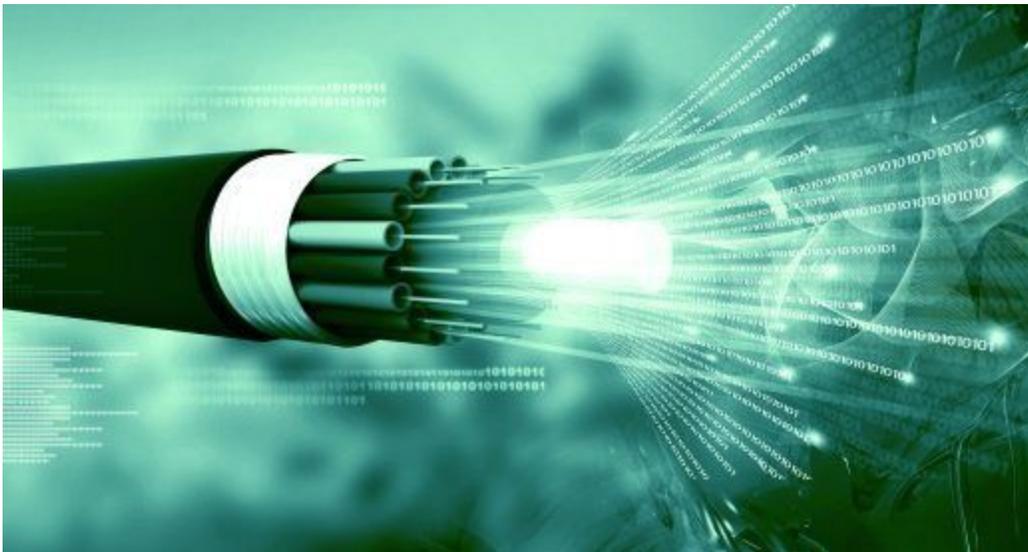


Providence City Technical Advisory Committee (TAC)

First Recommendation to City Council

Municipal Fiber-Optic Network Technical Review



Introduction

The Providence City Technical Advisory Committee (TAC) is a volunteer advisory committee formed by Providence City Staff at the request of the Providence City Council to further advise the City Council on technical and logistical matters related to the potential for a municipal fiber-optic network. The TAC is made up of citizens and staff of Providence City and includes outside industry fiber-optic expertise. All citizens of Providence City have been invited to join the TAC based on interest and/or technical expertise related to the subject matter of municipal fiber optic networks. At the time of this first recommendation, the TAC consists of members with expertise in the following minimum areas: electrical and

computer engineering, public broadcast engineering, amateur and public radio, public works and construction, network engineering, and fiber-optic project management.

Background

In [June of 2020](#), the City Council reviewed a [presentation](#) from Zion's Public Finance, Inc. regarding the requested study of municipal fiber for Providence City. Subsequently on July 14, 2020, a [public workshop](#) was held by Providence City on the topic of fiber and included many Providence City Citizens, Staff, Council Members, the Mayor, and participation from [Utopia Fiber](#) and [Strata Networks](#). Following the workshop in [July of 2020](#), the City Council approved a motion to "move forward with the intent to proceed with installation of fiber". The City Council specifically discussed the "Utility Model" and the "Subscription Model" as potential options for a municipal fiber-optic network. On September 02, 2020, another [public workshop](#) on fiber was also held. On the same day, the first meeting of the TAC occurred and has been subsequently followed-up with weekly meetings.

In late August of 2020, Providence City received an "Unsolicited Proposal" under Utah State Law (63G-6a-712) from Strata Networks for a "public-private partnership" relating to the installation and operation of a municipal fiber-optic network. The proposal contained technical and financial details based on the concept of providing fiber-optic service to Providence City residences and businesses either as a utility (i.e. Utility Model) or based on subscription as an "opt-in" or "opt-out" service (i.e. Subscription Model). Based on a general review of municipal fiber and a review of the public-private partnership proposal from Strata Networks, the TAC provides this first recommendation to the City Council and requests further direction from the City Council on this topic.

