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5G Technical Assessment Report

November 2021

MISSISSAUGA

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Connectivity has become essential for the cultural, social, and economic development of a municipality.

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Sections

About the author:

Yeliz Ali, Strategic Advisor Digital Transformation
Information Technology Division, City of Mississauga

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Section 1 – Getting Started.

Executive Summary

The Smart City Master Plan, endorsed by Council July 2019, contained several strategic initiatives including an assessment of the 5G technology standard for cellular networks, for the City of Mississauga.

City of Mississauga staff have been actively assessing the implications of 5G through the engagement of key internal and external stakeholders, including benchmarking across Canada and globally. The Scope of the assessment ranges from City planning to the approvals and operational impacts of the supporting infrastructure for 5G within the City right-of-way and on City owned lands. A Steering Committee for the 5G assessment was established with strong technology, operational and legal expertise along with consultation with the Region of Peel Health department on 5G health related topics and Alectra Utilities regarding power related matters. There are specific synergies with City of Mississauga street lighting infrastructure for 5G small cell attachments as well as City owned properties. 5G is being positioned by industry as the high speed Internet of Things (IoT) network that will create connectivity required for digital advancements for residents, businesses and government. Connectivity for services such as Advanced Traffic Management, sensor based technologies and future considerations of Autonomous Vehicles are examples of use cases for the high speed connectivity promised by 5G. The built environment will also be a significant factor, which will require governance and processes in place to ensure that 5G small cell infrastructure is planned and managed for effective deployment and meeting federally regulated standards for installation and operation.

This report identifies the required information to make informed decisions for 5G deployment including processes, fees and governance through master agreements enabling the City to take an active role and influence how 5G is implemented in the City of Mississauga.

The term 5G can be defined as the “fifth generation technology standard for cellular networks”, and with it brings ultrafast and reliable communications. In municipalities, this will provide a variety of services including safer roads, waste collection, green power grids and much more. Connectivity has become essential for the cultural, social, and economic development of a municipality and it is predicted that by 2024 more than 1.5 billion devices will be connected to 5G. The City of Mississauga is uniquely positioned with the Public Sector Network and Wireless Network to be less reliant on 5G for services although existing Cellular connected devices may transition to 5G as a course of the broader cellular upgrades to 5G.

Canada’s approach to radio frequency (RF) exposure safety is among the most stringent in the world. The Government of Canada continuously monitors the research and scientific literature on the health effects of RF exposure to ensure that Canadian limits are consistent with the current scientific consensus to prevent potential adverse health effects. The Region of Peel Health Department submitted a report (item 7.1-1) to Regional Council regarding 5G and have identified that 5G, when implemented to the specifications identified and regulated by ISED, meets Health Canada’s requirements and aligns with a standard known as Safety Code 6.

Innovation, Science and Economic Development Canada (ISED) manages the governance and licensing of cellular spectrum. The results from the Spectrum auction, which ended July 23rd, 2021, illustrate the heavy investments made by each Carrier. Bell, Rogers, and Xplornet made bids for, and were the successful incumbents in the Toronto area.

On August 6, 2021, the federal government proposed exclusion and protection zones around airport runways. Exclusion zones do not permit any 5G base stations (small cells) to be in the area. Protection zones are locations around the airport where 5G services face restrictions. These restrictions are being introduced because there are concerns about possible interference between 5G spectrum and altimeters (aviation navigation tools used in automated landing).

Diagram 3 contains a Map of Exclusion and Protection Zones

To make best use of different types of spectrum, 5G deployment will include a mix of traditional cell towers and antennas on rooftops carrying signals over long distances, plus Small Cells at lower heights supporting huge bandwidth use over shorter distances.

The deployment of Small Cells in Mississauga will concentrate in densely populated areas, such as Business Improvement Areas (BIA), Mississauga's downtown core and urban areas. Subdivisions and areas without above ground power poles are not likely to be selected. Carriers will not rely exclusively on city-owned infrastructure, as they have a healthy mix of telco-owned assets, private assets, and utility agreements that they can utilize.

Third Party entities such as, Telecommunication Service Providers and other municipal partners (Region of Peel, City of Brampton, Ministry of Transportation, and educational institutions) may request permission, and access to City of Mississauga Streetlight poles to co-locate third party equipment. These devices can range from Road Weather stations, Traffic Sensors, Telecommunications Cellular Radios, Wi-Fi Access points, Environmental sensors, as well as other IoT devices. Third Party entities are responsible for submitting detailed information regarding their proposed Cellular Small Cell equipment. The City of Mississauga and Alectra Utilities must approve all Pole attachments and installations must follow existing City of Mississauga PUCC/Road Occupancy processes.

Fees and charges for Pole Attachment Permits that have been approved into By-law are listed in Table 8. An increase in requests for access to City infrastructure is anticipated. This will result in a significant rise in the number of permits that must be evaluated and processed. It is anticipated that resources will be required to handle the increase in work volume. It is expected that revenues generated from Pole Attachment permitting will fully offset the cost of additional resources. Master Agreements with telecommunication providers for Pole Attachments have been drafted and are expected to be in place early in 2022.

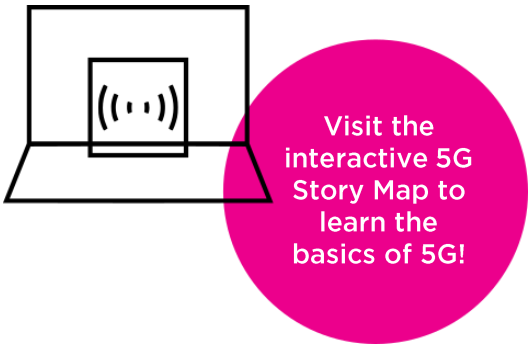
The introduction and proliferation of Small Cell equipment deployed within the street right-of-way on hydro poles and streetlights has impacts on the public realm. One solution that the City of Mississauga has explored to address Small Cell clutter is the integration of Smart Poles into street right-of-ways. Smart Poles are multi-functional poles with fully integrated lighting systems. They can increase urban efficiency while reducing energy costs. The City of Mississauga has been working closely with Street Lighting Pole vendors to create an Electrical Safety Authority (ESA) compliant Smart Poles based on existing poles being used in the city with new features to support 5G being added to the design. These Smart Poles will be a first in Canada and will become the City standard moving forward. Working collaboratively with Street Lighting, Works Operations, Planning and Engineering has ensured that these redesigned Smart Poles will be used moving forward for new development and as small cell technology is deployed. The replacement of the pole is recovered from the telecommunications provider and is included in the 2022 Fee's and Charges By-law with provisions for full cost recovery.

The City of Mississauga currently owns the largest Public Sector Network (PSN) in Canada. It boasts 985 connected sites and 47,000 km of fiber (nearly enough to cover the circumference of the Earth). The coming generation of connected technologies requires the high speed, high connectivity and low latency characteristics that 5G can provide. Some of these will be met with Mississauga's existing infrastructure (PSN, PBSN, fiber); however, there will be areas where small cells will be required in

order to achieve these benefits. There also exists a potential revenue stream for the City of Mississauga through the leasing of its dark fiber.

There are 5G pilots underway in Canada to test various use cases, the technology and the capabilities. Rogers and the University of British Columbia have embarked on a pilot rendering UBC Canada's first 5G smart campus. A 5G Pilot in partnership with Post-Secondary Institutions is the typical approach observed in neighbouring municipalities and across Canada. Additional pilots of varying scale are underway in the following municipalities: Brampton, London, Toronto, Hamilton, Kitchener, Waterloo, Ottawa, Montreal, Kelowna, and the Region of Peel. The City of Mississauga decided to pause the implementation of a 5G pilot project in light of COVID-19. However, the merits of a pilot for the City would be considered moving forward.

To help explain 5G and how it will be implemented and used, an interactive 5G Story Map has been created that simplifies the technical concepts contained within this report.



Introduction

Connectivity has become essential for the cultural, social, and economic development of a municipality. COVID-19 has only magnified and increased pressures for Telecommunication providers. As more companies move to encouraging telework, the demand on cellular networks continues to increase and the current LTE (4G) networks are struggling to meet the required speed, latency and bandwidth capacity that telework requires. Dramatic network outages are occurring more frequently and have come under increased scrutiny, making the demand for 5G that much more urgent and competitive. Additionally, in many smaller and rural parts of municipalities, broadband and wireless services remain challenging to access.

"Beyond the technology itself, 5G could add 250,000 permanent new jobs, and $40 billion in annual GDP to the Canadian Economy by 2026 (Accenture 2018)"

The next generation of innovation is upon us as Telecommunications carriers, the federal government and the CRTC are gearing up for the deployment of the first components of the fifth generation of wireless technology (or "5G") - a necessity if Canada is to remain competitive on the world stage. **Table 1** (5G Terminology) is provided to assist in reading and understanding some of the technical terms and acronyms.

Table 1 – 5G Terminology

Term	Definition
5G	Fifth generation technology standard for cellular networks.
Bandwidth	Measures the *amount* of information that can be sent over an internet connection in a given amount of time. Usually measured in megabits per second (mbps).
Speed	How *fast* information is received or downloaded.
Access Point (AP)	A piece of hardware that allows other Wi-Fi devices to connect to a wired network. The AP usually connects to a router (via a wired network), but it can also be an integral component of the router itself. APs support the connection of multiple wireless devices through their one wired connection.

Broadband	The name given to any fast, permanent internet connection. Dial-up internet is slow because it uses a single band. Broadband uses many bands. A separate band for uploading, downloading and voice. Making it a fast, permanent internet connection.
Cell Towers	An elevated structure with the antenna, transmitters and receivers located at the top. The primary function of a cell tower is to ensure proper elevation to antennas that receive and transmit radio-frequency signals from cell phones and other devices.
Millimeter Waves	Wavelengths that are so small they are measured in millimeters. Millimeter waves can carry huge amounts of data but they do not travel very far.
Internet of Things (IoT)	Physical objects ("things") that are embedded with sensors, software, and other technologies. This enables them to connect and exchange data with other devices and systems over the internet.
Latency	A fancy word for the lag that is experienced while waiting for something to load. The amount of time it takes information to travel from one connected device to another connected device.
Safety Code 6	Created by Health Canada for the purpose of establishing safety limits for human exposure to radiofrequency (RF) electromagnetic energy in the frequency range from 3 kHz to 300 GHz
Small Cells	Low-powered radio equipment and antennas. They are about the size of a pizza box, and used to transmit data to and from a wireless device. They enable millimeter wave frequencies, which means that they transmit data over short distances (10 meters to a few kilometers).

See Section A for more terminology.

