

Private LTE Network Proposal and Grant Application

Name of Organization:

City of Ann Arbor
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City website: www.a2gov.org

Funds Requested: \$600,000.00

Proposal Summary

The City of Ann Arbor is requesting \$600,000.00 from the existing Technology Park funding to implement a Private LTE network in the Downtown Development Authority District (DDA). The Private LTE solution will allow for the deployment of IoT sensors and smart city solutions to complement and extend electronic communications capabilities of the Technology Park fiber network recently implemented and funded by the LDFA. Community organizations wanting to utilize the Technology Park fiber and Private LTE network will have access to an end-to-end communications network to monitor and control IoT sensors, and capture data they produce.

A private LTE solution will allow for the continued digital transformation of City of Ann Arbor communications infrastructure and provide a “living lab” and(or) production platform for community organizations to promote economic development, conduct research and education, enhance city and community services, promote competition, and create a safer, more vibrant, and environmentally sustainable community.

Background

The Local Development Finance Authority (LDFA) funded the implementation of a fiber-optic network in the Downtown Development Authority (DDA) District, aka “Technology Park”. The Technology Park consists of 40,000 feet of underground fiber optic cable located in the DDA District. The Technology Park and other City of Ann Arbor dark fiber is available to community organizations wanting access to a high-speed fiber optics network. The proactive deployment of this fiber eliminates cost and other barriers that could otherwise prevent organizations from utilizing this asset.

Physical high-speed fiber optics is a viable solution for connectivity between structures/buildings but is not practical and cost effective for connecting IoT sensors. Private LTE networks have been developed to accommodate thousands of IoT sensors required to implement smart city solutions and require connectivity to high-speed fiber networks such as the Technology Park.

The City of Ann Arbor currently has 2 fiber networks with a 3rd being implemented in 2024. These networks are designed as the backbone, or one piece of a complete end-to-end communications network. A Private LTE network will provide the final piece of this network so IoT sensors and smart city applications can be deployed, and a true digital transformation of the Ann Arbor community infrastructure can be achieved.

Proposal Narrative

A strong, sustainable communications infrastructure exists in the City of Ann Arbor in large part to the LDFA's overall vision for the community and funding of the Technology Park, the implementation of multiple fiber optic networks by the City of Ann Arbor, the city's Smart City Strategic Plan, the experience and commitment of the city's Information Technology department, and the city's commitment to our community.

Unlike technology solutions in the planning stages or futuristic, the City of Ann Arbor has implemented all components of an end-to-end communications ecosystem except for a Private LTE network. The solution being proposed is a state-of-the-art, best in class Private LTE solution from Cisco Systems and Airspan capable of meeting current and future needs of the community.

The City of Ann Arbor IT department design and architecture best practices for the city's communications ecosystem consistently employs security, resiliency, redundancy, and failover. These components are built into the Private LTE network solution to address high availability, sustainability, and a connected community. Organizations connected to this ecosystem can take advantage of seamless communications to other organizations in the network, if required.

We do not anticipate any major challenges. City property will be utilized for the installation of outdoor antennas and the remaining equipment will be located in the city's data center where all city fiber is terminated. The Private LTE network will be supported and maintained by the city's IT department staff.

Project Goals and Objectives

This goal of this project is to implement a private LTE network in the Downtown Development Authority (DDA) District to facilitate Smart City initiatives, deployment Internet of Things (IoT) sensor technology, and provide an end-to-end wireless communications network to the Ann Arbor Community (see Figure 1 below). The Private LTE network will create a living laboratory so organizations can utilize the Technology Park and other city fiber optics and deploy outdoor radios and IoT sensors to allow for implementation, research, development, and testing of Smart City initiatives. These initiatives will digitally transform the DDA District infrastructure assets (streetlights, environmental sensors, traffic control, cameras, etc.), promote economic development, education, safety, data-driven decision making, enhanced city services, a healthy and environmentally friendly community, and improve the overall quality of life.

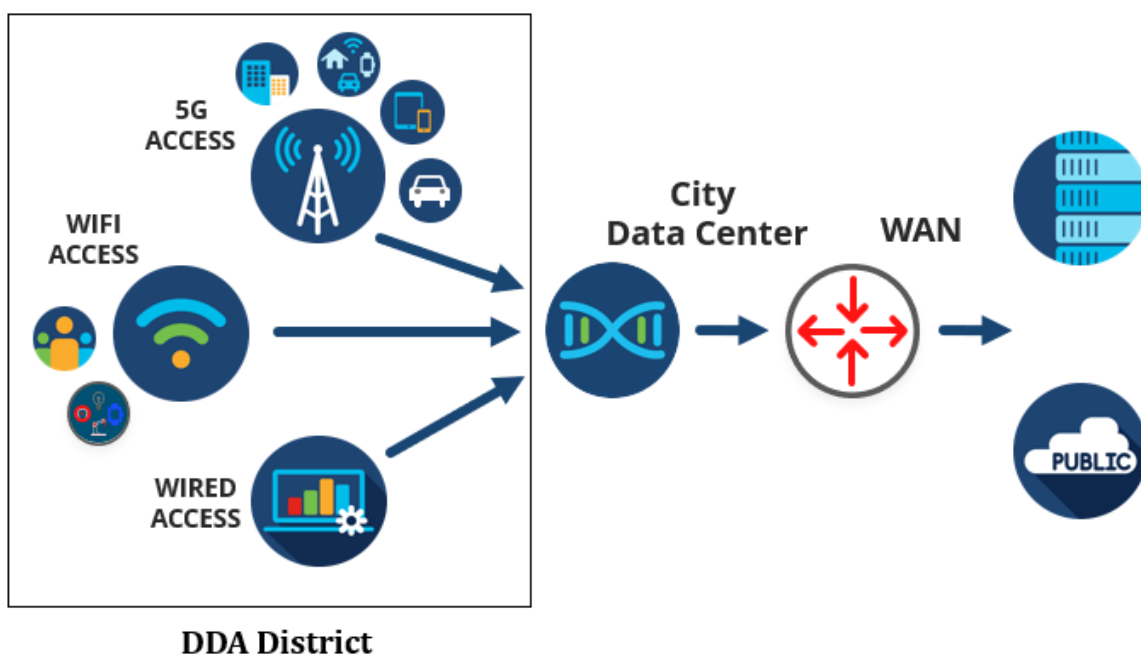


Figure 1: Private LTE Network

A Private LTE network in combination with the Technology Park fiber will facilitate the replacement of older infrastructure assets and implement new state-of-the-art technology.

The City of Ann Arbor Information Technology department will project manage and procure the hardware, professional services, and maintenance, and locate the equipment in the City of Ann Arbor data center. Outdoor radios will be strategically installed in the DDA District to provide maximum cellular coverage. The equipment and private LTE network will be maintained by City of Ann Arbor Information Technology department staff. The initial purchase will cover a minimum 3-years maintenance and subscription. The City of Ann Arbor will assume responsibility of the cost beyond the 3-years and obtain ownership of the private LTE network when the initial implementation is complete.

Like the Technology Park fiber optics network and according to the State of Michigan METRO Act, the City of Ann Arbor cannot activate fiber or the private LTE network for any organization other than the city. As a result, organizations wanting to utilize the private LTE network is responsible for using their own/city fiber, install their own radio(s) and IoT sensors, and procure their own cloud service of choice (AWS, Azure, etc.). The City of Ann Arbor IT department will assist organizations with their deployment and provide Subscriber Identity Module (SIM) chips to place in their IoT sensors. Activated radios and sensors in the DDA District will connect to the Private LTE hardware in the city's data center, and all data will be passed-through this hardware to the cloud so the organizations can access IoT sensor data and monitor and control IoT sensors. The City of Ann Arbor may choose to store some of their data on-premises.

