN spectrum, beating incumbent carriers on cost.
- Better resiliency for Public Safety communications than commercial carriers via a layered multi-carrier roaming model + direct municipal controlled infrastructure. This is directly linked to a better level of Community Safety & Wellbeing via disaster preparedness.
- Far more net voice capacity than an LMR-only approach for First Responders, along with a more resilient level data service that is not available on the market.
- Possibility for a municipal revenue stream to offset Public Safety cost through monetization of spectrum when not in use, for rural broadband access initiatives or as an additional 911 resiliency layer for residents, bringing technology innovation.

### Town of Orangeville Vision & Values

- ✔ • a barrier-free community
  - encouraging community involvement
- ✔ • spending taxpayers' money wisely and responsibly
  - encouraging a healthy lifestyle
  - caring for the environment
- ✔ • enhancing the town's environment
- ✔ • encouraging business growth
  - supporting arts and culture
  - exceptional recreational and leisure opportunities
- ✔ • a safe and secure environment
  - honouring our heritage
- ✔ • well-maintained infrastructure

### Mapping to Town Council Vision



✔ = vision elements supported by the proposed LMR / PSBN upgrade

Figure 12 - Overview of the mapping between the proposed PSBN / LMR course of action and the applicable elements of the Town’s Vision + “5 Key Areas” strategy.

<sup>2</sup> Town of Orangeville - <https://www.orangeville.ca/en/town-hall/resources/Documents/Strategic%20Plan%202017.pdf>

Private 5G / PSBN technology is a key wireless services model used around the world, which opens new markets & services that haven't existed in the past, and also serves to advance emergency preparedness. As such PSBN is both an innovative 911 service enabler and also a progressive tool to prepare for coming Next Gen 9-1-1 services for residents. The following is a summary mapping of both the Town's 5 Key Priorities versus the Business Case Proposed Actions. The full report contains further detailed information.

## 4.2.1 Mapping - Town Key Strategic Areas vs. Proposed Business Case Actions

### Key Priorities

#### 1. Municipal Service

- Delivered with a focus on customer service
- Effective & efficient
- Respectful of cost & impact to the community



- Improved resident access via municipal Wireless
- Ability to offer "Digital Divide" lower cost access
- Cost savings for municipality telecom

#### 2. Strong Governance

#### 3. Economic Vitality

- Attract, retain & expand business
- Foster entrepreneurship
- Stimulate tourism & cultural development
- Further workforce development



- Improved wireless services attract industry
- New 5G PSBN services foster entrepreneurship
- Development of new tools for municipal staff

#### 4. Community Stewardship

- Safe & protected
- Active & Healthy
- Engaged & Involved
- Champions of the environment



- Improved resident access to wireless 911 calling
- Prepares infrastructure for new NG-9-1-1 services
- Improved LMR & LTE → better 911 & disaster response
- PSBN can be leveraged for environmental sensors

#### 5. Sustainable Infrastructure

- Maintain current assets
- Plan for Growth
- Support Innovation
- Provide systems that keep people moving



- Improved Cybersecurity of critical infra. assets
- Build reserve capacity for disasters / 911 calling
- Telecom systems for supporting public transit

Figure 13- Overview of the mapping between the proposed PSBN / LMR course of action and the Town's Strategic Priorities.

As a municipal investment, PSBN / Private 5G networks and 5G neutral-host networks have been widely cited as opening new greenfield benefits for utilities, such as the mass scaling of the Internet of Things (IoT), and as a key enabler for scaling the growing societal trend of video-calling as seen during the Coronavirus pandemic (increasingly replacing voice-only communications). Growing First Responder use of cybersecure Cloud apps & data storage for field operations efficiency, along with new Next-Gen 9-1-1 data needs are also driving the need for resilient and integrated First Responder voice & data services.

Consensus opinion in the telecommunication market points to projections of exponential growth in Cloud-based data access and Cloud-based applications for business + consumer use, and First Responders - all driving value in Private 5G / PSBN style municipal networks. A "Private 5G" PSBN model also has a key benefit for municipalities as a secure communications layer in a municipal critical communication strategy and a "secure pipe" for critical control signalling of municipal infrastructure such as mass transit, water systems, electricity systems, energy & more.

# 5 ENGINEERING DESIGN CASE - OVERVIEW

## 5.1 PSBN Technology Overview

The proposed business structure for the PSBN RAN system in Orangeville (and the County) consists of choice between two main model options:

- a.) a wholly municipally owned capital investment project for the PSBN RAN, which plugs into neutrally-held secure PSBN core networks with service offered by a PSBN authority for the Province of Ontario (ie., the PIA or other entity named by the Ministry of Solicitor General as the steward for PSBN multi-network core services in the province);
- b.) a P3 partnership with vendors, capital investors, and an “anchor mobile network carrier” partner with a concession on wholesale rate within the partnership;

In monetizing the value of 700MHz spectrum, when the spectrum is not used by First Responders, the PSBN neutral-host core model permits granting access to either an exclusive “anchor MNO” that makes use of the spectrum for its customers, or via a pool of carriers that would have customers “roam” or ride on the neutral-host 5G infrastructure.

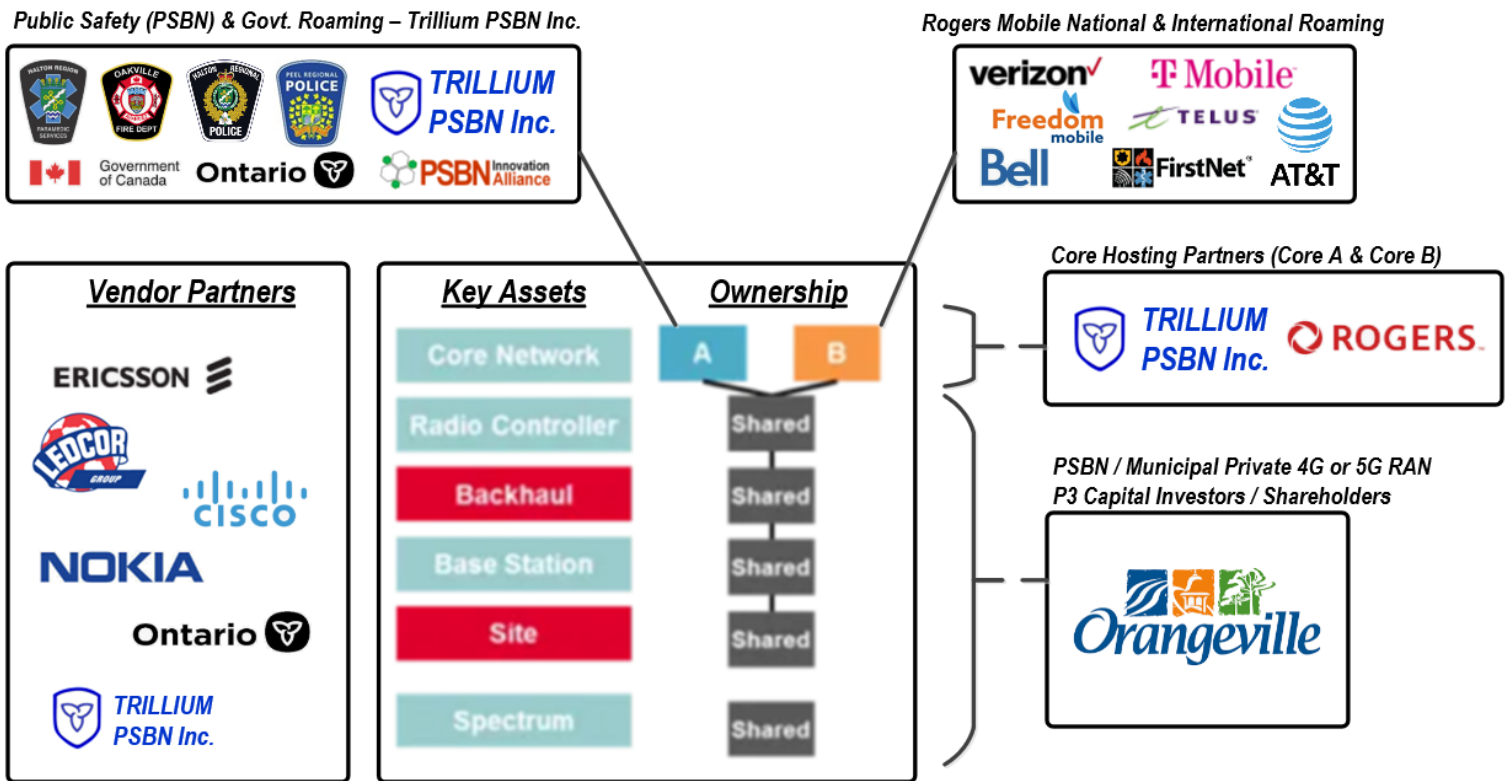


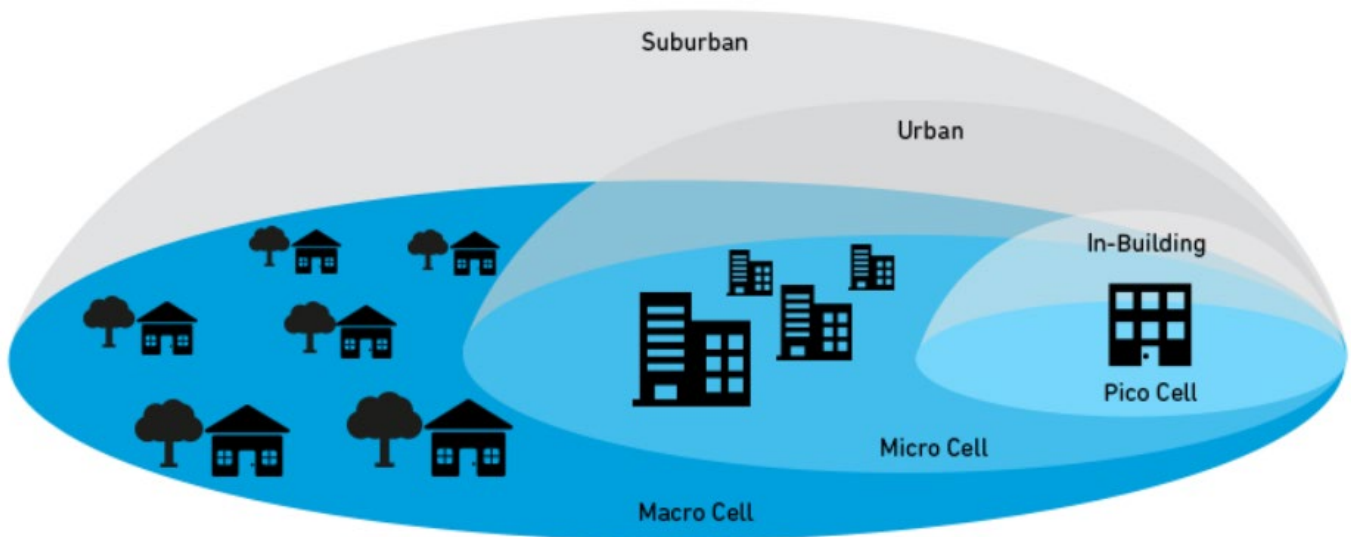
Figure 14 - Conceptual view of key business relationships – A hypothetical example to illustrate key components of the model and possible roles and responsibilities of actors and partners. Other scenarios such as P3 ownership of the asset are also possible.

The Orangeville RAN will “plug into” the nascent Halton-Peel Region 4G / 5G neutral public safety core network (PSBN) and use that system for core network control functions hosting for the Orangeville PSBN 700MHz RAN. The partnership scenario could optionally use an anchor MNO to provide the connectivity and municipal integration with

the neutral provincial PSBN cores (e.g. TELUS or Rogers). The included partnership diagram in this section provides a purely hypothetical but illustrative example of key elements, ownership and vendor relationships in the business model.

In designing Private 5G systems, a key technology concept to be aware of is the architectural layering of “macro-cell”, “small cell or micro-cell” and “pico-cell” footprints, each of which use differing RF frequencies. A macro-cell is typically deployed using low-band UHF frequencies, while small-cells use high-band “millimeter wave” frequencies above 4GHz from commercial carrier partners, or for example via unlicensed 5G RF spectrum recently made available in Canada.

Small-cells have high data rates in the range of several Gigabits per second, while macro-cells have data rates in the hundreds of Megabits per second. In the current PSBN 700MHz design in this report, only macro-cell sites are used to provide the base layer of access for First Responders however, the model is extensible to blend in small cells in the future if the Town wished to expand municipal Private 5G services for residents with future unlicensed spectrum that has recently been allocated by ISED in the 6GHz band.



Cell Type	Output Power (W)	Cell Radius (km)	Users	Locations
Femtocell	0.001 to 0.25	0.010 to 0.1	1 to 30	Indoor
Pico Cell	0.25 to 1	0.1 to 0.2	30 to 100	Indoor/Outdoor
Micro Cell	1 to 10	0.2 to 2.0	100 to 2000	Indoor/Outdoor
Macro Cell	10 to >50	8 to 30	>2000	Outdoor

Figure 15 -- Conceptual view<sup>3</sup> of ranges and capacities of various macro- / micro- / pico- and femto-cell profile networks that combine for coverage. PSBNs would be examples of macro-cell overlays in an overall tele communications capacity plan for the Town of Orangeville

<sup>3</sup> Qorvo - <https://www.qorvo.com/design-hub/blog/small-cell-networks-and-the-evolution-of-5g>.



As a generational “Municipal Private 5G” strategy for the Town over the next 15 years, there is the potential for future Private network enhancement, and leveraging of the PSBN investment by overlaying un-licensed 5G small-cells in the newly opened 6GHz band in Canada – similar in some respects to the role that CBRS Private 5G systems play in the USA today. A small-cell network could be intergrated alongside the municipal PSBN coverage footprint as a future strategy. Therefore as an added benefit, a PSBN can act as a nucleus for future partnerships and enhancement of broadband services via small-cell systems as the Town population and economy continues to grow in the future over the next 15 to 20 years and beyond.

## 5.2 LMR Technology Overview

In regard to the business model in the LMR scenarios considered a Design-Build-Maintain approach was used, where optional financing is provided by the incumbent vendor or could be secured by the Town through a bank note, municipal bond or other such financial vehicles for capital and debt.

Other models are certainly possible, and can be decided upon by the Town or County as they proceed to the next phase of preparation for a tender per the Deliverability Case within the overall business case.

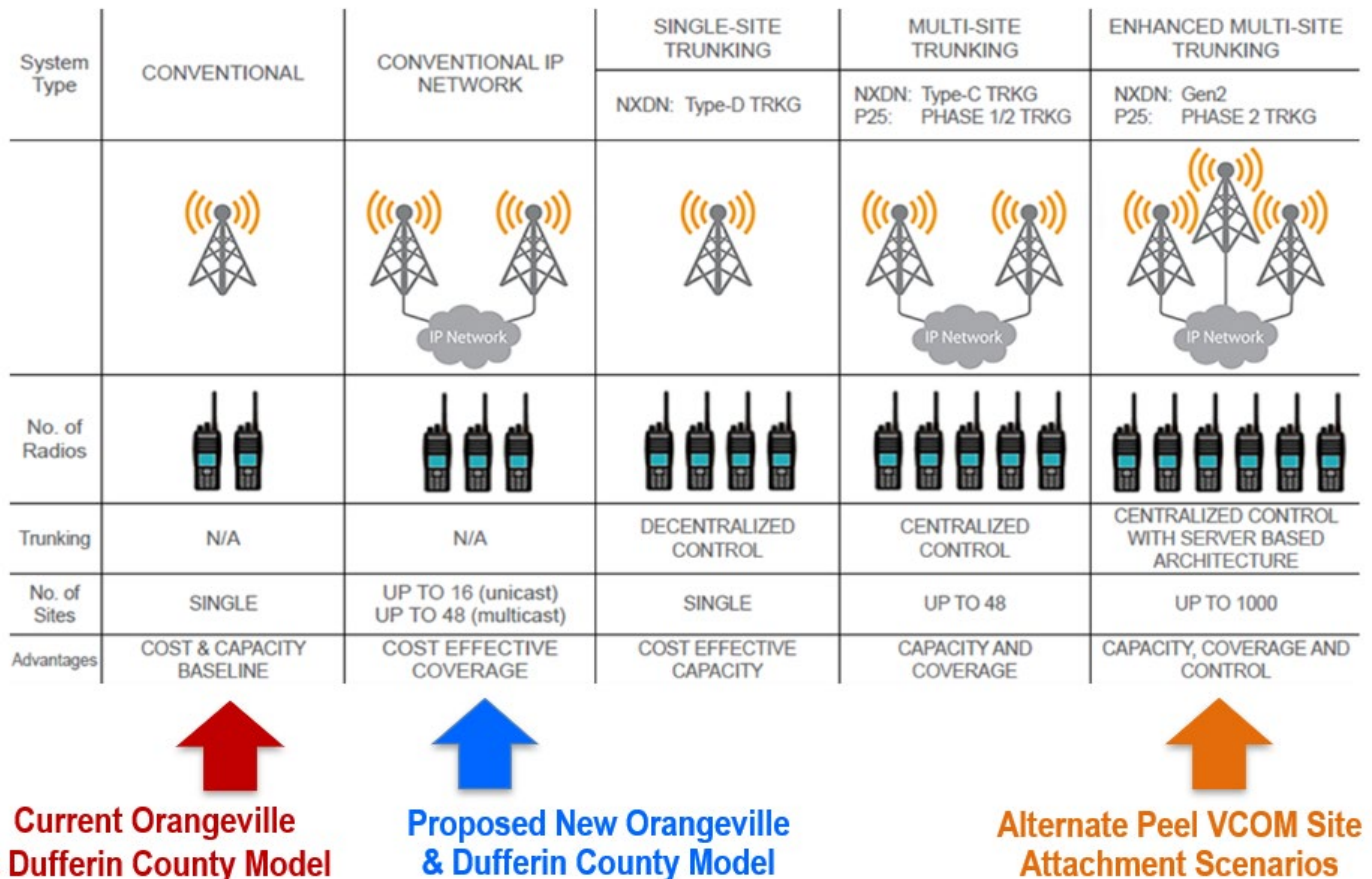


Figure 16 - High Level overview of the Conventional vs. Trunking technologies evaluated in the costing analysis.