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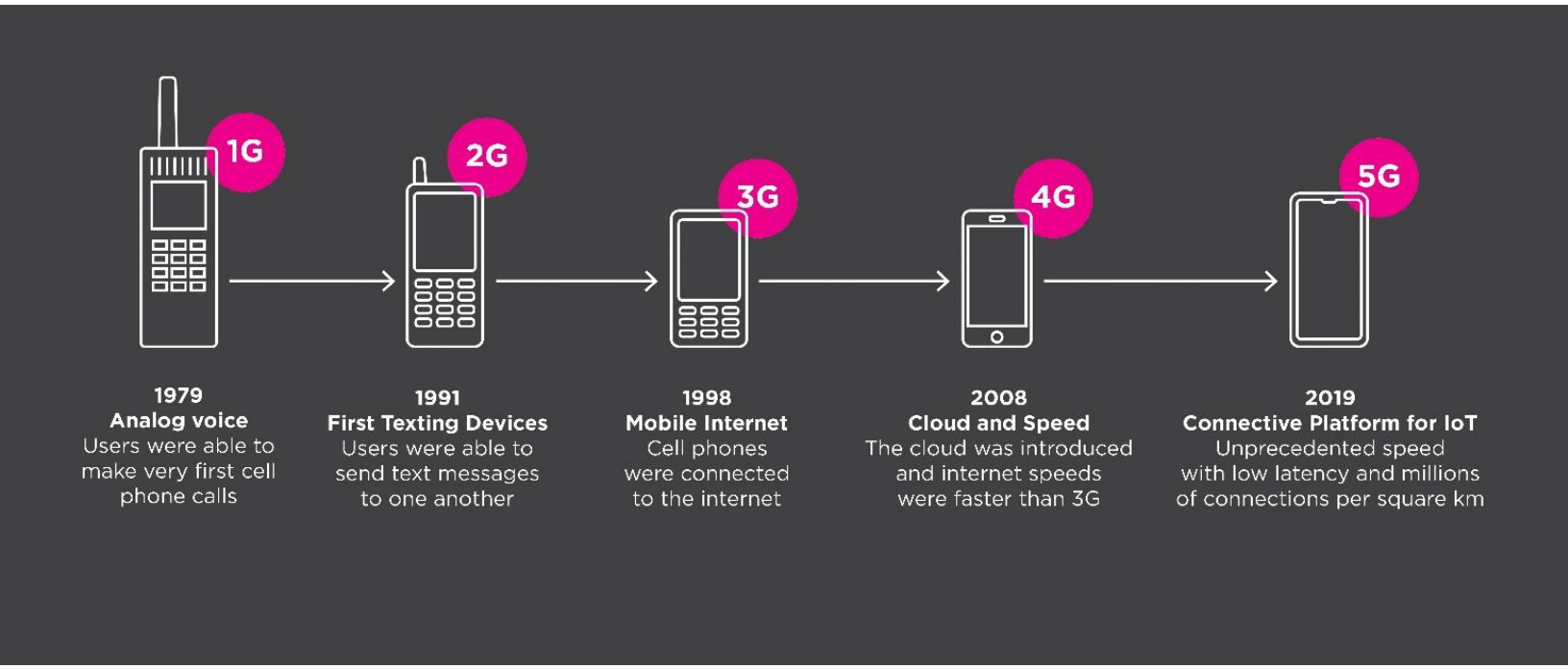
Section 2 – Background.

The G in 5G

Just over 40 years have passed since wireless cellular technology was introduced to the world and a lot has changed since then.



The G in 5G stands for generation. 5G is the **fifth** generation technology standard for cellular networks. Each generation has been marked by their data transmission speeds and the uses they enable. At its core, 5G is an **enabler**, unlocking capabilities with three dramatic improvements:

1. Greater speed
2. Lower latency
3. More connected devices at once

1. Greater Speed

20x to 1000x faster than 4G (that's like downloading an HD movie in seconds).

2. Lower Latency

Latency is a fancy word for lag. It represents the amount of time it takes for information to travel from one connected device to another (like a smartphone connected to the internet). The lower the latency, the faster that data moves. **Table 2** refers to the reductions in latency across generations.

3. More Devices at Once

5G will provide the ability to connect up to one million devices per km^2 vs. the current capacity of 4,000 devices per km^2 with 4G LTE.

Connectivity refers to the number of devices that can connect to a network at the same time. This is essential as more smart devices enter the market and use Canadian telecommunications networks. In highly populated urban areas where there are many residents and businesses, small cells will address growing capacity issues by allowing more users to connect.

Table 2 – Latency Comparison

Characteristic	4G/LTE	4G+	5G
Speed	150 Mb/second	800 Mb/second	2,400 Mb/second
Average time to download a HD movie	240 seconds	40 seconds	13 seconds
Latency (time between the send and response)	50 milliseconds	25 milliseconds	1 millisecond

The Science Behind 5G

How are these improvements achieved? Before we can answer this question, we need to define a couple of words: Electromagnetic Radiation and Radio Waves.

Electromagnetic Radiation (EMR) is a form of energy that is around us. For example, the visible light that comes from a lamp in your house or the radio waves that come from your cell phone.

Radio Waves are a type of Electromagnetic Energy. Radio waves are important because they are used to carry cellular signals. 5G devices will communicate with base stations by transmitting and receiving radio waves.

5G networks will use millimeter-waves; wavelengths are so small they are measured in millimeters. Millimeter waves can carry huge amounts of data but they do not travel very far – this means that many small cells placed close to each other are needed.

Small cells are about the size of small pizza boxes and are attached onto hydro or light poles. A 2018 Accenture analysis predicted there will be up to 273,000 small cells installed across Canada by 2026.

> **"Millimeter waves can carry huge amounts of data but they don't travel very far."**

This will result in a significant increase in pole attachment and other infrastructure attachment applications for municipalities to review and process.

Traditional Cell Tower

5G Small Cell

Smart Poles

While Small Cells may solve spectrum limitations, they introduce other considerations for Municipalities – impacts to the Public Realm. The introduction and proliferation of Small Cell equipment deployed within the street right-of-way, on hydro poles and streetlights is a big departure from large Cell Tower and rooftop implementations.

One solution that the City of Mississauga is exploring to address Small Cell clutter is the integration of Smart Poles. Smart Poles are multi-functional poles with fully integrated lighting systems. They can increase urban efficiency while reducing energy costs and align with existing LED systems. They contribute to solving many urban problems due to their ability to incorporate software controls, electronics and sensors that can receive and transmit data all in a single aesthetically pleasing pole.

The City of Mississauga has been working closely with Street Lighting Pole vendors to create an Electrical Safety Authority (ESA) compliant Smart Pole based on existing standard poles with new design features added to meet the requirements of 5G small cell attachments. This Smart Pole will be a first in Canada and will become the City standard moving forward. According to the ESA, "This is the most advanced smart pole design we have seen." See **Diagram 1**.

In Canada, "Smart Pole+" systems have yet to be adopted, but they are in use in other countries around the globe. Although the Smart Pole has the ability to integrate software controls, electronics, and sensors that can receive and transmit data, the Smart Pole+ has these features already built in. See **Diagram 2**.

> "This is the most advanced smart pole design we have seen." – Electrical Safety Authority (ESA)

Table 3 compares different types of street lighting poles and their presence within the City of Mississauga.

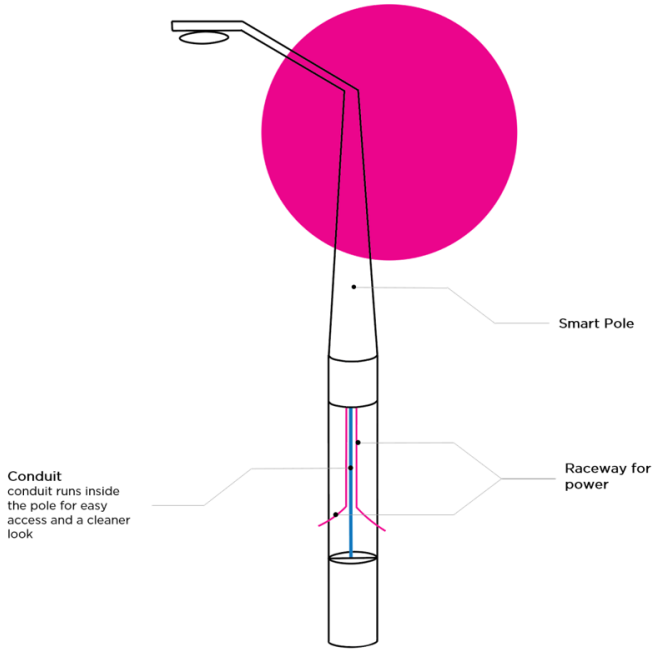


Diagram 1 – New City Standard Smart Pole

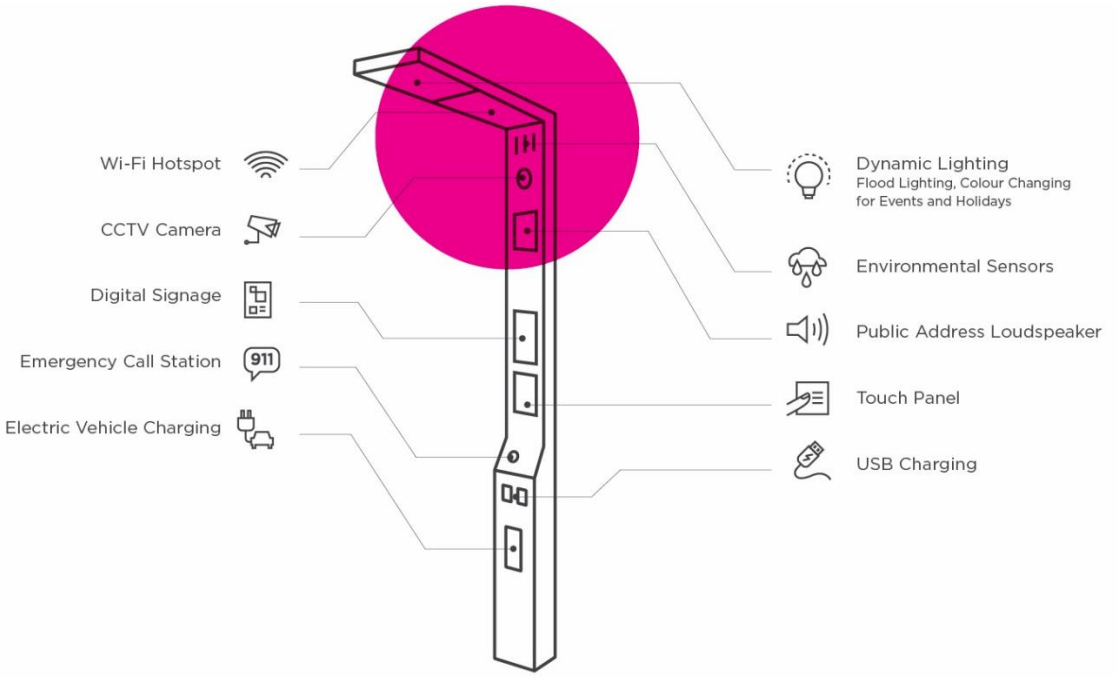


Diagram 2 – Evolution towards Smart Pole+

Table 3 – Evolution of Smart Poles

Attribute	Regular Pole	Trafalgar Pole	Smart Pole	Smart Pole+
Diameter	32.5”	32.5”	32.5”	Varies
Function	Provides Lighting Only	Provides Lighting Plus	Provides Lighting Plus	Provides Lighting Plus
Description	Sole function is to provide lighting	Decorative pole with a large base at the bottom to house Wireless Service Providers’ (WSP) residential communications cabling (fiber). Pole was designed to eliminate the need for street lawn furniture (big green electrical boxes)	Raceways for separating power and fiber are located inside the pole. Hidden from external view. Conduit runs inside the pole, for easy access and cleaner look. Accommodates integration of technologies (ex. small cell, sensor, IoT devices, wireless) on the pole	Multi-Functional poles with fully integrated IoT capabilities
Access	N/A	Access covers are present on the pole. They easy access to their cables during maintenance. Unfortunately, during maintenance, these covers often get damaged or broken. In some cases, access covers are completely missing after work has been completed.	Extra handhold and blank off plate for a pole attachment (e.g. small cell)	Variable. Some have access covers; others incorporate electronics into base of the pole.
Raceways	Raceways on the interior of the pole do not exist	Raceways on the interior of the pole do not exist	Separate raceways for power and fiber allowing for Telco and City differentiation	Software controls, electronics and sensors are incorporated into the pole
Compliance	ESA compliant CSA compliant	ESA compliant CSA compliant	ESA compliant CSA compliant	ESA is Ontario only. Smart Poles are not in use in Canada
Use in Mississauga	**Standard Pole in Mississauga**	**Used in key locations within Mississauga**	**Will become the new City standard. Deployment plans are in progress**	**Plans for procurement or deployment are currently not under consideration**

Radio Frequency

The 5G spectrum falls under Federal Government jurisdiction through the Innovation, Science and Economic Development (ISED) and Canadian Radio-television and Telecommunications Commission (CRTC) and is regulated for its use by ISED across Canada. As part of the Permitting process, the City of Mississauga ensures that pole attachments such as 5G Small Cells meet Industry specifications for installation.