The City of Ann Arbor IT department will create a private LTE network service offering, legal agreement, and pricing for community organizations wanting to utilize the network. The offering will include existing City of Ann Arbor fiber optic network pricing established with the Technology Park.

Attached is the City of Ann Arbor Smart City Strategic Plan established in 2021. This plan states the overall goals and objectives of the digital transformation for the city. The Private LTE solution is the remaining infrastructure component needed to achieve our goals.

Work Plan

Following are the overall activities needed to meet the goals and objectives of this project:

- An amended grant agreement between the LDFA and the City of Ann Arbor.
- The city IT department will create a legal agreement for private LTE services, like the Technology Park Fiber and Conduit Use Agreement, to offer community organizations.
- The city IT department will develop and submit a resolution to Ann Arbor City Council for approval of the private LTE solution.
- Once the resolution is approved, the city IT department will procure the private LTE solution, install the outdoor radios at designated parking garage locations, connect the radios to the Technology Park fiber, and install the hardware in the city data center.

We do not anticipate any significant risks or challenges deploying the solution because the implementation will occur on City of Ann Arbor property and the City of Ann Arbor IT department will be supporting and maintaining the solution and entire city/community communications ecosystem. The solution being proposed will be offered to community organizations willing to execute a legal use agreement for Private LTE services, like the Technology Park Conduit and Fiber Use Agreement.

Outcomes

The private LTE network consists of 8-4G/5G outdoor radios mounted on select City of Ann Arbor parking garages and connected to the Technology Park fiber optic network. Three UCS servers will be installed in the city's data center and 50 SIM chips will be purchased for distribution to users of the Private LTE

offering. Additional SIM's will be purchased as needed. The city will procure and provide network switches to securely connect the UCS servers to the Internet. Like the Technology Park fiber network, the private LTE solution being deployed will provide redundancy, failover, and resiliency which is critical to maintain a high-level of availability.

The private LTE network being recommended is a Software as a Service (SaaS) technology solution with a 3-year maintenance agreement, 24x7 monitoring, and regular updates to the system. The City of Ann Arbor will fund the maintenance beyond the third year. The initial deployment of the private LTE solution is capable of being expanded beyond the DDA District and can continue to grow over the years.

Below is an estimated list of deliverables and a timeline for the project:

Task Name	Start	Finish	Duration
Private LTE Implementation Project Plan	Thu 2/1/24	Wed 9/4/24	155 days
Develop and execute an amended or new grant agreement	Thu 2/1/24	Wed 4/24/24	60 days
Develop a Private LTE Use Agreement	Thu 2/1/24	Wed 4/24/24	60 days
Create and submit a resolution to City Council for acceptance of the grant and purchase of the Private LTE solution	Thu 2/1/24	Wed 4/3/24	45 days
Design and Procure Private LTE Solution	Thu 4/4/24	Wed 6/5/24	45 days
Install outdoor antennas	Wed 6/5/24	Tue 8/6/24	45 days
Connect fiber to the antennas	Wed 8/7/24	Tue 8/27/24	15 days
Install network switches and servers in the data center	Wed 6/5/24	Tue 6/25/24	15 days
End-to-end testing	Wed 8/28/24	Tue 9/3/24	5 days
Project Closure	Wed 9/4/24	Wed 9/4/24	1 day

Community Collaboration

Attached you will find support letters from the University of Michigan ITS, the Downtown Development Authority (DDA), The Ride, and the City of Ann Arbor acknowledging the importance of the Private LTE network to their organizations and the community.

Merit Networks is a non-profit ISP currently utilizing city fiber and can be an enabler for new organizations wanting to utilize the Private LTE network. All organizations above currently utilize city fiber and can easily take advantage of the Private LTE network.

Private LTE Network Benefits and Impact

According to an online article by Statista (Vailshery, 2023) the number of connect IoT devices in the world will reach 17.18 billion by 2024 and 29.42 billion in 2030. IoT devices can generate massive amounts of data otherwise unattainable using human labor. This data is crucial and will fuel the future use of Artificial Intelligence and Quantum Computing. These technologies will exponentially increase how fast data can be processed and decisions can be made, thus having the greatest impact to society of any technology since the Digital Revolution.

Data, and the knowledge it can provide organizations can be used as a powerful tool to gain competitive advantages, make informed business decisions, enhance research and development, promote efficiencies, and reduce costs. Public and private organizations not having access to or taking advantage of a robust communications infrastructure will lag.

We anticipate organizations currently using city fiber will eventually utilize the proposed Private LTE network and connect new and existing IoT devices. The city will create a Private LTE service that will

complement dark fiber services already offered. The city will continue to advertise and attract organizations to utilize our robust communications infrastructure that bring value to our community.

The City of Ann Arbor and the DDA have numerous IoT devices already deployed in the DDA District and can take immediate advantage of the Private LTE network. Existing and new technology companies can utilize the Private LTE network for research and development. The University of Michigan Transportation Research Institute (UMTRI), which has operated their connected vehicle program since 2011 and utilize the city's fiber optic network, can use the Private LTE network to enhance their research and development. The Private LTE network could also be expanded to the City of Ypsilanti Smart Zone.

Management Competency

The City of Ann Arbor IT staff consists of 27 employees with the burden of the support for the Private LTE solution falling on approximately 8 full-time employees. Combined information technology experience of the IT staff involved in supporting the Private LTE network exceeds 100 years. The IT Director has over 42 years IT experience working with both private (28 years) and government (14 years) organizations and has led large IT organizations (over 100 full-time employees) providing a myriad of technologies to a wide range of businesses. City Infrastructure and Networking teams have decades of similar experience working with private and public organizations.

The technologies involved supporting and maintaining a Private LTE network are a core strength of the city Infrastructure and Networking teams who currently manage all infrastructure and network technologies for the City of Ann Arbor.

The budget for the initial purchase of all hardware, software, professional services, maintenance, and support will be funding wholly by the \$600,00000 being requested. This will support the Private LTE network for 3-years, at which time the city will assume all future maintenance and support costs. The City of Ann Arbor will immediately assume all administration, project management, data center expenses, hardware expenses (network switches), and staff labor costs to implement and maintain the system. No matching funds or other cost sharing will apply.

Conflict of Interest

We do not anticipate any conflict of interest. The City IT department and Attorney's office sought external legal counsel with expertise in municipal telecommunications for the Private LTE solution and services being offered.

Attachments

- Memo – LDFA Private LTE Network Proposal
- City of Ann Arbor Smart City Strategic Plan
- Downtown Development Authority (DDA) Letter of Support
- University of Michigan ITS Letter of Support
- The Ride Letter of Support
- The City of Ann Arbor Letter of Support

References

Vailshery, L. S. (2023, July 27). *Number of Internet of Things (IoT) connected devices worldwide from 2019 to 2023, with forecasts from 2022 to 2030*. Retrieved from [statista.com](https://www.statista.com/statistics/1183457/iot-connected-devices-worldwide/):
<https://www.statista.com/statistics/1183457/iot-connected-devices-worldwide/>

Ravi Pendse PhD

Vice President for Information Technology and Chief Information Officer

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Ann Arbor, MI 48109-1079
Office: 734-763-7590

January 15, 2024

Mr. Tom Shewchuk
City of Ann Arbor
301 E Huron Street
Ann Arbor, MI 48107

Dear Mr. Shewchuk,

Given the value University of Michigan Information Technology Services (ITS) sees in public entities being able to leverage newly available **Citizens Broadband Radio Service (CBRS)** (3.5 GHz) shared spectrum technology, U-M ITS is supportive of the city's initiative to deploy a private cellular infrastructure as part of its Smart City Strategic Plan. We look forward to working with the city in whatever capacity would be mutually beneficial.

