Calix

City of Superior

ConnectSuperior Fiber Network Equipment and Services

Request for Information (RFI) #23-39-IT

October 3, 2023

Contact:

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Regional Account Manager

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Table of Contents

October 3, 2023

City of Superior
1316 N. 14th Street
Superior, WI 54880

Attention:	Jane Darwin, Contract Analyst
Email:	arwinj@ci.superior.wi.us

Subject:	ConnectSuperior Fiber Network Equipment and Services
	Request For Information #23-39-IT

Dear Ms. Darwin:

Calix greatly appreciates the opportunity to respond to the City of Superior RFI for ConnectSuperior Fiber Network Equipment And Services

Calix is leading the way by allowing Broadband Service Providers (BSPs) to deliver exceptional subscriber experience through platforms that lower the cost of running their business. Founded in 1999, our cloud and software platforms, systems, and services have enabled BSPs of all types and sizes to innovate and transform their businesses. These platforms empower our BSP customers to utilize real-time data and insights to **simplify** their businesses and deliver an increasing array of services to **excite** their subscribers. We believe these insights enable CSPs to **grow** their businesses through increased subscriber acquisition, loyalty, and revenue, thereby increasing the value of their businesses and contributions to their communities. This is our mission – to enable CSPs of all sizes to simplify, excite and grow. With more than 1,900 customers worldwide, Calix is at the forefront of enabling the innovative ways that BSPs deliver advanced services and value to their subscribers.

Calix has focused for 20+ years on the success of BSPs, and we believe that we are 100% strategically aligned with the City of Superior. In Wisconsin, 26 BSPs have successfully partnered with Calix to deploy XGS-PON solutions. In addition, over 70% of municipalities deploying broadband services partner with Calix, as our municipality webpage indicates at https://www.calix.com/solutions/service-providers/municipalities.html. Our goal is to help BSPs like ConnectSuperior thrive by deploying technologies and delivering experiences that will build deeper relationships with your subscribers.

We look forward to discussing how our response to this RFP can help our partnership grow and succeed. Please contact me at 612-310-6515 with any questions or concerns. We want to earn your business by providing the best technology, the best solutions, and industry-leading customer service.

Sincerely,

Mark Emslie
Regional Account Manager
Calix

Executive Summary

Calix is pleased to respond to the City of Superior's RFI for ConnectSuperior Fiber Network Equipment and Services. As a leader in the PON space for over 20 years, we have seen the evolution of PON worldwide, where the de-facto standard for deploying FTTH services is now XGS-PON. 10Gbps symmetric XGS-PON is ubiquitous today, with standards for 50Gbps and 100Gbps PON already in the works. Optical and chipset vendors are laser focused on PON technologies. With this in mind, Calix is responding to ConnectSuperior's requirements with an XGS PON solution. We have deployed XGS-PON to over 500 Broadband Service Providers (BSPs) worldwide, and our experience extends to 26 BSPs in Wisconsin alone.

We view the RFI as having two tightly integrated functional areas: the control layer and storefront for ConnectSuperior's subscribers/ISPs, and the actual FTTH technology. While Calix is focused on the FTTH technology, our management platforms are all architected with API interfaces as a central tenant. We have implemented an open, published API on our Subscriber Management Platform (SMx) that provides M-2-M connectivity to our partner ecosystem. Partnering with leading Open Access software vendors like COS Systems, we have implemented these interfaces, allowing for a best of breed solution. COS is an elite partner with Calix - and our integration brings together two top brands merging hardware and software to bring a successful open access network to the City of Superior. We have included COS Systems' independent response as an Addendum to our submission. In this environment, ISP's will enjoy flow through provisioning from the Business Engine into the Operators' network (OLT/ONT). Calix has a robust set of APIs and will integrate into whichever solution you choose.

For the physical FTTH layer, Calix is offering our E7-2 OLT platform, supported by our E9-2 based aggregation router. Each 1RU E7-2 supports 32 XGS-PON ports. The E7-2s are interconnected to each other and the E9-2 ASM router via 100GbE links. Our assumptions include a 32-way split for each PON. Each E7-2 ring is configured to support 5,000 subscribers (3 rings).

The E7-2 is powered by the AXOS operating system offering several features that will support the City of Superior as the Operator of the Open Access network:

- • **PON Bandwidth protection:** AXOS has built in controls to prevent individual ISPs from over-provisioning a PON port based on Class of Service (CIR). The support for per service, per subscriber, per PON, per Access, per ISP, policing and shaping are among some of the key features enabled in the solution.

