EDMONTON'S DIGITAL ACTION PLAN 2019

Edmonton

Prepared by the City of Edmonton

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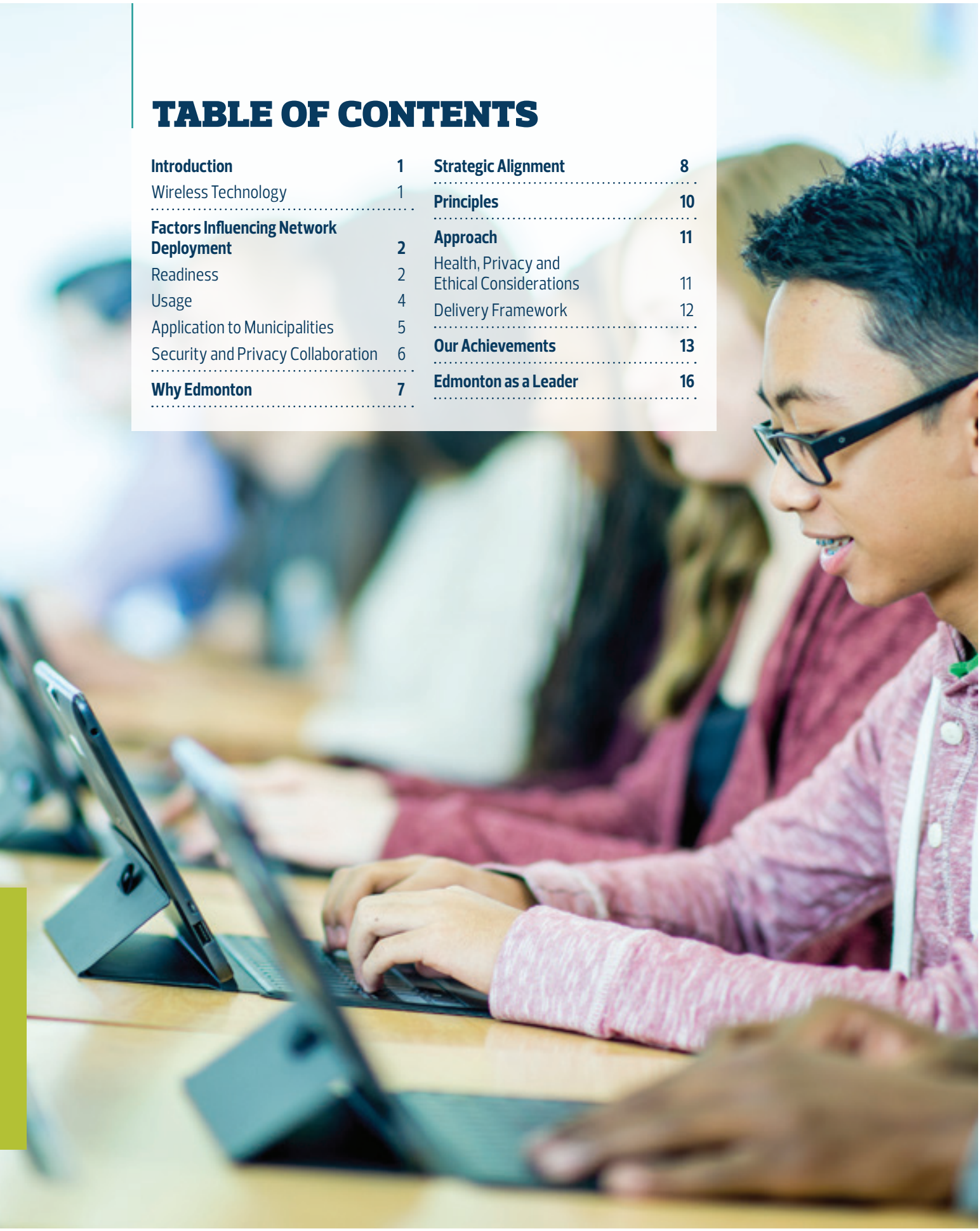