Frequencies are radio waves that are used to carry cellular signals. Current networks use low and medium band spectrum. Low-band radio waves can travel long distances and penetrate buildings, but they cannot carry as much data as the higher frequencies. High-band radio waves carry huge amounts of data, but cannot travel far or penetrate buildings. Small cells will be used for high-band waves. Trials of 3.5 GHz spectrum showed that its range is about 400 meters outdoors.

Low-band 5G:	600 MHz – 700 MHz
Mid-band 5G:	2.5 GHz – 3.7 GHz
High-band 5G:	25 GHz – 39 GHZ

5G Rollout by Tech Companies

To make best use of different types of spectrum, networks will include a mix of traditional cell towers and antennas on rooftops carrying signals over long distances, plus a web of small cells at lower heights supporting huge bandwidth use over shorter distances. These will be rolled out by Telecommunication providers in phases over a period of many years, with phase one currently underway.

The next 2 years– these will be a mix of traditional cell towers (600 MHz) and small cells (3.5 GHz) in high traffic areas. The deployment of Small Cells will be concentrated in high traffic areas such as downtown, Business Improvement Areas and other high foot traffic mixed used locations.

Providers – Antennas - Towers

The Federal Government has jurisdiction over Telecommunication Companies. The Telecommunications Act outlines that Municipalities cannot legislate to control the activities of telecommunications carriers and circumvent the CRTC's jurisdiction, even indirectly.

Telecommunications towers are proposed by private telecommunications providers and are exclusively regulated by Federal legislation under the Radiocommunication Act and administered by Innovation, Science and Economic Development (ISED) Canada. Therefore, Provincial legislation such as the Planning Act, including zoning by-laws, does not apply to these antenna/tower systems. ISED Canada, while requiring proponents to follow the City of Mississauga's Telecommunication Antenna/Tower Siting Protocol, makes the final decision on whether or not an antenna/tower system can be constructed. The City of Mississauga can only provide comments to ISED Canada and does not have the authority to stop the construction of an antenna/tower system.

The City of Mississauga has a protocol for public notification; however, section 4.1 of this protocol exempts antennas mounted on structures such as lampposts, therefore the City is required to be notified of these proposals. Read the City of Mississauga's Telecommunications Tower Siting protocol.

Federal siting rules require telecoms to consult with municipalities, where civic officials may have legitimate concerns over safely setting up equipment in city right-of-ways; however, the Federal government has the final decision. We recognize that with small cell technology there is an opportunity to work collaboratively with key stakeholders to find a balanced solution. Read the ISED information regarding telecommunications towers report - CPC-2-0-03 — Radiocommunication and Broadcasting Antenna Systems.

5G and Health

"Reputable health agencies worldwide have concluded that, based on available evidence, there is no scientific evidence to indicate that RF-EMFs cause negative health outcomes."
– Region of Peel – Public Health

5G Radiofrequency and Health - 5G is new for everyone, however, the frequency spectrum that it resides on is part of the existing spectrum that is monitored and regulated by Health Canada and in particular Safety Code 6. All telecommunications towers, equipment and systems must comply with Health Canada's Safety Code 6, which regulates radio frequency (RF) exposure. The Safety Code 6 limits for human exposure to RF fields are designed to provide protection for all age groups, including children, on a continuous (24 hours a day/seven days a week) basis.

Canada's limits are consistent with the science-based standards used in other countries. Health Canada continues to monitor and analyze scientific research on this issue and should new scientific evidence arise demonstrating that exposure to radiofrequency fields poses a health risk to Canadians, Health Canada will take the appropriate action to safeguard the health of Canadians.

Large safety margins have been incorporated into these limits to provide a significant level of protection for the public and personnel working near radio frequency sources. ISED's regulatory framework, including market surveillance and compliance audits, provides safeguards to protect Canadians against overexposure from wireless devices and antenna installations.

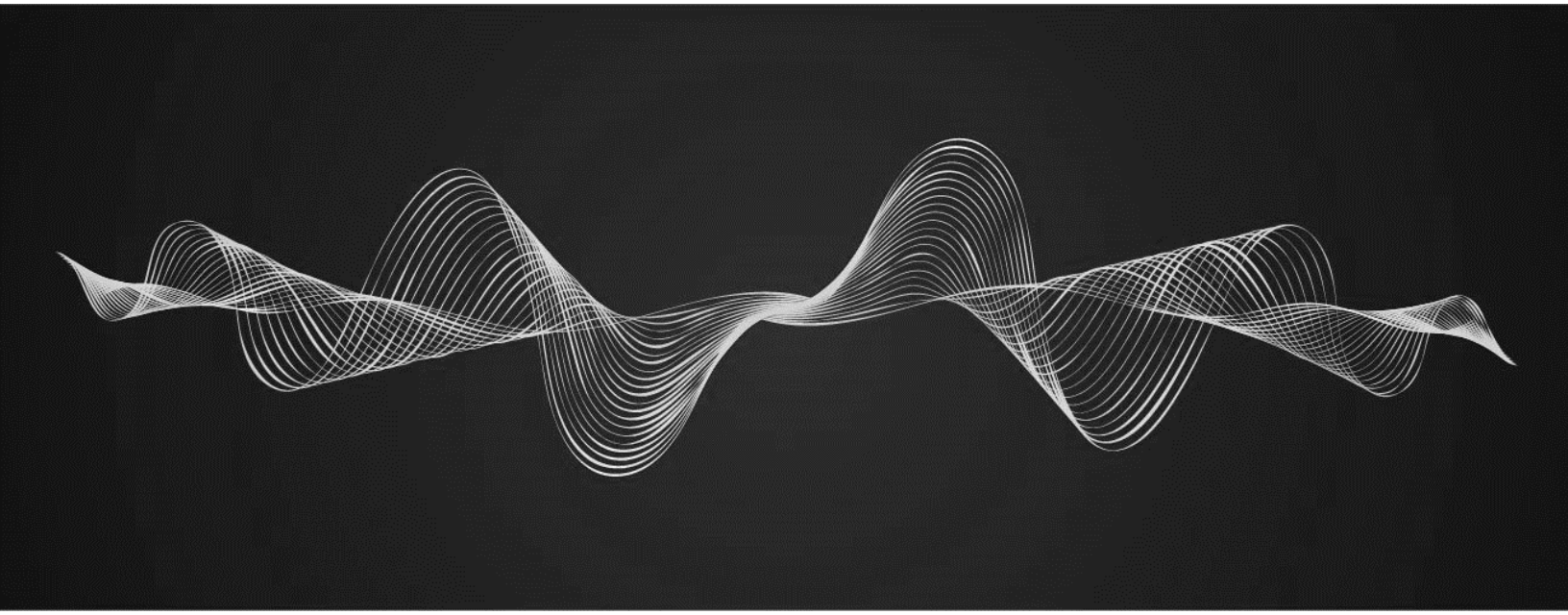
To this effect, ISED requires that all wireless equipment sold in Canada, including consumer devices such as cell phones, tablets and Wi-Fi routers comply with Safety Code 6. Carriers are obligated to comply with these regulations. Similar to current wireless devices and installations, 5G devices will need to meet RF exposure requirements before they can be sold in Canada. Antenna systems operators using 5G technology will continue to have the same RF exposure compliance obligations. Furthermore, compliance with RF exposure requirements will continue to be an ongoing obligation. In cases where residents express concern about this technology and health risks, carriers and Health Canada should be equipped to address the issue.

Canada's approach to RF exposure safety is among the most stringent in the world. The Government of Canada continuously monitors the research and scientific literature on the health effects of RF exposure to ensure that Canadian limits are consistent with the current scientific consensus to prevent potential adverse health effects.

The Region of Peel Health Department submitted a report (item 7.1-1) to Regional Council regarding 5G and have identified that 5G, when implemented to the specifications identified and regulated by ISED, meets Health Canada's requirements and aligns with a standard known as Safety Code 6.

The City of Mississauga will adhere to the same high level of standards by closely following Public Health Canada, CSA and Industry standards.

Cellular Spectrum Auction



Innovation, Science and Economic Development Canada (ISED) manages the governance and licensing of cellular spectrum. It is expected that the broader implementation of 5G across Canada will activate in 2022.

A consultation on 3800MHz spectrum was set to begin in August 2021 to advance on that portion of the 5G spectrum. Both 3500MHz and 3800MHz are considered key due to their ability to transport data at 5G speeds over a reasonable distance.

In light of COVID-19, the Canadian Government delayed the spectrum auction for 3500 MHz from June 5, 2020 to June 15, 2021. Bidding ended on July 23, 2021 with Bell, Rogers and Xplornet successfully winning licenses in the Toronto area (amongst other locations). Amidst its proposed acquisition by Rogers, Shaw Communications did not participate in the 3500MHz spectrum auction.

In March 2021, Rogers Communications signed a deal to buy Shaw Communications in a transaction valued at $26 billion. As part of the transaction, the companies said that Rogers would invest $2.5 billion in 5G networks over the next five years across Western Canada. Rogers also promised not to raise Freedom Mobile prices for at least three years after the deal closed.

The transaction is now awaiting approvals from Canadian Regulators - the Competition Bureau, the Canadian Radio-television and Telecommunications Commission (CRTC), and ISED - but it is expected to close in the first half of 2022.

If Shaw had applied to take part in the auction, ISED Canada would have had to rule on whether the company would be allowed to participate in the auction.

Broadband

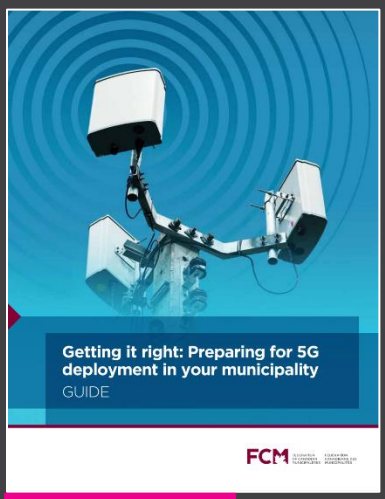
Telecommunications towers and associated technology like fiber to the home are proposed by private telecommunications providers and are exclusively regulated by Federal legislation under the Radiocommunication Act and administered by ISED Canada.

The City helps facilitate the permitting process for Telecommunication companies such as Bell, Rogers, and Telus to support their infrastructure upgrade plans and augmentation to their consumer networks. The companies' internal business processes and competitive strategies drive city locations selected for infrastructure upgrades.

As part of the City recovery plans (Economy, Financial, Corporate, Community) the City will be looking at opportunities for small business, entrepreneurs and industry in general to recover including access to any grants or funding from Provincial or Federal programs and are actively advocating for business and supports for recovery. The Provincial Government has been making funding announcements on broadband but primarily for rural and underserved areas. The City will continue to monitor for any funding opportunities in an urban setting.

Bell is actively building out fiber to the home and Rogers is active on implementing 5G starting in 2021 and scaling up in 2022 moving forward although some exploration and implementation of the 600 MHz has already started. Due to COVID-19, a massive shift to work from home has taken place. Bell and Rogers have paused expansion efforts and instead have been upgrading and adapting their existing wired infrastructure to accommodate the significant demand. COVID-19 has placed greater need on network infrastructure to support the home network.

FCM 5G Position



"Connectivity has become essential for any community's economic, cultural and social development. Even though important challenges remain in terms of access to basic broadband and wireless services in many smaller and rural municipalities—challenges which FCM continues to address in its work—the next wave of innovation is upon us. Telecommunications carriers, the federal government and the CRTC are gearing up for the deployment of the first components of the fifth generation of wireless technology (or "5G")—a necessity if Canada is to remain competitive on the world stage."
Bill Karsten, President FCM

The Federation of Canadian Municipalities (FCM) has issued a guide "Getting it right: Preparing for 5G deployment in your municipality." Implementation advice is provided to municipalities for when 5G is launched across Canada. Additionally, the guide offers a comprehensive overview of 5G, and how FCM has been involved in the regulation commenting process.

The City of Mississauga is aligned with FCM's approach and has been active in assessing and working towards the incorporation of these practices within the organization. Below are some guidelines set out by FCM.