- • **Service Fingerprinting:** The Operator can track services at any level: ONT, UNI, or service mapping. This greatly simplifies Operator troubleshooting in support of multiple ISPs.

- • **Full compliance to major Open Access specs for VLAN tagging (to identify ISPs):** S+MAC or S+C or S+C+MAC switching. Each ISP is logically segmented within the Operator network.

- • **IPFIX Streaming:** Eliminate the need for external monitoring devices and have precise info about the physical state of the OLT/ONT from a centralized platform, i.e., eliminates truck rolls via remote troubleshooting.

As stated above, each E7-2 G.8032 ring attaches to the E9-2 based ASM 3001 router. The ASM router is configured to provide 64 10GbE as well as 8 100GbE ports. All E7-2 access nodes are connected via 100GbE to the router. ISP's may connect at 1Gb/10Gb/100Gb. We have configured (6) 10Gb 10km Optical connections (assumes redundant connectivity for (3) ISPs). The ASM Supports Layer 2 and 3

aggregation for business and residential services (Q-Q, IPv4, IPv6, Dual stack, OSPF/ISIS/BGP, MPLS, L2/L3 VPN, etc.).

The City of Superior has requested an integrated ONT/RG with Wi-Fi for the subscriber premise. Calix is proposing the GigaSpire BLAST u4xg solution. The GigaSpire BLAST u4xg is a premium smart home integrated system that delivers the latest Wi-Fi 6 certified technology (802.11ax). It integrates an XGS ONT to provide carrier-class WAN and enables residential subscribers to receive 10 Gigabit broadband data, Internet Protocol (IP) video, and voice (POTS) services. Using the latest 802.11ax technology in both the 2.4 and 5 GHz radios, the GigaSpire BLAST u4xg incorporates 4x4 streams of Wi-Fi delivery (2x2 @ 2.4 GHz and 2x2 @ 5 GHz). In addition, with multi-user multiple-input and multiple-output (MU-MIMO) and beamforming, the GigaSpire BLAST u4xg allows service providers to extend the access network inside the home and establish a strategic location for the delivery and control of broadband services.

Note that if the City of Superior, acting as the Operator, would prefer to deploy a residential "ONT only" model (no Wi-Fi), the GP1101x GigaPoint with 10G LAN port would save $900,000+ off the GigaSpire BLAST u4xg that is included in the enclosed bill of materials.

In summary, Calix has built some of the largest Open Access Networks in the world, we are the leader in FTTH technology, and we have the team and services to partner with the City of Superior in making Connect Superior a valuable long-term community asset.

Solution Description

Introduction

A scalable, intelligent network based on software platforms will provide the City of Superior the opportunity to build a next generation open access architecture, unimpeded by legacy hardware architectures of the past and future-proofed to support the needs of your subscribers for decades to come.

We at Calix strive to not only develop solutions that enable service providers like ConnectSuperior the ability to deliver multi-Gigabit services over an all-fiber infrastructure, but to also provide platforms that offer a comprehensive solution using advanced technologies that overcomes the limitations of legacy processes and systems. We are confident that the proposed Calix solution is ideally suited to help ConnectSuperior provide gigabit-speed broadband for the households in their region.
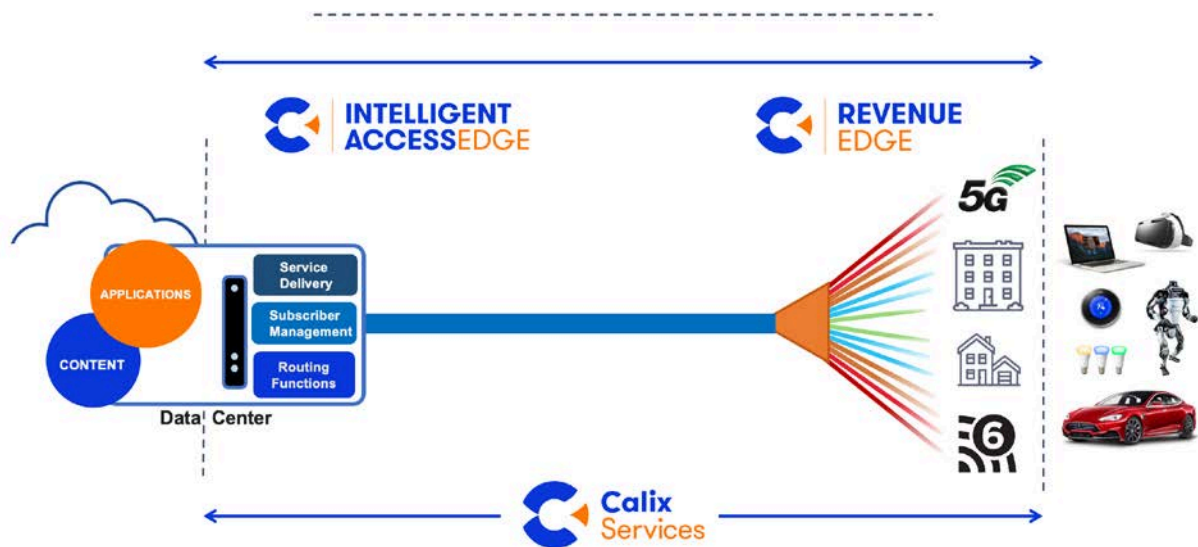
Our product strategy centers on our strategic platform-based solutions. These platforms simplify BSPs' businesses by delivering intelligence and automation across the entire subscriber facing network – from the data center edge to the subscriber's devices. Our platforms also enable critical functions within a BSP's business, such as marketing, support, and operations, to leverage real-time data to continually understand and optimize the experience for their subscribers. Our strategy is to continually augment and extend these platforms with features and services directly or through partners to allow our customers to deliver innovative services to their subscribers.