INTRODUCTION

WIRELESS TECHNOLOGY

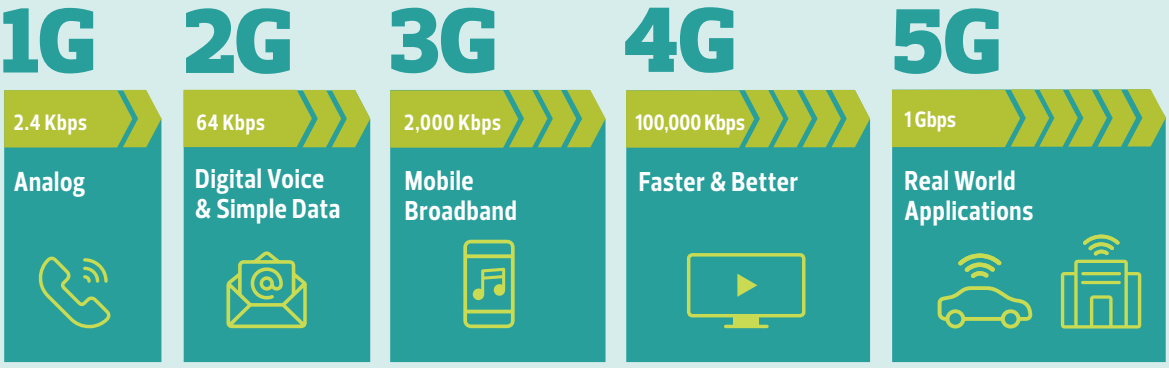
Mobile wireless communication systems have advanced significantly over the past three decades, since the introduction of the first generation mobile network in the early 1980s.

This technology continues to evolve in order to meet increasing consumer demands and requirements, including addressing challenges of availability of the wireless spectrum, and the security of end users.

The first generation of mobile communications networks delivered expensive and often unreliable analog voice calling to very few users. The second generation of mobile communications delivered reliable digital voice services and at a reasonable price point. The third generation, often known as 3G, delivered reliable mobile internet that facilitated the development of smartphones and mobile apps. The fourth generation of mobile communication networks, often referred to as the Long Term Evolution (LTE) network, made significant advancements in mobile internet and digital voice features and enabled streaming media, peer-to-peer asset sharing services and the evolution of social media.[1]

According to the World Economic Forum, the 5G network is intended to transfer more data with greater speed, more responsive communication, and the ability to connect a large number of sensors and smart devices simultaneously. This network is expected to bring disruptive services, not only in terms of increased bandwidth, but also for mobile users, Internet of Things (IoT) devices and industrial control scenarios.[2]

Evolution in Wireless Communication[3]



1 Rosenberg, D., & Qualcomm. How 5G will change the world. Retrieved from https://www.we forum.org/agenda/2018/01/the-world-is-about-to-become-even-more-interconnected-here-s-how/

2 The MobileBroadband Standard. Retrieved from https://www.3gpp.org/

FACTORS INFLUENCING NETWORK DEPLOYMENT

READINESS

The Third Generation Partnership Project (3GPP) is a consortium of seven telecommunications standards development organizations.

The 3GPP anticipates that the next wave of wireless technology will be deployed commercially in Canada in 2020. In 2016, the 3GPP initiated a new standardization process which is divided into two phases:

PHASE 1 Provide the basic features and functionality of the next wave of wireless technology.

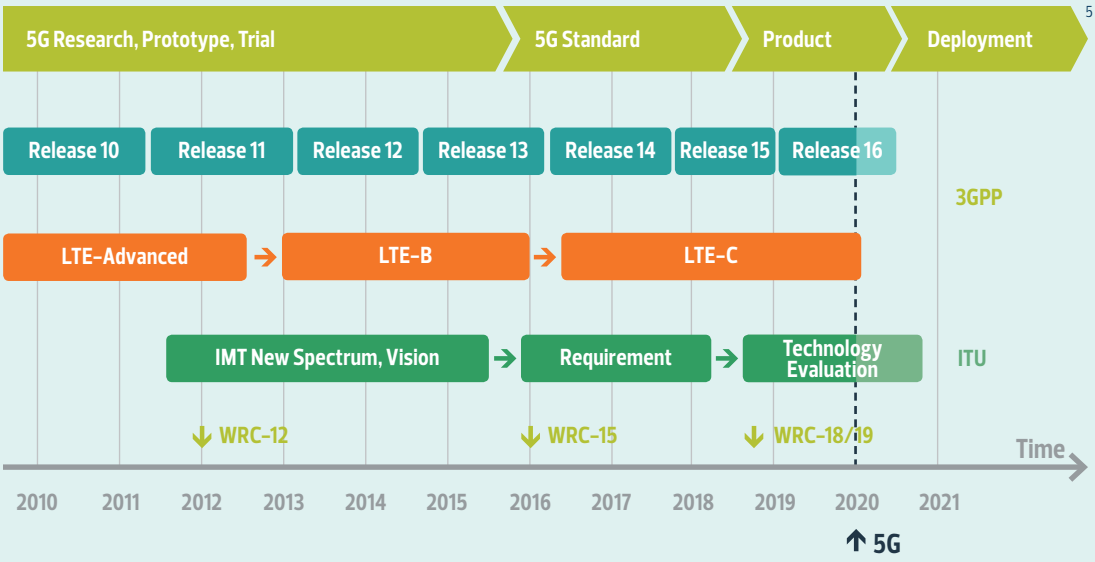
PHASE 2 Deliver additional functions to improve network capabilities, supporting more services, use cases, and higher frequency bands.