At the Forefront

It has been identified from Canadian municipalities at the forefront of this work and from experience elsewhere, that there are certain steps municipalities can take right away in order to protect municipal interests while making the deployment of 5G networks on their territory as smooth as possible.

Internal Engagement

Depending on your municipality's size and its approach and experience in processing applications from carriers for traditional Rights-of-Way (ROW) work, your internal structures and/or resources may or may not be adequate to deal with 5G issues comprehensively.

Coming together internally to figure out the basic “who does what,” including designating a 5G function within your structure, is often a necessary and worthwhile first step, even before the carriers come knocking.

Engaging Carriers

Being able to anticipate and plan for the arrival of 5G with the carriers is certainly the preferred approach. This might be an optimistic objective as deployment is largely market-driven, with carriers going first where they can make the most money. This can make it challenging to obtain detailed plans in advance. Carriers want to protect their competitive advantages and may be reluctant to share too much information. Furthermore, experience has shown that plans can change suddenly as carriers review their commercial priorities. Nonetheless, engaging carriers as early as possible remains a preferred approach and has proven to work well in Mississauga.

Obtaining information on planned service areas, deployment timelines, preferred support structures, the types of small cells that will likely be used, the requirements for power and cable connections, etc., will allow municipalities to assess what measures are required to ensure that the framework is in place to manage the arrival of 5G technology. A healthy dialogue is often the most efficient way of resolving issues related to infrastructure and implementation.

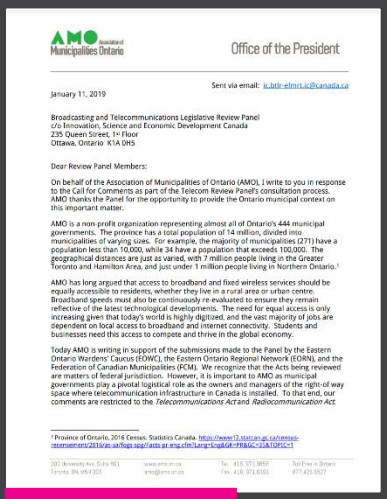
Provider Relationships

By and large, municipalities at the forefront of 5G deployment in Canada have reported good success with most carriers in jointly developing the parameters for a successful 5G introduction on their territory.

Pilots and Soft Launches

In the Canadian municipalities where 5G deployment has progressed the most, municipal officials and carriers have tended to work together in order to proceed incrementally and learn and develop best practices collectively. This has been achieved through limited pilot projects (installing a few small cells in different environments to identify practical issues that need to be resolved) or through soft launches of comprehensive business processes. In these cases, a permitting process and basic legal framework are put in place, a number of installations take place, and the lessons learned from this initial phase are used to inform the final versions of the permit process and master agreement between the carriers and the municipality.

AMO 5G Position



Office of the President

Sent via email: ic.btlr-elmrt.ic@canada.ca

January 11, 2019

Broadcasting and Telecommunications Legislative Review Panel
c/o Innovation, Science and Economic Development Canada
235 Queen Street, 1st Floor
Ottawa, Ontario K1A 0H5

Dear Review Panel Members:

On behalf of the Association of Municipalities of Ontario (AMO), I write to you in response to the Call for Comments as part of the Telecom Review Panel's consultation process. AMO thanks the Panel for the opportunity to provide the Ontario municipal context on this important matter.

AMO is a non-profit organization representing almost all of Ontario's 444 municipal governments. The province has a total population of 14 million, divided into municipalities of varying sizes. For example, the majority of municipalities (271) have a population less than 10,000, while 34 have a population that exceeds 100,000. The geographical distances are just as varied, with 7 million people living in the Greater Toronto and Hamilton Area, and just under 1 million people living in Northern Ontario.[1]

AMO has long argued that access to broadband and fixed wireless services should be equally accessible to residents, whether they live in a rural area or urban centre. Broadband speeds must also be continuously re-evaluated to ensure they remain reflective of the latest technological developments. The need for equal access is only increasing given that today's world is highly digitized, and the vast majority of jobs are dependent on local access to broadband and internet connectivity. Students and businesses need this access to compete and thrive in the global economy.

Today AMO is writing in support of the submissions made to the Panel by the Eastern Ontario Wardens' Caucus (EOWC), the Eastern Ontario Regional Network (EORN), and the Federation of Canadian Municipalities (FCM). We recognize that the Acts being reviewed are matters of federal jurisdiction. However, it is important to AMO as municipal governments play a pivotal logistical role as the owners and managers of the right-of-way space where telecommunication infrastructure in Canada is installed. To that end, our comments are restricted to the *Telecommunications Act* and *Radiocommunication Act*.

[1] Province of Ontario, 2016 Census. Statistics Canada. https://www12.statcan.gc.ca/census-recensement/2016/as-sa/fogs-spg/Facts-pr-eng.cfm?Lang=Eng&GK=PR&GC=35&TOPIC=1

"Today AMO is writing in support of the submissions made to the Panel by the Eastern Ontario Wardens' Caucus (EOWC), the Eastern Ontario Regional Network (EORN), and the Federation of Canadian Municipalities (FCM). We recognize that the Acts being reviewed are matters of federal jurisdiction. However, it is important to AMO as municipal governments play a pivotal logistical role as the owners and managers of the right-of-way space where telecommunication infrastructure in Canada is installed. To that end, our comments are restricted to the Telecommunications Act and Radio communication Act." Jamie McGarvey, AMO President

The Association of Municipalities of Ontario (AMO) President, Jamie McGarvey, wrote to the Broadcasting and Telecommunications Legislative Review Panel in January of 2019 with AMO's position on 5G. In the letter dated January 11, 2019, AMO identifies key issues including the municipality's role in managing the right-of-way and advocates for universal and affordable access.

Municipal governments are essential partners in achieving national connectivity objectives, and are committed to facilitating the timely, orderly, and cost-effective deployment of communications infrastructure.

The role of municipal governments in managing public space for the benefit of all users is a task that no other entity can perform – operationally or legally.

This role is central to achieving the federal government's objectives, particularly as the national deployment of 5G and small cell technologies is set to begin.

That is why AMO agrees that achieving national connectivity objectives must build on and enhance the long-standing partnership with municipalities. These partnerships are critical if the country wants to provide universal access and affordability to all Canadians, as AMO is concerned these issues will only be exacerbated in our province if system-wide solutions are not developed before the next wave of technology is implemented.

CWTA on 5G

The Canadian Wireless Telecommunications Association (CWTA) represents companies that provide wireless services and products. They represent industry before all levels of government and various regulatory agencies, with the goal of ensuring continued growth of the wireless sector in Canada.

In 2019, Canada's telecommunications industry contributed $74.5 billion in GDP to Canada's economy, and supported 638,000 jobs. A 2018 Accenture analysis estimated that Canadian wireless carriers will spend $26-billion on 5G network infrastructure, while adding 250,000 permanent new jobs, and $40 billion in annual GDP to the Canadian Economy by 2026. Read the Letter to Canadian City Officials.

5G can provide more than economic benefits. In December of 2020, the Government of Canada introduced "A Healthy Environment and a Healthy Economy" climate plan, building on the 2016 Pan-Canadian Framework on Clean Growth and Climate Change (Canada's first-ever national climate plan). The new plan is in place to have a net-zero emissions future by 2050. While Canada has made progress toward achieving its climate action goals, 5G is crucial in delivering on reduction commitments that remain a challenge.

A new CWTA report developed by Accenture highlights the role that 5G plays in getting Canada to net-zero emissions.

With the consumption of mobile data surging, the energy efficiency that could be achieved becomes a real focal point. 5G cell sites use only 8-15% of the energy that our existing 4G sites use. In addition, the power consumption by a millimetre wave could be as low as 2% of what is consumed by a 4G macro site. Accenture estimates that these radios, coupled with the implementation of 5G enabled, extended reality, and wireless technologies will result in a reduction of 48 to 54 metric tonnes of carbon dioxide emission in Canada by 2025. That is the equivalent of taking 10.5 million vehicles off the road for a full year.

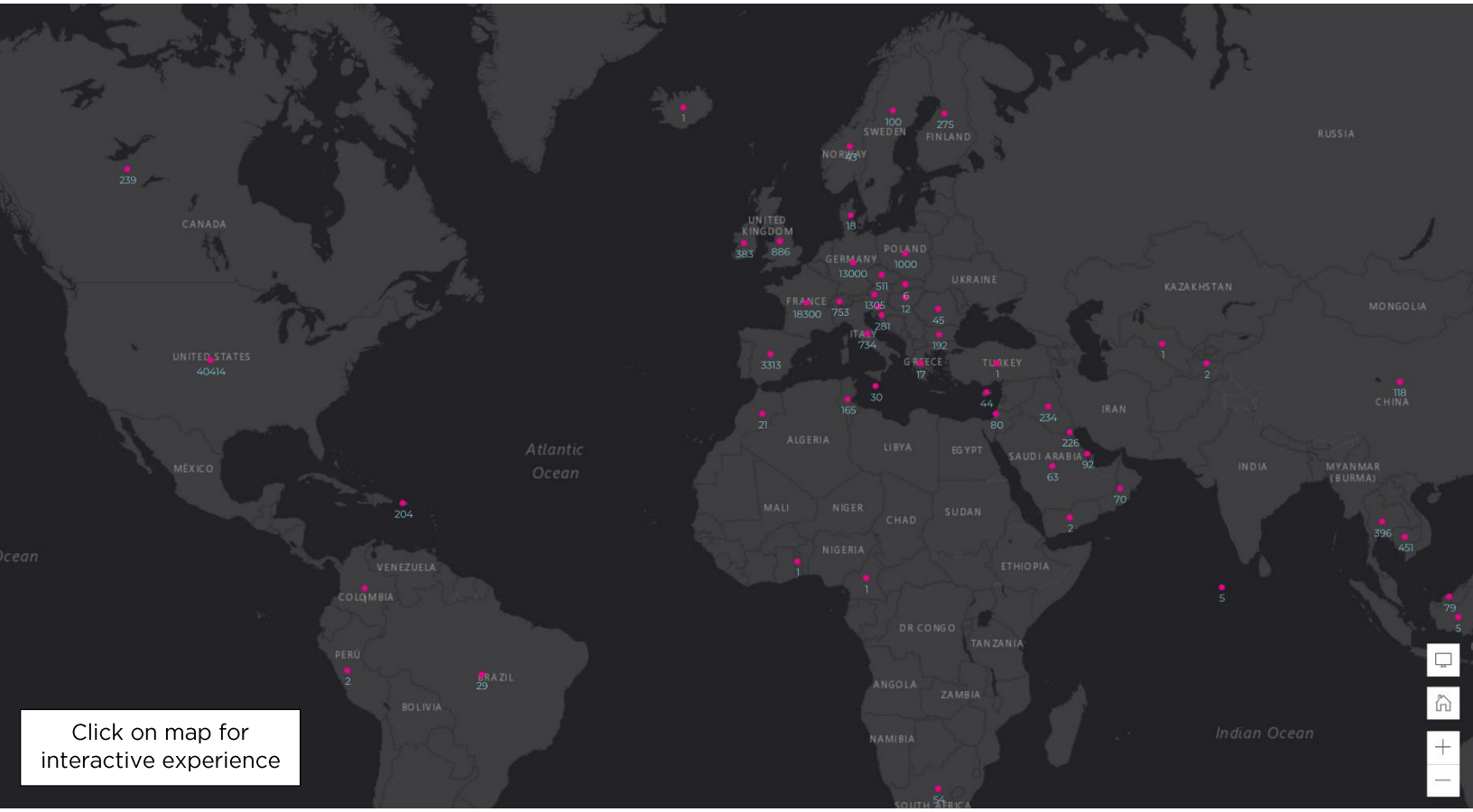
> **"Investing in 5G is key to reducing Canada's carbon footprint."**

Robert Ghiz (President & CEO, CWTA) and Tejas Rao (Managing Director, Global 5G Offering Lead, Network Services, Accenture) emphasize that in order to realize this potential, policy makers have a role. It is essential that siting approval processes are streamlined, access to municipal infrastructure is timely, and the release of radio spectrum in a timely manner occurs.