We see multiple key benefits to the deployment of a private cellular network in the Smart City context. This network will allow public entities to provide a direct, secure, end-to-end connection between their mission-critical cellular devices (sensors, networked vehicles, remote e-displays, etc.) and existing network resources. It enhances the economics of scaling these connected devices for public entities, and provides additional visibility, control and predictability for system operations.

As always, we are also interested in ways we can partner with the City of Ann Arbor to share information technology infrastructure to the extent possible.

We enthusiastically support the city's efforts.

Best regards,



Ravi Pendse, Ph.D.
Vice President for Information Technology
Chief Information Officer

January 12, 2024

Subject: Letter of Support for Private LTE Network in the City of Ann Arbor

To whom it may concern,

I am writing this letter to express my strong support for the implementation of a Private LTE network in the City of Ann Arbor. As Deputy CEO of Finance & Administration of the Ann Arbor Area Transportation Authority, I understand the critical role that advanced telecommunications infrastructure plays in fostering economic development, enhancing public safety, and improving the overall quality of life for residents and businesses.

A Private LTE network would undoubtedly bring numerous benefits to the City of Ann Arbor. Here are some key points highlighting the advantages of such a network:

1. **Public Safety Improvements:** The implementation of a Private LTE network can significantly enhance public safety by enabling more efficient communication among emergency services, law enforcement, and other critical response teams. This will result in quicker response times, improved situational awareness, and ultimately, a safer community.
2. **Smart City Initiatives:** A Private LTE network serves as the foundation for the development of smart city initiatives. From smart traffic management to environmental monitoring, the City of Ann Arbor can leverage this technology to enhance urban efficiency, sustainability, and the overall quality of life for its residents.
3. **Business Attraction and Retention:** Cities with advanced telecommunications infrastructure are more attractive to businesses seeking to establish or expand their operations. A Private LTE network will position Ann Arbor as a forward-thinking and technologically advanced city, attracting investment and fostering economic growth.
4. **Community Empowerment:** A Private LTE network can empower residents by providing them with improved access to digital services, educational resources, and healthcare options. Bridging the digital divide and ensuring equitable access to technology is crucial for building a more inclusive and connected community.

I believe that the implementation of a Private LTE network aligns with the City of Ann Arbor's vision for a sustainable, innovative, and resilient future. As stakeholders invested in the prosperity of our community, it is essential to embrace cutting-edge technologies that will pave the way for continued growth and development.

I am confident that the City of Ann Arbor's leadership and decision-makers will carefully consider the advantages of a Private LTE network and take the necessary steps to make this vision a reality. Should you require any additional information or support, please do not hesitate to contact me at dreed@theride.org or (734) 794-1768.

Thank you for your time and consideration.

Sincerely,



Dina Reed
Deputy CEO of Finance and Administration / AAATA – TheRide



ANN ARBOR
DOWNTOWN DEVELOPMENT AUTHORITY
150 S. FIFTH AVENUE STE. 301
ANN ARBOR, MICHIGAN 48104

January 9, 2024

Local Development Finance Authority
Board of Directors

This memo is in support of the City of Ann Arbor's funding request to implement a Private LTE network in the Ann Arbor Downtown Development Authority (DDA) district. This Private LTE network will complement the Technology Park fiber recently implemented by the City in the DDA district and will provide the DDA and the community with opportunities to take advantage of state-of-the-art technology that would otherwise be cost prohibitive.

The Downtown Development Authority strives to make public improvements to strengthen the downtown area, technology is increasingly a key element towards our success. Our ability to collect and analyze data helps maximize the benefit of projects and planning efforts. The addition of a private LTE network will allow the DDA to implement new smart city solutions and connect existing smart city assets such as streetlights, pedestrian counters, and parking meters, and eliminate expenses such as cloud services and monthly cell phone charges.

The DDA and the City collaborate on an ongoing basis. The DDA recently joined the City's network and now utilizes the City's IT department for all IT needs. In addition, public parking structures, which are managed and operated by the DDA, will shortly be connected to the Technology Park high-speed fiber and will replace older existing fiber to increase communications performance.

The implementation of a Private LTE network would be a significant enhancement in the DDA district.

Thank you.

Maura Thomson
Interim Executive Director Ann Arbor Downtown Development Authority



CITY OF ANN ARBOR, MICHIGAN

301 E. Huron, P.O. Box 8647, Ann Arbor, Michigan 48107

Phone (734) 794-6110

FAX (734) 994-8296

January 12, 2024

TO: Ann Arbor/Ypsilanti SmartZone Board

RE: Support for Grant Funding of a Private LTE Network

This is a letter in support of a proposal being submitted by the City of Ann Arbor for the implementation of a Private LTE network in the Downtown Development Authority (DDA) District in the City of Ann Arbor. This network will greatly benefit the City of Ann Arbor and is a crucial infrastructure component as we continue to deploy smart city solutions and IoT sensors in alignment with the city's Smart City Strategic Plan. The city continues to digitally transform older infrastructure to promote economic development, improve city services, make data-driven decisions, enhance safety, improve the quality of life, and build and maintain a modern, innovative, and sustainable smart city ecosystem.

The City of Ann Arbor with grant assistance from the Local Development Finance Authority (LDFA) has invested over \$9 million dollars in a fiber-optic communications infrastructure since 2017. This infrastructure is a critical component towards achieving a digital transformation and a Private LTE network will complement and complete an end-to-end communications network capable of implementing technologies needed to build smart city solutions in a "living lab" and (or) real-world production environment.

Current users of the city's fiber networks included the Downtown Development Authority (DDA), Ann Arbor Area Transportation Authority (AAATA), Ann Arbor District Library (AADL), and Merit. The city's communications infrastructure is designed and priced to make it easy for existing and new community organizations to utilize this technology to serve the community and promote innovation for many years to come. The City of Ann Arbor will implement, house, maintain, support, and administer the Private LTE network like the Technology Park and other city fiber networks and will continue to onboard additional community organizations.

Thank you in advance for your consideration.

Sincerely,

Milton Dohoney Jr.

City Administrator

City of Ann Arbor

Smart City Strategic Plan

City of Ann Arbor, MI

A Digital Transformation



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What is a Smart City?

“A smart city utilizes modern technology and the collection of data to maximize operational efficiency, reduce costs, and enhance how we serve our community”

The rise of the Digital Revolution and the Internet of Things (IoT) has made it possible to connect critical infrastructure assets such as street lights, parking meters, trash and recycling bins, environmental sensors, water pipes, sewer pipes, etc. to the city’s communications infrastructure (fiber optics, wired, or wireless networks), the web/cloud, or cellular network. Today, connected assets can be monitored and controlled remotely, and report critical data that can be utilized to make informed business decisions that can lead to innovation, operational efficiencies, cost savings, and economic development.

A smart city solution is comprised of the following elements. These elements are highly interactive, dependent on each other, and must be treated as a system in order to be a truly effective smart solution.

- ✓ **IoT Sensors/Devices (Things)**

Digital or electronic sensors or devices, connected to city assets such as street lights, water meters, trash bins, parking meters, etc.