According to the 3GPP roadmap, Phase 2 of the standardization process will be completed in 2019 with the goal of commercial deployment and service launch in 2020. In conjunction with standardization processes, the 3GPP recommends deploying pilot networks under real-world conditions prior to the commercial launch of the next wave of networks globally.[3] In Canada, public and industry consultation on the Policy and Licensing Framework for the 5G Wireless Spectrum in the 3500 MHz Band will be completed by 2019. The 3500 MHz Band will be auctioned in 2020 and a 5G-friendly millimetre-wave spectrum will be auctioned in 2021.[4]

3 Marabissi, D & Mucchi, Lorenzo & Fantacci, R & Spada, Mariarita & Massimiani, Fabio & Fratini, Andrea & Cau, Giorgio & Yunpeng, Jia & Fedele, Lucio. (2018). A Real Case of Implementation of the Future 5G City. Future Internet. 11. 4. 10.3390/fi11010004.

4 Spectrum Auctions. Retrieved from http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/h_sf01714.html

WIRELESS NETWORK EVOLUTION



LTE – Long Term Evolution

ITU – International Telecommunications Union

3GPP – Third Generation Partnership Project

IMT – International Mobile Telecommunications

WRC – World Radiocommunication Conference

5 AlMousa, Eba & Alshahwan, Feda. (2015). Performance Enhancement in 5G Mobile Network Processing. Lecture Notes on Information Theory. 3. 10.18178/lnit.3.1.19-24.

FACTORS INFLUENCING NETWORK DEPLOYMENT CONTINUED

USAGE

In the short term, the next wave of wireless technologies will provide enhanced mobile broadband and improve personal communication experiences such as video calling, instant messaging and social networks, media streaming and sharing, and internet browsing.[6]

In the medium term, there will be a gradual shift in use cases. The medium term will also include deployment of large-scale IoT applications and systems delivering smart mobility, smart health, public safety, virtual reality, smart utility, and smart industry services.

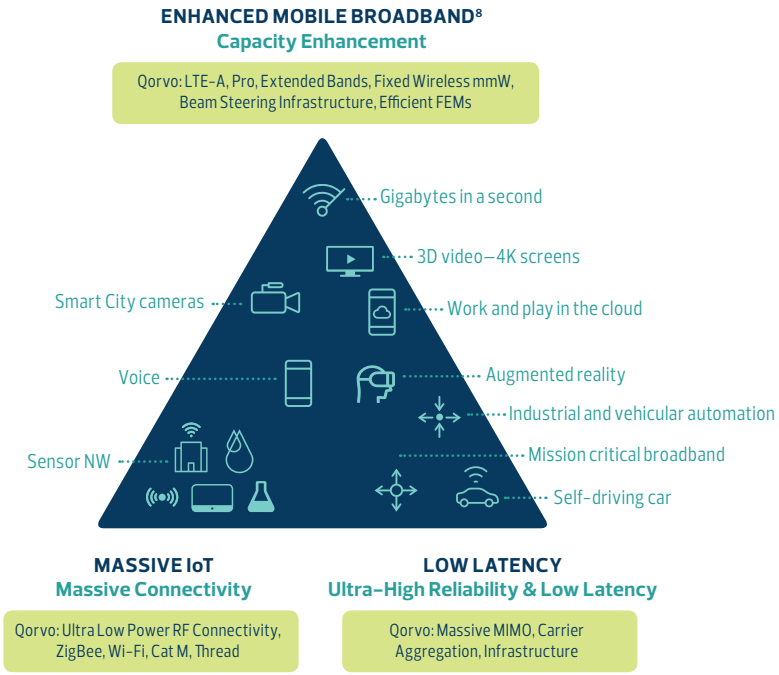
The International Telecommunications Union (ITU) categorizes wireless technologies into three broad network types based on increased or varied adaptation, scalability, reconfigurability, virtualization, and self-organization that support the following three main categories of usage:[7]

1. **Enhanced mobile broadband (eMBB):**
   Wirelessly delivers data at a high speed and high volume.
2. **Massive machine-type communication (mMTC):**
   Wirelessly connects billions of sensors to gather and store data.
3. **Ultra reliable and low-latency (URLL) communication:**
   Wirelessly allows real time communication with high reliability for critical services.