SMRT CTY

Section 3 – Current State.

5G Global Footprint



When looking at the 5G global landscape, 62 countries had 5G networks as of August 2021 and many more have had 5G mobile technology deployed in part. A more detailed analysis reveals that this network is made up of 84,696 deployments and 179 Operators.

Regarding its adoption, Telecommunication providers have been steadfast in the competition towards 5G. Investments in the technology are being made in almost every country in South and South-East Asia as well as South America. South Korea was the first country to deploy the first 5G network and it is anticipated that they will stay in the lead; by 2025, 60% of mobile subscriptions are expected to be for 5G networks. It is expected that 5G will reach 1 billion users in 3.5 years; this is in contrast to **4 years** it took for **4G** and **12 years** for **3G** to reach the same **1 billion-user mark**.

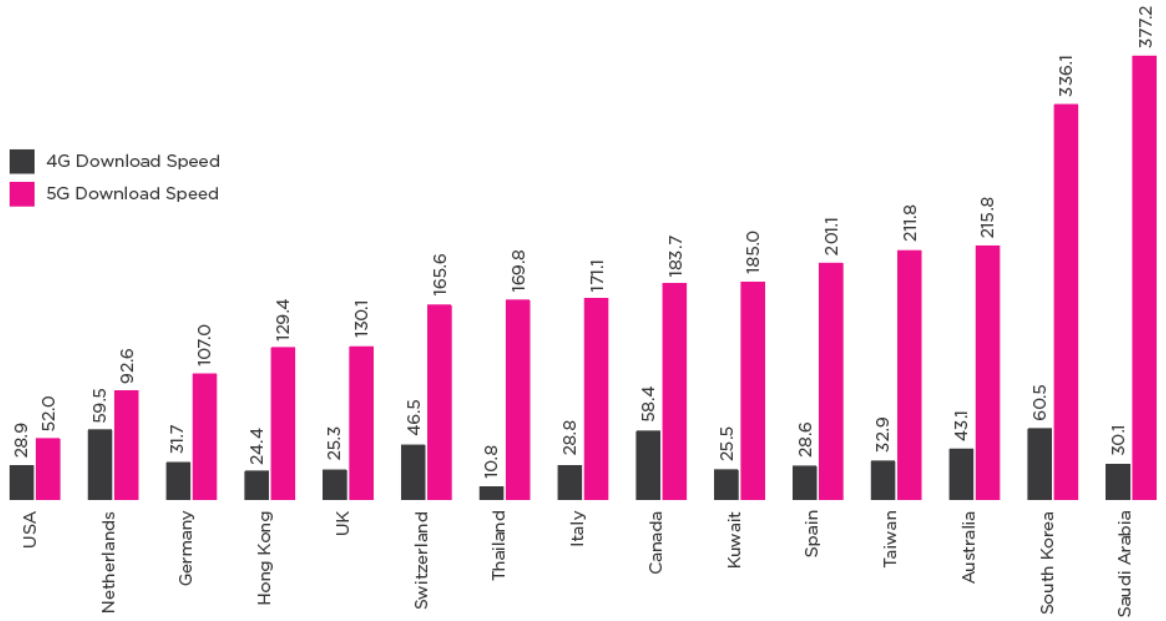
Opensignal's analysis demonstrates that across the globe 5G download speeds are dramatically faster than 4G, with Thailand and Saudi Arabia being the frontrunners (*Opensignal analysis – Benchmarking the Global 5G User Experience* – October, *published on 13, Oct © 2020*).

Canada has been a global leader in fast, reliable telecommunications; **Chart 1** below illustrates that in regards to 4G speeds Canada is amongst the top. 5G speeds depicted in the chart point to a deployment that is not fully established, so we will see greater speeds emerging – especially now

that the spectrum auction has concluded and higher band 5G wavelengths are being deployed. These speeds are achieved whilst adhering to Canada's strict safety regulations and standards.

As was the case with 4G, the safety of the public will be the top consideration and Telecommunication providers will deploy in accordance with the same standards that were in place for previous generations of cellular equipment and infrastructure.

Chart 1 - Download Speeds around the Globe

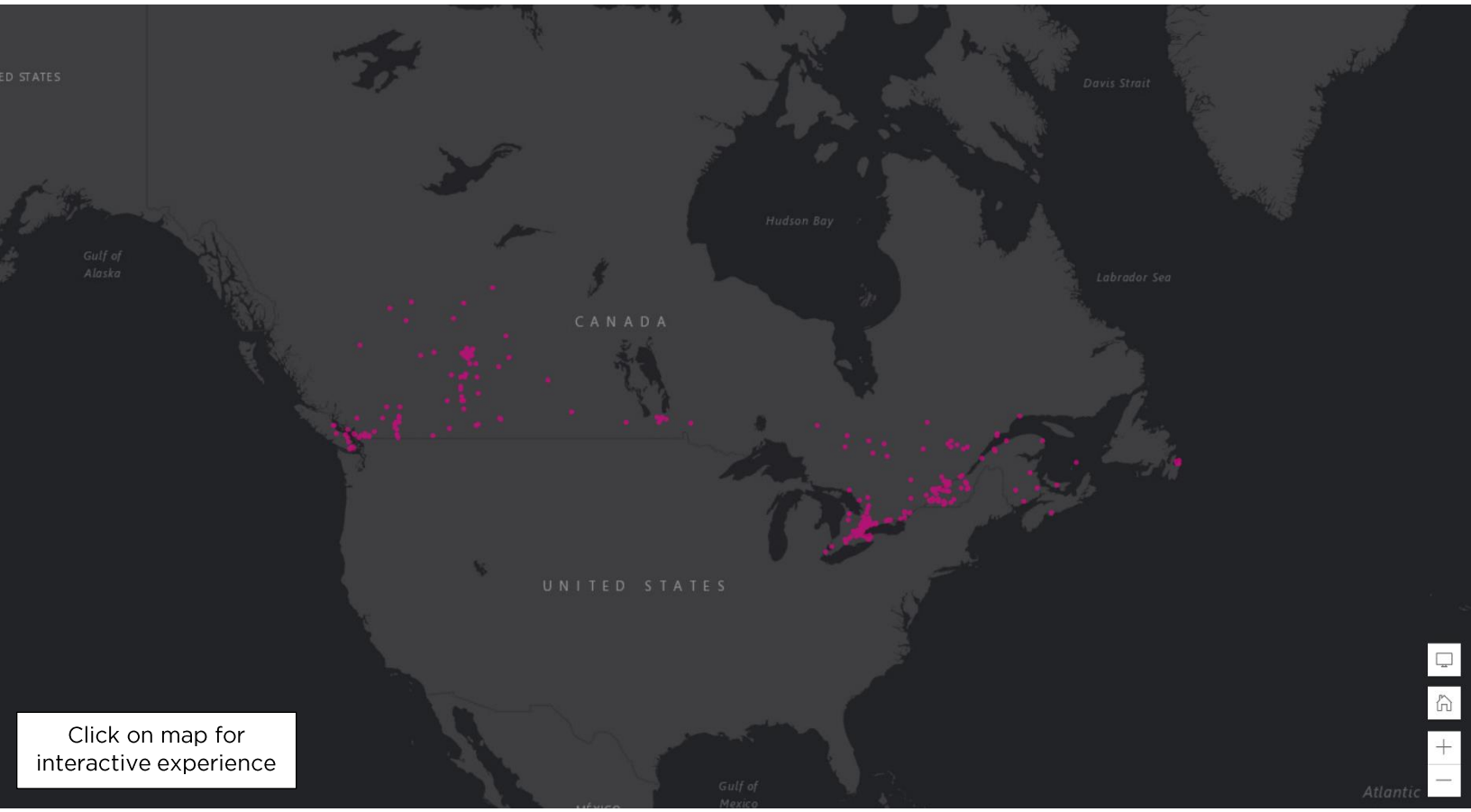


Data collection period: July 1, 2020 – September 28, 2020 - © Opensignal Limited

Table 4 – 5G Global Footprint

Year	Device
2020	• 200 million 5G devices will be shipped in 2020
2021	• 450 million more 5G devices will be shipped in 2021 • 10 million always-connected PC will be shipped
2022	• 1.4 billion 5G smartphones will be shipped by 2022

5G Canadian Footprint



Carriers + Networks

There are currently four 5G service providers in Canada: Rogers Wireless, Bell Mobility, Telus Mobility and Videotron. Rogers went live with its first 5G network in downtown Vancouver, Toronto, Ottawa and Montreal in early 2020. Bell and Telus activated their 5G service the following June in Vancouver, Edmonton, Calgary, Toronto and Montreal. Videotron announced its 5G service in late 2020, but coverage is limited to Montreal for now. It will expand over the next year throughout the province, but it is unclear if customers will be able to use 5G on nationwide partner networks.

Table 5 – When is 5G Coming to Canada?

Carrier	Network	Possible Launch
Bell Mobility	Bell	Available
Rogers Wireless	Rogers	Available
Telus Mobility	Telus	Available
Fido	Rogers	2021
Koodo Mobile	Telus	2021
Virgin Mobile	Bell	2021
Freedom Mobile	Freedom	2021?
Shaw Mobile	Freedom	2021?
SaskTel	SaskTel	2021+
Videotron	Videotron	Available

The results from the Spectrum auction, which ended July 23rd, 2021, illustrate the heavy investments made by each Carrier. Bell, Rogers, and Xplornet made bids for, and were the successful incumbents in the Toronto area (amongst other locations).

ISED set the opening bid for all available spectrum at around $590 million. Final auction revenues came to $8.91 billion due to competitive bidding. **Table 6** represents the 3500MHz spectrum auction results for Canada.

Table 6 – 5G Spectrum Auction

Telecommunications Provider	Licenses Purchased	Amount	Total Population Covered
Rogers	325	$3.32 billion	34,955,719
Bell	271	$2.05 billion	34,269,028
Telus	142	$1.91 billion	24,918,405
Vidéotron	294	$830 million	29,968,515
Cogeco	38	$295 million	10,295,549
Xplornet	263	$243 million	16,585,157
SaskTel	68	$145 million	1,094,704
Valley Fiber	6	$4.8 million	174,449
TBay Tel	4	$1.1 million	29,918,405

Canadian 5G Pilots

There are 5G pilots underway in Canada to test various use cases, the technology and the capabilities. Rogers and the University of British Columbia have embarked on a pilot rendering UBC Canada's first 5G smart campus. A 5G Pilot in partnership with Post-Secondary Institutions is the typical approach observed in neighbouring municipalities and across Canada. Additional pilots of varying scale are underway in the following municipalities: Brampton, London, Toronto, Hamilton, Kitchener, Waterloo, Ottawa, Montreal, Kelowna, and the Region of Peel. In light of COVID-19, the decision to pause on the implementation of a 5G pilot project for the City of Mississauga was made.

The merits of a 5G pilot for the City will be considered under the right conditions and subject to the appropriate approvals.