Regarding LMR designs, consideration was made to duplicate or improve upon the current site constellation (i.e., going from 4 sites within Dufferin County to 5 sites) and in gaining synergies across sites. In the case of the Conventional scenarios studied, both

analog & digital P25 VHF conventional technologies were costed, with a blended price provided as an estimator in order to permit the Fire Chiefs the choice of analog vs. digital technology.

**Recommendation – A Digital P25 Conventional approach:** if Conventional technology is selected then a digital P25 conventional approach should be used for the LMR air-interface, with potentially with a P25 digital “simulcast” feature option for improved wide-area signal-strength if County budgets permit.

### 5.3 Hybrid Technology Overview - PSBN+LMR Model

The main architectural element of this scenario’s Hybrid solution is that it offers a Public Safety Broadband Network (PSBN) overlay using 700MHz reserved spectrum for Public Safety<sup>4</sup>, as a type of “Private 5G” network for First Responders on top of the baseline LMR coverage seen in the Conventional VHF system coverage described above.

A key benefit from the PSBN “Private 5G” model is that it provides the Town with a degree of tighter control on network standards for a net better system reliability plus with resiliency over the status quo’s separate single-site LMR systems.

On the wireless broadband side of the design, the Hybrid network approach, with both a layer of private broadband dedicated to First Responders, and multi-carrier priority roaming on commercial networks, provides several key advantages over the single-carrier cellular model seen today in Public Safety wireless broadband communications.

The inherent value of the PSBN overlay model is it provides the community with state-of-the-art 4G / 5G wireless access for First Responders for data and cellular voice communications - in a safe and secure manner - focusing on improving First Responder access in areas that today have poor or spotty data connectivity and data speeds. The value of PSBNs to First Responders has been extensively proven in successful and active PSBN systems in the USA (FirstNet) and other such networks being deployed around the world (e.g., South Korea’s SAFECOM, EU nations, Australia).

#### 5.3.1 PSBN Design - Complementary Data & Interoperability & Voice Resiliency

The PSBN layer provides the ability to offer First Responders new functionality which is absent from today’s communications posture:

- 1.) Private and Cybersecure data access for Tri-Services agencies (e.g., for maps, Cloud data access, patient records, video, building drawings, CAD, data apps and more).
- 2.) Ability to link in non-traditional users with First Responders for Community based response (e.g., utility workers de-energizing power lines in disasters, Social Workers assisting police in de-escalation actions, government officials, international first responders in major disasters)

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<sup>4</sup> Public Safety Canada - <https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/tnc0-en.aspx>





- 3.) An interoperability layer for First Responders arriving on-scene from neighbouring jurisdictions (e.g., in a hypothetical plane crash in Dufferin County, first responders convening on a site would overwhelm Conventional networks – PSBN and 700MHz would provide an interoperability layer for integrated communications)
- 4.) An additional layer of voice communications resiliency, to permit multi-band LMR user devices that operate in both Conventional mode + 700MHz PSBN LTE mode of communications, which allow for communications to transition between LMR VHF Conventional coverage where available, and in turn PSBN 700MHz coverage where available. In this manner the network coverage for First Responders becomes the aggregate of both VHF Conventional and PSBN coverage footprints.

### 5.3.2 PSBN Design – Mission Critical Push-to-Talk Feature (PTToC or MC-PTT)

An additional key feature and benefit of PSBN systems is the use of Push-to-Talk over Cellular (PTToC) or “Mission Critical Push-to-Talk” (MC-PTT) technologies to foster interoperability with First Responders and secondary supporting actors in emergency response (e.g., Critical Infrastructure, utilities, social work agencies, etc).

In the proposed design costs are included for PTT-over-cellular / MC-PTT services offered via a PSBN core hosting service (i.e. the Halton-Peel PSBN system in Ontario). MC-PTT services are typically a monthly operational service cost for end-user cell phones similar to an app-fee on Smart Phones.

The key benefit of MC-PTT services is the ability to bridge voice and data collaboration across both LMR and LTE / 5G systems, and other IP-based broadband networks.

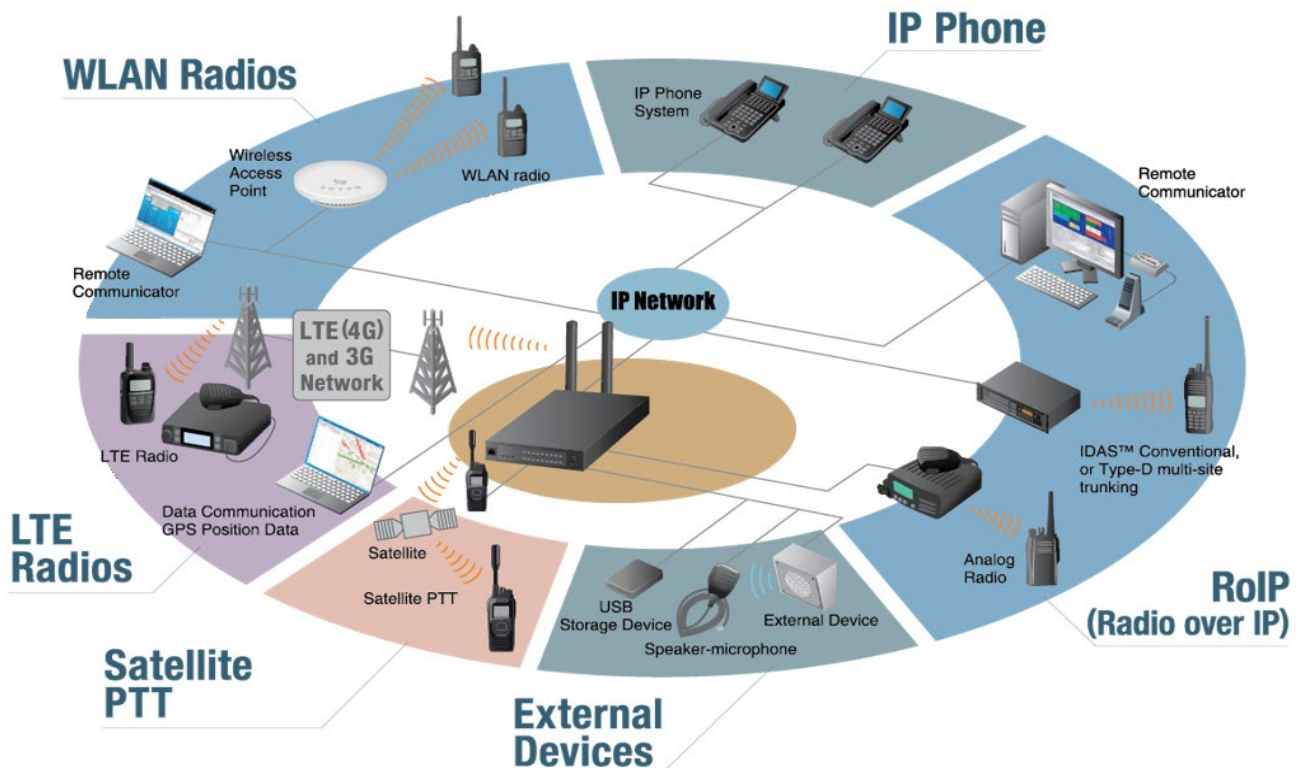


Figure 17 - Conceptual view of Mission-Critical PTT / Push-to-Talk-over-Broadband services across media.

### 5.3.3 PSBN Design – Multi-Carrier Roaming on Commercial Carriers

The PSBN Innovation Alliance<sup>5</sup> (PIA) Community Safety Broadband model for provincial PSBN operations in Ontario consists of a multi-carrier / “network of networks” approach to telecom core services. The distributed PSBN cores are run as a type of “Private 5G” neutral core service that permit open-access municipal RANs to “plug in” to a secure municipal shared core, which provides Public Safety with centralized orchestration of services, along with resilient and seamless roaming across multiple operators.

In the PIA “network of networks” PSBN model, a small distributed set of “neutral host” 5G network cores are used – potentially held in part or fully by the Government of Ontario ESTD division - and stack regional roaming access across both existing incumbent carriers (commercial network roaming) and new municipally held “Public Safety LTE” / 5G infrastructure (PSBN Private 5G Networks). These Private 5G PSBN municipal networks can be wholly owned by a municipality or deployed using a shared P3 business model with municipal lead on tendering of vendors and selection of partners to suit local needs.

Multiple commercial roaming agreements are under negotiation and to be struck between the Provincial neutral-host core entity (called Trillium in the PIA’s model) and multiple commercial carriers, permitting wholesale access and cost savings on data when roaming. A set of “Tier 1” roaming carriers will provide seamless call transitions in carrier transitions from PSBN 700MHz / Private 5G infrastructure and commercial service.

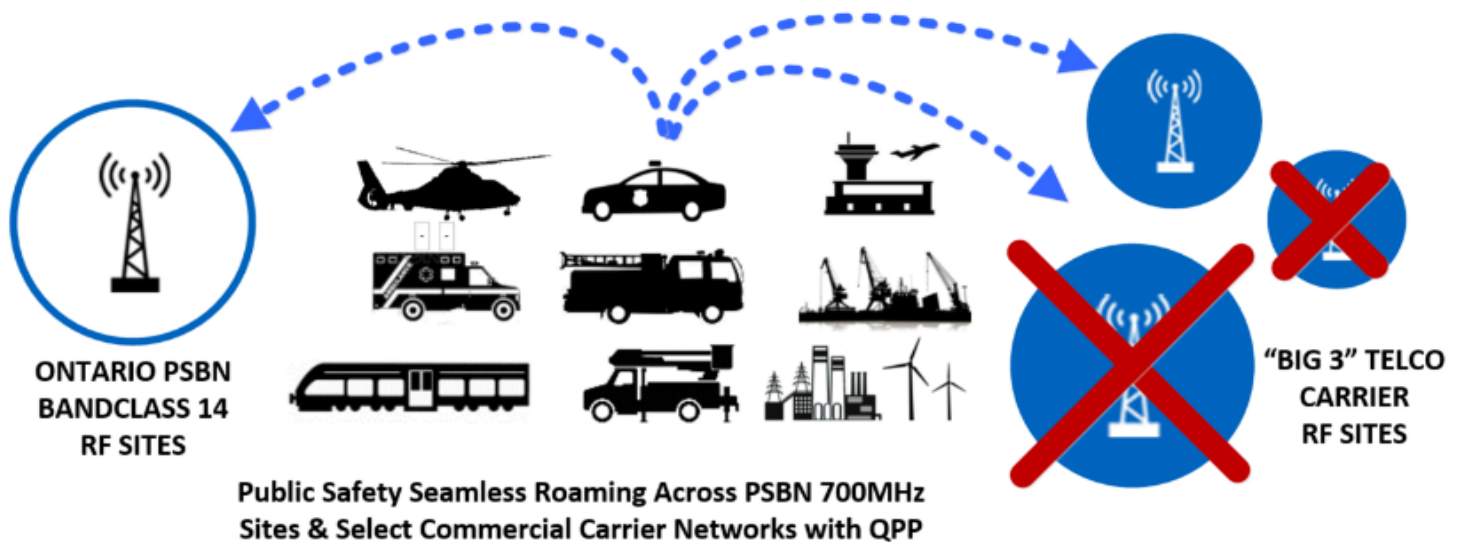


Figure 18 - Conceptual view of the value of the multi-carrier PSBN model proposed by the PIA.

An added key value of the PIA model for Ontario’s PSBN is that by stacking the network reliabilities of several broadband service providers within the PIA model (ie. across multiple commercial carrier roaming systems and PSBN wireless tower sites) – one obtains a net better reliability and resiliency in a given region than with the current status-quo single-carrier approach.

<sup>5</sup> PIA - <https://www.psbnnnovationalliance.ca/>

### 5.3.4 PSBN & LMR Design – RF Coverage

In this section an overview is provided of the Rough Order of Magnitude (ROM) RF coverage design conducted for this report. It is important to note a future round of RFP preparation will conduct a full and detailed RF coverage analysis and drive test to obtain an RF baseline for the region, as a follow-on to this feasibility report. Therefore a rough order of coverage estimation is provided here, based on heuristics for RF coverage for LMR and VHF Conventional system, in alignment with terrain elevations and geographic features.

#### 5.3.4.1 RF Site Selection Details

In relation to proposed site ERPs (Effective Radiated Power), radio base station power, line losses, tower site loading, antenna selection and simulcast phase delay optimization – all these design parameters will be worked on in the next phase of tender preparation and design refinement, after this exploratory design study.

The BCN team did not have access to RF sites nor project scope to complete RF site surveys and signal measurements, nor physical site civil and mechanical survey manuals of facilities for detailed site design – due to schedule, and the impact of the COVID-19 pandemic on site accessibility.

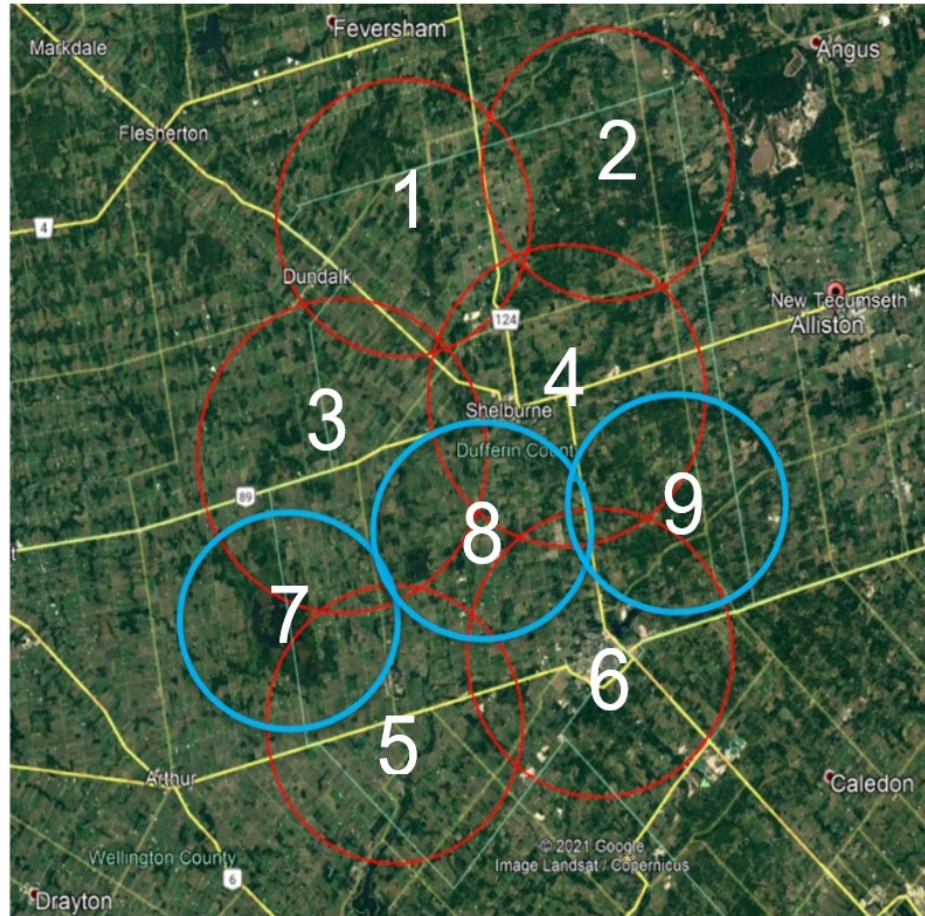


Figure 19 - ROM Coverage Design Map – Red Circles represent optimal Areas for a baseline VHF Conventional site

**Important Caveat & Note:** All design estimates are thus contingent on site surveys and verification to be conducted in the next phase of RF simulation prior to tender and via a region-wide RF signal measurement drive test, to determine a baseline RF profile for the region (no such existing information exists for any of the existing systems in Orangeville or Dufferin County.)