6 Marabissi, D & Mucchi, Lorenzo & Fantacci, R & Spada, Mariarita & Massimiani, Fabio & Fratini, Andrea & Cau, Giorgio & Yunpeng, Jia & Fedele, Lucio. (2018). A Real Case of Implementation of the Future 5G City. Future Internet. 11. 4. 10.3390/fi11010004.

7 Shafi, M.; Molisch, A.F.; Smith, P.J.; Haustein, T.; Zhu, P.; Silva, P.D.; Tufvesson, F.; Benjebbour, A.; Wunder, G. 5G: A Tutorial Overview of Standards, Trials, Challenges Deployment, and Practice. IEEE J. Sel. Areas Commun. 2017, 35, 1201–1221.

WIRELESS NETWORK TECHNICAL COMPONENTS



APPLICATION TO MUNICIPALITIES

Next generation wireless networks have the potential to transform not only the City of Edmonton but also the Metro Region.

POTENTIAL USE CASES:

Ambulances with connectivity will allow for monitoring equipment on the ambulance to instantaneously transfer key metrics about the patient to the hospital.

Network infrastructure will enhance a vibrant urban experience, encouraging residents to live, shop, work and play in the community through improved wireless transactions.

A network's ability to interact with a large number of sensors will allow for better monitoring of traffic flows and patterns in high pedestrian traffic areas. This data will better inform city planning on possible rerouting or expansions to reduce congestion on roads and walkways, resulting in less time commuting and more time living.

Network infrastructure will enable industries such as manufacturing, agriculture, energy, and utility to reduce their carbon footprint by increasing reliance on interconnectivity and automation.

Utility monitoring and transportation will become more efficient with wireless networks allowing for real time monitoring of systems and identification of inefficiencies.

8 ITU-R IMT 2020 requirements

SECURITY AND PRIVACY COLLABORATION

The deployment of next generation wireless networks will usher in an era of hyper-connected individuals, smartphones, sensors, household devices and critical urban systems. From connecting critical infrastructure and collecting large volumes of personal information to automating city operations and making data driven decisions, future networks will change how we live, work and play in our community. This hyper-connected network, if not deployed appropriately, could increase the security risk to individuals, organizations and society. Ahmad et al. (2017) identified privacy violations, threats originating from the internet, sensor breaches, data breaches and illegal network intercepts as potential threats that could increase with the deployment of next generation wireless networks. The implications of making a policy or operational decision based on critical data that has been corrupted during transmission by these networks could be catastrophic.

To address these concerns, the Next Generation Mobile Networks and 3GPP are actively working to develop the security and privacy designs, requirements and standards for next generation networks. In addition, the Open Networking Foundation is publishing technical specifications to ensure the security of the technologies that will operate in conjunction with these networks. Recognizing and considering these issues before network deployment will minimize the likelihood of potential security and privacy breaches.[9]

9 Ahmad, Ijaz, et al. "5G security: Analysis of threats and solutions." 2017 IEEE Conference on Standards for Communications and Networking (CSCN). IEEE, 2017.

WHY EDMONTON

READY FOR THE FUTURE

Modern municipalities currently operate in a period marked by a rapidly changing business and societal complexity.

As cities and communities search for new ways to address complex challenges, there is a growing recognition that multi-sector collaboration and organizational agility are essential for solutions to be meaningful and transformative.

GLOBAL LEADER

The City of Edmonton is a global leader in open data, open government, digital innovation and Smart City initiatives. Edmonton is Canada's Most Open City (Public Sector Digest, 2015, 2016 and 2017) and a Smart City Readiness Challenge Winner (Smart Cities Council, 2019). The Digital Action Plan is another way the City will continue to lead and contribute to Edmonton's thriving technology ecosystem.

ECOSYSTEM

The 2019 Global Startup Ecosystem Report showcased Edmonton as a leader in Canadian entrepreneurship and its technology innovation landscape. Some of Edmonton's unique strengths were identified in this report: an available talent pool fed by world class post-secondary institutions, availability of investors, research and development tax credits, and industry strengths in life sciences and artificial intelligence, big data and analytics. Adopting the next generation of technologies will enable the City to maintain its competitiveness and relevance globally.

ENGAGED COMMUNITY

Edmonton's Digital Action Plan focuses on creating the conditions to build new digital infrastructure for the city. The City works with many partners and business stakeholders to build and enhance physical infrastructure including roads and commercial and industrial areas that create the conditions for a vibrant economy. The next generation of wireless technology represents a key new asset in the digital infrastructure that will strengthen Edmonton's position as an entrepreneurial hub that supports investment and further innovation.

STRATEGIC ALIGNMENT

CONNECTEDMONTON

In June 2018, City Council approved ConnectEdmonton – Edmonton's Strategic Plan for 2019–2028. ConnectEdmonton sets the direction for the future of Edmonton and outlines the changes needed today to achieve an aspirational vision for Edmonton in 2050.