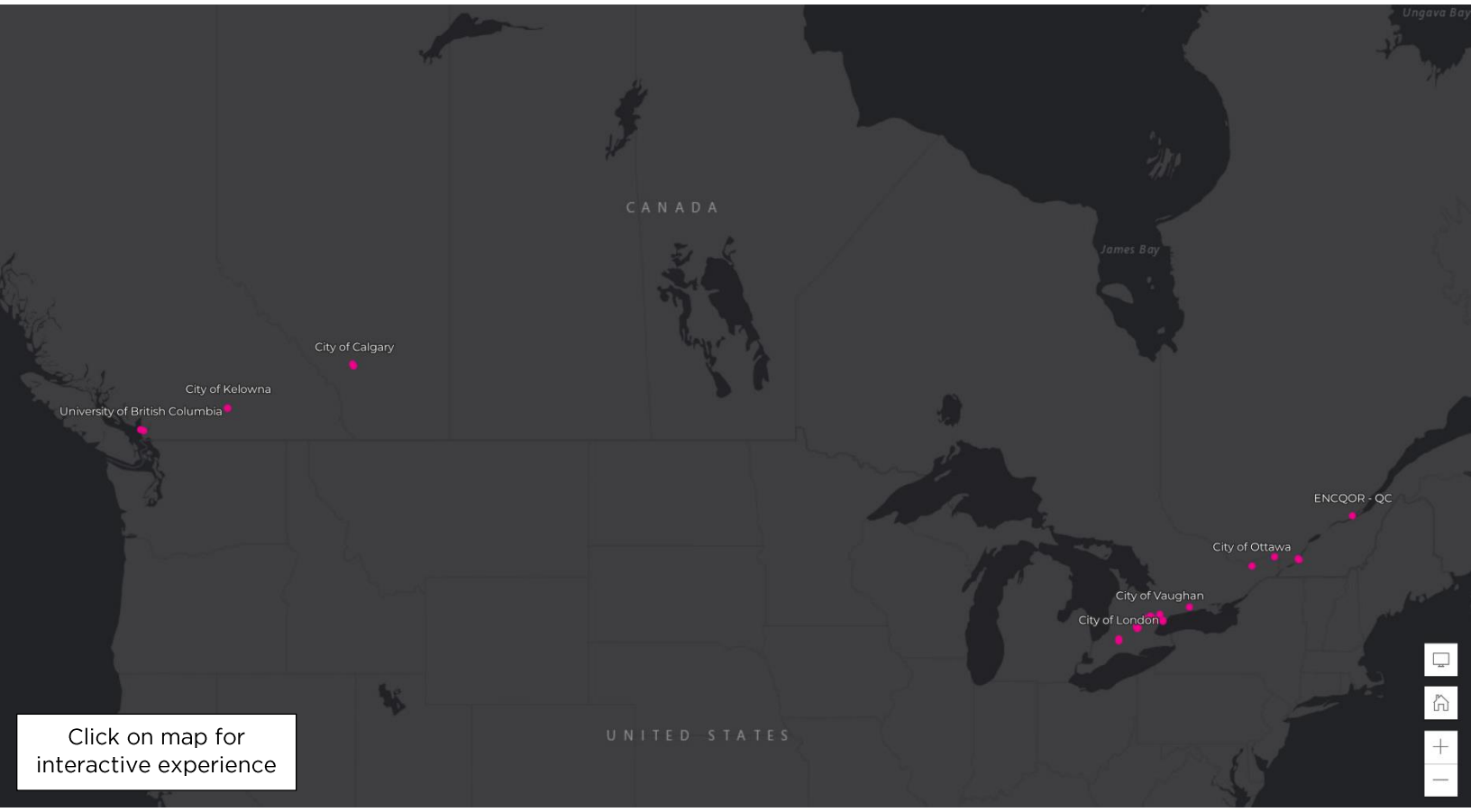


Table 7 – 5G Pilots in Canada

Location	Initiative and Description
Toronto	**Roger's Centre – 5G Test Lab** Rogers Centre stadium is being used to test frequencies and network optimization. The 5G test lab will assess how networks can manage thousands of connected devices and high peak data usage. The stadium's dense concrete structure provides the opportunity to test in an environment that is challenging for 5G. **Ryerson University – 5G Research** Rogers 5G has also been deployed for research purposes with Ryerson University in Toronto, Ontario
British Columbia	**University of British Columbia. First 5G smart campus in Canada and a hub for related research** UBC became the first campus in Canada to be fully outfitted with 5G wireless technology. The pilot was part of a multi-million dollar partnership with Rogers Communications. The campus includes 5G towers and a data centre used by researchers to test 5G applications in a real-world setting. Examples of research projects: earthquake and tsunami detection technology, digital mining technology and 5G Mobility as a Service (MaaS).
Vancouver	**5G Living Lab** Telus is testing 5G technology in Vancouver in partnership with Huawei. Focussing on: designing, testing and deploying new technologies, leading towards the development of 5G based telecommunications networks.
London	**5G Small Cells and related infrastructure** 5G equipment has been installed on 31 municipal lamp posts and traffic signals across 3 pilot areas throughout the city (North London, University campus, downtown London) **Bell + Western University** Western University partnered with Bell Canada to create an advanced 5G research centre effectively turning the campus into a "living lab." Bell will be installing 5G network equipment and infrastructure throughout the campus, investing $2.7 million into the project. The partnership will study 5G applications, including virtual and augmented reality use, smart vehicle and smart city applications, autonomous vehicles, industrial Internet of Things applications, multi-access edge computing, battery and small cell research, machine learning and artificial intelligence.
Brampton	**Algoma University – 5G Smart Campus** 5G will be used within Robotics and Technology classes at Algoma University. **5G Small Cells** 5G Small Cells (Sub-6) will be used for the pilot; this network will be upgraded after next spectrum auction.

	5G Assessment & Technology Study Brampton city staff are working on a 5G Opportunities report to Council. Staff are actively seeking opportunities to collaborate with stakeholders and share relevant data. In addition to this, they have increased their budget to incorporate a 5G technology study. Brampton council passed a motion directing city staff to report back on making 5G technology available across Brampton. **Garden Square** City staff are in the procurement stage of a lighting project for Garden Square that would see new poles and fixtures installed as part of a one for one replacement of the existing lighting assets in the square. The poles are customizable with options ranging from speaker heads, event lighting, CCTV, and Wi-Fi /5G capabilities.
Region of Peel	**Body-worn Cameras** Peel police are testing Axon body cameras. **5G Phones** 5G phone speeds are being tested.
Kitchener + Region of Peel	**Smart Transportation** 5G is being utilized to test mobility as a service and smart transportation capabilities.
Kitchener	**Small Cell and 5G** Small Cells and related 5G technology is being tested. The pilot is similar to the city of London.
Waterloo	**5G Innovation Lab** Three-year partnership between Rogers Communications and Communitech was established to open a 5G innovation lab that will advance made-in-Canada 5G technology and commercialize 5G use cases. The lab is located in Waterloo. **University of Waterloo Smart Campus** University of Waterloo's smart campus is part of a plan by Rogers to advance 5G research in the Toronto-Waterloo tech corridor. The Smart Campus will be a live test bed for advanced research into the design and operation of the network, and the infrastructure necessary to develop and test technologies that 5G will enable.
Kelowna	**Pedestrian and Cycle Safety** In March of 2020, several UBC students were part of a "virtual hackathon," designed to explore how technology could help the city find ways to improve how people move around downtown, and to improve pedestrian and cyclist safety. Two light sensors, powered by the Rogers 5G network will be installed at two downtown intersections next week, one at Bernard and Water Street, the other at Bernard and Pandosy Street. The pilot will allow the city to collect detailed information about the way cyclists, pedestrians and vehicles move and behave in urban environments, which historically has been difficult to collect and share in real time.

UBC + Waterloo + Kelowna	**Pedestrian and Resident Safety** Rogers 5G has also been deployed for research purposes with University of Waterloo, UBC and pilot project in Kelowna. Areas of research include LiDAR based systems towards Vision Zero goals. Emergency Dispatch in Waterloo has also leveraged this data for piloting purposes.
Montreal	**5G Living Lab** Preparations for a "living lab" to test 5G technology in Montreal started in summer 2020. In the fall, the city and private sector partners installed about 200 antennas in the downtown core. The goals are to ensure that 5G is deployed as quickly and efficiently as possible, and to investigate whether there is any truth to claims of adverse health effects from 5G. The pilot project, partly subsidized by the Quebec Union of Municipalities, will allow high-tech start-ups and other companies to test applications.
Ottawa	**Outdoor 5G Test Site at City Hall** The Communications Research Centre (CRC) has built an outdoor 5G test site at City Hall. The CRC is part of ISED. CRC in collaboration with the City of Ottawa have built a 5G site, testing out 5G core capabilities – how 5G devices should communicate with 4G networks, research into overcoming technical challenges posed by 5G.
Calgary	**Platform to Combat Homelessness** The City of Calgary is looking at 5G to combat and prevent homelessness. Utilizing Open Data and AI to detect patterns revealed by data can indicate individuals who are at risk of becoming homeless. This data will be utilized to prevent the issue before its onset.
Vaughan	**5G Small Cell Pilot and Master License Agreement** The execution of a Master License Agreement between Bell Mobility and the City to permit the placement, maintenance, repair and replacement of micro-cell telecommunication equipment on city streetlight poles in the Block 55 development area. The micro-cell technology has been installed on thirty-one city streetlights in the residential community in Block 55 – Kleinburg Summit as a pilot project. The Master License Agreement has been drafted based on the existing agreement related to the joint-use (Trafalgar) streetlight pole.
ENCQOR 5G Locations - Ontario (Ottawa, Toronto, Kitchener-Waterloo) and Quebec (Montreal and Quebec City)	**Canada's first pre-commercial 5G wireless testbed for open innovation** Companies and organizations are carrying out or planning tests at the Montréal and Québec innovation sites to prepare for receiving 5G technology and to measure its benefits for their products and services. There have been 5 hub locations launched: Ontario (Ottawa, Toronto, Kitchener-Waterloo) and Quebec (Montreal and Quebec City). These facilities offer high connectivity, high capacity, and low latency, a perfect testbed for vendors to test and measure the benefits of their products and services. ENCQOR 5G brings together, industry, government, researchers and academia in both Quebec and Ontario to collaborate on the

	commercialization of disruptive products, processes, and services, providing a first-to-market advantage for new 5G innovations. ENCQOR 5G includes five digital technology leaders (Ericsson, Ciena Canada Inc., Thales Canada Inc., IBM Canada, and CGI) as well as provincial coordinators INNOVATION ENCQOR, Prompt and CEFRIO in Quebec and Ontario Centres of Excellence (OCE) in Ontario. The five-year ENCQOR 5G project is made possible in part by funding from the Canadian government and the provincial governments of Quebec and Ontario and is expected to create 4,000 jobs including 1,800 specialized 5G jobs.
Hamilton	**5G/LTE/AV Pilot - Multimodal and Integrated Mobility** Hamilton's Innovation Factory is testing traffic sensors at the Centre for Integrated Transportation and Mobility (CITM) to support autonomous vehicle startups. Tests involve equipping street furniture with 5G transmitters designed for traffic optimization, parking detection, environmental monitoring and other public safety functions. Locations of these tests will start at the McMaster Innovation Park and then expand to Hamilton Mountain. Hardware for these tests will be supplied by GE and Nokia.

5G Mississauga Footprint

Telecommunication carriers are actively deploying the 5G network within the City of Mississauga.

To make best use of different types of spectrum, deployment will include a mix of traditional cell towers and antennas on rooftops carrying signals over long distances, plus a web of Small Cells at lower heights supporting huge bandwidth use over shorter distances.

The deployment of Small Cells will concentrate in densely populated areas, such as Business Improvement Areas (BIA), Mississauga's downtown core and urban areas. Subdivisions and areas without above ground power poles are unlikely to be selected.

"Telecommunication carriers are actively deploying the 5G network within the City of Mississauga."

Carriers will not rely exclusively on city-owned infrastructure, as they have a healthy mix of telco-owned assets, private assets, and utility agreements that they would leverage.

Toronto Pearson International Airport

The federal government has proposed exclusion and protection zones around airport runways. Exclusion zones do not permit any 5G base stations (small cells) to be in the area. Protection zones are locations around the airport where 5G services face restrictions.