Summary of TAC Recommendations

The Providence City TAC has met and reviewed various options for pursuing a municipal fiber-optic network. The TAC provides its recommendations to the City Council regarding which model (utility or subscription) to pursue and requests direction from the City Council so that the TAC can continue to meet and discuss important technical and logistic details for that particular model. The time spent by volunteers in the TAC can be best utilized if the City Council were to provide direction regarding the pursuit of a specific model and

direct the City Staff to indicate whether or not pursuit of a fiber-optic master plan and contract should be considered.

Specifically, the Providence City TAC recommends that the City Council consider the following:

1. That Providence City continues to pursue a municipal fiber-optic network
2. That Providence City specifically pursues the "Utility Model" wherein *all* current home and business premises in Providence City will receive access to the fiber-optic network infrastructure and internet services for a nominal monthly utility fee
3. That Providence City pursues development of a master plan (with input from the TAC) for a municipal fiber-optic network that includes appropriate technical, logistical, and geographical details for the municipal fiber-optic network
4. That Providence City pursues development of a contract (with input from the TAC, City Council, City Staff, and City Legal Council) with Strata Networks for the purpose of pursuing the proposed public-private partnership (PPP)

The Providence City TAC recognizes the importance of high-speed internet connectivity in today's fast-paced and communication-based world. Recent economic disasters brought upon by the COVID-19 pandemic combined with business and school restrictions for in-person contact have highlighted the basic need for every household and business to have access to reliable high-speed internet connectivity for critical educational, business, economical, personal, and familial needs. Internet connectivity is clearly one of the most basic ways in which the citizens continue to communicate with each other and the global world in extremely efficient and effective ways. The Providence City TAC provides these recommendations based on significant technical, logistical, and personal review of the information available to date. Some of the rationale and proposed risk mitigation strategies are included; however, full details of all considerations are not provided for the purpose of brevity.

The recommendation for the Utility Model is based on the following assumptions:

- Providence City owns and controls the municipal fiber-optic network

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- Providence City gains revenue potential when a minimum number of citizens or businesses choose to subscribe to an enhanced (e.g., 250 Mbps / 1Gbps service) internet service.
 - Every existing residence and business in Providence City is provided with, at a minimum, basic internet service through the municipal fiber-optic network without additional hook-up fees beyond the typical monthly utility fee.
 - A baseline of \$10 - \$15 per resident household (\$TBD for businesses) is assessed to all residences; however, citizens that show “hardship” (details TBD) can obtain a waiver for this fee. For resident households that choose to subscribe to an enhanced internet service, the suggested ~\$10 fee is included in the enhanced service package (initial presumptions to be a total of ~\$65 for 250 Mbps or ~\$75 for 1 Gbps for residential customers).
 - An open-access network model is employed whereby one or more Internet Service Providers (ISPs) can provide internet service on the municipal fiber-optic network (noting that such ISPs should meet specific criteria determined by Providence City and agree to terms set forth by Providence City).
 - A network service model is employed whereby the City employs a third-party (e.g., Strata Networks) to service the fiber-optic network in accordance with contract terms to be determined.
 - Risk to the city and hence its citizens and future citizens is mitigated by ensuring the cost of the fiber-optic network is spread across all households and businesses in Providence City while only needing less than 1 in 4 households subscribe to an enhanced service to pay for the infrastructure (actual value depends on specifics).
 - Future potential use and expansion of the fiber-optic network (based on a passive optical network baseline) is considered in the fiber-optic master plan and contract including bandwidth oversubscription levels, physical network architecture and maintenance locations, construction requirements, increased bandwidth potential by means of sufficient additional connectivity options, and ability to utilize a hybrid

passive optical network (PON) architecture with potential for active ethernet as-needed.

In addition to confirming the specific direction the city should pursue, the TAC invites the City Council to provide further feedback on these assumptions and to provide additional input to the financial and technical model being used by Strata Networks to determine the cost-basis.