ConnectEdmonton, in consultation with Edmontonians and City Council, has identified four strategic goals that require transformational change in the next 10 years:

HEALTHY CITY:

Edmonton is a neighbourly city with community and personal wellness that embodies and promotes equity for all Edmontonians.

URBAN PLACES:

Edmonton neighbourhoods are more vibrant as density increases, where people and businesses thrive and where housing and mobility options are plentiful.

REGIONAL PROSPERITY:

Edmonton grows prosperity for our Metro Region by driving innovation, competitiveness and relevance for our businesses at the local and global level.

CLIMATE RESILIENCE:

Edmonton is a city transitioning to a low-carbon future, has clean air and water and is adapting to a changing climate.

The implementation of the Digital Action Plan will have the highest impact on advancing the Regional Prosperity goal by encouraging business innovation, improving competitiveness and ensuring the relevance of the Metro Region in the future. The City of Edmonton, with partners such as Edmonton Metropolitan Region Board, Edmonton Global and Edmonton Economic Development Corporation, will enable opportunities for partnership and collaboration that will promote economic diversity and increase the City's capacity for economic growth and sustainability. In addition, the Digital Action Plan will enable all city building partners and Edmontonians to collectively achieve the ConnectEdmonton goals.

EDMONTON'S CORPORATE BUSINESS PLAN

The City of Edmonton's Corporate Business Plan is a four-year plan that advances the City towards the ten-year strategic goals of ConnectEdmonton. It presents an integrated overview of the City of Edmonton's work to achieve its corporate promise. The Digital Action Plan will enable the Corporate Business Plan's objective to deliver excellent services to the community and residents. In addition, the implementation of the Digital Action Plan will improve or transform services over time and will ensure they meet the evolving needs of Edmontonians.

BUSINESS TECHNOLOGY STRATEGY

The Business Technology Strategy moves the City of Edmonton forward to better embrace innovative technologies and use data. Through this strategy, the City has the opportunity to define the role that business technology has in shaping the quality of life in Edmonton.

The Digital Action Plan aligns to the principles within the Business Technology Strategy: Enhance Citizen Experience, Provide Reliable Information, Promote Collaboration, Transform Through Innovation and Think City-Wide. The implementation of the Digital Action Plan will result in a more engaged and collaborative community where technology is a tool to understand and meet the needs and expectations of Edmontonians.

PRINCIPLES

The City realizes that the benefits resulting from technological innovations and other Smart City technologies are exponential.

To ensure wireless technology benefits all Edmontonians, the City will adhere to the following principles throughout implementation of this Action Plan:

EQUITY: Edmonton's digital future is inclusive and equitable. The City envisions a future that not only enables internet access and accessibility but also improves social and economic outcomes for Edmontonians.

TRUST: The City recognizes that the vision of a connected future cannot be achieved without building and maintaining trust with Edmontonians. The City will build trust with Edmontonians through transparency and accountability while prioritizing health, privacy, security and ethical practices.

INNOVATION: The City fosters new approaches and develops new business models that provide effective services and improve the resident experience. The City embraces disruptive technology as an opportunity to future-proof and enable the digital transformation of Edmonton.

COLLABORATION: The City develops partnerships to transform Edmonton to a network of ecosystems that make collective contributions to advance community efforts and achieve shared goals and outcomes.

APPROACH

The evolution of technology is empowering municipalities with a wide range of smart applications and business models.

However, at the same time, the pace of technology innovation, the emergence of new ways of doing business, and the evolving expectations of residents are disrupting municipalities across the world.

This Digital Action Plan addresses the disruption by focusing on solving diverse use cases with a primary focus on learning and proving value to Edmontonians. The City will work with partners in an agile and lean fashion to deliver shared goals and outcomes.

HEALTH, PRIVACY AND ETHICAL CONSIDERATIONS

The privacy and security of Edmontonians is of critical importance to the City of Edmonton. In order to address the privacy and ethical concerns related to networks deployments, the City will embody a privacy-by-design approach where the implementation of wireless technologies will remain open to public oversight and input so that concerns are addressed. The City will play a significant role in balancing the value to the industry with the value to society by considering ethical best practices.

To date, the health implications and environmental considerations of 5G technologies are not readily understood. The City will engage academic institutions and health and environmental experts to gain a deeper understanding of the risks and impacts of 5G as they are identified globally. If considerations resulting from wireless technology are identified in the future, the City is positioned to address and adapt as necessary.