In the Dufferin County scenario studied, a key design synergy for Orangeville is that County sites in the South provide “bonus” RF additive coverage into the Town of Orangeville proper, thereby potentially saving a dedicated site for Orangeville. Through combining the VHF Conventional coverage of Areas #3, #4 and #5 in the above design map, a site can be saved for Orangeville, given the dual effect that these three sites have of providing both Dufferin County RF coverage as well as fill-in coverage into the Town of

Orangeville. The blue circles denoting coverage Areas #7, #8 and #9 in the design maps, are for possible PSBN / Private 5G fill-in coverage sites to account for officially projected future population growth areas in Orangeville and County.

#### 5.3.4.2 Coverage Support for Hospital & Key Buildings

Both VHF Conventional and PSBN radio system frequencies be included in In-Building Distributed Antenna Systems (DAS) to ensure coverage in key public facilities, and should be mandated in municipal building codes.

During the stakeholder engagement discussions held in the course of preparing this report, it was noted that the main Hospital for the Town of Orangeville (and also the County), the Headwaters Hospital facility, has poor to non-existent LMR coverage in various lower level areas, whereas cellular access is perfect throughout the building.

The Headwaters Hospital issue should be verified during the RF coverage drive test and RF coverage prediction work, to be conducted in the next phase of tender preparations. A general solution that would guarantee in-building coverage in public buildings is to include the pertinent RF frequencies in the In-Building DAS which repeats RF signals from the outside to all-corners of the given building.

**Recommendation - Hospital In-Building DAS Upgrade:** In the case of the hospital, based on stakeholder anecdotes of excellent in-building cellular coverage in the facility, it is likely a DAS within the hospital that is providing commercial cellular frequency signal boost in the building. Therefore, the RF filtering and DAS equipment need to be verified in the RF survey phase and a new DAS filtering and signal booster procured as part of the project (or by the Hospital) to account for both new 700MHz PSBN RF spectrum signals and future VHF Conventional Channels for the new LMR system. In this way, future PSBN & LMR frequencies will be propagated to every corner of the hospital.

This concept of requiring DAS signal boosting in the Hospital can also be extended to all public facilities or risk-prone locations in the Town (and County). In fact there is a trend in North America related to recent Fire Code reviews, whereby municipal bylaws are being amended to include requirements for In-Building DAS repeat of Public Safety RF bands in all buildings above a certain size (e.g., high-rise condominiums, arenas, hospitals and large public healthcare facilities, universities, schools, shopping centers, etc.)

**Recommendation - Municipal By-Law Initiative for Public Buildings:** the Town consider mandating new municipal bylaws for public safety communications in exactly the above manner and in alignment with PIA PSBN standards, and new NFPA guidelines for Fire communications in buildings as well. In this way all new facilities built in Orangeville (and the County) over the next generation will include lifesaving access to communications for First Responders.

### 5.3.5 PSBN & LMR Design – Block Diagrams

The following pages provide system block diagrams and maps as a high level overview of the proposed sites, systems and interconnected links between system elements.



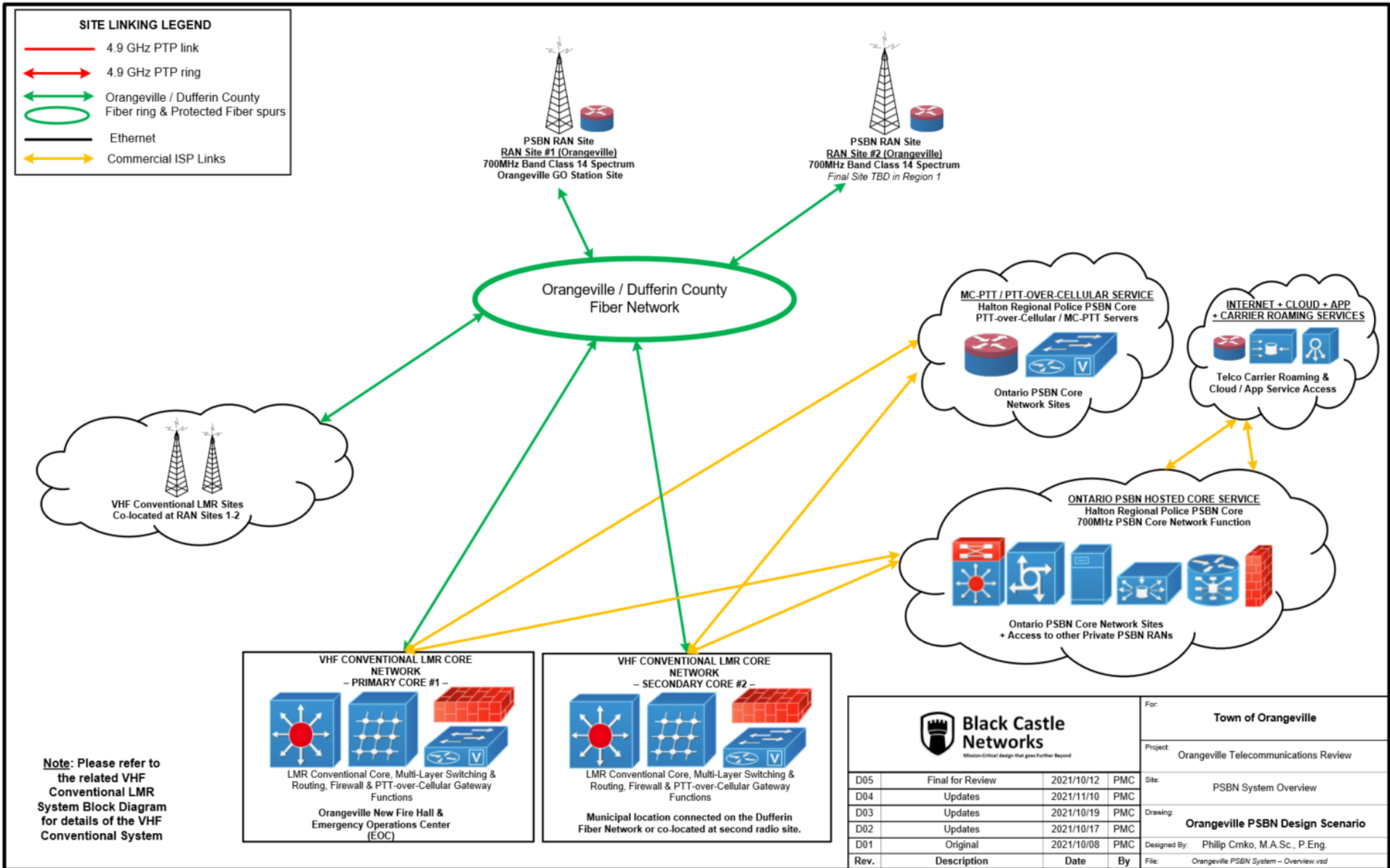


Figure 20 – PSBN System Block Diagram – Orangeville-only PSBN design with linkages to PSBN Core Hosting Services, MC-PTT Hosting Services, and LMR System connections.

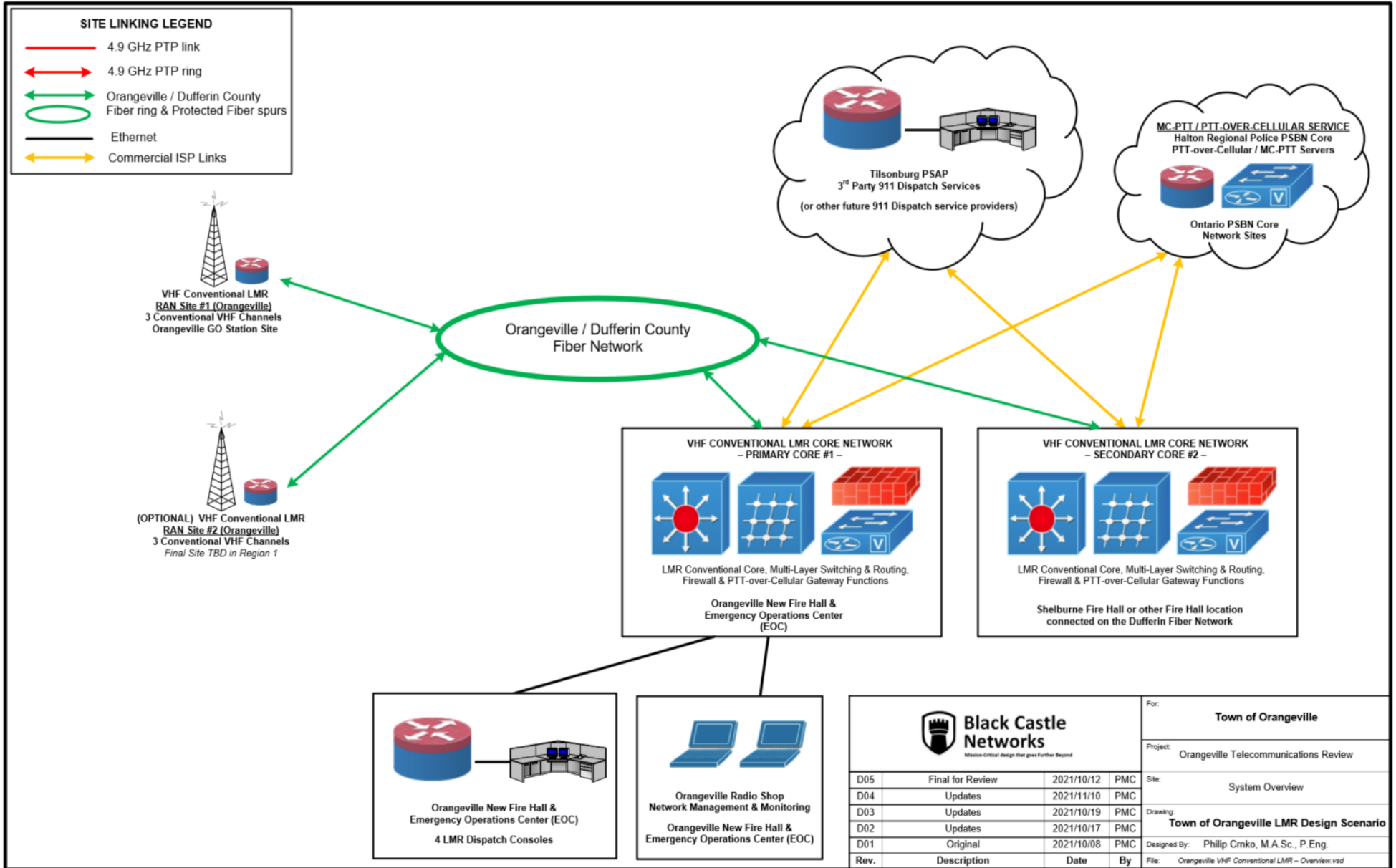


Figure 21 – PSBN System Block Diagram – Orangeville-only Conventional LMR design with linkages to MC-PTT Hosting Services, and PSBN System connections.



Figure 22 – ROM Coverage Design Map – Red Circles represent 39 optimal locations for a baseline VHF Conventional site constellation and PSBN RF equipment co-located at those sites. Cyan circles represent “fill-in” coverage sites for just 700MHz PSBN spectrum. Site 2 and Site 8 are proposed in the design (see full report for details).

## 6 DELIVERABILITY & OPERATIONS CASE – OVERVIEW

This section provides an overview of the project delivery considerations for an LMR and wireless Private 5G network deployments, plus a summary project delivery schedule and GANTT chart for a possible PSBN & LMR project. In addition, potential project risks are identified and an overall risk posture along with possible risk mitigation steps for the Town to consider. Refer to the full report for a complete treatment of the delivery options and in-depth risk analysis.

### 6.1 Deliverability & Operations Risks - Overview

The PSBN business model and business case has a relatively low risk related to delivery and operations risks, and on-par with other examples of highly profitable and successful wireless broadband regional system deployments in Canada and around the world.

Table 2 - Orangeville Deliverability & Operations Case Summary – Evaluation by Option

Element	Town of Orangeville PSBN Private Scenario	Dufferin County PSBN Neutral Host Scenario	Dufferin County PSBN Private Scenario	Business as Usual Scenario Telco Services
<b>Deliverability &amp; Operations Case – Evaluation by Option</b>				
Deliverability	High probability of success with proven DBFM model	High probability of success with proven DBFM model	High probability of success with proven DBFM model	No actions – No deliverability risk
Operations	High probability of success with proven DBFM model	High probability of success with proven DBFM model	High probability of success with proven DBFM model	No actions – No risk
Maintenance	High probability of success with proven DBFM model	High probability of success with proven DBFM model	High probability of success with proven DBFM model	No actions – No risk
Risk Posture	<b>Low</b> – see following section on Risk for details. Primary risks are related to final CRTC wholesale pricing levels, and % residential uptake of 5G services. However, mitigation steps are available for primary risks, and early signs on 5G uptake and market demand per public reports from US and international telcos. <sup>6,7,8</sup>	<b>Low</b> –Same rationale as for the Dufferin County Private 5G scenario at left.	<b>Low</b> –Same rationale as for the Dufferin County Private 5G scenario at left.	No actions – No risk

<sup>6</sup> Telecoms.com - <https://telecoms.com/501060/global-5g-uptake-wont-start-to-really-ramp-until-2021-ericsson/>

<sup>7</sup> CNDUFFERIN COUNTY - <https://www.cnDufferinCounty.com/2019/11/25/5g-will-span-two-thirds-of-global-population-in-6-years-ericsson-says.html>

<sup>8</sup> ZDNet - <https://www.zdnet.com/article/why-the-next-iphone-will-be-the-unofficial-start-to-5g/>





## 6.2 Risks Related to CRTC & Federal ISED Spectrum Regulatory Matters

In turn, beyond delivery risks, there is an additional risk related to the final spectrum Conditions of License (CoL), as set by the Ministry of Industry, Science and Economic Development (ISED) as a step in finalizing access rules for spectrum in Canada.

In summary, Public Safety Canada has completed its final recommendations and final report for PSBN spectrum policy, via the “Temporary National Co5rdination Office” (TNCO) in favour of a Model aligned exactly with the tenets of the PIA’s PSBN model, and the model discussed in this report. ISED is next slated to take that report and proceed with a final public consultation on the RF band in the first half of 2022, for final CoL.

There is therefore a risk related to spectrum allocation rights for municipalities if ISED were to veer away from the recommended course of action per the TNCO’s final report on the dossier.

- **Risk Evaluation:** Moderate (5 /10 relative estimated score)

- **Mitigation Possibilities:** A mitigation approach would be for Orangeville to participate with the Association of Municipalities Ontario (AMO) and like-minded municipalities in the Greater Toronto-Hamilton Area (GTHA) in lobbying to the CRTC and ISED as related to Smart City initiatives (e.g. via submissions to CRTC & ISED public consultations on the spectrum) and reaching out to government representatives for meetings on the value of PSBN policy to Canada’s municipalities and provinces.

One avenue already in existence for this lobbying is the PSBN Innovation Alliance (PIA), a not-for-profit association focused on Public Safety and municipal needs in the telecom arena. The Halton and Peel Regional Police Services are members, along with a number of other major agencies and municipalities (e.g. Toronto Police, City of Mississauga, Ontario Association of Chiefs of Police, Ontario Association of Fire Chiefs, and many more) and is rapidly growing in membership and stature. The PIA is advocating for both Public Safety policy needs and the option for municipalities to leverage PSBN spectrum assignments to enable local Smart City networks.

