Project Narrative

Nature of Improvements

The proposed project is a Last-Mile deployment of fiber-to-the-home (FTTH) within areas of Gila, Navajo, and Apache Counties. This project will deploy roughly 155 miles of fiber, serving 2,023 homes, businesses, and anchor institutions. Working with contacts in and around the area, Conexon Connect will construct both aerial and underground cable to complete this project on an expeditious timeline. Additionally, Conexon Connect hopes to work with Navajo County and their proposed Middle-Mile build to deploy this project and help solve what one county official called "the number one priority." This deployment, in conjunction with the County's build, will provide a resilient, high-speed network to thousands of unserved Arizonans.

How the Southeast Navajo Project Addresses the Needs of this Area

During the course of the COVID-19 pandemic, the glaring disparities between rural and urban areas became increasingly clear. While students in the urban areas were able to continue learning remotely, students without reliable access to an Internet connection fell behind. This project will help address this issue in an area that needs it the most.

The Southeast Navajo Project will provide a Last-Mile connection to locations largely underserved by Internet per the latest available data from the National Telecommunication Information Agency. The students that live in these homes are unable to access vital resources if the need arises. The education of children cannot be trusted to spotty connections at home - or to services that sometimes require thousands of dollars just to receive a connection.

Furthermore, this project will provide connection to vital services such as telehealth for residents. One of the institutions connected by this project is Apache Behavioral Health in Whiteriver. Telehealth can be used to provide mental and behavioral health resources that may otherwise be unattainable for rural citizens. Studies have shown that access to these resources improve both quality of life and can help avoid other preventable deaths.

There are also roughly 17 anchor institutions that will receive access to a network from this project, including schools, churches, and fire stations. A broadband location at places such as a fire station is critical in early warning of threats such as wildfire, but also in deployment of assets to battle these fires if they breakout. Fiber-optic networks also allow rapid communication with the public in the event of potential emergencies.

These areas need high-speed Internet, and fiber is the most resilient option for addressing this need. The largest issue facing this area is its rurality - major telecommunications companies don't see a feasible way to get their money back, so they either don't serve the area or charge obscene rates which render the area de facto unserved. Conexon Connect sees a different story. We believe these communities are worth it and the state can help us make this a reality.

Community Anchor Institutions Served: 17

Households Served: 1,998

Businesses Served: 8

Population Served: 5,200

Miles of Fiber to be Installed: 155.73

Anticipated Economic Development Benefit

The connection to high-speed network is probably most important for the telehealth and education purposes described above. However, the economic benefits of access to a fiber-optic network cannot be ignored. The current situation in the area is inadequate for business development. Most of Navajo County (where a majority of the project is located) is driven by the tourism sector. In speaking with County officials, Conexon Connect learned that broadband expansion was the number one priority for Navajo County. This expansion would help local businesses and consumers. This evidence is not just anecdotal - a 2014 study found that there is a higher GDP per capita in areas with gigabit Internet service.[1]

The Location of Fiber to be Built

The fiber being constructed for this project is both aerial and underground. A majority of the project however will utilize overhead cable.

Commitment to Operate and Maintain the Network for Five Years

The formal, signed document demonstrating Conexon Connect's commitment to this network is attached to the application and called Letter of Service Committment. Conexon Connect is dedicated and committed to operating and maintaining this network for the foreseeable future as a part of our long-term investment in Arizona.

The Rural Digital Opportunity Fund (RDOF) is a reverse auction administered by the FCC to help fund rural broadband deployment. As a winner in the latest round of RDOF bidding, Conexon Connect has an obligation to build in the proposed project area. This project is one of two pilot projects that Conexon Connect is excited to launch in Arizona - kicking off long-term investment and partnerships across the State.

1 The Fiber Broadband Association | https://www.fiberbroadband.org/page/economic-impact

Parties that Will Perform the Infrastructure Construction

Conexon Connect's parent company, Conexon, is a pioneer in the development and deployment of rural broadband networks. Design, financials, and project management will be undertaken by Conexon, while contractors will be selected from a competitive bidding process. Connect will rely heavily on the years of experience Conexon has, as well as Conexon's construction management capabilities and preferred pricing on materials.

Meeting Eligibility Requirements Under Section 1.4

The proposed project meets all requirements under Section 1.4 of the NOFO for determining an eligible project. The project will serve unserved and underserved areas with 1000/1000 Mbps speeds within 24 months of the award date. Additionally, Conexon Connect's pricing is competitive (if not cheaper) than similar service in major metropolitan areas (see Service Tiers on page 7). Furthermore, the Navajo County Middle-Mile project (described in more detail on page 6) this will provide the needed backhaul for this project.

As stated in the commitment to service on page 2, Connect won RDOF funding in this area. This money is not intended for capital expenses, and Conexon will not use it for such. RDOF is for operation of the network and other costs that are not being applied for under this grant program.