The TAC believes that it can best serve Providence City if the majority of its efforts are expended in assisting with the development of the fiber master plan and in providing input regarding the technical and logistical aspects of agreements required to execute a path for the Providence City municipal fiber-optic network (both with the potential network provider and ISPs). For this purpose, the TAC awaits further input and specific direction from the City Council on how to proceed.

Overview of Utility and Subscription Models

The two models considered by the TAC are the “Utility Model” and the “Subscription Model”. A brief description of each along with some pros and cons are provided. Only a few of the top comparative pros and cons are listed.

Utility Model

The Utility Model is based on the premise that all homes / businesses currently in Providence City are connected to the physical infrastructure of the municipal fiber-optic network. In this model, every home / business pays a utility fee which is used to build and maintain the fiber-optic network. The utility fee would also cover basic Internet sufficient to provide email and low-speed web services. As additional residences or businesses are built within Providence City, additional municipal fiber-optic infrastructure would be added to accommodate this expected growth. The additional growth can be funded through impact fees, existing fiber revenues, or other means as determined by the City Council and City Staff as may be appropriate.

A few of the Pros and Cons of the Utility Model are as follows:

Utility Model Pros

- The premises of all homes and businesses are connected to the fiber network
- No additional fees or construction is required to connect existing homes and businesses
- The required subscription rate for enhanced Internet services in order to sustain the fiber network is substantially lower (e.g., ~14% to 25% take-rate depending on level of special allowances for hardship)
- Low basic utility fee due to large number of connections (e.g., ~\$10)
- Every home receives basic Internet services at a minimum
- Known number of existing connections and easier to increase subscription rate for enhanced services due to low-barrier to entry
- New move-ins will already have physical fiber connection regardless of previous residence's decision on subscription

Utility Model Cons

- Every home / business required to pay the basic utility fee
- A home / business cannot opt-out of the basic utility fee even if it chooses to utilize an ISP that does not operate on the Providence City fiber network
- Given the assumption of a lower utility fee (e.g., ~\$10 as opposed to ~\$30), there is a minimum take-rate for enhanced services required to pay for the fiber network
- Higher initial cost to the city for build-out (e.g., ~\$1.6M more based on initial modeling from Strata Networks)

Subscription Model

The Subscription Model is based on the premise that homes / businesses either opt-in or opt-out of a subscription (e.g., either 250 Mbps or 1 Gbps). A basic Internet service is not provided in the case of the Subscription Model. In the Subscription Model, only the homes / businesses that commit to a subscription are serviced with a physical fiber connection to the premises. Once the build-out is complete, if a home / business determines at a later date to subscribe to the Providence City fiber network then additional construction work to physically connect the premises to the network is required.

A few of the Pros and Cons of the Subscription Model are as follows:

Subscription Model Pros

- Only homes / businesses choosing to utilize the Providence City fiber network pay an Internet service fee
- Lower initial cost to the city for build-out given that not all homes / businesses are connected to the fiber network (~e.g., ~\$1.6M lower based on initial modeling from Strata Networks)
- Potential to guarantee a minimum number of subscribers before committing to build-out of the fiber network

Subscription Model Cons

- A substantial cost is borne by the city or the new subscriber for an existing home / business that did not opt-in to the original subscription (e.g., ~\$1k per added connection)
- The additional cost required for an existing home / business that did not originally opt-in to join the fiber network is a large barrier-to-entry which may deter new subscriptions and hence reduce the take-rate
- Due to the transient nature of communities (i.e., move-ins / move-outs), the number of opt-in / opt-out requests could remain fluid throughout the build-out of the fiber network
- No basic Internet service since only homes / business committing to an enhanced Internet service are initially connected
- Higher take-rate required to build and sustain the fiber network (e.g., at least ~38%)

Risk Consideration and Suggested Mitigation

During review of the technical and logistic considerations as well as the public-private partnership (PPP) proposal submitted by Strata Networks, the TAC recognized a number of risks and discussed some mitigation strategies for these risks. The listed set of risks is not intended to be comprehensive and only those risks associated with technical or logistical concerns, in accordance with the recommendations from the TAC, are provided. A few of the highlighted risks, not already considered explicitly in the PPP proposal, along with their recommended mitigation strategies are listed below. The TAC recommends that these risks and mitigation strategies be considered.