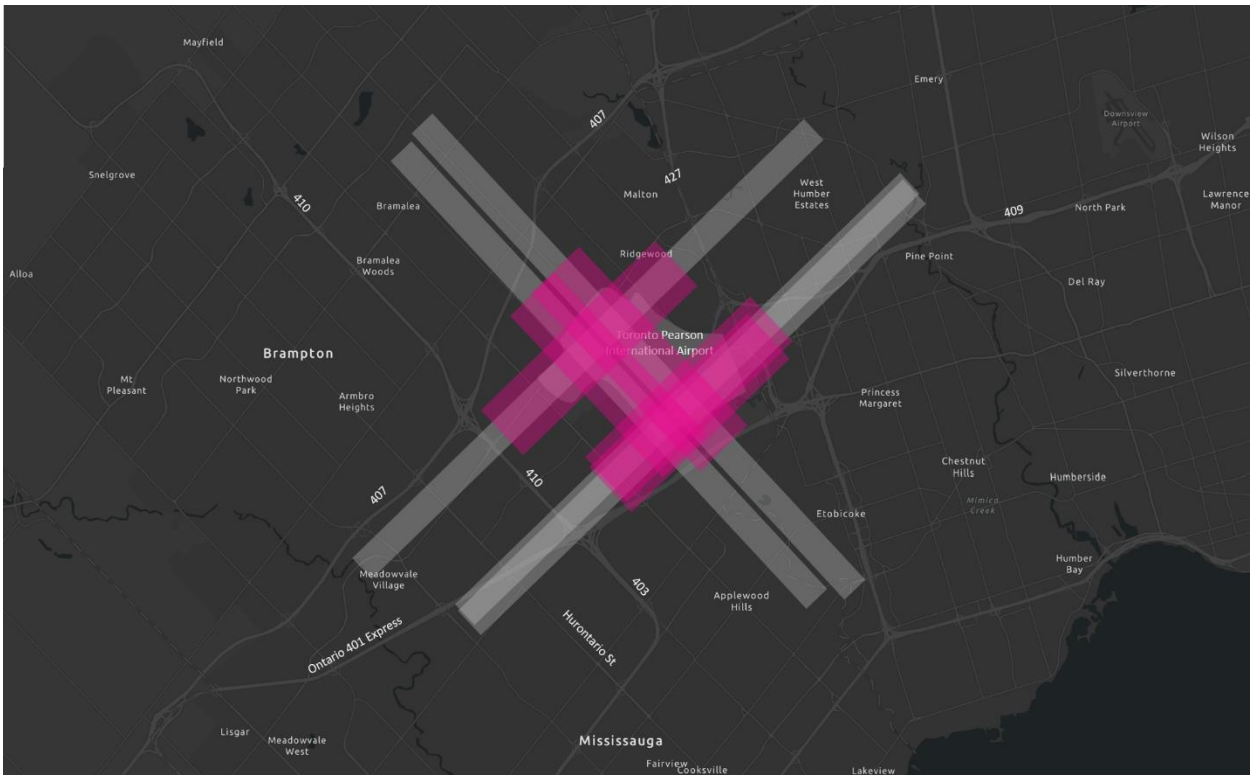
See **Diagram 3** for a map of the exclusion and protection zones for Toronto Pearson International Airport.

These restrictions are being introduced because there are concerns about possible interference between 5G 3500MHz spectrum and altimeters (aviation navigation tools used in automated landing); Radio altimeters operate in the 4,200MHz to 4,400MHz frequency band.

In comparison, Canada is proposing a buffer between 550 MHz and 700 MHz, whereas regulators in the United States have determined a guard of 220 MHz, Australia of 200 MHz and Japan of 100 MHz.

The Department of Innovation, Science and Economic Development (ISED) was set to hold a consultation on Oct 15, 2021 before applying the restrictions. The original date of Aug 6 was pushed back to allow more time for Carriers to file their comments with ISED.

Diagram 3 – Exclusion & Protection Zones around Pearson [back to top]



Map source: Government of Canada. An Interactive version of the map is available here.

Public Engagement

The Smart City website has been updated and includes information related to 5G. The website is a location where the public can learn about the Smart City Master Plan, projects that the City is undertaking, and enables public consultation and input. 5G is one of the projects identified in the Smart City Master Plan.

5G Public engagement events were suspended due to COVID-19, but remain an integral component not only to 5G but to the overall Smart City program. Citizen engagement is engrained in our Smart City Master Plan. The Centre for Civic Curiosity was introduced in the Smart City Master Plan, and will serve as a space for public engagement and input. Due to COVID-19, the physical space and related activities were suspended, but plans for launch are still underway.

Public Sector Network

The City of Mississauga currently owns the largest Public Sector Network (PSN) in Canada. It boasts 985 connected sites and 47,000 km of fiber (nearly enough to cover the circumference of the Earth).

The City of Mississauga has been a leader in public service by building its own fibre infrastructure for over 25 years. Through a partnership with Peel, Brampton and Caledon, Mississauga established the Public Sector Network and it is the largest publicly owned and operated fibre network in Canada. It also provides dark fibre services within Peel to other agencies at very favourable costs. This has been a foundational aspect for becoming a Smart City and an important asset for the Smart City Master Plan. The City has been able to enable voice and data communications across a large campus of buildings and infrastructure supporting first responder and city services without leased line costs. In addition, the city has the largest outdoor free public Wi-Fi network in Canada; Wi-Fi is also located indoors in all facilities serving in excess of 8 million hours of free public Wi-Fi on average each year.

The coming generation of connected technologies requires the high speed, high connectivity and low latency characteristics that 5G can provide. Some of these will be met with Mississauga's existing infrastructure (PSN, PSBN, fiber); however, there will be areas where small cells will be required in order to achieve these benefits. There also exists a potential revenue stream for the City of Mississauga through the leasing of its dark fiber. The opportunities that 5G holds will begin to reveal throughout the coming years as more is learned about the technology and its capabilities.

Public Sector Broadband Network (PSBN)

Through the VCOM group, the Region of Peel is currently building out a 700 MHz Public Safety dedicated LTE cellular network in partnership with Peel Police and Halton Police. Public Safety Broadband Network (PSBN) was established and the 700 MHz spectrum was assigned for public safety as a key recommendation because of 911. This will ensure dedicated and uninterrupted cellular service for first responders and critical infrastructure communications. The broader roll out of PSBN across Canada is currently being reviewed with a decision from ISED expected which will see the implementation and operations of PSBN across the country. This is expected to be a hybrid model with Commercial Carriers and PSBN operators expanding cellular infrastructure across Canada and providing opportunity to provide consumer and business broadband in areas underserved across Canada. This will be staged over many years but the objective is to collaborate and optimize cellular and wired infrastructure across Canada. In February 2020, the City had the opportunity as a member of the PSBN Innovation Alliance, along with Police and Fire Chiefs from the GTA, to make submissions to the CRTC on broadband focussing on PSBN and advocating for a hybrid model across Canada.

Agreements and Permits

Carriers looking to install cell towers have to get approval from the Federal Department of Innovation, Science and Economic Development. This is a departure from the process required for small cell deployment; if carriers wish to attach small cells to public infrastructure or lay wire underground, they must get permission from the local municipality.

There have been disputes between cities and carriers over the locations of cell towers or the need to trench roads to install fibre. Although, the CRTC has the ability to resolve disputes over transmission lines, the process can be lengthy. It is common for negotiations with municipal governments to last two years or longer. The growing concern from carriers is that if governments delay access to infrastructure, Canada could fall behind other countries in the race towards 5G.

PUCC

For broadband/cable, trenching and installations Telco's need approvals from a variety of agencies. The PUCC system streamlines this process by allowing each Telco to apply online and all members to receive a notification to an item that requires their attention. Approvals are recorded in a centralized system that all appropriate parties have access to. The steps in the application are automated and advance through each phase according to the process guidelines. Auditing controls are in place and ensure that every step and document is captured and stored.

Agreements

Throughout the City, there are agreements that exist – but none of them directly specified/included 5G Small Cell technology. To ensure there was no overlap with the new 5G processes underway, revisions were made to the existing agreements to include 5G considerations.

City Agreements Include - Municipal Access Agreement, Pole Attachment Agreement, Telecommunication Antenna/Tower Siting Protocol, Leases/Tower Agreements, and Signal Enhancing Devices.

SMRT CTY

Section 4 – Future State.

Public Realm

Streets define the image of a city and promote walkability. Streets, like well-designed architecture, aspire to achieve good aesthetics and practical goals. As the City of Mississauga shifts away from auto dependence towards public transit, walking and cycling, it is important to place a greater emphasis on the pedestrian portion of the boulevard.

As a result of the move towards a more urban environment along corridors and intensification areas in the City, the amended boulevard treatment becomes relevant. An "Amended Boulevard Treatment" currently exists for the Downtown Core. With the increase of urban development and a focus on creating an attractive and predictable streetscape throughout the City, boulevard treatment will be expanded to locations such as Intensification Areas, Corridors and Community Nodes, and for sites that propose buildings that are located close to the street to create an urban feel.

The City's intensification nodes and corridors, as described in Mississauga Official Plan (MOP), require that the public realm, or boulevards espouse a high quality design treatment to create a strong sense of place that is attractive, comfortable and creates civic pride. In the intensification nodes and corridors, the City holds the public realm to the highest design standards.

Section 9.2.1.36 of MOP states, "Streetscape improvements including trees, pedestrian scale lighting, special paving and street furniture in sidewalks, boulevards, open spaces and walkways, will be coordinated and well designed."

"Streetscape improvements including trees, pedestrian scale lighting, special paving and street furniture in sidewalks, boulevards, open spaces and walkways, will be coordinated and well designed."

As per the 2016 06 27 Report to Planning and Development Committee, development applications are required to provide an upgraded boulevard treatment, or an "Amended Boulevard Treatment" in the intensification nodes and corridors. The Amended Boulevard Treatment generally provides a wide sidewalk for pedestrian use, a corridor for the planting of trees and it is within this corridor that the vertical elements such as streetlights are provided. Co-ordinated streetscape furnishings are also provided in this corridor. Where Smart Poles are introduced in place of streetlights into boulevards along intensification corridors or in intensification nodes, they must complement the existing components in the boulevards. Further, the installation of a Smart Pole into an existing Amended Boulevard Treatment must be undertaken in a manner that does not disturb or destroy existing trees or eliminate the opportunity for future street trees.

MISSISSAUGA

Small Cell Requirements

Pole Attachment Permits

The City of Mississauga owns the Streetlight poles and Streetlight luminaires within the City of Mississauga. Telecommunication Service Providers own their Cellular Towers and they lease attachments on privately owned buildings/structures/property. To provide improved cellular coverage for areas of high density, Service Providers are requesting access and permission to mount Antennas (also known as Small Cell Radios) on City owned Streetlight Poles.

Third Party entities such as, Telecommunication Service Providers and other municipal partners (Region of Peel, City of Brampton, Ministry of Transportation, and educational institutions) may request permission, and access to City of Mississauga Streetlight poles to co-locate third party equipment. These devices can range from Road Weather stations, Traffic Sensors, Telecommunications Cellular Radios, Wi-Fi Access points, Environmental sensors, as well as other IoT (Internet of Things) devices.

The Carriers are responsible for submitting detailed information regarding their proposed Cellular Small Cell equipment. The City of Mississauga considers many variables when reviewing and allowing potential device installations on Streetlight Poles, such as safety regulations, aesthetics, RF interference, streetlight pole loading, and electrical power provisioning and installation. The City of Mississauga and Alectra Utilities must approve all Pole attachments and installations must follow existing City of Mississauga PUCC/Road Occupancy processes.

The City of Mississauga is putting in place an online solution that will handle the intake of all Pole Attachment Permit requests and manage the process end-to-end. Pole reservations will be processed on a first-come, first-served, basis.

“The City of Mississauga is putting in place an online solution that will handle the intake of all Pole Attachment Permit requests and manage the process end-to-end.”

Fees and Charges

Table 8 represents the Fees and Charges approved into By-law for Pole Attachment Permitting.

Table 8 – Fees and Charges [back to top]

Fee	Description	Unit	Frequency	Allocation
$2,000	Permit Fee	Per Attachment	One time	City of Mississauga
$250	Maintenance Fee	Per Attachment	Annually	City of Mississauga
Direct Cost + Admin Fee	New Pole Cost + Admin Fee	Per Pole	One Time	City of Mississauga Alectra Power Services

Revenue and Resource Impacts

An increase in requests for access to City infrastructure is anticipated. It is anticipated that resources will be required to handle the increase in work volume. It is expected that revenues generated from Pole Attachment permitting will fully offset the cost of additional resources. The revenues generated from Pole Attachment permitting will provide the funding for these resources with one-time revenues for installation and ongoing annual fees for ongoing inspections and maintenance.