The delivery approach will ensure:

» adherence to privacy regulations and legislations

» adequate accountability

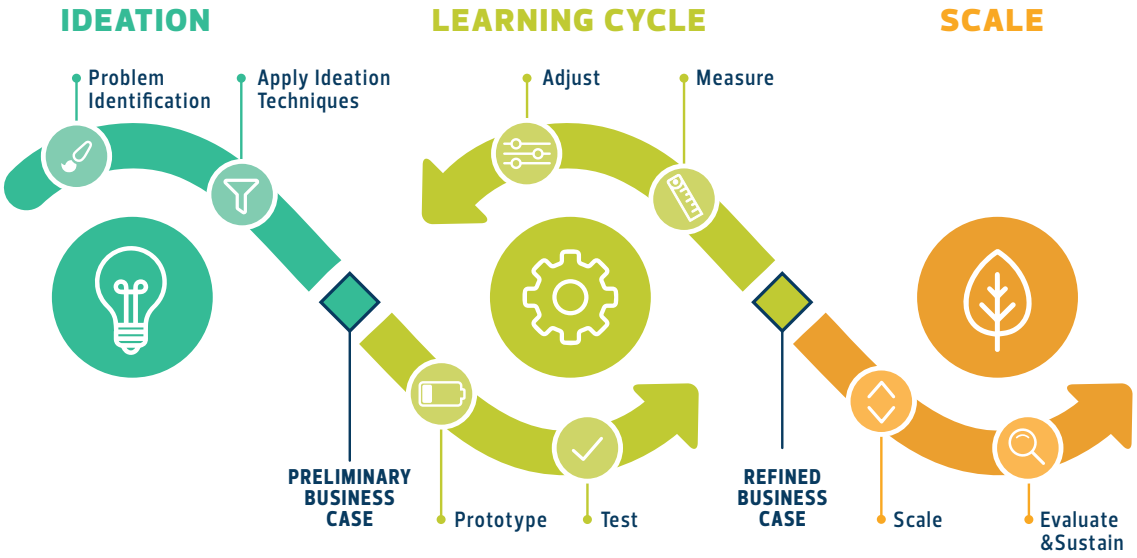
» the collection of only anonymous data

» transparency related to its application and use

The City, in partnership with regional partners, research institutes and industry, will continuously learn and evolve its approach to ensure adherence to industry best practices when it comes to health, privacy and security.

DELIVERY FRAMEWORK

Wireless technology, standards, privacy and ethical implications, business models, and resident expectations are evolving at a rapid pace. To accommodate this changing landscape and minimize the risk of deploying wireless networks, the City will adopt a delivery lifecycle to implement the Digital Action Plan. This approach will ensure that initiatives incorporate learnings from the ecosystem and adjust approaches before implementing large scale deployments.



The delivery lifecycle will consist of three phases, as described below, with gates between each phase.

1 **IDEATION:** During the ideation phase, the City will collaborate with residents and industry partners to identify opportunities, uncover the root causes of a problem, and generate potential use cases.

2 **LEARNING CYCLE:** The City, along with our residents and industry partners, will iterate several times through the learning cycle, progressively testing the technical feasibility and evaluating the value created. This phase will include multiple proof-of-concept or pilot projects. The focus of this phase is to gather feedback and adjust the approach as the technology landscape evolves.

3 **SCALE:** The City will evaluate options to scale the deployment of wireless technologies and applications.

OUR ACHIEVEMENTS

EVOLUTION FROM THE DIGITAL PLAN

As an Open Government and Smart City leader, the City developed Edmonton's first Digital Plan in 2015 to guide the Open Access program.

The Digital Plan focused on building a connected city by increasing the availability of high-speed broadband services to Edmontonians and facilitating broader access to digital and online information and services through the provisioning of high-speed broadband internet. Edmonton's Digital Plan has evolved to include the development of the Digital Action Plan that will position the City of Edmonton as an early adopter in the deployment of new wireless technologies and enable new possibilities for economic development, environmental sustainability, quality of life and innovation.

The World Economic Forum's Strategic Intelligence portal highlights "business model disruption, digital divide, coverage, policy uncertainty, and privacy and security as critical factors that will influence the large-scale deployment of 5G technologies in cities around the world."[10]

Edmonton's Digital Action Plan highlights the initiatives the City of Edmonton is undertaking over the next 24 months to remove these barriers, develop partnerships with key stakeholders, and implement pilot projects that lay the path to accelerate the deployment of wireless technologies to benefit all Edmontonians.

This Action Plan, in conjunction with the tools and frameworks that guide the implementation of the Business Technology Strategy, provides a comprehensive roadmap that will enable the deployment of new wireless networks in Edmonton.