Potential Risks	Potential Mitigation Strategies
Insufficient subscription / take-rate of enhanced Internet services to pay for build-out	<ul style="list-style-type: none"> • Marketing through basic Internet service and network ISPs. • Pre-commitment priority fee option. • Increased utility fee.
Unforeseen problems or natural disasters during or after build-out	<ul style="list-style-type: none"> • The additional revenue from fiber network is used for the network (as opposed for use in other areas of the city). • Ensure fiber master plan includes consideration for the “worst-case” for budget considerations and thus build margin for error into the project.
Unable to persuade ISPs to join the Providence City open-access fiber network	<ul style="list-style-type: none"> • Add terms in agreement with Strata Networks for Strata Networks to be a minimum ISP option • Market opportunity to ISPs.
ISP service fees are substantially higher than budgeted by Strata Networks	<ul style="list-style-type: none"> • Add terms in agreement with Strata Networks for Strata Networks to formally commit to the ISP prices stated in the PPP proposal.
ISPs do not provide the basic free internet service to non-subscribers in the utility model	<ul style="list-style-type: none"> • Add terms in agreement with at least one ISP provider (e.g., Strata Networks at a minimum) to provide basic free internet services that can also be used as a marketing tool.
When there is an issue with Internet service it could be either the responsibility of the ISP, the network operator (e.g., Strata Networks in the PPP proposal), or the city. Who does the customer call?	<ul style="list-style-type: none"> • Add terms in the ISP agreements to ensure the ISP is the point of contact for service issues. The ISP then works with the network operator and the city as-needed.
The customer will receive two bills - one from the city with the Internet utility / service fees and one from the ISP.	<ul style="list-style-type: none"> • Communicate early with Providence City citizens to educate them on the process for selecting an ISP and how billing will work.
Technology evolves quickly and enhanced bandwidth above the 1Gbps may be required for some customers	<ul style="list-style-type: none"> • TAC to review oversubscription level of bandwidth in current PPP model • TAC to propose a minimum allowance for “jumpered”

	<p>connections at a given Fiber Distribution Hub (FDH) to be converted to active ethernet or other options.</p> <ul style="list-style-type: none"> • Ensure fiber master plan and agreement with Network Provider account for these possibilities and consider future growth.
Network vulnerability to single-point failures	<ul style="list-style-type: none"> • TAC to review and provide recommendations on network topologies and infrastructure options in the fiber master plan and Network Provider agreement to ensure appropriate network redundancy.
Providence City and its citizens are not satisfied with the services provided by a Network Operator or ISP (i.e., not meeting specific criteria)	<ul style="list-style-type: none"> • Ensure agreements with ISPs and the Network Operator are set for appropriate term lengths and provide specific criteria to ensure citizens of Providence City receive the expected service. Allow for Providence City to seek immediate alternatives if criteria are not met.
Infrastructure build-out is a significant interruption to Providence City daily life	<ul style="list-style-type: none"> • Providence City Staff to review and approve construction methods ahead of time. Permitting done according to city ordinances and in accordance with the terms in the agreement with the Network Provider.
Network Security	<ul style="list-style-type: none"> • Providence City to have agreements with the Network Provider, Network Operator, and ISP that outline minimum expected cybersecurity levels and terms as recommended by the TAC.

The TAC welcomes additional input and direction from the City Council regarding any additional risks or mitigation strategies that should also be considered related to technical or logistical aspects of the proposed municipal fiber-optic network.

Next Steps

The TAC awaits further direction and/or confirmation regarding the recommendations provided herein. Should the City Council choose to continue to pursue a municipal fiber-optic network, the following next steps are recommended:

1. The City Council and TAC should consider if further improvements or modifications to the base-line assumptions in the PPP proposal are sufficient or if further refinement is necessary.
2. If the PPP proposal option is selected then the TAC should work with Strata Networks to develop a Providence City Fiber-Optical Network Master Plan. If the PPP proposal option is not selected then the City Staff should prepare one or more "Request for Proposals" (RFPs) to seek alternative options and develop a master plan under the alternative option.
3. Based on the developed Providence City Fiber-Optical Network Master Plan, agreements between Providence City and the Network Provider / Operator / ISPs should be developed in accordance with the master plan and considerations provided herein and by the City Council.