- ✓ **Communications Infrastructure**

The city’s fiber optic, wired, or wireless network, the web/cloud, or a cellular network (Verizon, Sprint, T-Mobile, etc.) that IoT sensors/devices are connected to.

- ✓ **Data Storage**

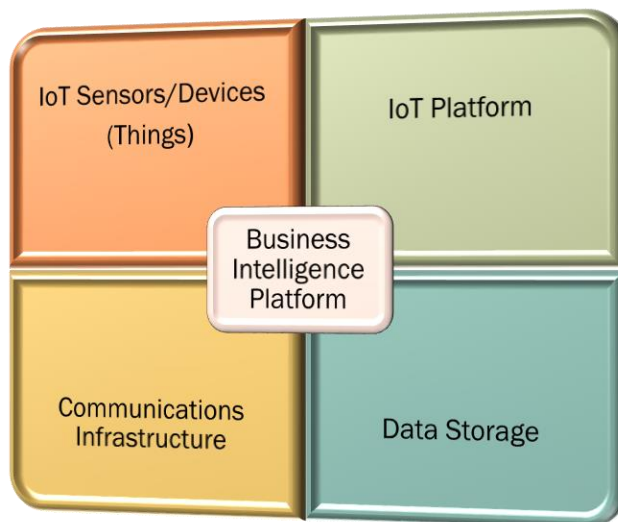
Storage located in the city data center or the cloud that stores information generated and captured from the IoT sensors/devices. The data is stored in the city Storage Area Network (SAN) or in the cloud where it can be utilized and analyzed in real-time or in the future.

- ✓ **IoT Management Platform**

Software specific for the remote monitoring and the management of IoT sensors/devices. The software can proactively address issues, report on the health, and provide data for a IoT sensor/device.

- ✓ **Business Intelligence (BI) Platform**

Aggregates and integrates data collected from city assets in a central location so data science and advance analytics can be applied. Dashboards and visualizations can be produced and provided to city business units for data-driven decision-making or for public consumption.



What Does A Smart City Look Like?

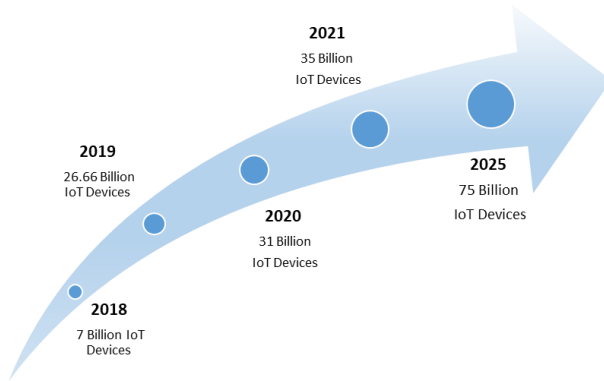
IoT Sensors/Devices (Things)

Imagine **environmental sensors** are strategically placed throughout the city that could report CO2 emissions, temperature, pollution, and toxic gases, and rainfall data. Buildings could be equipped with **smart automation systems** to control operations, report energy usage, and provide advanced notification to Safety Services in the case of an emergency. **Video cameras** could monitor parking



spaces and utilize **machine learning** and **artificial intelligence** to capture parking capacity and consumer tendencies. **Connected vehicles** could communicate with each other and the communications infrastructure, to improve safety and shorten travel times. **Signal preemption** on traffic signals could expediate emergency vehicle response or transit on-time performance. Remotely controlled **Smart lighting** could facilitate public safety emergencies or community events or be programmed to reduce energy. IoT sensors could be placed on **storm sewers** to control discharge into our rivers based on the amount of rainfall. **Smart kiosks** could be placed throughout the downtown for visitor information and messages that could be changed in real-time.

The above are just a few examples of the capabilities current technology has made possible.



In 2018, there were 7 billion active IoT devices (Things). In 2019, the number of active IoT devices reached 26.66 billion. Every second 127 new IoT devices are connected to the web. During 2020, experts estimate the installation of 31 billion IoT devices. By 2021, 35 billion IoT devices will be installed worldwide and by 2025 more than 75 billion IoT devices will be connected to the web. (Maayan, 2020)

Communications Infrastructure

Connecting thousands of IoT sensors/devices require a dense and robust **communications infrastructure**. The city and private industry provide a variety of fiber, wired, and wireless communications networks to accommodate future connectivity needs.

Connecting current and future city assets provide the following key benefits over traditional non-connected assets:

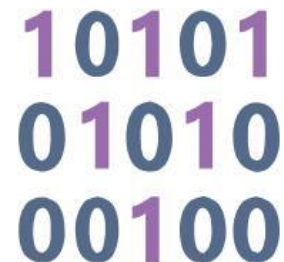
Real-time Operation, Remote Control, and Monitoring of Smart Assets

IoT management platforms/applications are utilized to remotely monitor and control IoT sensors/devices from anywhere an internet connection can be achieved. The status and health of the asset can be viewed or reported in real-time and allow for immediate or proactive resolution to an issue or problem. For example, if a smart streetlight failed, it would immediately notify the system (IoT Platform) of the outage so maintenance could be scheduled. Currently, if a failure occurs it must be identified for repair by city staff or passersby. This results in a Cityworks or A2 Fix It request, and requires additional city resources to resolve the issue.

In the case of a smart streetlight, the **IoT management platforms/application** can also be utilized to program one, or all, streetlight functions based on time of day, traffic, weather, etc. and can be remotely re-programmed at any time. In addition, software can be developed to automate the routing of service calls based on issues captured over a period of time. Traditionally, lighting modifications required manual changes and automation was limited to photocell technology and streetlights were not connected to a communications network.

Data-Driven Decision Making

Unlike traditional city infrastructure assets, smart assets are connected to a communications network and report data on their status, operation, and health. This **data** is stored in the **cloud** or on the city's **storage area network (SAN)**. In conjunction with **data sciences** and the city's **Business Intelligence (BI) Platform (aka "Big Data")**, data captured from all assets can be analyzed, visualized, and provided back to city employees to aide in solving business problems, performing cost analysis, budgeting, operational performance, and informing the community. Possessing data generated from



connected assets promote a ***data driven culture*** and provide the ***knowledge*** needed to enhance the delivery of exceptional services to our community.

A Connected Smart City Ecosystem

A smart city is only as good as its foundation. Over time, the city has strategically implemented the key foundational components (fiber, conduit, data storage, networking, security, BI platform) in coordination with other city capital projects. The city's systems can support a long and sustainable smart city ecosystem capable of connecting city assets and devices. As with any system, the foundation is only as strong as its weakest link. Our smart city ecosystem must be treated as a highly integrated system and all elements must work together in order to be successful.

Executive Summary – A Digital Transformation

The evolution of digital technology and the Internet of Things (IoT) has given the City of Ann Arbor the opportunity to reshape, transform, and elevate the way the city operates and serves its community. The City of Ann Arbor Smart City Strategy will address how we leverage advances in technology to improve city operations, more efficiently use city resources, utilize data to make more informed business decisions, solve city and community problems, and provide exceptional services to our community.

Today, through the deployment of smart devices/sensors or IoT devices (Things), we have the capability to connect city infrastructure assets to the city network. Connecting these assets allows for the remote management, monitoring, and the collection of data that was historically not feasible. The more infrastructure assets we are able to connect, the more we will enhance our ability to serve our community, and in a more efficient and effective manner.