## 6.3 PSBN & LMR Technology Deployment Timeframe

The preliminary GANTT chart on the following page provides a chronology of a potential RFP Tendering, Contracting and Deployment timeline with phases for an Orangeville telecommunications deployment. Note that the starting date can be shifted out from 2022 into 2023 or 2024, (a delay of N-many months) without significant impact to the overall business case rationale and profitability / opportunity outlined in this report.



**TOWN OF ORANGEVILLE / DUFFERIN COUNTY - POTENTIAL PROJECT TIMELINE FOR PSBN & LMR SYSTEM DEPLOYMENT**

TASKS	2022												2023												2024					
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
RFP	Finalization of Business Model - Final Detailed Costing	█	█	█	█																									
	Municipal Tender or RFP (or) Solicitation of Investor-Partners					█	█	█	█																					
	Preliminary Legal Work - Draft Framework Agreement with Municipality		█	█	█	█	█																							
	Negotiations with Partners / RFP Winners									█	█	█	█																	
	Final Contract Design Agreement & Corporate Financing										█	█	█																	
CONTRACTS	Setup of Program Joint Steering Committee + "HoldCo" for Municipal PSBN										█	█																		
	Joint Engineering & Design Team Named (P3 Municipal Partnership Approach)											█	█	█																
	Final Network Engineering RF / Capacity / Network Design Work										█	█	█	█																
	Signing of initial Partnership / Investment Agreements											█	█	█																
	Initial Contract Payments (Negotiable)												█	█																
SETUP	Signing of MNO / MVNO Roaming Contracts - Initial Year 1 MNOs & Anchor MNO											█	█	█																
	Finalization of ISED Spectrum Licensing / Regulatory + CRTC MNO Certification				█	█	█	█	█	█	█	█	█	█	█															
	Final Tower Surveys by Rigger / Civil Surveys of Sites														█	█	█	█												
	Civil Engineering Permitting and Safety Code 6 / RF Coverage															█	█	█	█											
	Setup of other MNO / MVNO Service Contracts																█	█	█	█										
	Potential / Optional New Tower Design & Deployment																													
INSTALL	Infrastructure Equipment Order																													
	Manufacture / Staging / Shipping / Receiving																													
	Installation & Setup of Headquarters NOC @ Orangeville EOC Facility																													
	Installation of PSBN 5G RAN Sites - Tower Deployments & Fiber Deployment																													
EA	Commissioning & Start-Up of Anchor MNO - MOCN / MORAN integration at PSBN Core																													
	Field Coverage Tests & Verification of Field Results vs. Coverage Prediction Maps																													
	Start-Up of Early Access (EA) Services for Pilot Market Tests / Rural Roaming Tests																													
	Start-Up of Integration work for PSBN Core (Halton Police)																													
GA	Start-Up of Integration work for PSBN Applications (e.g., PTTtoC)																													
	General Access (GA) Operations for all PSBN Users																													
	General Access (GA) Operations for all Rural / Carrier Partner 5G Roaming Customers																													

Figure 23 - GANTT chart summary of the RFP and Contracting phases of the project. Start of project can shift from 2022 into 2023 with limited or minor impact to profitability and cost structures within this report.

## 7 THE CASE FOR CHANGE – OVERVIEW

### 7.1.1 Problem and Opportunity Statement

Assuring the continuity of operations and disaster preparedness of telecommunications services for residents is an important municipal task and is related to maintaining the Community Safety and Wellbeing of Towns and Cities across Canada.

In reviewing the wireless communications posture of the Town of Orangeville there are faced with four main motivating factors or thematic issues prompting a case for change:

- 911 Emergency Responders Need Reliable & Resilient Voice & Data Services
- Orangeville Residents Need Reliable Access to 911 Voice & Data Service
- Chronic Orangeville 911 Interoperability Problems with Neighbouring Communities
- High Cost of Telecom Services in Canada and Exploding Data Usage

Below is a brief elaboration on each of these driving factors:

1. 911 Emergency Responders Need Reliable & Resilient Voice & Data Services  
Emergency 911 field operations rely on continuous and reliable access to wireless voice and data services in their lifesaving services to society, as a key efficiency tool, but also to remain safe in their day-to-day work.  
  
Data has become as important as voice to effective and efficient emergency response by Fire, Police and EMS, and secondary responders such as electric utilities, transit, and other critical infrastructure entities. There is also a new emphasis on better integrating social work agencies, healthcare and mental-health organizations that support new emergency response / de-escalation paradigms in 911 operations.
2. Orangeville Residents Need Reliable Access to 911 Data & Voice Service  
Wireless access to 911 calling is a key and growing part of how Canadians engage 911 emergency services dispatchers, and in the near term will be augmented with new Next Generation 9-1-1 services (NG-9-1-1) that will permit both voice & data communications to emergency services personnel.
3. Chronic Orangeville 911 Interoperability Problems with Neighbouring Communities  
Currently the Town of Orangeville is faced with a further generational decision in upgrade or replacement of current Emergency Services LMR wireless technology for First Responders, due to serious performance issues in the current Land Mobile Radio (LMR) system, and chronic problems related to LMR device interoperability with neighbouring jurisdictions.

These LMR interoperability issues with neighbouring Towns impact the ability for Orangeville First Responders to receive, and give assistance in the event of



disasters or emergencies impacting the disaster preparedness of the Town, thereby posing a risk to Town residents. A PSBN would provide both an interoperability layer for mutual-aid voice communications in disasters, and a complementary assured data-services layer alongside an upgraded Conventional LMR system.

4. High Cost of Wireless Telecom Services in Canada and Exploding Data Usage  
Wireless broadband data use for First Responders, municipal government and society in general is widely projected to explode in the coming decade. Coupled with Canada's position as one of the highest-cost jurisdictions in the world for wireless telecommunication, municipal data costs for 911 emergency services, , and for residents will in turn skyrocket.

This high cost regime for telecommunication in Canada is a double economic hit to residents of Orangeville and all Canadians. First in terms of residents' high and growing cost on their cellular phone bills, and secondly through increased taxes to pay for municipal staff and emergency services to use those same high-cost services.

From an economic efficiency theory stance, the high cost telecommunication model in Canada provides an opportunity for market alternatives to improve efficiency and thereby reduce costs for residents and in turn improve access to services. Indeed, there are technology based alternatives which can facilitate cost reductions – relating to Private 5G municipal services – which have been proven and de-risked from a technology stance in successful international deployments.

In this regard, deploying a PSBN would provide the Town (and County) with a “bonus” monetization opportunity, permitting re-sale of excess 700MHz PSBN spectrum when un-used to major carriers for user roaming / 5G Network Slicing, to provide extra wireless broadband capacity to customers. Thereby, further improving cost recovery for Orangeville's PSBN system + improving community access to 5G also, and in turn mitigation of some of the high cost of telecom for residents.

## 7.1.2 Continuity of 911 Emergency Services Communications

From the stance of Public Safety wireless telecommunications for the Town of Orangeville, there are several areas of interest in generational emergency communications planning for the next 15 to 20 years which BCN's proposals help address:

- Adequate wireless voice & data coverage and capacity for Tri-Services First Responders and secondary emergency responders (e.g., utilities, social work agencies, elderly health facilities), for both day-to-day and emergency / mass-event incidents. The Hybrid PSBN & LMR technology also provides extra capacity & backup for LMR.
- Adequate ability to support new mandated mobile data-oriented applications such as Next Gen 9-1-1 for required wireless data flows to Emergency



Responders in the field given new media and data needs (e.g., NG-9-1-1 data, SMS text, Body Worn Camera video, Zoom video calling, and much more).

- Adequate civilian 911 access for telecom surges during disaster scenarios.

## 7.2 International precedent cases and reference deployments:

In terms of recent precedent cases considered which align to the recommendations of this report, and as consideration we note that Private 5G networks are a fast growing trend in telecom markets around the world. We describe the following key benchmark cases for the Town of Orangeville, in the Appendix section of this report:

- Barcelona, Spain<sup>9</sup>
- Bristol, UK<sup>63</sup>
- Lucca, Italy<sup>63</sup>
- Aberdeen, UK<sup>10</sup>
- Dublin, Ireland<sup>11</sup>
- London, UK<sup>12,13</sup>
- Paris, France<sup>14</sup>
- Lisbon, Portugal<sup>15</sup>
- Sunderland, UK<sup>16</sup>
- Cascais, Portugal<sup>68</sup>
- Liverpool, UK<sup>17</sup>
- Tucson, Arizona, USA
- Auckland, New Zealand<sup>18</sup>
- Halton Region & Peel Region, Ontario

## 7.3 Conclusions

In conclusion, the current state of Orangeville LMR interoperability and compatibility of 911 communications technology among emergency response stakeholders is in a serious & concerning state. Prompt short & long term actions have been recommended in this extended summary report.

This report evaluated the stakeholder needs, evaluated the current state of the LMR and wireless broadband systems used in Orangeville (and in Dufferin County), and provided a positive business case related to deployment of a municipal PSBN, as:

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<sup>9</sup> Accelleran - <https://www.acceleran.com/5gcitydrax/>

<sup>10</sup> Commscope - <https://www.commscope.com/blog/2017/city-of-aberdeen-paves-the-way-for-5g/>

<sup>11</sup> Enterprise IOT Insights - <https://enterpriseiotinsights.com/20200806/channels/news/ireland-looks-to-put-cities-in-charge-of-coordinated-neutral-host-5g>

<sup>12</sup> CCSL - <https://www.ccsl.com/v1/uploads/files/CCS-City-of-London-Case-Study.pdf>

<sup>13</sup> TechUK - <https://www.techuk.org/insights/opinions/item/13533-is-neutral-host-infrastructure-the-way-forward>

<sup>14</sup> Ericsson - [https://www.ericsson.com/en/news/2020/7/ericsson-private-network-to-serve-paris-airports-2?utm\\_expId=aF\\_zZyrDR\\_iQu2NKcDj6jq.1&utm\\_referrer=https%3A%2F%2Fwww.google.com%2F](https://www.ericsson.com/en/news/2020/7/ericsson-private-network-to-serve-paris-airports-2?utm_expId=aF_zZyrDR_iQu2NKcDj6jq.1&utm_referrer=https%3A%2F%2Fwww.google.com%2F)

<sup>15</sup> Enterprise IOT Insights - <https://enterpriseiotinsights.com/20190930/channels/news/dense-air-to-build-neutral-host-5g-smart-city-network-in-portugal>

<sup>16</sup> Mobile Europe - <https://mobileeurope.co.uk/press-wire/14582-sunderland-to-become-a-neutral-host-5g-city>

<sup>17</sup> Enterprise IOT Insights - <https://enterpriseiotinsights.com/20200811/channels/fundamentals/all-about-liverpools-smart-city-5g-win>

<sup>18</sup> The Indian Sun - <https://www.theindiansun.com.au/2020/06/29/dense-air-partners-with-spark-to-enhance-mobile-broadband-services-in-new-zealand/>



- a back-up network for LMR system resiliency, plus
- extra voice communications capacity for 911 calls, plus
- as a data enhancement for 911 actors in the Town, plus
- as an enhancement for critical infrastructure Cybersecurity, plus
- a municipal cost savings approach to growing data usage and high telecom costs.

The recommendation to deploy a PSBN also provides new lifesaving tools for both current Tri-Services 911 responders, and those new de-escalation / social services agencies that cannot use bulky legacy “walkie talkie” systems, but that will nevertheless become more and more a part of future emergency response in North America.

The proposed “Cap and Grow” strategy to technology upgrade for the Town and County is the most cost effective of all models, reduces liability and risks for the Town, and provides spectrum monetization revenue as an option.



# II. COUNTY-WIDE SCENARIO

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## 8 DESIGN OPTION – EXPANSION TO HOST COUNTY-WIDE AGENCIES

In this section, a design variant is provided for consideration by the Town of Orangeville and in turn by the County, for a holistic Dufferin County-Wide LMR network and associated PSBN overlay network, which would provide substantial additional value to the Town of Orangeville and also to all regional stakeholders.

The additional value provided would include both significantly improved interoperability across all stakeholders, and in better mutual aid among 911 Emergency Responders across municipal borders during disasters or larger 911 events, and from a stance of improving overall RF coverage for First Responders in 911 operations across the County.

### 8.1 **Advantages to proceeding with a County-Wide LMR+LTE Design**

There are substantial benefits to the Town of Orangeville in considering participating in a fully County-Wide solution to upgrade the current LMR system, and in turn deploy a PSBN overlay in alliance with Dufferin County's other municipalities.

We provide a summary of some of the key advantages below that a County approach is better for the Town, than an "Orangeville-only" design scenario:

1. Shared costs on LMR Conventional core and PSBN backhaul translate into cost savings for the Town of Orangeville. Shared cost synergies extend to other facets of common equipment sparing strategies, user device spares, and economies of scale on tendered procurement of wholesale quantities of devices and infrastructure.
2. Substantially improved interoperability in the event of disasters and 911 emergencies that straddle municipal boundaries, and in cases of large fires or disasters in Orangeville where Dufferin County firefighters are coming to assist the Town's 911 response.
3. Substantially improved personal safety for Orangeville Firefighters having to assist Dufferin County in mutual-aid situations where Orangeville staff are assisting in fighting a fire in Northern communities in the County.
4. Coverage synergies between southern Dufferin County RF sites and Orangeville territory, which means "free coverage" that effectively spills over from Dufferin sites, thereby improving overall RF coverage. In simulcast designs for LMR there is a similar synergistic advantage with including Dufferin Sites alongside Orangeville. The result is effectively a site savings for the Town in the Dufferin County case over alternative scenarios with only Orangeville.

#### 8.1.1 **"All-at-Once" County-Wide Deployment Approach**

An up-front merger or combination of the design into a Dufferin County design, rather than a phased approach is recommended. An up-front or "all-at-once" design permits gaining synergies on cost, design and helps guarantee site acquisition, and helps avoid any interface issues or capacity / sizing problems that a phased approach faces, which we elaborate on in the next section.





## 8.1.2 “Phased” County-wide Deployment Approach

The phased approach scenario begins where the Town of Orangeville proceeds first with a Hybrid Model LMR+LTE deployment, and is followed later by County-Wide agencies. In this way, the Town could proceed first and the County “catch-up” later as a hosted entity on an Orangeville core, or via a shared-cost business approach.

However this phasing of an Orangeville build first, is not ideal from a costing stance, nor from a design stance and creates new interface, infrastructure versioning, and procurement risks when attaching Dufferin County sites later. The following are concerns with this County-wide phased in approach:

- In this phased approach, the Town of Orangeville could proceed first – where elements of backhaul capacity could be “pre-seeded” with capacity needs for the County – and with a similar “pre-seeding” in terms of core capacity, LMR features and such items. However a negative aspect of this phased approach is that it would ultimately burden the front end costs of the project on the Town of Orangeville.
- From a Simulcast phasing approach, RF filtering and a number of other system configuration parameters upgrading the entire County at once would save on later “re-work” to reconfigure the Town’s radios for new sites that would be added later.
- Any desired radio tower sites and optimal tower-top antenna placement slots for Dufferin County LMR or PSBN equipment that are identified up-front when the system is designed, could be lost to competing carrier clients if there is a delay of several years between Orangeville’s initial deployment - and a Dufferin County add-on scenario.
- A “phased” approach adds a degree of duplicate pre-work for design, as the coverage, network and design specifications for the final County-wide design would need to be undertaken up-front in the “first phase” in any tenders that the Town of Orangeville decided to conduct on its own, to ensure capacity needs are met. Then a second round of design work incurs further cost for Dufferin County to re-verify parameters, years later, prior to tender of the “second phase” deployment for the County. This re-work would include a number of design estimates and site surveys of locations in Dufferin to ensure capacity and features / ordering / etc. / potential simulcast sites would be accounted for when the County eventually joined onto the Orangeville base deployment.

In spite of these concerns, it is important to note that a phased “pre-seeding” design could indeed be completed. However, for all the above reasons, and the benefits due to shared costs and overall solving of current interoperability problems it is strongly recommended that the design of all County sites and infrastructure be prepared up-front at the same time as the preparations and design of the Orangeville-only system, to ensure no elements are “lost between the cracks” when the County joins.