Conclusion

The Providence City volunteer Technical Advisory Committee (TAC) appreciates that the City Council has considered a municipal fiber-optic network. Providence City is a beautiful place to live. By adding critical fiber infrastructure to the city, Providence City stands to be a front-runner and exemplar for other cities in Cache Valley. The TAC invites the City Council to consider the recommendations provided herein and to give direction and feedback on this matter.

Respectfully,

The Providence City Technical Advisory Committee (TAC)

Appendix 1: Related Fiber Network Definitions

Fiber-optic Cable	A glass cable that uses light waves to transmit data that consists of a fiber bundle or single fiber, strength members, and a cable jacket.
Open Access Network	An open-access network (OAN) separates the physical access to the network from the delivery of <u>services</u> . In an OAN, the owner or manager of the network does not supply services for the network; these services must be supplied by separate retail/content (ISP) service providers.
Utility Model	A business model whereby a city installs, operates and maintains a physical fiber network that is connected to all city addresses and all residents pay a minimum “utility” charge.
Subscription Model	A business model that installs fiber trunk lines to every city street, but only connects and charges those addresses that “subscribe” to the network.
Active Ethernet	An Active Ethernet network has a direct point to point connection that provides a dedicated link from the network to the subscriber.
PON/GPON	Passive Optical Network (PON) is a point-to-multipoint access network. Its main characteristic is the use of passive splitters in the fiber distribution network, enabling one single feeding fiber from the provider to serve multiple homes and small businesses. GPON is Gigabit Passive Optical Network.
Aerial Installation	Installation of cable above ground on existing power company poles.
Inground Installation	Underground installation of fiber conduit and cable.
Service Drops	A connection to a customer facility from the network cabinet.
Take-rate	The percentage of subscribers out of the total number of available service addresses.
Micro-Trenching	Micro-trenching is an installation method in which a narrow and relatively shallow trench is cut, usually on an asphalt roadway. Trench dimensions can range from .75 to 2.24 inches wide and 8 to 16 inches deep.
Nano-Trenching	A shallower trenching method than micro trenching; google fiber used this in some locations and cable was popping out of the asphalt.
Directional Drilling	Directional drilling (HDD), is a minimal impact <u>trenchless</u> method of installing underground utilities that offers significant environmental advantages over traditional cut and cover pipeline/utility installations. The technique is routinely used when conventional trenching or excavation is not practical or when minimal surface disturbance is required.

Missile Boring	Missile boring, also known as horizontal boring, underground pneumatic boring, or impact boring is a method of point to point underground boring. Missile boring has been utilized as a standard for installation of public utilities.
Pedestal	A telecommunications pedestal is a ground-level housing for a connection point for underground cables. Pedestals are used for CATV (known as a cable box in such a situation), telephone, <u>PONS</u> , and other telecommunications systems.
Franchise taxes	The term franchise tax refers to a tax paid by certain enterprises that want to do business in a government jurisdiction.
Backbone	A backbone interconnects and ties together diverse network locations together located at different geographical locations.
Ring Topology	In a ring network, every device has exactly two neighboring devices for communication purposes. It is called a ring topology as its formation is like a ring.
Star Topology	In a star topology there exists a <u>point-to-point connection</u> between a node and hub device. The hub device takes a signal from any node and passes it to all the other nodes in the network. The hub works as a server and it controls and manages the entire function of the network.
Symmetrical Connections	In a symmetrical internet connection, the upload and download speeds are the same.
Cabinet, Shed, Hut	An enclosure that houses electrical equipment.
Hub	A hub is a basic networking device that connects multiple computers or other network devices together. Unlike a network switch or router, a network hub has no routing tables or intelligence on where to send information and broadcasts all network data across each connection. Sometimes the term hub is also used to indicate a location where various interconnections occur physically in a star topology.
Churn / Replacement	Churn is customer turnover. Replacement is making up for lost customer business.
Main Line / Trunk Line	The primary fiber backbone or line from which feeder lines are split off.
Feeder Line	A feeder line is a peripheral route or branch in a <u>network</u> , which connects smaller or more remote nodes with a route or branch carrying heavier traffic.
Infrastructure Fee	A fee charged to pay for the cost of network infrastructure.
Network Refresh Fee	A fee paid to cover the cost of replacing equipment that fails, needs repair or becomes obsolete.