“smart cities’ spending on technology in the next six years is expected to expand at a compound annual growth rate of 22.7%, reaching **\$327 billion by 2025** from \$96 billion in 2019” (StateTech Magazine, 2020)

Many smart city solutions have already been implemented by the city such as smart water meters, smart trash and recycling bins, and smart lighting. Over the past few years, in preparation for smart city solutions, the IT department has made significant improvements to the city’s fiber optics communications network and technology infrastructure, and has implemented a Business Intelligence (Big Data) platform. These systems are the foundational building blocks needed to support any successful smart city ecosystem.

The COVID-19 pandemic has been challenging for all, but has brought to light how technology can allow us to perform our jobs and maintain services to the community. It has proven teleworking is viable and that many employees can be just as productive when working from home. Smart city solutions make it possible for workers to manage city assets from anywhere you can achieve a reliable and secure internet connection.

Smart City Strategic Planning Meetings

The city conducted two strategic planning meetings with city departments and community stakeholders consisting of the City of Ann Arbor Service Areas, City of Ann Arbor City Administration, DDA, University of Michigan, AAATA, SPARK, LDFA, and Washtenaw Community College. In addition, two community meetings were conducted with the public. The results of these meetings can be found at [Smart City Strategic Planning Results](#).

Participants in the meetings responded to a series of questions and feedback was solicited to identify desired characteristics of a smart city, how community problems can be solved, how the standard of living can be improved, the value of a smart city to the community, and challenges that should be considered or addressed. A gallery walk was conducted in the city/community stakeholder meetings and responses were categorized, voted on, and tallied based



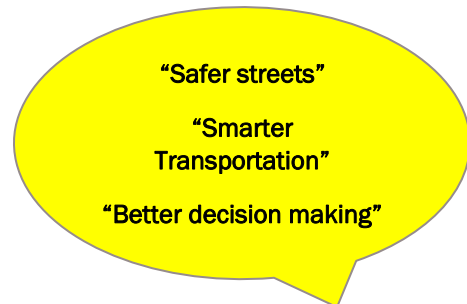
Main Characteristics of a Smart City?

on the highest number of responses. These results were coupled with feedback from the public in our community meetings and resulted in the following themes:

- ✓ The **main characteristics** of our Smart City Strategy should possess strong partnerships and sharing. It needs to be flexible and adaptable, equitable, sustainable, and data driven.
- ✓ The main **community problems** our Smart City Strategy should address is to eliminate social problems and improve the environment, city services, public safety, and parking.
- ✓ To **improve the standard of living** in our community our Smart City Strategy should promote economic development, safety, city services, and produce reliable and transparent data/information.
- ✓ The **value** of a smart city to the community is to improve city services, improve infrastructure, economic diversity, and economic development.
- ✓ The main **barriers and challenges** a smart city will encounter are political, legal, fear of change, privacy, security, shared vision, prioritization, sustainability, and safety.



What community problems should a Smart City Strategic Plan address?



Improve the standard of living and economic opportunities?

Main Strategic Goals

As a result of the planning meetings and the feedback, the following **main goals** for the City of Ann Arbor Smart City Strategic Plan were established and are explained in greater detail later in this plan.

	<p><i>The Most Desirable City to Live, Work, and Play</i></p>
	<p><i>Improve the Quality of Life</i></p>
	<p><i>Build and Maintain A Modern, Innovative, and Sustainable Smart City Ecosystem</i></p>

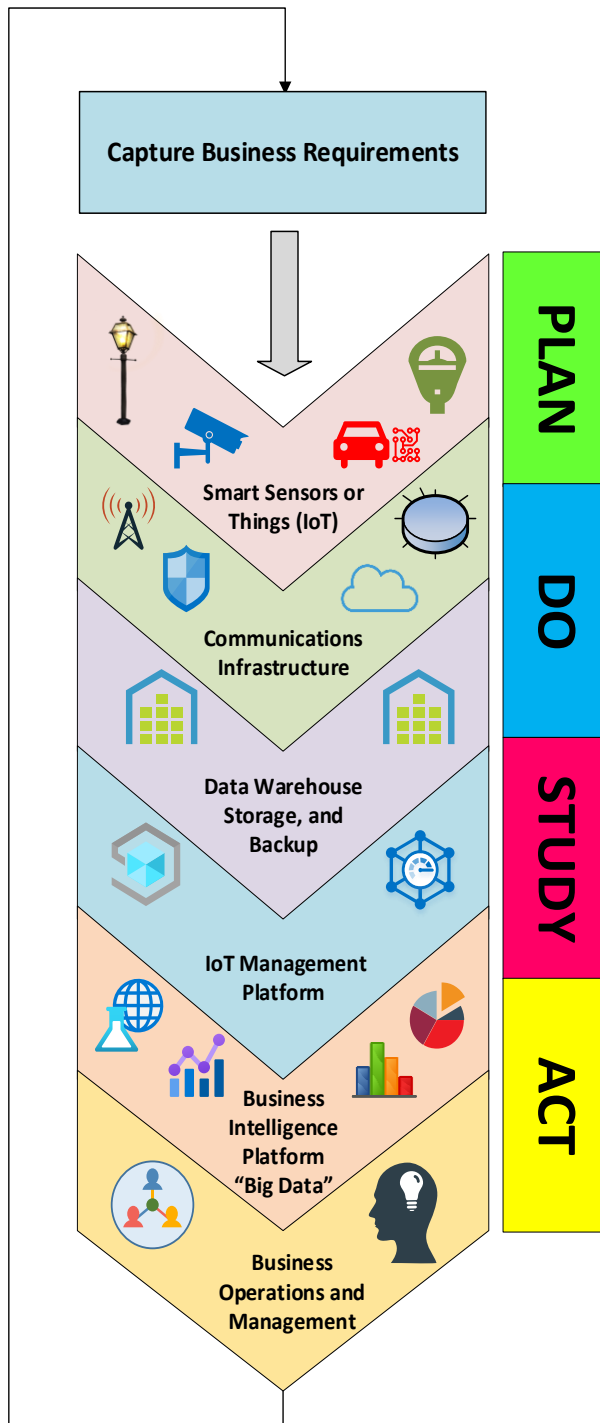


Figure 1

Our Approach

Our approach is to organically grow our smart city ecosystem in order to solve community problems, improve the service we deliver to the community, and enhance city services. To achieve the goals stated above, our smart city strategy must be community focused, holistic, and align with strategies and best practices set forth by our organization such as the City of Ann Arbor Strategic Plan, A2Zero, Vision Zero, Complete Streets, One Community, the Information Technology (IT) Department Technology Plan, Cellular Strategic Plan, and Priority Based Budgeting (PBB), etc. In order to be successful, the design and implementation of our smart city ecosystem must be treated as a system of highly interactive components, must remove traditional community and organizational barriers and silos, and instead, converge and create synergies.

A true smart city environment is very complex and comprised of numerous moving parts that are constantly evolving. Many of the foundational components required for a successful smart city have already been implemented, which significantly reduces future capital expenditures for the city as well as the community. Possessing a strong communications infrastructure removes a significant barrier and will increase the success of future smart city solutions.

The design, planning and implementation model in **figure 1** will be utilized to ensure all elements of a smart city are taken into consideration as opportunities present themselves, and continuous improvement is designed into solutions utilizing a PLAN-DO-STUDY-ACT framework and the IT department Project Delivery Methodology.

As the city addresses opportunities to remediate, replace, or implement new infrastructure, sustainability and equity requirements must be taken into consideration. The ability to connect

city infrastructure assets to the city network allow us to remotely monitor the health of each asset to determine their status, thus allowing us to respond proactively to outages, problems, or maintenance needs in an equitable and inclusive manner.