Proposed Solution for ConnectSuperior

The proposed solution for this RFI is made up of two Calix Intelligent Access EDGE systems, both running under the AXOS platform:

The first system is the Calix E9-2 Intelligent Edge System (referred throughout this document as "E9-2") with the Aggregation Services Manager ("ASM3001"), capable of routing traffic using Layer-3 protocols or bridging Layer-2 traffic. Depending on the operators' needs, either Layer-2 or Layer-3 can be used. The E9-2 ASM3001 has four 100GE ports and thirty-two 10GE ports. Each E9-2 chassis can have two cards installed for a total of eight 100GE ports, and sixty-four 10GE ports per chassis. These ports can be used as links to an ISP or as an uplink from subscriber facing service equipment.

The second system is the E7-2 Intelligent Modular System ("E7-2") with the XG1601 XGS-PON card, , capable of providing bandwidth up to 10G. One XG1601 card can provide sixteen XGS-PON ports, and by using a split ratio of 1x32, a single card can provide service to 512 subscribers. Each E7-2 chassis can have two cards installed for a total of 1,024 subscribers serviced. This design also gives you the flexibility to build out the network on an as-needed basis. By installing an E7-2 chassis and XG1601 card into a ring when needed, you can incrementally build out the network 512 subscribers at a time.

Traffic on the E7-2 XGS-PON, going to or coming from a subscriber, will be separated by VLANs based on the ISP and service. The VLAN will be uplinked to the E9-2 ASM3001, where it will be either bridged to the ISP, or the Layer-2 VLAN will be terminated and routed to the ISP depending on their needs.

ConnectSuperior Network Design
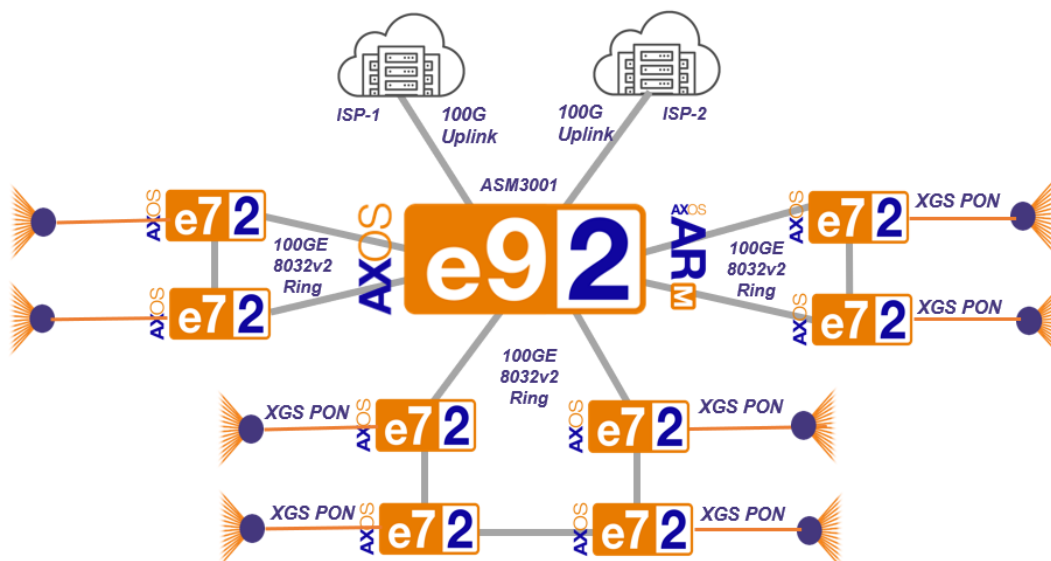
The proposed diagram offers the following benefits:

- E9-2 can be either Layer-3 or Layer-2

- E9-2 uplinks to ISP can be 100G, 10G or LAG, E7 XGS can have split ratios up to 128

- E7-2 XGS-PON, pay-as-you-grow, increase card counts as needed

- Ring speeds can be 100G, 40G, 10G or LAG, Optical, or Direct Attached cables

Open Access Solution

The diagram below provides a logical description of the ConnectSuperior Network. Notice SMx providing the boundary interface to the Open Access provisioning system via a dynamic machine-to-machine interface.
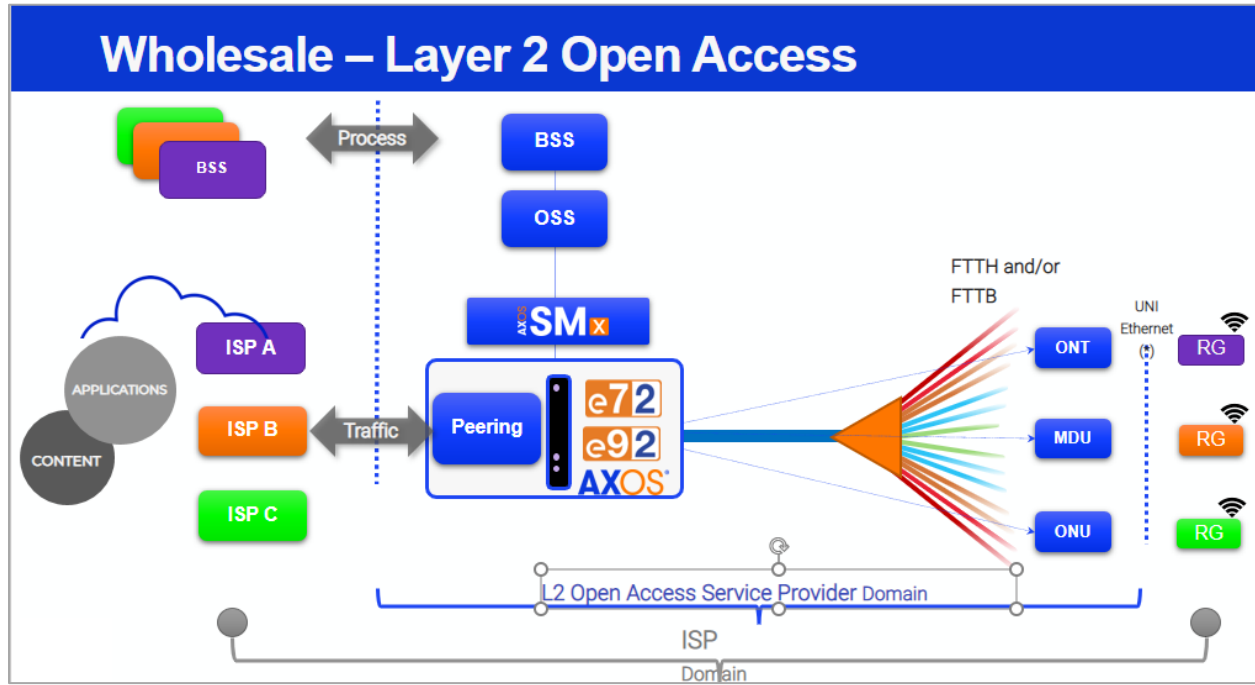
The Calix AXOS platform will support multiple business models necessary to operate a successful Open Access Network. Connect Superior will value reliability, scalability, and simplicity while ISP's will be interested in promoting their brand and generating revenue from additional applications beyond Wi-Fi (household network protection, subscriber APP for controlling the in-home experience, etc.):