Therefore, it is strongly recommended the County-Wide scenario be selected, to permit the County as a whole to proceed as a single unit – all at once – in order to unlock the design and cost synergies in terms of mutually enhanced RF coverage, and for appropriately harmonizing on features, capacity and interoperability. By considering a County-wide approach the Town can also strategically avoid a repeat of the current patchwork of LMR systems and interfaces that are unfortunately incompatible at present.

## 8.2 Proposed County-Wide Long-Term Strategy & Next Step Actions

The following summary provides a view to the main differences between this County-Wide scenario and the main Town of Orangeville scenario described above in this report.

### 8.2.1 Technology Strategy – Infrastructure

The proposed County-Wide strategy consists of two technology concepts combined into a common Hybrid LMR+LTE solution design just as in the Town of Orangeville design above, for unified voice & data communications and improved interoperability:

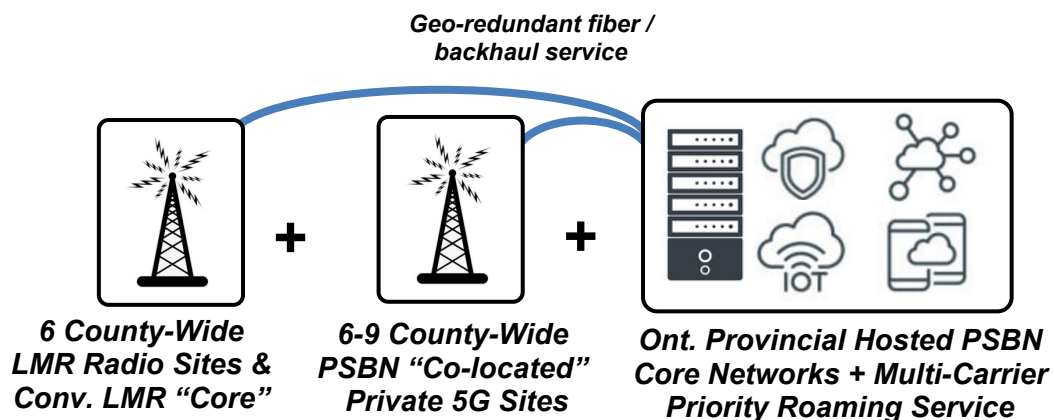


Figure 24 - High Level Conceptual view of the County-Wide scenario Hybrid Model LMR+LTE system infrastructure / key elements.

### 8.2.2 Technology Strategy – Hybrid LMR & LTE User Devices

In terms of user devices – as in the Town of Orangeville scenario described earlier in this report, the proposed project would use existing County-Wide agency device replacement budgets to procure replacement / upgraded devices that would work on both LMR & LTE networks. Please refer to our full report for added details on LMR & LTE Hybrid devices and the FirstNet ecosystem of PSBN devices.

## 8.3 County-Wide Scenario – Financial Case – Overview

### 8.3.1 Cost Summary – County-Wide LMR Scenario – Infrastructure Only

The following summary table provide an evaluation of the CAPEX (capital expenditures) and OPEX (operational expenditures) for the various key LMR scenarios discussed in the solution generation work. A 15 year timespan was used with a 7% NPV (Net Present Value) used for inflation and investment margin, and with the caveats and case notes described in the Economic Case (please refer to the accompanying full report for details on all the financial methodologies and parameters used).

As can be noted, the most economical scenario based on raw financial costs over the 15 year operational period were the Conventional family of LMR scenarios.

#### Infrastructure

##### K Core Scenario (Digital or Analog Conventional LMR)

	CAPEX Grand Total	OPEX 15yr Grand Total	TOTAL (CAPEX + OPEX 15 yr)
LIST	\$808,018.00	\$1,082,000.00	\$1,890,018.00
Est. DISCOUNT (20%)	\$686,414.40	\$662,000.00	\$1,348,414.40

Figure 25 – Summary of the “winning” lowest cost scenario for a Dufferin County-Wide Conventional LMR core network with six LMR sites providing coverage over the service area.

### 8.3.2 Cost Summary – County-Wide PSBN Scenario – Infrastructure Only

The following summary tables provide an evaluation of the CAPEX (capital expenditures) and OPEX (operational expenditures) for the various PSBN scenarios discussed. A 15 year timespan was used with a 7% NPV (Net Present Value) used for inflation and investment margin, and with the caveats and case notes described in the Economic Case (refer to the following section for details on the financial methodologies used).

As noted in our full report, the most economical scenario based on raw financial costs over the 15 year operational period is the Peel-Halton PSBN Hosted Core / Attachment scenario, where the Town would connect to a neutral-host core network located at Halton Regional Police facilities, as part of an overall Provincially hosted core network.

#### Infrastructure

##### PSBN Halton-Peel Scenario (PIA / Ontario PSBN Open Core Concept w. 4G/5G Wireless RAN)

	CAPEX Grand Total	OPEX 15yr Grand Total	TOTAL (CAPEX + OPEX 15 yr)
LIST	\$1,132,300.00	\$3,037,500.00	\$4,169,800.00
Est. DISCOUNT (20%)	\$945,840.00	\$3,037,500.00	\$3,983,340.00

Figure 26 – Summary of the “winning” lowest cost scenario for a Dufferin County-Wide PSBN system with between 6 to 9 PSBN radio sites providing coverage over the Town’s service area.



## 8.4 County-Wide Scenario – Economic Case - Overview

The need to remedy the existing serious and chronic problems with the Town and County’s LMR systems is a matter of critical liability and Public Safety need, and is understood to be a necessary and justified investment from the stance of being able to provide essential 911 municipal service. The LMR investment justification is therefore excluded from the following summary economic narrative which focuses on the incremental cost justification for a PSBN overlay on top of a remediated LMR system.

The PSBN 5G Business Model is a moderate initial capital investment for the County (approx. \$945K for a 100% stake, and options for smaller shares in P3 scenarios) but with substantial benefits to the business climate, to Community Safety & Wellbeing, and overall County telecom quality in support of up-coming Next Gen 911 services. The analysis included in this Economic Case illustrates how the project’s benefits exceed costs.

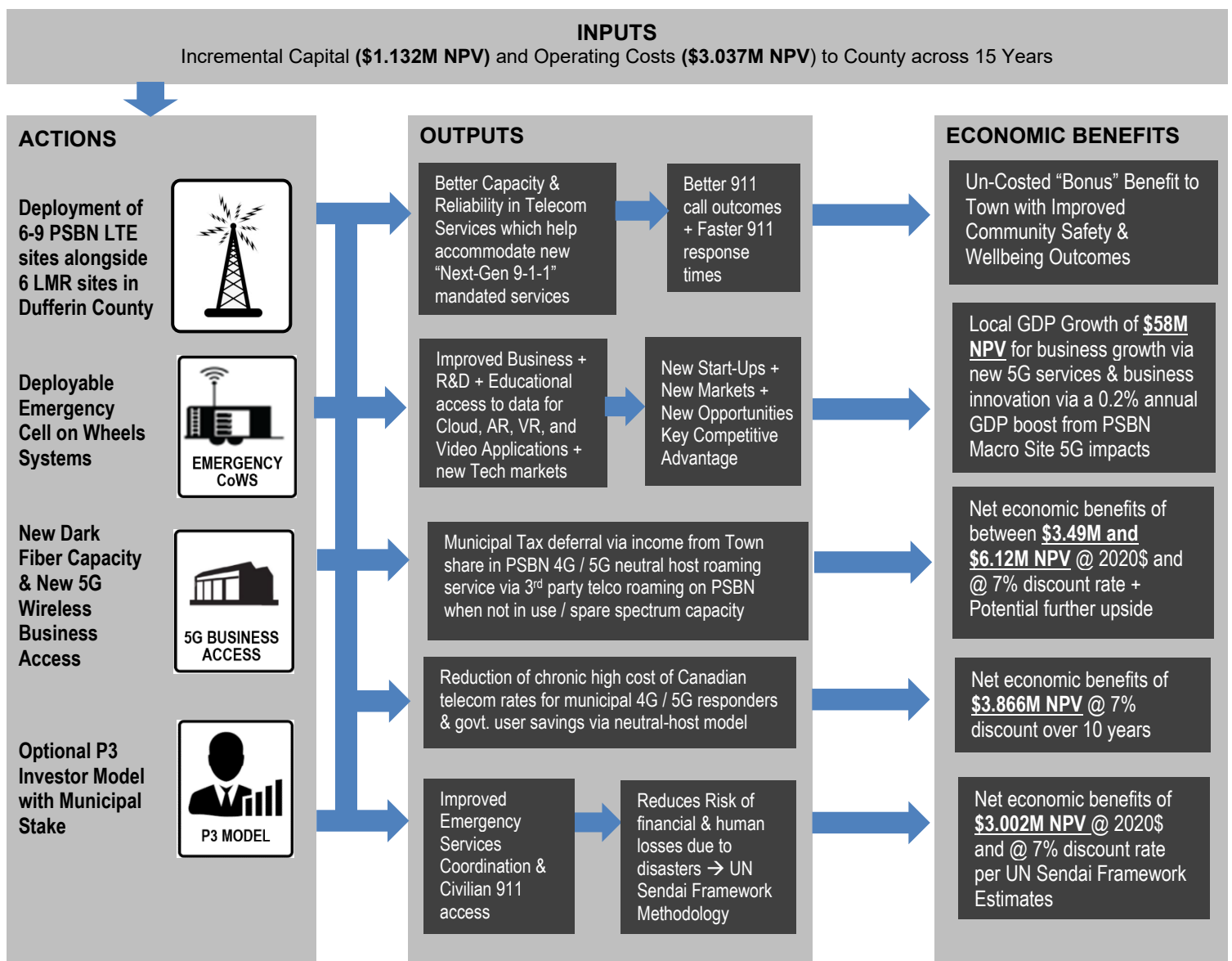


Figure 27 – Summary Economic Case – Overview of Key Inputs, Actions, Outputs and accrued benefits.

The Economic Case and Benefit-Cost Ratio for a number of project scenarios were calculated and found to all be above a ratio of 1.0, which is the threshold for a positive decision. Conservative estimates of costs and gains were used throughout the model.

In summary, a Benefit-Cost Ratio score of 2.027 was obtained for the Dufferin County Private PSBN scenario, and 2.866 for the Dufferin County Neutral Host Scenario.

Therefore, the proposed scenarios are viable from a municipal investment stance given a 7% IRR for investments used, obtaining a healthy buffer margin above the 1.0 Benefit-Cost Ratio decision threshold. Results for the Town of Orangeville scenarios are provided in the following table – as noted above earlier in this report.

## **8.5 County-Wide Scenario – Schedule & Timeline**

In terms of schedule for a County-Wide scenario tender and deployment, the rough order timelines and GANTT charts provided earlier for the Town of Orangeville scenario would be more-or-less similar to the County-Wide timings for deployment and operations. Please refer to the above Town of Orangeville material for the approximate schedule for this County-Wide scenario.

## **8.6 County-Wide Scenario – Financial Case Summary & Block Diagrams**

The following pages provide the summary table of financial benefits for the scenarios considered, along with system block diagrams and maps as a high level overview of the proposed sites, systems and interconnected links between system elements for the County-Wide scenario.

Please refer to our accompanying full report document for additional design, costing and engineering details for both the County-Wide scenario and the Town of Orangeville scenario.



Table 3 - Orangeville Economic Case Summary – Financial Benefits to County via proposed PSBN design

	Town of Orangeville PSBN Private Scenario	Town of Orangeville PSBN Neutral Host Scenario	Dufferin County PSBN Private Scenario	Dufferin County PSBN Neutral Host Scenario	Business as Usual Scenario Telco Services
<b>Economic Case – PSBN Municipal Revenue Benefits</b>					
Total Economic Benefits (2021\$, Net Present Value) (NPV)	\$7.396M NPV @ 7% discount rate over 15 yrs.	\$8.562M NPV @ 7% discount rate over 15 yrs.	\$8.454M NPV @ 7% discount rate over 15 yrs.	\$11.953M NPV @ 7% discount rate over 15 yrs.	\$0 – no PSBN infrastructure
Estimated PSBN Dividends / Roaming Revenue (NPV) Assuming a 100% stake for PSBN model scenarios	\$0 - No roaming / Fully Private infrastructure scenario and so no local income from 5G	Between \$1.166M and \$2.041M NPV Dividends from roaming fees over 15 years	\$0 - No roaming / Fully Private infrastructure scenario and so no local income from 5G	Between \$3.499M and \$6.124M NPV Dividends from roaming fees over 15 years	\$0 – no PSBN infrastructure
Estimated 5G infrastructure asset stake value in an asset sale scenario in Year 10	NPV = \$528k NPV @ 7% discount rate in a year 10 sale scenario	NPV = \$528k NPV @ 7% discount rate in a year 10 sale scenario	NPV = \$1.586M NPV @ 7% discount rate in a year 10 sale scenario	NPV = \$1.586M NPV @ 7% discount rate in a year 10 sale scenario	\$0 – no PSBN infrastructure
Estimated UN Sendai Framework Value of Risk Mitigation Benefits over 15 years	\$3.002 Million NPV over 15 yrs. @ 7% Discount Rate.	\$3.002 Million NPV over 15 yrs. @ 7% Discount Rate.	\$3.002 Million NPV over 15 yrs. @ 7% Discount Rate.	\$3.002 Million NPV over 15 yrs. @ 7% Discount Rate.	\$0 – no PSBN infrastructure
Estimated value of Government Agency Cost Savings via use of PSBN over High-Cost carriers over 15 years of operations	\$3.866 Million NPV over 15 yrs. @ 7% Discount Rate	\$3.866 Million NPV over 15 yrs. @ 7% Discount Rate	\$3.866 Million NPV over 15 yrs. @ 7% Discount Rate	\$3.866 Million NPV over 15 yrs. @ 7% Discount Rate	\$0 – no PSBN infrastructure
Net CAPEX & OPEX Costs	\$567K CAPEX & \$2.835M OPEX over 15 years NPV @ 7% Discount Rate	\$567K CAPEX & \$2.835M OPEX over 15 years NPV @ 7% Discount Rate	\$1.132M CAPEX & \$3.038M OPEX over 15 years NPV @ 7% Discount Rate	\$1.132M CAPEX & \$3.038M OPEX over 15 years NPV @ 7% Discount Rate	\$0 – no PSBN infrastructure
Benefit-Cost Ratio from Project Revenue (NPV)	= \$7.396M benefits / \$3.402M cost = 2.174	= \$8.562M benefits / \$3.402M cost = 2.516	= \$8.454M benefits / \$4.17M cost = 2.027	= \$11.953M benefits / \$4.17M cost = 2.866	= \$0.00M / \$0.0M costs = 0.00