Network Operator Fee	A fee paid to the contractor that oversees and manages the network.
Internet Service Provider Fee	A fee charged by an Internet Service Provider (ISP) for content including an internet connection, phone service and programming.
Total Retail Fee	The total amount charged to the customer including the Infrastructure Fee, the Network Operator Fee, the Network Refresh Fee, and the Internet Service Provider Fee.
Internet Service Provider (ISP)	An Internet service provider (ISP) is a company that provides customers with Internet access, often referred to as “the provider.” Services, such as telephone and television services, or personal websites or home pages may be provided. The services and service combinations may be unique to each ISP.
Content Provider	An ISP that typically provides connection to Internet services.
Landline	A phone connection via a wired network as opposed to a wireless connection such as cell service.
Megabit (Mb), Gigabit (Gb)	Megabit = 1,000,000 one million bits; Gigabyte 1,000,000,000 one billion bits, a thousand times more than a megabit. Bit = a unit of computer information or data-storage capacity that consists of a one or a zero. A byte is made up of 8-bits and therefore a megabyte and gigabyte are 8 times larger than a megabit and gigabit respectively.
Megabits per Second (Mbps), Gigabits per Second (Gbps)	Common data-rate metrics which express the number of bits per second sent across a network [see also Megabit (Mb), Gigabit (Gb) above].
UTOPIA/UIA	A fiber network service in Utah started about 15 years ago that serves about a dozen cities. UTOPIA offers a turn-key service at no cost to a city government as long as a certain threshold number of subscribers is achieved.
Network Operations Center	A network operations center, or NOC (pronounced “knock”), is a centralized location where IT technicians directly support the efforts of <u>remote monitoring and management (RMM) software</u> .
Telemetry	Telemetry, in general, is a term for technologies that accommodate collecting information in the form of measurements or statistical data, and forward it to IT systems in a remote location.
Broadband	Broadband is data transmission that transports multiple signals and traffic types. The medium can be coaxial cable, optical fiber, radio or twisted pair. In the context of Internet access, broadband is used to mean any high-speed Internet access that is always on and faster than dial-up access.
FTTP	Fiber To The Premises (FTTP) is a fiber optic cable delivery medium that provides Internet access directly to a user or groups of users from an Internet service provider (ISP).

Public Private Partnership (PPP)	A public-private partnership is a cooperative arrangement between two or more public and private sectors, typically of a long-term nature. In other words, it involves government and business that work together to complete a project and/or to provide services to residents.
5G/Wifi Small Cells	Small cells are low power, short range wireless transmission systems (base stations) to cover a small geographical area or indoor / outdoor applications.
Smart City Initiatives	A smart city initiative uses different types of electronic sensors to collect data. Insights gained from that data are used to manage assets, resources and services efficiently; in return, that data is used to improve the operations across the city. This includes data collected from citizens, devices, buildings and assets that is then processed and analyzed to monitor and manage traffic and transportation systems utilities, water supply networks, waste, crime detection, information systems, schools, and other community services.
Redundant Network	Redundancy is the installation of additional or alternate network devices or equipment to ensure availability in the case of device or path failure to avoid an extended outage. A ring topology is redundant by nature because two paths exist to a given interface.
Backhaul	A backhaul is the communication and network infrastructure responsible for transporting communication data from end users or nodes to the central network or infrastructure and vice versa. It is the intermediate communication infrastructure that connects smaller networks with the backbone or the primary network.