10 Forum, W. E. Strategic Intelligence: World Economic Forum. Retrieved from https://intelligence.weforum.org/

THE CITY WILL EMBODY A PRIVACY-BY-DESIGN APPROACH WHERE THE IMPLEMENTATION OF WIRELESS TECHNOLOGY WILL REMAIN OPEN TO PUBLIC OVERSIGHT AND INPUT SO THAT CONCERNS ARE ADDRESSED.

EDMONTON'S PROGRESS

Open City Wi-Fi: With more than 1,100 Wi-Fi access points, the City provides free public Wi-Fi internet access to Edmontonians at 200 City facilities.

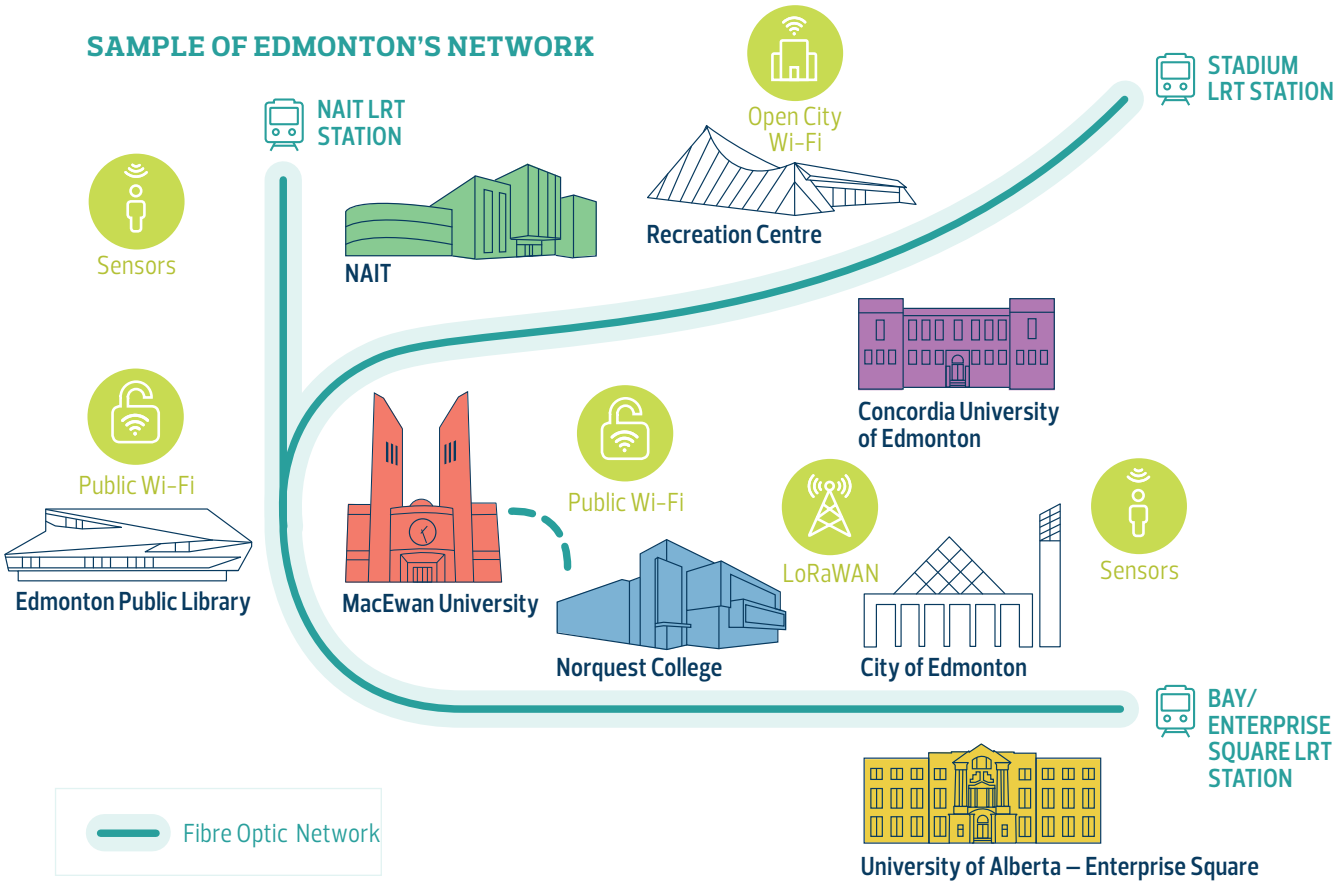
LoRaWAN: The City deployed a LoRaWAN network, a media access control (MAC) protocol for wide area networks, in downtown Edmonton to connect sensors and transmit data that enables data driven decision making.