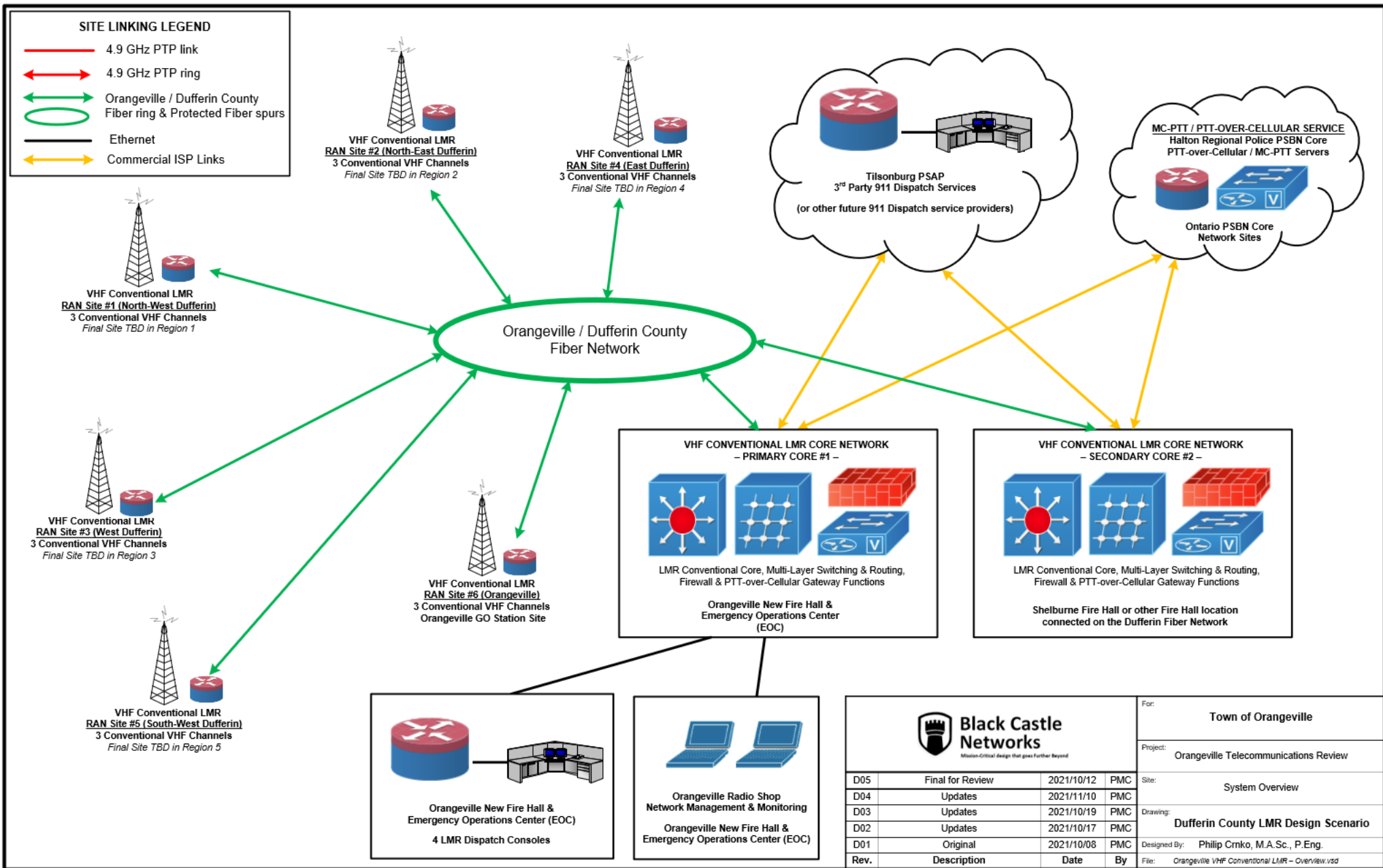


Figure 28 - PSBN System Block Diagram – Dufferin County Scenario LMR Design with linkages to MC-PTT Hosting Services, and PSBN System connection

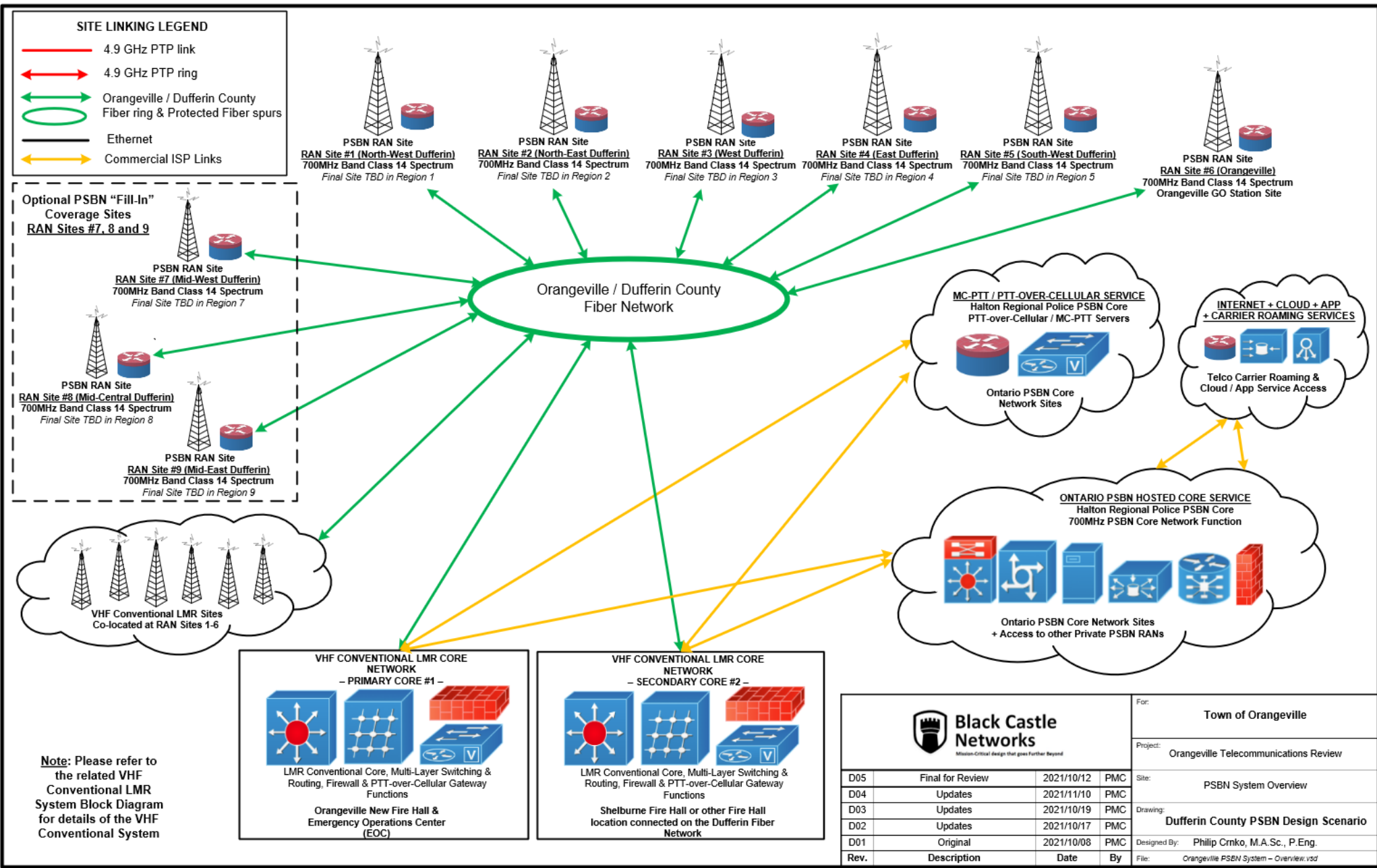


Figure 29 - PSBN System Block Diagram – County-Wide Scenario PSBN Design with linkages to PSBN Core Hosting Services, MC-PTT Hosting Services, and LMR System connection.



# III. APPENDICES

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## 9 APPENDIX A – GLOSSARY OF KEY TERMS & ACRONYMS:

This section provides an overview of key technical terms and acronyms used in this questionnaire:

<b>4-NINES</b>	- 99.99% reliability	<b>NB-IoT</b>	- Narrow-Band Internet of Things
<b>5-NINES</b>	- 99.999% reliability	<b>NG-9-1-1</b>	- Next Generation 911
<b>802.11 WiFi</b>	- Unlicensed multi-user, wireless wide-area short-range data communications standard	<b>On-Prem</b>	- On-premises deployment of an IT service or application (instead of a Cloud-based service)
<b>AR</b>	- Augmented Reality	<b>OPP</b>	- Ontario Provincial Police
<b>Avg.</b>	- Average	<b>Ops1</b>	- Operations 1 – commonly used Talkgroup name for field operations – an example name
<b>Apps</b>	- Smart Phone Applications	<b>P25</b>	- Project 25 standard for LMR systems
<b>ASTRO25</b>	- Project 25 Land Mobile Radio System brand / model	<b>PSAP</b>	- Public Safety Answering Point (in essence a 911 call center)
<b>BYOB</b>	- Bring your own device policy for cell phone use at work places	<b>PSBN</b>	- Public Safety Broadband Network
<b>e.g.</b>	- Example	<b>PSRN</b>	- Public Safety Radio Network – Province of Ontario LMR system
<b>GB</b>	- Gigabytes	<b>PTT</b>	- Push-to-Talk functionality for immediate person-to-person, or group calling based on a dedicated button on “walkie-talkie” / LMR handheld radios
<b>GHz</b>	- Giga-hertz	<b>PTT over IP</b>	- Push-to-Talk functionality on any generic IP-based communications service PTT over cellular Push-to-Talk functionality for cell phones that permits bridging together both Cellular and LMR system users to communicate together across LMR / cellular / IP networks
<b>Harris Conventional</b>	- Conventional analog or digital LMR communications – non-trunking	<b>PTT over broadband</b>	- Push-to-Talk functionality over any broadband service, including WiFi or wireline / fixed desktop-based clients located in building facilities
<b>HPD</b>	- High Speed Data – a commercial branding for legacy LMR low-speed data service	<b>RF</b>	- Radio Frequency
<b>i.e.</b>	- In Essence	<b>SMS</b>	- Short Message Service / cellular text service
<b>IoT</b>	- Internet of Things	<b>Telecom</b>	- Telecommunications
<b>IT</b>	- Internet Technology	<b>Tech</b>	- Technology
<b>KB</b>	- kilobytes	<b>Temp</b>	- Temperature
<b>LoRaWAN</b>	- Standard for Low-power wide area networks for machine communications	<b>Unified Communication</b>	- Integrated group-based voice & data applications for rapid / immediate collaboration across work teams and through an enterprise
<b>LMR</b>	- Land Mobile Radio (“walkie talkie” radio systems)		
<b>LTE</b>	- Long Term Evolution – cellular standard for 4 <sup>th</sup> & 5 <sup>th</sup> Generation wireless systems		
<b>LTE-M</b>	- LTE-Machine / LTE for Machine type communications and IoT data		
<b>M2M</b>	- Machine-to-Machine / IoT data		
<b>MAN</b>	- Metropolitan Area Network		
<b>MB</b>	- Megabytes		
<b>MoH / MOH</b>	- Ministry of Health		
<b>Motorola SmartZone</b>	- Pre-P25 Trunked LMR brand / model		
<b>NA</b>	- Not Applicable		



## 10 APPENDIX B - GAP ANALYSIS

This section provides a summary of the key gaps identified in the course of the stakeholder engagement work and survey of the Stakeholder Public Safety agency pain points, identified failure modes and 911 communications flow issues. Also provided is a benchmarking of the Town of Orangeville and Dufferin County LMR current-states against industry best practices for Public Safety telecom infrastructure.

Table 4 - Overview of Key Telecom Services Gaps identified across the various levels of analysis and review

#	Area	Problem	Risk	Potential Fix	Cost
<b>General Industry Best Practices – Identified Issues</b>					
1	LMR	Infrastructure out of maintenance / warranty & very spotty record of system → no records / manuals.	High - Replacement / break-fix issues	Renew warranty or upgrade / replace	Included in infrastructure estimates in report
2	LMR	RF coverage problems at hospital, other noted “dead” areas in Dufferin County and Orangeville	High – some workarounds in place, some not in place	Improved RF coverage design & site placement	Included in infrastructure estimates in report
3	LMR	Resiliency issues – no deployable or backup in the event of site outages + “unfinished system” problem	High – link failures at sites / component failures	PSBN provides always-on backup & data as bonus	Included in infrastructure estimates in report
4	LMR	Communications are “in the clear” and unencrypted – eavesdropping possible	High – snooping on Public Safety, no encryption	Renewed radio system will provide encryption	Included in infrastructure estimates in report
5	LMR / Interop.	Lack of cohesive interoperability among Dufferin users / Orangeville / Caledon → system “silos”	High – lack of interop delays response / mistakes	LMR refresh + PSBN investment for “Private 5G”	Included in infrastructure estimates in report
6	PSBN / Cellular	“Surge” Capacity in Town / County during disasters may not cover “swarm” of users and civilians that typically occur during crisis events & emergencies	High – data slowing down / halting during disasters	PSBN investment for “Private 5G” 911 data pipe	Included in infrastructure estimates in report
7	PSBN / Cellular	Lack of carrier resiliency in the event of outages leaves batches of users “stranded” during outages (e.g., Rogers, TELUS recent national outages)	High – some users may not be able to connect / call others during disasters	PSBN investment for “Private 5G” 911 data pipe + multi-carrier roaming	Included in infrastructure estimates in report



8	Consoles & Dispatch	Some potential failure modes of concern during power outages or Bell carrier outages	High – failure mode degrades to Bell dial-up via copper lines	LMR refresh + PSBN investment for “Private 5G”	Included in infrastructure estimates in report
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### Failure Modes and Effects Analysis – Identified Issues

9	LMR & Dispatch	Tillsonburg dispatch “over-the-air” mobile radio links to Orangeville LMR systems have single points of failure.	An outage risks removing access to dispatch	Improved LMR design and replacement / upgrade of system	Included in infrastructure estimates in report
10	LMR & Dispatch	Tillsonburg dispatch “over-the-air” mobile radio links to Dufferin LMR systems have single points of failure.	An outage risks removing access to dispatch	Improved LMR design and replacement / upgrade of system	Included in infrastructure estimates in report
11	LMR	Incompatibility between Analog radios of Dufferin Fire users and Digital P25 radios of Orangeville	Issues communicating reported where users en-route to mutual aid cannot communicate – can lead to errors and mistakes in field operations	Improved LMR design and replacement / upgrade of system that takes a holistic view to the entire Dufferin County as a single LMR system	Included in infrastructure estimates in report
12	LMR	No backup to Conventional LMR systems in the event of site outages – no bleed-over or redundant coverage solutions in Dufferin County	If a single site fails, there is no effective rural communications for Fire agencies as local talk-around range is limited without repeater access	Deployment of PSBN as a backup to a new and improved LMR system design and replacement / upgrade that takes a holistic view to coverage across the County	Included in infrastructure estimates in report
13	LMR	No local spares pool of equipment for the Dufferin or Orangeville LMR systems which means in a component failure the network could be down for days until a replacement unit is ordered and shipped	If a key component fails the Fire agencies and any civilian agencies on the LMR system could be without access for days or weeks	Deployment of a proper spares pool for key radio elements to ensure break-fix in < 1hr by a system maintainer / service provider	Included in infrastructure estimates in report
14	Carrier 4G / 5G Data	No backup to carrier data in the event of an outage on one carrier network → all data comms halt for Tri-Services responders and other response agencies.	If the current Orangeville / Dufferin carrier goes down, no data even if other carriers are active	PSBN and multi-carrier roaming mean better resiliency and survivability – if one carrier goes down users will jump to another or potentially rely on PSBN for voice & data comms.	Included in infrastructure estimates in report



14	Carrier 4G / 5G Voice	No backup to carrier data in the event of an outage on one carrier network → all cellular voice comms halt for Tri-Services responders and other response agencies.	If the current Orangeville / Dufferin carrier goes down, no data even if other carriers are active	PSBN and multi-carrier roaming mean better resiliency and survivability – if one carrier goes down users will jump to another or potentially rely on PSBN for voice & data comms.	Included in infrastructure estimates in report
15	LMR	Identified coverage holes and gaps throughout Dufferin County → a chronic issue that has not been addressed for years	Firefighter Line of Death due to lack of basic RF coverage in region	Improved LMR design and replacement / upgrade of system + PSBN deployment	Included in infrastructure estimates in report

### RF Coverage Problems – Identified Issues

16	LMR	Orangeville Coverage Issues Area 1 – Headwaters Hospital (see Section 3 for detailed description)	Firefighter Line of Death or poorer civilian outcomes in emergencies due to lack of basic RF coverage in region	Improved LMR design and replacement / upgrade of system + PSBN deployment	Included in infrastructure estimates in report
17	LMR	Orangeville Coverage Issues Area 2 – North Orangeville Commercial Area	Firefighter Line of Death or poorer civilian outcomes in emergencies due to lack of basic RF coverage in region	Improved LMR design and replacement / upgrade of system + PSBN deployment	Included in infrastructure estimates in report
18	LMR	Orangeville Coverage Issues Area 3 – North Orangeville Commercial Area	Firefighter Line of Death or poorer civilian outcomes in emergencies due to lack of basic RF coverage in region	Improved LMR design and replacement / upgrade of system + PSBN deployment	Included in infrastructure estimates in report
19	LMR	Dufferin Coverage Issues Area 1 – North-West and Northern Region Fringe	Firefighter Line of Death or poorer civilian outcomes in emergencies due to lack of basic RF coverage in region	Improved LMR design and replacement / upgrade of system + PSBN deployment	Included in infrastructure estimates in report
20	LMR	Dufferin Coverage Issues Area 2 – North-East Fringe and Eastern Valleys	Firefighter Line of Death or poorer civilian outcomes in emergencies due to lack of basic RF coverage in region	Improved LMR design and replacement / upgrade of system + PSBN deployment	Included in infrastructure estimates in report