Master Agreements

Staff from various departments have been engaged and are working towards a Master Agreement for Pole Attachments. Master Agreements with telecommunication providers for Pole Attachments have been drafted and are expected to be in place early in 2022, which will enable the implementation of 5G and ensure provisions are in place for the ongoing operation of 5G small cell technology on City owned infrastructure.

Wooden Poles

No Cellular Telecommunications Carrier Small Cell attachments will be permitted on City of Mississauga Wooden Streetlight Poles.

Spacing of Small Cells

Third Party Pole attachments will be limited to attachments on every other pole in a linear pole line. This will ensure equity of access to telecommunication providers for the installation of small cell technology as well as limiting the attachment to just one per pole.

Future Pilot

The population of Mississauga is becoming increasingly digital. As a result, the demands on telecommunications infrastructure are rapidly increasing. Future linked technologies, driverless vehicles, IoT-enabled devices, virtual and augmented reality will increase bandwidth, connectivity, and latency demands on networks dramatically.

> "A 5G Technology Pilot project would demonstrate how the provision of services could be enabled by high-speed broadband."

The increased demand for digitization and connectivity among our residents and businesses mandates the implementation of telecommunications equipment that can meet these demands.

A 5G Technology Pilot project would demonstrate how the provision of services could be enabled by high-speed broadband.

Staff will assess any opportunities, should they arise, and ensure that the required processes, communication and agreements are completed.

Beyond 5G

Data moving close to the speed of thought. Cyberspace being able to support human thought and action in real-time. Mesh networks instead of cellular networks. This is the anticipated world of 6G. While the focus remains largely on 5G, some countries are already in the early research phase of 6G.

Table 9 – Beyond 5G

Timeframe	Initiative Description
2018	Finnish 6G Flagship Program centered at the University of Oolu in Finland. An eight-year research program defining the 6G Vision for 2030. The program will consist of four research areas: wireless connectivity, device and circuit technologies, distributed intelligent computing, and sustainable human services and applications.

2020	China has already put a 6G experimental satellite into orbit. The satellite weighs 70kg and is being used to test data transmission over long distances using Terahertz spectrum. China plans to roll out 6G by 2029 and the CNIPA (China National Intellectual Property Administration) claims to have 35% of the ~38,000 patents related to 6G.
2021	EU (European Commission) began research on 6G. Focus will be on developing the vision for 6G systems and the technology that will enable human, physical and digital worlds to be connected; applications that will connect humans not only to machines but also to the digital world. These connections can be used for preventative healthcare or a network that understands our intentions. The research project includes a consortium of industry and academic stakeholders; Nokia and Ericsson are key members of the consortium. United States and Japan have teamed up to invest in 6G technology. U.S. President Joe Biden and Japanese Prime Minister Yoshihide Suga have agreed to jointly invest $4.5 billion for the development of 6G. United States has agreed to contribute $2.5B and Japan has agreed to $2B. The investment will be put towards research, development, testing, and deployment of secure networks and advanced information and communications technology. The intention is to create an alternative to a China-led communications network by looking at Open-RAN. Open-RAN is an open-source platform where network operators can mix and match hardware from different vendors, without having to own entire systems of antennas and base stations. Another goal is to elevate Japan's share of patents to 10%. This will require U.S sanctions on China to be revisited. China is a major market for Japanese equipment makers. Japan is also investing independently of the U.S. $482M is being put towards helping 6G become more widespread in the next few years. Funding is also being allocated to a research facility to develop wireless projects. Goal is to highlight standout technologies by 2025. United States also announced its partnership with South Korea for 6G research. Mobile companies AT&T, Verizon, and T-Mobile are leading an industry initiative with Alliance for Telecommunications Industry Solutions (ATIS) called the Next G Alliance to help organize and further 6G research throughout North America. In May of 2021, the Next G Alliance began a technical work program to coordinate a series of new workgroups with the specific goal of developing 6G technology. If the patent numbers are correct, United States comes in second behind China, with around 18% of all 6G patents at this time. Germany announced that they are establishing a 6G research facility in Dresden.
2026	South Korea is looking to launch a 6G pilot in 2026. South Korea – Samsung working on 6G and predicting 6G deployment to occur in 2028.
2030	Nokia expects 6G systems to launch commercially by 2030.

Speculation into 6G

The world of 5G and its technology is still the primary focus for Mobile Technology companies. There are still many issues with 5G that are being addressed, so while it may seem premature to think about 6G, research has already began. It is not unusual in the tech world to do things this way; even though Small Cells are only now commercially available, they actually existed back in 2013.

Researchers and scientists are talking about 6G going beyond the "wired" network, where devices like our smart phones, will act as antennas over a decentralized network (not under the control of a single operator); making device-to-device connection possible. This will replace the cellular networks that we have today with the expansion of mesh networks.

Wearable devices and micro-devices mounted on the human body will support human thought and action that will be processed in real time. 6G will likely operate on Terahertz spectrum; this means that data will move close to the speed of thought (1 terabyte per second). With that kind of speed, 6G will make 5G look like 2G. It has also been estimated that with 6G speed, we will have the ability to download 142 hours of Netflix movies in one second.

The technology is expected to support wireless brain to computer interfaces and brain implants that control computers. To a degree, this already exists today. Neuralink, a neurotechnology company founded in 2016 by Elon Musk and eight others develop implantable brain-machine interfaces (BMIs). Although human trials are anticipated for 2021, monkeys and pigs have demonstrated early functionality of these devices.

There is also an expected proliferation in the use of smart materials, metamaterials, and metasurfaces, where everyday surfaces and materials will be able to communicate digitally. Beyond digital surfaces, remote holographic surgery, hologram user interfaces, and high fidelity mobile holograms may also emerge.

There is plenty of hypothesizing, however the reality is that, 6G will depend on how high a frequency is selected and how much infrastructure investment is made. 6G standards (just like its predecessors), will come from the International Telecommunication Union (ITU). It took more than eight years for these standards to be established for 5G, so the length of time for it to arrive for 6G is not known. However, it is anticipated that early commercial deployment of 6G is expected around 2028-2029 (not full deployment, just early presence of it).

SMRT CTY

Section A – Terms.

Terms

Term	Definition
5G	Fifth generation technology standard for cellular networks.
Access Point (AP)	Hardware that allows other Wi-Fi devices to connect to a wired network. The AP usually connects to a router (via a wired network), but it can also be a component of the router itself. APs support the connection of multiple wireless devices through their one wired connection.
Artificial Intelligence (AI)	The ability of a computer program or a machine to think and learn. The ability of computer systems to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.
Augmented Reality (AR)	A combination of real and virtual worlds. A technology that superimposes a computer-generated image onto a user's view of the real world.
Autonomous Vehicles	A vehicle that is capable of sensing its environment and moving safely with little or no human input.
Backhaul	A portion of the network. It consists of intermediate links between the core (backbone) network, and the small subnetworks at the edge. Used to transmit a signal from a remote site to another site (usually a central one).
Bandwidth	Measures the *amount* of information that can be sent over an internet connection in a given amount of time. Usually measured in megabits per second (mbps).
Big Data	A massive volume of both structured and unstructured data that is so large it is difficult to process using traditional database and software techniques.
Broadband	The name given to any fast, permanent internet connection. Dial-up internet is slow because it uses a single band. Broadband uses many bands. A separate band for uploading, downloading and voice. Making it a fast, permanent internet connection.
Cabinet Box	Fully enclosed cabinets that help protect electrical cabling and other equipment from potentially damaging environments, including those that contain dust, rain, ice, and external heat. They also ensure that the equipment in the box is only accessible to authorized personnel.
Cell Towers	An elevated structure with the antenna, transmitters and receivers located at the top. The primary function of a cell tower is to ensure proper elevation to antennas that receive and transmit radio-frequency signals from cell phones and other devices.

Conduit	Duct pipes that are used to house and protect electrical power and telecommunications cables. High-density polyethylene (HDPE) is the preferred material that conduit is made from. It offers unmatched corrosion and chemical resistance, and it is flexible and durable.
Edge Compute	Computing that is done at or near the source of the data. Minimizes the amount of long-distance communication that has to happen between a client and server. This reduces latency and bandwidth usage.
Electromagnetic Spectrum	Term used to describe the entire range of light that exists. It includes both visible and invisible light.
Fiber (aka Dark Fiber)	A type of cable that is used for high-speed data transmission. It contains tiny glass or plastic filaments that carry light beams. Digital data is transmitted through the cable via rapid pulses of light. Because fiber optic cables transmit data via light waves, they can transfer information at the speed of light.
Frequency	A measurement unit is in hertz (Hz). Measures the number of waves that pass by a point in one second.
Handhole	Pull box, access box, underground utility box, junction box, underground enclosure, and splice box are all terms used interchangeably for a Handhole. A shallow access hole large enough for a hand to be inserted for maintenance and repair of fiber, equipment.
Internet of Things (IoT)	Physical objects ("things") that are embedded with sensors, software, and other technologies. This enables them to connect and exchange data with other devices and systems over the internet.
Joint Use Trench (JUT)	Joint trenching is the practice of burying different *dry* utilities (hydro, electricity and telecommunications) together in one trench. The pipes and cabling for dry utilities can be run through a single trench. JUTs are typically located within boulevards. Wet utilities (gas, water, storm, and sewer) are *not* co-located in a JUT. Wet utilities are typically found in roadways and maintain a separation from each other.
Latency	A fancy word for the lag that is experienced while waiting for something to load. The amount of time it takes information to travel from one connected device to another connected device.
Light Detection and Ranging (LiDAR)	A technology that measures the distance between objects by hitting the target with a laser and analyzing the reflected light. This data is then used to generate 3D representations of the target. LiDAR sensors are used by autonomous vehicles to navigate their environments, but they have many additional applications, across various industries and fields.
Living Lab	A living lab, or living laboratory, is a research concept, which may be defined as a user-centered, iterative, open-innovation ecosystem, often operating in a territorial context (e.g. city, agglomeration, region or campus), integrating concurrent research and innovation processes within a public-private-people partnership.

Millimeter Waves	Wavelengths that are so small they are measured in millimeters. Millimeter waves can carry huge amounts of data but they do not travel very far.
Public Sector Network (PSN)	The largest Public Sector Network in North America. It consists of 47,000 km of fiber optic cable. In partnership with the City of Mississauga, Town of Caledon, Region of Peel, and City of Brampton.
Radio Wave	A type of Electromagnetic wave. They are used to transmit long, short, FM wavelength radio waves, and TV, telephone, wireless signals or energies. Most radio waves pass freely through the earth's atmosphere.
Safety Code 6	Created by Health Canada for the purpose of establishing safety limits for human exposure to radiofrequency (RF) electromagnetic energy in the frequency range from 3 kHz to 300 GHz.
Sensors	A device that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena.
Small Cells	Low-powered radio equipment and antennas. They are about the size of a pizza box, and are used to transmit data to and from a wireless device. They enable millimeter wave frequencies, which means that they transmit data over short distances (10 meters to a few kilometers).
Smart City	A Smart City is the effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens.
Virtual Reality (VR)	The computer-generated simulation of a three-dimensional image or environment that can be interacted within a seemingly real or physical way by a person using special electronic equipment, such as a helmet with a screen inside or gloves fitted with sensors.
Vision Zero	A global movement to eliminate all traffic fatalities and severe injuries. Ensuring that all people have safe, healthy, and equitable mobility.
Wavelength	A measurement. Distance from the peak of one wave to the peak of the next.
Wi-Fi (IEEE 802.11x)	Wi-Fi is the name of a wireless networking technology that uses radio waves to provide wireless high-speed internet and network connections.