Summary

The digital revolution allows us to accomplish things previously not feasible. Our smart city pursuit is a journey, will never end, must be realistic and achievable, and will evolve over time. The opportunities are endless, and it is imperative we build smart solutions intrinsically into our DNA so we can continue to serve our community at the highest level.



Goal 1: The Most Desirable City to Live, Work, and Play

Our Smart City strategy and infrastructure is designed to support next generation systems and facilitate enhanced city services such as transportation, mobility, housing, community services/parks, parking, the arts, festivals, parks and other leisure and cultural events in order to make Ann Arbor the most desirable community to live, work, and play.

Ann Arbor is unique in the way its critical infrastructure is managed and operated. The City Transportation Department operates traffic signals, public transportation is operated by the Ann Arbor Area Transportation Authority (AAATA), electricity and lighting are primarily provided by DTE, parking is the responsibility of the Downtown Development Authority (DDA), and the University of Michigan Transportation Research Institute utilizes the city's fiber network for conducting connected vehicle research. This hybrid model poses unique challenges and requires effective collaboration, communications, and strong relationships.

Objective: Enhanced City Services

Efficient city services are crucial to any community. The city has already deployed and embraced smart city solutions such as our smart water meter system, Automated Vehicle Location (AVL) system for city vehicles, and smart trash and recycling bins. Smart city concepts apply to any infrastructure assets that can accommodate a smart sensor such as the tagging of assets, water pipes, sewer pipes, river water flow sensors, storm water basins, parking meters, environmental sensors, etc. As new opportunities arise, existing smart city solutions will be expanded, and new opportunities pursued to enhance services provided to the city and the community.



Following are actual or potential smart city use cases the city is currently pursuing or could potentially pursue as opportunities arise:

Smart Street Lighting

Work is already underway to implement 70+ smart streetlights in the downtown area. The smart streetlight heads allow us to remotely monitor, control, and capture health data about each light. Issues with streetlights can be proactively determined in advance to mitigate the chance of a problem or an outage. Smart streetlight heads have the capacity to install additional modules to accommodate other smart city solutions such as: public or private wireless network, the ability to detect pedestrian traffic via cell phone signals, or connecting the city's fiber that would allow us to connect cameras or environmental sensors.

Snow/Rainfall/River Water Flow/Water & Sewer Pipes/Storm Water

Sensor technology can be utilized on our roads, in our rivers, and on city infrastructure assets to determine amounts of rain or snow, water flow, health or issues with water pipes, and the amount of storm water being discharged into our rivers. Data captured from these assets, coupled with software applications, can proactively sense problems before they occur or automate the routing of city resources to address and resolve issues or scheduled maintenance.

Smart Asset Tagging

City assets can be tagged with sensors to track/locate equipment, prevent loss, and improve safety. City assets such as rental kayaks or canoes can be automatically located in the case of an emergency or inclement weather, or inventoried at the end of the day thus eliminating manual labor currently utilized.

Smart Parking and Curb Management

Parking can be enhanced through the use of Artificial Intelligence (AI) and Machine Learning. Sensors and cameras can be strategically placed to monitor parking spots and determine parking tendencies without compromising privacy. The information captured can be used to determine parking capacity, change rates in real-time based on availability, provide real-time parking information for city visitors, provide intelligent curbside management, or route people to available parking spots. The city and the Downtown Development Authority (DDA) are working together to connect all city owned parking structures/lots in the DDA District and will provide the DDA with ample capacity to implement technology and future smart city solutions.

Smart Downtown Ann Arbor/Technology Park

A project is currently in progress to densify the city's communications infrastructure in the DDA District to accommodate future smart city solutions designed to

promote an innovation district, attract and retain people and businesses, and facilitate enhancing the vibrant downtown experience. Solutions such as connected intelligent kiosks to provide visitors with information and aide in navigating the city, digital signage/marquise/message boards, EV charging stations, public/private wireless networks, dark fiber access, parking sensors, electronic parking bollards, audio speakers, in-ground lighting, etc. could be considered.

Objective: Smart Transportation/Mobility

People should be able to move efficiently and safely through our community utilizing multi-modal transportation. Our transportation system must be truly seamless and integrated. It must capture data, both scheduled and on-demand, from all mobility sources to facilitate informed decision making. It must support the city's Vision Zero, Complete Streets, carbon neutrality, and equity goals.

Public and private organizations require a solid communications infrastructure that can accommodate the capacity needed for implementation of new and future technology to improve mobility, increase accessibility, reduce emissions, and improve safety. The infrastructure that supports the city's current transportation/mobility needs and the University of Michigan Transportation Research Institute (UMTRI) is aging and requires upgrades. New projects are currently in progress to densify our fiber and conduit in the city to support robust mobility corridors in order to maintain our position as the leader in connected vehicle and infrastructure research, transportation, and mobility.

Objective: Promote an Innovation District

Businesses and our community need people and technology resources to accomplish their goals and thrive. This smart city strategy is designed to further position the City of Ann Arbor as the elite and most desirable smart city "playground," Technology Park, and Innovation District in the country. Access to affordable high-speed communications infrastructure capable of supporting our business startups/incubators, teleworking, distance learning, and smart city initiatives are key to attracting and retaining talent and businesses to our area. The city will continue to expand our communications infrastructure to promote competition and choices for affordable high-speed broadband access for our community for many years to come. We will work with key community stakeholders to ensure they have knowledge of the city's infrastructure availability and capabilities so they we can take full advantage of this very valuable asset.

Objective: Promote Smart Affordable Housing

The city IT department works very closely with the Ann Arbor Housing Commission and their business/technology needs in order to align with their mission. As new sites are constructed and remediated, smart building automation systems will be considered to gauge indoor air quality, reduce energy consumption, increase safety and security, reduce costs, and increase efficiency. Each housing facility is connected to the city's network and has access to high-speed broadband and excess fiber for future connectivity needs.

Objective: Bridge the Digital Divide

The COVID-19 pandemic has demonstrated the reliance and need for quality high-speed broadband access. A key design consideration for our communications infrastructure is to make it easily



accessible to our public schools and community so we can further bridge the digital divide and facilitate reliable and equitable distance learning and teleworking. We will continue to build in excess capacity into our communications infrastructure and market the use of our fiber networks to public and private entities to promote competition, equality, choices, affordability, and access to high-speed broadband access.



Goal 2: Improve the Quality of Life

Smart City solutions must be inclusive, transparent, accessible, environmentally friendly, and equitable to improve the quality of life in our community. Smart city solutions must be designed to reduce crime, improve health, improve the environment and solve community problems and have a positive impact on people's lives.

A strong smart city ecosystem will remove traditional barriers and facilitate for a safer, healthier, and environmentally friendly community.

Objective: A Safe Community

Our community wants to feel safe and smart city solutions can be considered to increase safety. For example, signal preemption can be implemented to open faster routes to hospitals; video cameras and drones can be used to get a visual at the scene of a crime or fire prior to the arrival of first responders so initial conditions can be assessed; Artificial Intelligence can mitigate crime or anticipate large crowds on-demand; smart street lighting can be remotely monitored and controlled on-demand; gun-shots can be detected and automatic notification can be sent to police as they occur utilizing Ring systems for 2-way video communications between citizens and Safety Services. The data collected from connected smart devices can be fed to crime mapping applications for analysis, and existing body worn cameras and in-car camera systems for Police can be enhanced by allowing real-time upload of videos.



A smart and robust communications infrastructure is necessary for seamless communications among first responders, Safety Services, health care organizations, and other community members in order to improve communications, response, and safety.