21	LMR	Dufferin Coverage Issues Area 3 – Eastern Valleys	Firefighter Line of Death or poorer civilian outcomes in emergencies due to lack of basic RF coverage in region	Improved LMR design and replacement / upgrade of system + PSBN deployment	Included in infrastructure estimates in report
22	LMR	Dufferin Coverage Issues Area 4 – Eastern Valleys & Mono / Hockley Valley	Firefighter Line of Death or poorer civilian outcomes in emergencies due to lack of basic RF coverage in region	Improved LMR design and replacement / upgrade of system + PSBN deployment	Included in infrastructure estimates in report
23	LMR	Dufferin Coverage Issues Area 5 – Coverage Gap between Orangeville & Dufferin	Firefighter Line of Death or poorer civilian outcomes in emergencies due to lack of basic RF coverage in region	Improved LMR design and replacement / upgrade of system + PSBN deployment	Included in infrastructure estimates in report

### 911 Communications Flow Efficiencies – Identified Issues

24	LMR	Orangeville Fire does not have direct access to OPP and EMS or Hospital – requires patching and relay of messages by PSAPs	Missed messages, delays, possibility of human error via “relay” messages that result in reduced field operations efficiency or accidents.	Improved LMR design and replacement / upgrade of system + PSBN deployment	Included in infrastructure estimates in report
25	LMR & Carrier 4G / 5G Services & Unified Communications	There are limited “horizontal” communications flows today, possibly due to tradition for more PSAP / dispatch quarterbacking of all calls. “Horizontal” inter-agency flows are primarily between Fire agencies themselves, and between OPP and EMS, but not across those groupings.	In the event of dispatch failure or overload no ability to have field staff interoperate directly. Tax on LMR resources.	PSBN and multi-carrier roaming can facilitate better inter-agency interactions via Unified Communications Concepts	Included in infrastructure estimates in report
26	Carrier 4G / 5G Services & Unified Communications	Social Work agencies (e.g., Family & Childrens Services) and other such “de-escalation / social services” that are starting to be integrated into 911 along traditional tri-services, have no means to communicate with Tri-Services today, other than via un-prioritized Cellular / phone calls.	In disasters or cellular outages these social services agencies are left out. Also, they cannot participate in group calls with Tri-Services today.	PSBN and multi-carrier roaming can facilitate better inter-agency interactions via Unified Communications Concepts	Included in infrastructure estimates in report



27	Carrier 4G / 5G Services & Unified Communications	Upper Grand District School Board staff / teachers are only connected to Tri-Services responders via un-prioritized Cellular / phone calls today. In a mass-event scenario in a school shooting or similar school disaster these actors would be potentially jammed or prevented from communicating due to jammed cell phone towers / lack of call capacity for surges on commercial areas.	In disasters or cellular outages these social services agencies are left out. Also, they cannot participate in group calls with Tri-Services today.	PSBN and multi-carrier roaming can facilitate better inter-agency interactions via Unified Communications Concepts	Included in infrastructure estimates in report
28	LMR	Beyond individual LMR systems, in the event of LMR system outages there is no universally prioritized access to cellular or other alternative voice communications than carrier networks, which can jam in emergencies.	In disasters and mass-events carriers are jammed, and potentially with no prioritization of calls or an inability to get calls through due to surges / congestion at local cell towers. Also, no scaling of such 1-to-1 cell calling to large group calls today.	PSBN and multi-carrier roaming can facilitate better inter-agency interactions via Unified Communications Concepts	Included in infrastructure estimates in report
29	EOC / LMR / Carrier Communications	Dufferin County EOC is setup on a temporary basis, is housed in a small closet without any laptops, lacks the ability to move or function in a mobile fashion in the event the EOC is damaged in a disaster, and lacks sufficient radio and cellular equipment resources to effectively communicate all at once across all the patchwork of separate LMR and cellular systems (i.e., 3 LMR networks + carrier + landlines)	Missed messages, delays, possibility of human error via “relay” messages that result in reduced field operations efficiency or accidents that can lead to serious outcomes for public & First Responders.	Investment in a new EOC and new EOC equipment, along with Unified Communications (MC-PTT and/or PTT-over-IP solutions)	Included in infrastructure estimates in report
30	Dispatch / LMR	Tillsonburg PSAP has possible single-point of failure issues with some of the “over-the-air” fixed mobiles used to access the Orangeville & Dufferin LMR systems, and no prioritized secondary backup communications via cellular	In the event of outages of the mobile fixed radios that are the only path to provide “over the air” connections, PSAP loses comms with field users in the Orangeville or	ISSI based interfaces instead of (or complementary to) “off-air” mobile interfaces for PSAP communications.	Included in infrastructure estimates in report



			Dufferin LMR systems – impacting effective 911 field operations		
31	LMR	Police, Fire and EMS report difficulties in communicating and interoperating with each other in Dufferin County due to incompatibilities of equipment and disparate LMR networks / frequencies	Missed messages, delays, possibility of human error via “relay” messages that result in reduced field operations efficiency or accidents that can lead to serious outcomes for public & First Responders.		Included in infrastructure estimates in report
32	LMR / Carrier 4G / 5G Services & Unified Communications	GO Transit lacks the ability to directly connect to local EOC or Tri-Services field operations in Orangeville and Dufferin County	Missed messages, delays, possibility of human error via “relay” messages that result in reduced field operations efficiency during evacuations or incidents involving GO Transit buses		Included in infrastructure estimates in report
33	LMR & Carrier 4G / 5G Services & Unified Communications	Dufferin County Public Works / Snow Plows have local VHF Conventional analog communications among themselves, but apparently no ability to patch or connect to other agencies when they are in the field on a call. They relay information from copper-dial-up calls from PSAP or Tri-Services agencies to field staff from their operations facility, or rely on cell phones for field communications in the event of failure of their LMR coverage	Single points of failure and backup systems that are prone to network congestion during mass winter events mean ineffective response in clearing roads that can in turn impact and delay other 911 field operations involving vehicles.		Included in infrastructure estimates in report
34	LMR & Carrier 4G / 5G Services & Unified Communications	Orangeville Hydro use of HAM Radios for field operations and unprioritized cellular carrier services for communications with outside agencies	Unlicensed radios are open to penalty-free interference with no legal recourse or deterrence when / if it occurs, and communications		Included in infrastructure estimates in report





			are un-encrypted leaving the Town open to liability for any information publicly disclosed on airwaves, or in event of issues that are confidential.		
35	IoT / 4G / 5G Services	IOT flows are not prioritized for Public Safety and Secondary Responders for future “Public Safety” Internet of Things messages that can have critical information (e.g., video cameras, field sensors, vehicular telemetry and sensors, etc.)	Public Safety IoT flows on commercial data networks are subject to no prioritization and are subject to Denial of Service attacks, and high Cybersecurity risks than on private / closed networks like PSBN.	Included in infrastructure estimates in report	
36	LMR & Carrier 4G / 5G Services & Unified Communications	International mutual aid responders (e.g., forest fire crews, utility crews in the event of ice storms, other disaster responders) have no interoperability layer in Orangeville and Dufferin County for communications. PSBN with 700MHz Band Class 14 spectrum is earmarked for this function in North America but there is no such Band Class 14 coverage in Ontario / Dufferin / Orangeville.	Poorer coordination in the event of disasters (ice storms, forest fires, nuclear accidents and evacuations, flooding, earthquake recovery and other disasters) as international assistance will rely on ad-hoc channels or need to support PSRN frequencies on their handsets (which not all do) and thus cannot interoperate with Canadian 911 operations.	Included in infrastructure estimates in report	

In the the full report, the formal Business Case and design analysis is provided for potential solutions to remedy the above Gaps and problems with the current Orangeville & Dufferin County 911 emergency communications posture.



## 11 APPENDIX C – INTEROPERABILITY CONTINUUM EVALUATION

The current Town of Orangeville and Dufferin County emergency services telecommunication infrastructure status represents a significant challenge but also an opportunity for improvement. There are many different vendor technology systems involved, with different governance policies and a mix of standard operating procedures (e.g each agency performs their own voice Push To Talk (PTT) group administration)

In order to improve the interoperability of systems within Town of Orangeville Agencies, Systems, Networks, Devices, Applications and Business Partners, it is pertinent to consider the US Department of Homeland Security (DHS) Safecom Interoperability Continuum<sup>19</sup> which provides a methodology for evaluating the maturity of communications systems, interoperability and agency processes versus an “ideal” interoperability status for Tri-Services agencies, across several dimensions of telecom service<sup>20</sup>.

The DHS Safecom Interoperability Continuum is well accepted in the Public Safety community in both Canada and the USA as a benchmark of performance and a means to identify areas of improvement for telecommunications performance and interoperability posture.

In considering the Interoperability Continuum as it applies to the Town of Orangeville and Dufferin County Systems and Telecommunications technology, BCN considered the current governance, Standard Operating Procedures, training and usage guidelines in the Town and also those of Dufferin County. The purpose of the Interoperability Continuum is to define an assessment of maturity levels of Voice and Data communications between Public Safety agencies. The diagram below has two dimensions:

- Horizontally, there are five rows (also called “swim lanes”) that describe the five elements of interoperability activities that are needed in disciplined Public Safety organizations. The five “swim lanes” are 1) Governance, 2) Standard Operating Procedures (SOPs), 3) Technology for Data and Voice communications (notice Video and IoT are missing) 4) Training & exercises and 5) Incident Usage types.
- Vertically, the columns describe levels of activities that describe maturity levels. On the left side the lowest maturity attributes are defined as limited leadership, Planning, Collaboration among areas with minimal investment in the sustainability of systems and documentation. Going from left to right, across the diagram, there are four levels of maturity activities for each “swim lane”. Each of the rows, then have a description of maturity activity for each particular column.

Thus, the goal for any agency that is using the Interoperability Continuum, is to improve the maturity level going from left to right in a given swimlane. The highest level of interoperability is achieved on the right side of the diagram. This highest maturity level is characterized as having the attributes of 1.) High degree of leadership, 2.) Planning, and

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<sup>19</sup> US DHS - <https://www.hsdl.org/?view&did=769874>

<sup>20</sup> CISA - <https://www.cisa.gov/publication/interoperability>



3.) Collaboration among areas with commitment to and investment in Sustainability of Systems and Documentation.

Interoperability with various agencies within the Town’s own agencies as well mutual aid partners is highly desirable functionality, especially in emergency situations. The following is the evaluated position of the Town of Orangeville and Dufferin County versus the Safecom Interoperability Continuum in 2021, based on the information available during the project work.

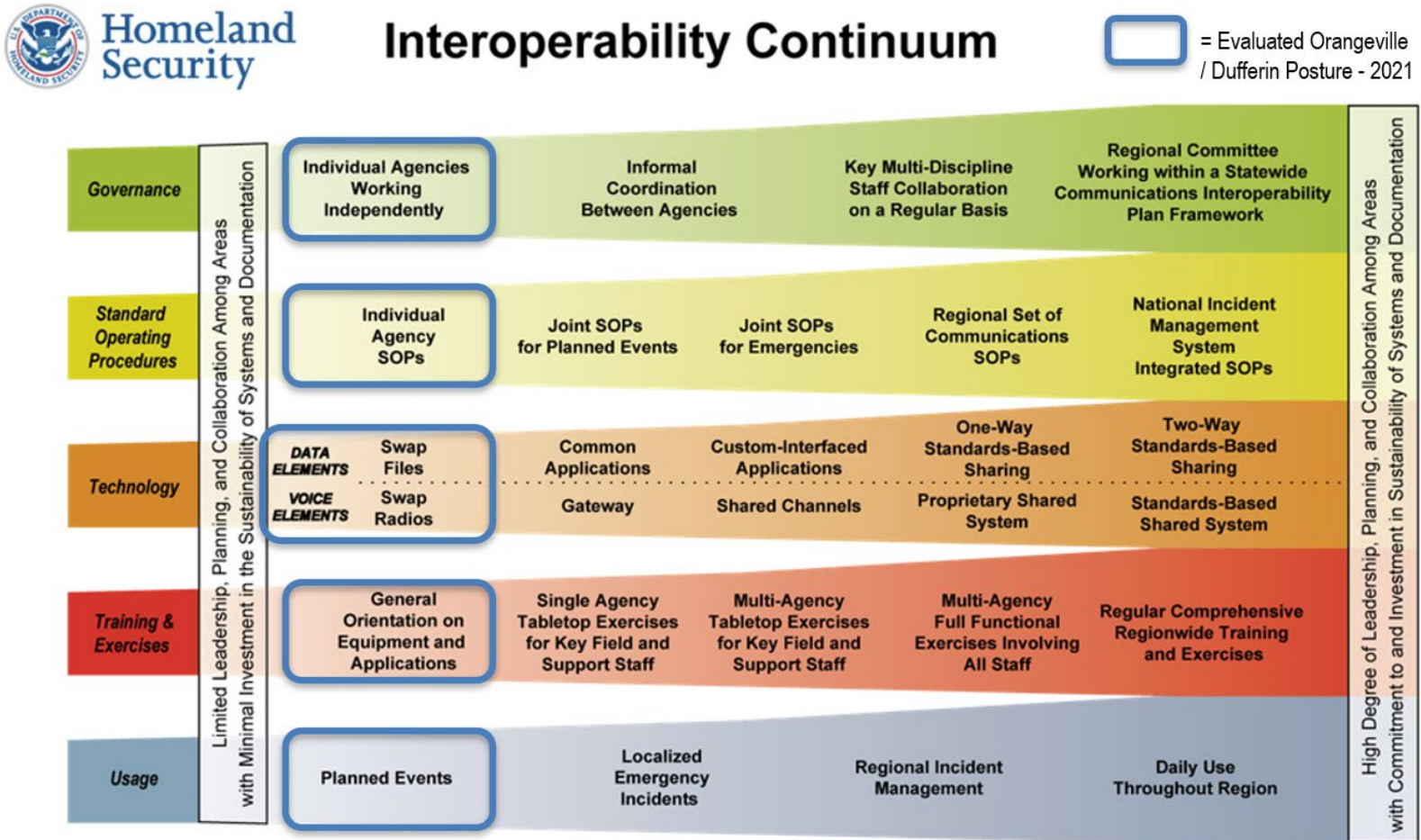


Figure 30 - Evaluation of the state of Orangeville and Dufferin County interoperability per the DHS SAFECOM Interoperability Continuum – as of November 2021, per information on the status of communications systems.

## Improving the Interoperability Maturity Level

In summary, the interoperability / telecommunication preparedness posture of the Town of Orangeville and Dufferin County is in the lowest tier of the Safecom Interoperability Spectrum – with the status:

*“Limited Leadership, Planning and Collaboration among areas, with minimal investment in the sustainability of systems and documentation”.*

BCN suggest this is an urgent matter to remedy for both the Town of Orangeville and the County. Coupled with noted RF coverage problems in the County radio system, and other incompatibility issues between the County and Town radio systems, the current state of affairs in County-wide is a potential liability given the number of years and the chronic nature of a number of the problems identified in BCN’s FMEA work (Failure Modes and Effects Analysis) and evaluation of 911 communications flows.

Also, per the evaluation of disaster scenarios and communications posture for known risk events at the Town and County, BCN suggests that the Town and County have a number of unhandled disaster scenarios and hazards with respect to communications coordinations during disaster scenarios that have happened historically. The noted communications problems and unhandled failure modes accordingly compound risks during disasters.

Given the chronic multi-year nature of some of the reported issues, BCN suggest Line of Duty (LoD) death liabilities due to a possible future failure in telecommunications, or LoD death or civilian death liabilities due to mis-communication, RF coverage holes, or due to inability to coordinate effective response – are a real liability risk that the Town of Orangeville and Dufferin County should responsibly and appropriately remedy as soon as possible.

In the full / main report, addresses each of these problem spaces and themes, and in turn provides detailed proposed solutions and recommendations. The resolution of each of the noted challenge themes is also used as a judgement criterion in the proposed prioritization / ranking criteria of the solutions.

The accompanying full business case in the main report provides an overview of the current state problems in the Town and across Dufferin County Public Safety communications, per stakeholder engagement meetings conducted, followed by the design of a holistic vision for unified communications for Orangeville and Dufferin County Emergency Management and Emergency Responder personnel, and then proceed to an overview of financials and prioritized recommendations and timing for a possible business case for selected solutions.



## 12 APPENDIX D - INTERNATIONAL PRECEDENT & EXAMPLES

In this section, the Case for Change is considered by looking at precedent in other jurisdictions in Ontario, Canada and around the world, for suggestions as to the viability or advantages inherent in the proposed PSBN initiative, and also the relative risk level.