Expected Timeline for Project Deployment

As this project is largely contingent on award from the state, the below hypothetical timeline is what Conexon Connect would aim for if awarded. It moves forward from January 1 as the date of contract execution. The main point is time between milestones and the time between execution of the contract and when installs begin [redacted]

[redacted]

Timing and Intended Uses of Match Funding

The match portion of the funding for this project is expected to work hand-in-hand with the grant funding from the Commerce Authority.

In this case, Conexon Connect anticipates using match funds at the same time and for the same purposes as state funds. As detailed in the budget attachment (South Navajo FTTH Project_Budget_Worksheet.xlsx), each line item is split 80/20. Conexon Connect will, per the Notice of Funding Opportunity (NOFO), pay the upfront cost for expenses and then seek the 80 percent reimbursement from the state.

Conexon's Commitment to Providing this Match

Conexon Connect understands how vital it is that grant recipients play a role in the funding of these projects. Matching contributions ensure that the recipient is truly invested in overseeing the success of the project. A commitment of these funds is attached in the same commitments document (Bank Support Letter). A brief overview of the financial capability of Conexon Connect is attached to the application as CONFIDENTIAL_Conexon 2020 Audit Report - Final.pdf.

Why this Project is Not Feasible Without Funding

The project area is extremely remote and population density is low. When population densities are this low, cost to build is high and most providers do not see a possibility on their return on investment. The few other service providers in the areas that have even a smidgen of service have to charge astronomical prices to recoup some amount of their investment. This is why most of the project area is unserved now. The market alone is unable to solve this problem. The only solution is State assistance through this grant - alleviating the burden of capital expenses for a project of this scale.

Project Description and Timeline - Development

Nature and Scope of the Project

As stated above, this is a roughly 155 mile deployment serving areas of three counties in east-central Arizona. There will be both aerial and underground construction in this project. The specific technology to be deployed in this project is highlighted on the next page under "Technical Specifications." The project goes from design and data collection through construction and ends with home-installs, and Conexon Connect maintaining operation and maintenance of the network.

Qualifications of Vendors/Contractors

As stated above, Conexon is a leader in this industry. Conexon was the first to deploy rural gigabit services in the nation and the first rural network to deploy next-generation PON technology on its networks. Conexon has worked with world-class professionals in the past and anticipates to do the same during the selection of contractors for this project area.

Technical Specifications

(Engineering Analysis, Project Approach Background)

The outside plant fiber network will be a mix of aerial and underground construction that generally follows an existing power utility network. Network will be approximately 95% aerial and 5% underground.

Access Network design parameters stipulate that fiber distribution cable be oversized as to not be fully utilized at the completion of the network build. The design threshold varies by fiber cable count between 50% and 80% maximum utilization. On the lowest end for example, a 12-count fiber cable that has 6 individual strands utilized (50%) is upgraded to a 24-count cable, leaving 18 unlit fibers for future use.
The outside plant fiber optic network is designed to support all current versions of PON network technology, including:

- GPON supporting 2.4 Gbps downstream and 1.2 Gbps upstream.
- XGS-PON supporting 10 Gbps downstream and upstream.
- NG-PON2 supporting 80 Gbps downstream and upstream.

These technologies are supported without the need for any outside plant construction or modification. Future expectations include vendors development of 25/50 Gbps PON technology that would be compatible with the fiber optic network. Internet service tiers will include offerings of 100 Mbps (Megabits per second) and 1 Gbps (Gigabits per second), also expressed as 1000 Mbps. Voice services will be primary line replacement delivered via SIP (Session Initiation Protocol) VoIP service provided over the PON network.

Conexon Connect will utilize GPON (ITU G.984) access network technology to deliver the last mile fiber optic connection between telecommunications huts and the subscriber home, or business subscriber, location via a newly constructed fiber optic network. GPON supports data rates of 2.488 Gbps downstream and 1.244 Gbps upstream shared across a maximum of 64 subscribers. Downstream data is the data sent from the fiber hut to the home (FROM the Internet TO the home) and upstream data is data sent from the home to the fiber hut (TO the Internet FROM the home). Outside plant network design standards limit the number of subscribers to a maximum of 48 to allow for future expansion of the network.

Conexon design parameters stipulate that fiber distribution cable be oversized as to not be fully utilized at the completion of the network build. Initial access network design was based on the following average PON leg assumptions and the equations below. Most totals are rounded up to the next whole number.