Sensors: The City installed sensors such as pedestrian counters, wildlife counters, and soil moisture monitors to remotely gather data and make data driven decisions.

Public Wi-Fi: The City partnered with service providers to install public Wi-Fi services in City facilities and libraries.

Fibre Optic Network: The City has installed a fibre optic network, in collaboration with Cybera, in our Light Rail Transit (LRT) system that extends to post-secondary institutions. This collaboration enables faster and more reliable connections for improved research and development. The City is also supporting service providers in their plan to expand fibre optic networks within Edmonton.

SAMPLE OF EDMONTON'S NETWORK



EDMONTON AS A LEADER
THE WAY FORWARD

The City of Edmonton does not intend to be an internet service provider and as such will partner with service providers and enable the deployment of next generation wireless networks.

However, service providers could have the inclination to deploy new technologies only in areas where they anticipate the greatest return on their investments. This has the potential to create a digital divide on the basis of whether a community has access to wireless networks and high-speed internet connectivity.

Hence, to achieve a balance between enabling and incentivizing the service providers to deploy wireless technologies in Edmonton, while ensuring equity for all residents in the Metro Region, the Digital Action Plan has defined two long-term goals:

GOAL 1 Bridge the digital divide and continue to build a connected community and region.

GOAL 2 Demonstrate thought leadership in Smart City implementation by leading the deployment of next generation wireless networks.

These two long-term goals are supported by six outcomes that will deliver measurable results associated with changes in economic investments, policies, processes and public perception. Preliminary initiatives to achieve each outcome have been identified in this Digital Action Plan and the scope, outputs and timelines for each sample initiative will be finalized during the implementation phase.

THE IMPLEMENTATION OF THE DIGITAL ACTION PLAN WILL HAVE THE HIGHEST IMPACT ON ADVANCING REGIONAL PROSPERITY BY ENCOURAGING BUSINESS INNOVATION, IMPROVING COMPETITIVENESS AND ENSURING THE RELEVANCE OF THE METRO REGION IN THE FUTURE.

GOAL 1

Bridge the digital divide and continue to build a connected community and region.

	OUTCOMES	SAMPLE INITIATIVES
1	**The City of Edmonton will enhance resident experiences by using connected and digital technologies.**	» Extend cellular connectivity through LRT tunnels. » Expand Open City Wi-Fi (free public Wi-Fi networks) to additional City facilities and locations.
2	**Edmonton and its regional partners will improve access to broadband and wireless networks for residents of the region.**	» Form strategic coalitions to advance the deployment of broadband and wireless networks in the Edmonton region. » Actively explore and adopt new business models to rollout regional broadband and wireless networks. » Install fibre optic infrastructure where appropriate.
3	**The City of Edmonton will improve digital literacy and digital rights for Edmontonians.**	» Deliver digital literacy programs in partnership with various stakeholders. » Adopt the principles of the Cities Coalition of Digital Rights, an initiative led by municipalities to protect, promote and monitor residents' and visitors' digital rights.

GOAL 2

Demonstrate thought leadership in Smart City implementation by leading the deployment of next generation wireless networks.

	OUTCOMES	SAMPLE INITIATIVES
4	**The City of Edmonton will be a thought leader in next generation wireless technology and Smart City deployments.**	» Develop testbeds in collaboration with partners and stakeholders. » Share lessons learned with other Canadian and global communities by developing toolkits for testbed implementation. » Demonstrate the implementation, feasibility and measured socio-economic benefit of the latest wireless technologies. » Maintain an External Advisory Group to provide guidance. » Address and adapt to any health or environmental risks, as they are identified globally.
5	**The City will collaborate with regional partners to promote economic development in the Edmonton region and attract new investments.**	» Pilot projects with partners to field test new wireless technologies in real life scenarios. » Advance the Innovation Accelerator Program in collaboration with post-secondary institutions, Edmonton Metropolitan Region Board, Edmonton Global and Edmonton Economic Development Corporation to attract start-ups and scale-ups to the Edmonton region. » Facilitate wireless technology investments to the Edmonton region through innovative partnership and investment models and an attractive policy framework. » Streamline processes and policies to attract businesses, academia and investors to the Edmonton region.
6	**The City will work to remove municipal regulatory barriers pertaining to wireless network deployments.**	» Collaborate with external stakeholders to identify gaps in the current municipal regulatory framework and update to accelerate wireless network deployment. » Research ethical, cybersecurity and privacy concerns pertaining to 5G deployments as they are identified globally. » Socialize and engage with Edmontonians to explore perceptions. » Set infrastructure design protocols to accommodate hardware in City infrastructure.

EDMONTON'S DIGITAL ACTION PLAN 2019