In terms of other communities in Ontario, there are several nearby municipalities currently considering or deploying neutral-host / P3 models, including Region of Halton and Region of Peel, and indeed neutral-host 4G and 5G networks are a very viable business model which has been used successfully in other countries – including in the USA telecom market, in Europe and Asia. Examples include the City of Aberdeen, Scotland, and London, England – the model has been proven to work in both urban / suburban settings as well – and therefore good precedent for the Town of Orangeville.<sup>21</sup>

Some examples of 5G early-adopter cities which have deployed Neutral Host and private / multi-tenant / hosted networks using 5G technology include:

- Barcelona, Spain<sup>22</sup>
- Bristol, UK<sup>63</sup>
- Lucca, Italy<sup>63</sup>
- Aberdeen, UK<sup>23</sup>
- Dublin, Ireland<sup>24</sup>
- London, UK<sup>25,26</sup>
- Paris, France<sup>27</sup>
- Lisbon, Portugal<sup>28</sup>
- Sunderland, UK<sup>29</sup>
- Cascais, Portugal<sup>68</sup>
- Liverpool, UK<sup>30</sup>
- United States Tower Hosting Firms which account for 84% of all US telecom infrastructure
- Auckland, New Zealand<sup>31</sup>
- Halton & Peel Region PSBN
- Tucson, Arizona, USA<sup>32</sup>

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<sup>21</sup> BAI Communications - <https://www.baicomunications.com/news-views/blog/neutral-host-networks-for-rail-systems-and-smart-cities/>

<sup>22</sup> Accelleran - <https://www.acceleran.com/5gcitydrax/>

<sup>23</sup> Commscope - <https://www.commscope.com/blog/2017/city-of-aberdeen-paves-the-way-for-5g/>

<sup>24</sup> Enterprise IOT Insights - <https://enterpriseiotinsights.com/20200806/channels/news/ireland-looks-to-put-cities-in-charge-of-coordinated-neutral-host-5g>

<sup>25</sup> CCSL - <https://www.ccsl.com/v1/uploads/files/CCS-City-of-London-Case-Study.pdf>

<sup>26</sup> TechUK - <https://www.techuk.org/insights/opinions/item/13533-is-neutral-host-infrastructure-the-way-forward>

<sup>27</sup> Ericsson - [https://www.ericsson.com/en/news/2020/7/ericsson-private-network-to-serve-paris-airports-2?utm\\_expid=aF\\_zYrDR\\_iQu2NKcDj6jq.1&utm\\_referrer=https%3A%2F%2Fwww.google.com%2F](https://www.ericsson.com/en/news/2020/7/ericsson-private-network-to-serve-paris-airports-2?utm_expid=aF_zYrDR_iQu2NKcDj6jq.1&utm_referrer=https%3A%2F%2Fwww.google.com%2F)

<sup>28</sup> Enterprise IOT Insights - <https://enterpriseiotinsights.com/20190930/channels/news/dense-air-to-build-neutral-host-5g-smart-city-network-in-portugal>

<sup>29</sup> Enterprise IOT Insights - <https://enterpriseiotinsights.com/20200305/channels/news/sunderland-preps-vendor-tender-for-uks-first-city-owned-neutral-host-5g-network>

<sup>30</sup> Enterprise IOT Insights - <https://enterpriseiotinsights.com/20200811/channels/fundamentals/all-about-liverpools-smart-city-5g-win>

<sup>31</sup> The Indian Sun - <https://www.theindiansun.com.au/2020/06/29/dense-air-partners-with-spark-to-enhance-mobile-broadband-services-in-new-zealand/>

<sup>32</sup> Business Wire - <https://www.businesswire.com/news/home/20210324005344/en/Geoverse-Brings-Power-of-LTE5G-Private-Networks-to-the-City-of-Tucson>



As an interesting example for Ontario and Canada to consider, the nation of Ireland is strongly considering taking a national policy stance that puts Neutral-Host 5G networks in the hands of municipalities, via a “coordinated neutral-host” strategy, whereby municipalities are open and encouraged to deploy neutral-host 5G infrastructure in “many flavours” but orchestrated centrally. This strategy is rooted in a successful 5G neutral-host network trial in Sligo County and the Docklands area of the City of Dublin.<sup>33</sup> Public Safety agencies in Dublin have also embraced the advantages of neutral-host small cell networks.<sup>34, 35</sup>

According to CONNECT™ – Ireland’s national telecom research center for future networks and communications:

*“A holistic approach to deploying a Neutral Host network within Irish cities and towns would be for respective local authorities to engage with a third-party operator through the development of a public/private partnership (3P) to help fund, operate and maintain the network for ‘open access’ among operators.”<sup>65</sup>*



This model of collaboration and neutral-host networks has been a success in Dublin, and as showcased by CONNECT™ via a scaled-up neutral-host model for 5G focused on municipalities<sup>36</sup> – is now being used collaboratively in municipalities across Ireland.

<sup>33</sup> City of Dublin - <https://www.slideshare.net/PlaceTech/trend-talk-dublin-smart-docklands>

<sup>34</sup> Fierce Wireless - <https://www.fiercewireless.com/5g/dense-air-demos-densification-for-5g-and-public-safety-dublin>

<sup>35</sup> City of Dublin / Smart Dublin - <https://smartdublin.ie/future-connectivity-bringing-5g-to-dublin/>

<sup>36</sup> CONNECT - [https://connectcentre.ie/wp-content/uploads/2020/08/5G-and-Future-Connectivity\\_Executive-Summary-FINAL.pdf](https://connectcentre.ie/wp-content/uploads/2020/08/5G-and-Future-Connectivity_Executive-Summary-FINAL.pdf)

*“Ireland has put city administrators and neutral host networks at the centre of a new five-year roadmap to bring 5G connectivity to the nation, and to stimulate economic growth. Dublin City Council will lead a “market engagement exercise” through the rest of 2020 to review the opportunity of neutral-host and shared-infrastructure 5G deployments.*

*Dublin City Council and Sligo County Council have teamed up with CONNECT, the country’s research centre for future networks and communications, to issue a discussion document that sets out these priorities, as a means to remove barriers to 5G rollout at local and national level. It makes clear a coordinated approach among stakeholders is the only way to deliver on the economic potential associated with 5G.”* <sup>37</sup> – Enterprise Insights – August 6, 2020

This neutral host focus and model in Ireland<sup>38</sup> is a viable scenario that could be adopted across Ontario, where several municipalities could independently deploy 5G RANs using whatever vendor of choice that they prefer or select via separate RFPs, and then “plug into” a common shared municipal PSBN 5G core network. In this manner, cost savings are generated all-round through a common P3 shared core network or shared core connection service from a 3<sup>rd</sup> party, while yet maintaining the advantage of a 5G revenue stream for each of the participating municipalities. The nation of Ireland and its municipalities have seen the value and the vision of neutral-host 5G networks deployed in a Public Private partnership approach. Per a recent quote from Dublin City Council:

*Jamie Cudden, Smart City Lead at Dublin City Council, said, “Local authorities, in particular, will play a vital role in Ireland’s path to 5G, so collaboration and engagement between councils and mobile operators will be essential to facilitate a sustainable rollout.”* – Mobile Europe – August 5, 2020

Another set of examples of international neutral host model initiatives are the “5GCity” projects held in Barcelona, Spain, Bristol, UK and Lucca, Italy.<sup>39</sup> The 5GCity initiative goal is to design, develop, deploy and demonstrate, in operational conditions, a distributed cloud and radio platform for municipalities and infrastructure owners acting as 5G neutral hosts. 5GCity has built neutral-host 5G networks in these three cities as a project of the European Commission, with the municipalities now proceeding beyond proof of concept to deployment phases. A number of architectural issues related to 5G network slicing have been proven in the municipalities, and feasibility of the neutral host model also proven from a technical and technology stance.<sup>40</sup>

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<sup>37</sup> Enterprise Insights - <https://enterpriseiotinsights.com/20200806/channels/news/ireland-looks-to-put-cities-in-charge-of-coordinated-neutral-host-5g>

<sup>38</sup> Mobile Europe - <https://mobileeurope.co.uk/press-wire/15019-ireland-makes-strategic-recommendation-to-capitalise-on-5g>

<sup>39</sup> 5GCity - <https://www.5gcity.eu/wp-content/uploads/2020/07/5GCity-Project-Final-Review.pdf>

<sup>40</sup> 5GCity - [https://www.5gcity.eu/wp-content/uploads/2020/05/WhitePaper\\_Enabling-5G-Neutral-Hosts-5GCity-Architecture-and-Business-Model-v1.0.pdf](https://www.5gcity.eu/wp-content/uploads/2020/05/WhitePaper_Enabling-5G-Neutral-Hosts-5GCity-Architecture-and-Business-Model-v1.0.pdf)





*“5G technology paves the way for new actors who simply own infrastructure and lease it to the operators. Network sharing among different operators has been here for some time now”, said Dr Shuaib Siddiqui, director of software networks at Fundació i2CAT, a Barcelona research foundation, and deputy coordinator of 5GCity. “But today we have to go beyond the conventional ways in which network sharing has been done. And 5G technology paves the way for new actors who simply own infrastructure and lease it to the operators.*

*Current base stations cover very big geographical areas,’ said Dr Siddiqui. ‘But in 5G the idea is that you have smaller but more dense cell infrastructure, which means you need to deploy a lot more base stations, also called small cells. But if every operator needs to install that many base-stations around a city, it’s going to get ugly really soon.’ He adds that it can also be difficult to get permits for building this type of infrastructure.” – Horizon Magazine – June 20, 2019<sup>41</sup>*

In the City of Lucca, a historical medieval Italian city, one advantage of 5G neutral host infrastructure is the concentration of cellular networks from multiple overlapping and duplicated layers – into a single inobtrusive layer controlled by the city, to prevent network sprawl and to promote a common look-and-feel to the deployment.

*It’s a small town and its downtown is medieval, which means it’s quite hard to dig things up and hang up new base stations,’ explained Dr Siddiqui. ‘Using neutral hosting, the municipality deployed new infrastructure, and with our platform they can slice it into different layers. Operators can then lease one of those slices during moments of high-usage, like during summer festivals – Horizon Magazine – June 20, 2019<sup>42</sup>*

<sup>41</sup> Horizon Magazine - <https://horizon-magazine.eu/article/how-5g-could-democratise-telecoms-industry.html>

<sup>42</sup> Horizon Magazine - <https://horizon-magazine.eu/article/how-5g-could-democratise-telecoms-industry.html>





Cascais, Portugal – is a municipality in the Lisbon region with a population comparable to Orangeville – 204k, in a 97km<sup>2</sup> waterfront area with urban / suburban mix similar to Orangeville. Cascais is the first neutral-host network in Portugal – and could be a deployment template for consideration by the Town of Orangeville, this time a 5G small-cell neutral-host partnership with Dense Air – a division of Airspan Inc.<sup>43</sup>

This Portuguese neutral-host network will consist of small-cells run on mid-band spectrum, with a 5G macro cell at a “prominent centrally located [government] building” in the city, alongside “strategically placed” small cells to bolster coverage and capacity.”<sup>44</sup>

An additional linkage to a local R&D / educational institution – the Nova Universidad in nearby Carcavelos – will be linked into the 5G neutral-host network as well – allowing students and researchers to “simulate and test” new business applications.

*Miguel Pinto Luz, deputy mayor for Cascais, commented: “We are really leading this process... We can be the first to offer our residents and visitors this service, which will greatly improve the lives of each of us.”*

*Dense Air said it has been planning the rollout for 12 months as part of its plans to establish “this neutral host small cell technology across Portugal”. It said it wants to complement national operators’ 4G and 5G services with network densification using its own spectrum.”* – Enterprise Insights – September 30, 2019



As two 5G neutral-host examples for the Town of Orangeville to strongly consider, the examples of London and Sunderland, both in England, with the City of London Neutral Host system consisting of 5G / pre-5G networks, designed and built in 2017 in collaboration with CTIL, and in partnership with “anchor MNO” Telefonica UK. Sunderland in turn went to tender in March 2020 with recent October 2021 announcements.



The London neutral host network combines the fastest free public Wi-Fi in the Europe & UK – with Gigabit speeds - and a pre-5G small cell network, backhauled by CCS Metnet and available to carry traffic for all UK MNOs. Metnet’s ability to deliver outstanding Wi-Fi and small cell connectivity in dense urban environments is providing a major boost to the capital –

<sup>43</sup> Jornal Economico - <https://jornaleconomico.sapo.pt/en/news/municipal-chamber-of-cascais-signs-partnership-with-dense-air-to-have-5g-network-494575>

<sup>44</sup> Enterprise Insights - <https://enterpriseiotinsights.com/20190930/channels/news/dense-air-to-build-neutral-host-5g-smart-city-network-in-portugal>



supporting London in its ambitions to become 5G-ready and enhancing its reputation as a world-leading Smart City. Around 3,600 street-level sites were made available by the City of London for the deployment, with 122 sites used for the original public pre-5G / Wi-Fi network.

In turn, Sunderland a city of 340,000 population, has tendered for a 5G neutral host network consortium<sup>45</sup> as of March 2020, with a procurement phase that has just completed as of November 2021 with start of deployment underway.<sup>46</sup> Sunderland is quite similar in scope and approach to the PSBN model, and so in many respects a case worthy of study by the Town of Orangeville.

In October of 2021, Sunderland City Council has awarded a 20-year strategic partnership<sup>47</sup> to BAI Communications to design, build and operate digital infrastructure including Wi-Fi, LoRaWan (long-range wide area network) and a private 5G small cell network.<sup>48</sup>

A ‘backbone’ of 5G connectivity, based on a neutral host model, will be established in the city by summer 2022. The council and BAI Communications are investing an equal initial sum of capital and will share revenue. The total contract value over the entire term is estimated at \$110 million USD. The city is making assets such as street furniture and buildings available for telecom equipment and infrastructure. The City of Sunderland has completed a Smart City strategic plan which outlines bridging the digital divide and economic growth from 5G services as compelling value propositions for the business case.<sup>49</sup>

The Sunderland municipal executive firmly believes the advanced network can stimulate economic growth, transform public service delivery, health and education, and reduce the digital divide.<sup>50</sup>

*“We want to be at the forefront of this agenda rather than wait for the mobile network operators to decide when to invest in our city so that we can begin to realize the significant social and economic benefits as soon as possible,” Patrick Melia, Chief Executive, Sunderland City Council, told Cities Today<sup>51</sup>.*

*“Our initial investment to build the infrastructure will complement the mobile network operators’ strategies and facilitate the operators in future to deploy at scale in Sunderland.”*

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<sup>45</sup> Smart Cities World - <https://www.smartcitiesworld.net/news/news/sunderland-seeks-partner-to-become-a-neutral-host-5g-smart-city-5082>

<sup>46</sup> Enterprise Insights - <https://enterpriseiotinsights.com/20200305/channels/news/sunderland-preps-vendor-tender-for-uks-first-city-owned-neutral-host-5g-network>

<sup>47</sup> Land Mobile - <https://www.landmobile.co.uk/news/sunderland-sets-goal-to-be-uks-leading-smart-city-with-bai-communications-partnership/>

<sup>48</sup> UK Authority - <https://www.ukauthority.com/articles/sunderland-plans-to-become-neutral-host-for-5g/>

<sup>49</sup> City of Sunderland - <https://www.sunderlandoursmartcity.com/wp-content/uploads/Smart-City-Prospectus-spreads-low-res.pdf>

<sup>50</sup> Mobile Europe - <https://mobileeurope.co.uk/press-wire/14582-sunderland-to-become-a-neutral-host-5g-city>

<sup>51</sup> ITU - International Telecommunications Union - <https://www.itu.int/en/myitu/News/2021/10/22/07/33/Sunderland-city-owned-5G-network-Cities-Today>





Sunderland sees particular opportunities for the new connectivity in areas such as social care to support independent living; education to better enable online and remote learning and increase digital inclusion; and manufacturing and logistics. With partners, the city is trialling autonomous heavy goods vehicles for the last-mile transfer of goods between the Nissan supply chain and the Sunderland Nissan car manufacturing plant.

BAI Communications said that initially the network will be private, so dedicated SIM cards will be used to access it. Over time, the partners will be assessing new use cases and rolling out capabilities to specific market sectors and geographies.

Figure 31 - City of Sunderland 5G Neutral-Host Business Case<sup>175</sup>



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