As the Operator, ConnectSuperior will need to quickly and accurately troubleshoot calls that come in from participating ISP's. The AXOS operating system provides a 3-level identification structure for quick ONT/Subscriber isolation:

Providing an equitable service to multiple ISPs across a shared PON is table stakes to the Operator role in hosting the network. The AXOS operating system allows for guaranteed configuration fairness across an XGS-PON port:

ISP's participating in the Connect Superior network will want to target high margin enterprise customers. These customers often require Service Level Agreements and end-to-end testing support for quick problem isolation. The AXOS operating system provides multi-hop service assurance for these environments:
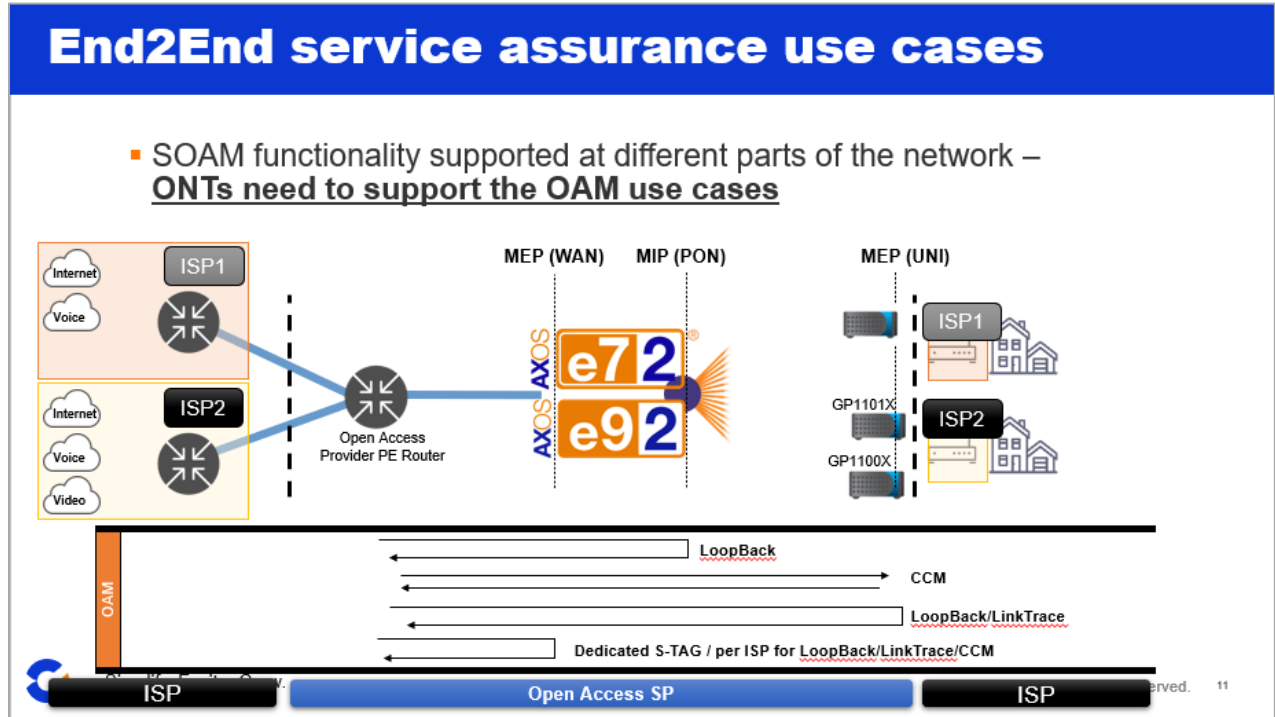
The Foundation: Software Platform

Software platforms are the innovation engines of our time, accelerating business transformation. They are modular and portable, easily programmed, and broadly extensible. They are also decoupled from the hardware they run on.

After revolutionizing data centers and handheld devices, software platforms are now transforming the business of broadband. For ConnectSuperior, a software platform driven implementation can simplify and automate the network and its operation, deliver a differentiated subscriber experience, and grow its business.

Network Innovation Platform (AXOS)

The Network Innovation Platform, AXOS, is the software foundation from which Calix builds our proposed fiber systems for ConnectSuperior. Based on the principle of hardware and software disaggregation, AXOS provides a common OS across hardware platforms and technologies, as well as common operational procedures across the entirety of your broadband service delivery network.