Objective: A Healthy and Environmentally Friendly Community

Our smart city strategy will facilitate and support the city's A2Zero Climate Action Plan in order to achieve the community's carbon neutrality goals. As the city implements A2Zero, our robust



communications infrastructure is available for, but not limited to, the implementation of building energy management systems, indoor/outdoor air quality sensors, and electric vehicle (EV) chargers.

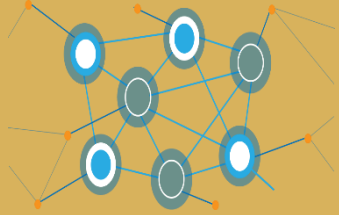
Strategically placing environmental sensors around the city can detect CO2 emissions, temperature, pollution, toxic gases, and rainfall amounts. New Electric Vehicle (EV) charging stations can be connected in order to remotely manage EV stations and collect data for energy cost optimization and energy usage.

Data captured from these devices can be utilized to monitor, collect, and analyze data about our environment to determine if we are meeting our carbon neutrality goals and making informed environmental and business decisions.

Objective: An Equitable and Inclusive Community

Smart city solutions must support the city's One Community Initiative and ongoing Diversity, Equity, and Inclusion (DEI) initiatives. It is crucial that all future projects and opportunities the city deploy have a data collection mechanism imbedded to help ensure DEI objectives are being met.

The IT department is currently working with Human Resources, Systems Planning, and Sustainability to develop an organizational analytics tool using the city's Business Intelligence Platform, GIS, and stored city data to aide in determining if we are providing city services in an equitable, inclusive and sustainable manner. The IT department will continue to utilize our project delivery methodology to identify equity and inclusion as part of new city projects and opportunities.



Goal 3: Build and Maintain a Modern, Innovative, and Sustainable Smart City Ecosystem

The primary foundational building blocks to a successful Smart City Ecosystem is a robust telecommunication infrastructure, Business Intelligence or “Big Data” Platform, cyber security, strong partnerships, and a consistent project delivery methodology to ensure business requirements and needs align with the city’s strategic plan(s).

Any organization, public or private, need assurances their telecommunications infrastructure is reliable, dependable, and sustainable. The city continues to expand its telecommunications infrastructure utilizing standards and best practices to maintain quality and implement additional capacity to serve the community well into the future.

Our communications infrastructure must remove traditional barriers and promote seamless access to facilitate for collaboration and communications for all community stakeholders..

The city has adopted the following strategies, standards, best practices, and specifications to ensure consistency, quality and sustainability in order to attract community organizations to utilize our telecommunications infrastructure.

Objective: Disciplined Telecommunications Strategies, Standards, and Best Practices

The city and the Information Technology department employ many strategies and a delivery methodology in order to maintain the integrity of the city’s information systems and meet the goals of the city. Following are some of the essential best practices and initiatives implemented, or being implemented as part of this plan, in order to maintain a healthy and sustainable ecosystem:

A Digitally Connected Community

The city’s conduit and fiber infrastructure are built to accommodate not only the city, but the community as a whole. As the city designs and plans our infrastructure, we engage key city and community stakeholders on a project-by-project basis and solicit feedback and input to ensure we are capturing needed requirements.

Our goal is to continue to build a fiber backbone so dark fiber is easily assessible and affordable to public and private organizations, which in turn will promote the use of the fiber and give the community more choices as it relates to high-speed broadband access. A connected community can greatly enhance collaboration, partnerships, and communications which can lead to efficiencies and cost savings.

Telecommunications Ownership, Maintenance, and Use

The city exclusively owns and maintains the city conduit and fiber infrastructure backbone. We feel this is critical to ensure consistency, integrity, access, sustainability, and availability of our telecommunications infrastructure. The city and (or) its contractor(s) are solely responsible for any adds, moves, and changes to the infrastructure.

The city will continue to solicit the use, and (or) lease, of our conduit and dark fiber assets to public and private organizations. The city incorporates the above standards into all use/lease agreements in place with the organizations using or wanting to use/lease conduit or dark fiber. The city is not, and has no plans to become an Internet Service Provider (ISP) and cannot “light” fiber for anyone except the city. Revenues generated from the utilization of the city’s dark fiber will be utilized to maintain a quality and sustainable telecommunications infrastructure.

Cyber Security and Data Privacy

Cyber security is pervasive to all aspects of information technology and mitigating cyber security threats to our network continue to be one of the most challenging tasks for the IT department. There is a potential for thousands of smart IoT sensors/devices that could be deployed throughout the city, thus increasing the risk of being compromised. It is critical data remain safe, secure, and private. All opportunities to connect smart sensors on the city’s network will be evaluated for security and other systems will be leveraged to harden our cyber security posture to mitigate threats.

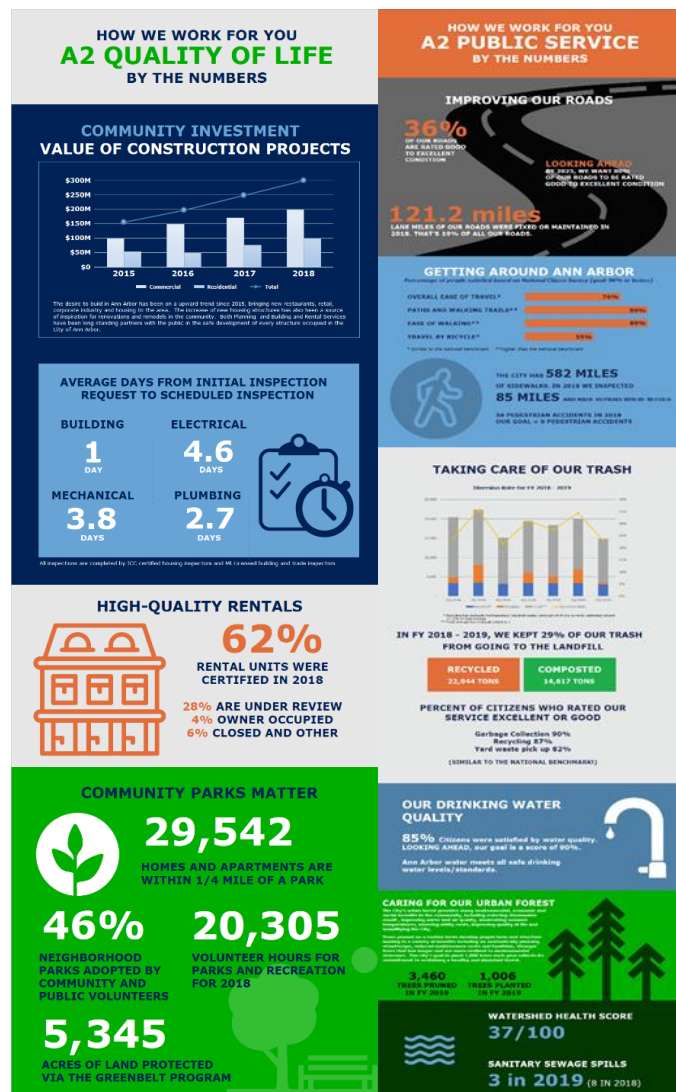
Objective: Promote and Support Enterprise Data-Driven Decision Making (A2 Analytics)

Data/Information or knowledge, if utilized properly, can be very powerful and lead us to operational excellence. Large quantities of data will be generated from smart city sensors/devices, systems, and applications. The IT department implemented a Business Intelligence (BI) platform (aka “Big Data”) to accommodate this influx of data as well as organize, analyze, cleanse, and report the data back to city business units and (or) the public in the form of metrics, dashboards, infographics, and Key Performance Indicators (KPI’s). The goal is to utilize this valuable information to provide city management and departments data about the performance of their systems and to facilitate informed decision making.