- 24 optical tap ports per PON leg
- 86.45% optical tap port utilization = 21 homes passed per PON leg
- 70% penetration over 5 years = 15 total Internet subscribers per PON leg
- 30% 1 Gbps take rate = 5 subscribers with 1 Gbps service per PON leg
- 70% 100 Mbps take rate = 10 subscribers with 100 Mbps service per PON leg

If future demand dictates, the two-way optical coupler in the telecommunications hut can be removed resulting in an effective doubling of available shared bandwidth to the PON leg. The access network will utilize Calix E7-2 chassis. Each chassis supports 2 access cards and 100 Gbps between the cards. Optical Line Terminals (OLT's) will consist of Calix GPON-8 r2 access cards in Calix E7-2 network chassis. Each GPON-8 r2 card has the following physical ports:

- 8 GPON OLT ports
- 8 CSFP 1GE ports (4 CSFP sockets, also support SFP modules)
- 2 SFP+ ports supporting 10GE and GE optical modules
- 2 XFP ports supporting 10GE optical modules

As network demand increases, fiber circuits and leased transport will be upgraded to handle the additional bandwidth. Upgrade options include, but are not limited to:

- LAG groups of multiple 10 Gbps links
- 100Gbps links
- LAG groups of 100 Gbps links
- CWDM and DWDM technologies to increase capacity per fiber strand

Typical PON latency across the access network is <200us downstream and <1700us upstream for GPON, XGS-PON and NG-PON2 over the length of the PON.

Utilizing actual traffic statistics provided by Conexon for customers on existing GPON networks in service for over 1 year supporting a mix of 1 Gbps and 100 Mbps service offerings, a 30-minute average peak utilization of 3.47 Mbps of downstream traffic per GPON ONT was observed over a 2-week period in early November 2020. While upstream data traffic may grow in the future, current ratios continue to show that upstream traffic on average is less than 20% of downstream traffic in production networks service the anticipated subscriber types. Due do that ratio, downstream traffic patterns and data are utilized to drive all future forecast for network utilization trends. Network planners can estimate future network capacity requirements based on subscriber growth within the standard network link speeds. For example, a 10Gbps Internet DIA connection would be expected to support 2,222 peak time subscribers averaging 4.5 Mbps download utilization in October of 2021.

As additional subscribers join the network and bandwidth needs increase, network capacity will be added. The table above will assist the technical team in discussions with business leadership on expected timing and costs of those upgrades well in advance of actual need.

In order to promote and ensure redundancy and reliability, all telecommunications huts are designed with G.8032 rings or LAG group connectivity to their connected MX204 pair. This provides fiber path and network interface redundancy northbound for each hut back to the access network MX204 pair. All Calix E7-2 northbound interfaces are split between the two GPON8-r2 cards in the shelf and configured into a G.8032 ring or multi chassis LAG terminating in the MX204 pair. This configuration allows for a port failure of any northbound interface without an interruption in service to the subscribers. Any card or shelf failure of the Calix access equipment will be limited to impacting the subscribers on that shelf only, which the exception of the number one shelf in the hut. If that shelf suffers a failure of both cards, then all subscribers in that hut will be offline. The chances of this happening outside of a full power failure in a hut are minimal. All access network MX204 routing locations are dual homed to the core network routers with a network link to each of the Atlanta and Kansas City data centers. The MX204 routers are capable of full BGP routes (IPv4 and IPv6) from both data centers (Atlanta and Kansas City) which allows for load balancing and traffic management to be manipulated as required across each network link. Alarms will be raised in the NOC for power failures and HVAC failures resulting in prompt dispatch of fix agents.

How the Project Improves Reliability

The proposed project addresses crucial aspects of reliability that are lacking across the areas of south Navajo County. In conversations with various stakeholders, it was learned that even within served areas of the County, there is little more than a single fiber line. Conexon design parameters stipulate reserving two full tubes (24 strands) dedicated to be used in the event they are needed due to an emergent situation or for future development.

Other Project Outcomes

This project differs significantly from other last-mile projects applying for this round of funding from the State. While most last-mile projects seek to go it alone, Conexon Connect was committed to involving stakeholders from around the project area. Conexon Connect has been in communication with officials in both Gila and Navajo Counties. There are ongoing conversations between officials in the counties and Conexon Connect for the possibility of future partnership.

Conexon Connect looks forward to serving the areas of Gila County that this project cover, and there is an attached letter of support from the District 3 Supervisor indicating this support.

However, Conexon Connect wants to draw attention to the work that Navajo County is doing to provide middle-mile infrastructure in this area of Arizona. As a result of several meetings with County officials, Conexon Connect supports their proposed-Middle-Mile project to provide connections to Flagstaff and to Phoenix. This middle-mile project provides Conexon Connect the opportunity to connect its proposed deployments to the requisite data centers, and there is mutual support for this idea. As will be seen on both Conexon Connect's and Navajo County's applications, this proposed middle-mile build runs within a few miles of the terminus of Connect's last-mile project.

STATEFP	COUNTYFP	TRACTCE	GEOID	NAME	NAMELSAD
04	001	970502	04001970502	9705.02	Census Tract 9705.02
04	017	940100	04017940100	9401	Census Tract 9401
04	007	940200	04007940200	9402	Census Tract 9402
04	017	940302	04017940302	9403.02	Census Tract 9403.02
04	017	940301	04017940301	9403.01	Census Tract 9403.01