Goal 4 of the 2021-2022 IT Department Technology Plan is to “Promote and Support Enterprise Data-Driven Decision Making.” Our approach is to utilize the IT department Project Delivery Methodology and data sciences to capture, analyze, visualize, and deliver our data to the organization and community. All relevant data will be placed in a central repository for use throughout the organization while eliminating redundancy. As business problems or opportunities arise we will take a holistic view of our data, ensure privacy and transparency, and determine the source(s) of our data is trusted.

Our new BI platform was selected because of its ability to be end user-friendly and self-service so the organization can utilize tools to analyze their data with minimal assistance from the IT department. As visualization tools are delivered to our business units they will be trained to be self-sufficient.

Metrics to support the city’s strategic plan have been defined, will continue to evolve, and will prominently be displayed both internally and externally. The goal is to capture and analyze data to inform our citizens and provide outcome-based metrics on how the city is performing.



Breaking Down “Knowledge Silos”

Historically, organizational data has existed in silos and required specialized resources to extract and make sense of the data. The City of Ann Arbor has 46 departments and 140 applications, with many departments having unique software needs. The needs for each department vary, thus making city operations very complex to support. The IT department has a history of developing integrations between software applications to improve efficiencies and automate tasks, and this will continue. As the city continues to pursue new projects or opportunities departments need to work together to integrate activities and tasks, and share data across departments.

The IT department project Delivery Methodology will continue to be promoted and implemented throughout the city to ensure we are considering equity, sustainability, and smart city concepts for all new opportunities and to ensure we are capturing clear and concise business needs that align with the goals of the city and continue to fine-tune our operations, eliminate waste, and improve our service delivery excellence.

Objective: Build Strong Community Relationships

Effective communications are key to a successful strategy. This strategy is not only being developed for the city but the community as a whole. Communication can always be improved, and traditional silos need to be broken down. A strong communication plan and a city/community Smart City advisory team will be established to ensure we are sharing information, exploring new opportunities, enhancing relationships, effectively communicating to all key city/community stakeholders, and taking full advantage of our smart city ecosystem.



Qualified workers in areas such as mobility, autonomous and connected vehicles, transportation, data sciences, Machine Learning and Artificial Intelligence are needed to meet workforce demands. The city will work with community educational institutions and offer assistance in developing curriculum and training needed for our next generation work force. A goal is to utilize our smart city ecosystem to attract businesses and talent to the area, and retain the talent, so we have a sufficient pipeline of qualified resources.

Goals, Objectives, and Initiatives Summary

Goal 1: The Most Desirable City to Live, Work, and Play

Objectives:	Initiatives:
<p>Enhance City Services</p>	<ul style="list-style-type: none"> ✓ Implement internal methodology to ensure smart city solutions are being considered for new implementations and upgrades to existing city infrastructure assets or systems. ✓ Connect city assets so data can be captured to assist the city in making more informed business decisions. ✓ Collaborate with the DDA to implement smart solutions in the DDA District. ✓ Examine the feasibility of Asset Tagging for Parks. ✓ Implement river water flow sensors for the Water Treatment Plant. ✓ Expand Smart Lighting. ✓ Implement snow and rainfall sensors for Public Services. ✓ Collaborate with the DDA on future smart parking and curb management technology.
<p>Smart Transportation and Mobility</p>	<ul style="list-style-type: none"> ✓ Continue collaboration with UMTRI vehicle to everything (V2X) connected infrastructure. ✓ Pursue opportunities to enhance the safe and efficient movement of people. ✓ Implement signal priority and/or preemption for efficient transit and emergency response. ✓ Continue to expand smart and connected signs and signals such as adaptive signal control. ✓ Develop a local intelligent transportation system architecture.
<p>Promote Technology Park/Innovation District</p>	<ul style="list-style-type: none"> ✓ Complete the Technology Park/Innovation District construction of fiber and conduit in the DDA District. ✓ Connect the remaining DDA parking structures and lots in the DDA District to the city fiber. ✓ Continue to densify the city communications infrastructure.

	<ul style="list-style-type: none"> ✓ Collaborate with SPARK, DDA, and other community stakeholders to promote the value and use of the city's communications network to attract and retain people and businesses to Ann Arbor. ✓ Pursue an EDA grant to connect the Ann Arbor and Ypsilanti Smart Zones.
<p>Promote Smart Affordable Housing</p>	<ul style="list-style-type: none"> ✓ Provide high-speed communications to all Housing Commission structures to accommodate employees and (or) tenants. ✓ Implement connected and integrated building automation systems. ✓ Provide smart technology to allow for Aging in Place.
<p>Bridge the Digital Divide</p>	<ul style="list-style-type: none"> ✓ Enhance affordability, equitable access, and choices to high-speed communications for all. ✓ Promote the use of the city communications network to local educational institutions and other government agencies.

Goal 2: Improve the Quality of Life

Objectives:	Initiatives:
<p>A Safe Community</p>	<ul style="list-style-type: none"> ✓ Pursue smart solutions to assist in keeping our community safe such as smart lighting, signal preemption, video surveillance, gunshot detection, 2-way citizen communications, etc. ✓ Enhanced collaboration and end-to-end communications among all community first responders to reduce response times and increase knowledge sharing.
<p>A Healthy and Environmentally Friendly Community</p>	<ul style="list-style-type: none"> ✓ Strategically place environmental sensors throughout the city to capture and make available environmental data. ✓ Strategically place informational kiosks around the city. ✓ Connect EV changers. ✓ Implement and connect buildings energy management systems to the city fiber.
<p>An Equitable and Inclusive Community</p>	<ul style="list-style-type: none"> ✓ Develop a mechanism to ensure Diversity, Equity, and Inclusion is being considered for all capital projects and city processes. ✓ Develop a DEI analytics tool. ✓ Implement an internal methodology to ensure DEI is being considered for all opportunities/project. ✓ Develop and implement a city privacy policy as it relates to data collection in outdoor public spaces.

Goal 3: Build and Maintain a Modern, Innovative, and Sustainable Smart City Ecosystem

Objectives:	Initiatives:
<p>Disciplined Telecommunications Strategies, Standards, and Best Practices</p>	<ul style="list-style-type: none"> ✓ Develop a community “Dig Once” strategy. ✓ Strategically expand the city communications infrastructure. ✓ Conduct regular CIP meetings to anticipate and plan for future fiber, conduit, and smart city solutions. ✓ Continue to enhance a city Fiber and Conduit Use model. ✓ Establish a Program Management Office and Project Delivery Methodology to ensure consistency, equity, sustainability, integrity, privacy, and security for all new opportunities/projects. ✓ Pursue public/private relationships.
<p>Promote Data Driven Decision Making</p>	<ul style="list-style-type: none"> ✓ Maintain a strong Business Intelligence platform. ✓ Build the use of metrics into city processes, operations, and the city culture. ✓ Promote the use of technology to monitor and operate city assets and to capture data for city assets, where feasible. ✓ Share data with transparency. ✓ Continue to integrate and consolidate enterprise data. ✓ Provide data for utilization in decision making.
<p>Build Strong Community Relationships</p>	<ul style="list-style-type: none"> ✓ Establish regular community stakeholder meetings and a communications plan to ensure collaboration and encourage the utilization of the smart city ecosystem. ✓ Continue to expand collaboration with community stakeholders ✓ Work with Educational Institutions to promote smart city education and use of the smart city ecosystem.