By leveraging AXOS-powered Intelligent Access Edge solutions, Calix can provide ConnectSuperior the software tools and connectors that reduce services integration time, enable the turn up and diagnosis of services issues that ensure service is always on, and ensure that you continue to meet and exceed subscriber expectations.
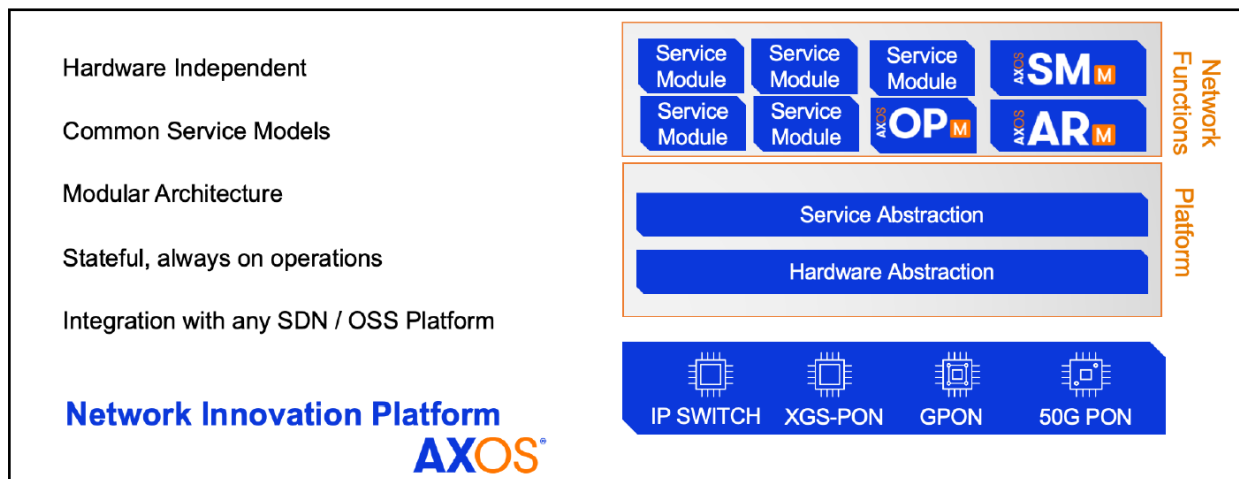
Services Management Connector (SMx)

Services Management Connector (SMx) is a virtualized system controller and management system, leveraging the power of the proposed AXOS systems to deliver and control services on ConnectSuperior's fiber networks. It comes with a comprehensive set of FCAPS capabilities and is designed to manage 10G PON systems.

SMx brings a user interface that provides network state visibility, workflow-based service configuration, and integration interfaces into the OSS or global SDN controllers, enabling a network wide view.

Built upon OpenDaylight, SMx makes it easy to integrate into an SDN ecosystem or operate in concert with an existing provisioning and billing system using common REST/JSON APIs.

All Calix AXOS systems provide a native northbound NETCONF/YANG interface for services and subscriber provisioning. SMx provides a translation from the NETCONF/YANG interface to a northbound REST/JSON interface for integration into OSS/BSS systems. This provides your company with the ability to choose the interface types and methods for back-office integration that works best for the network and network operations.
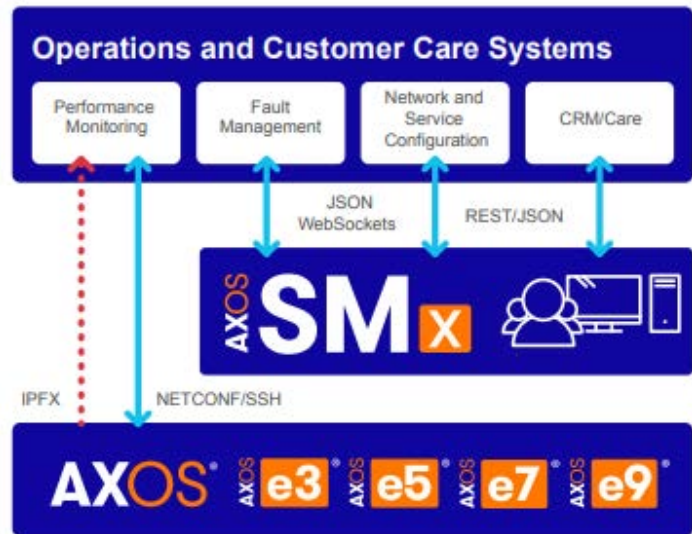
Diagnostics Toolbox

ConnectSuperior's deployment success starts with embedded tools that enable remote diagnostics to improve operational efficiency.
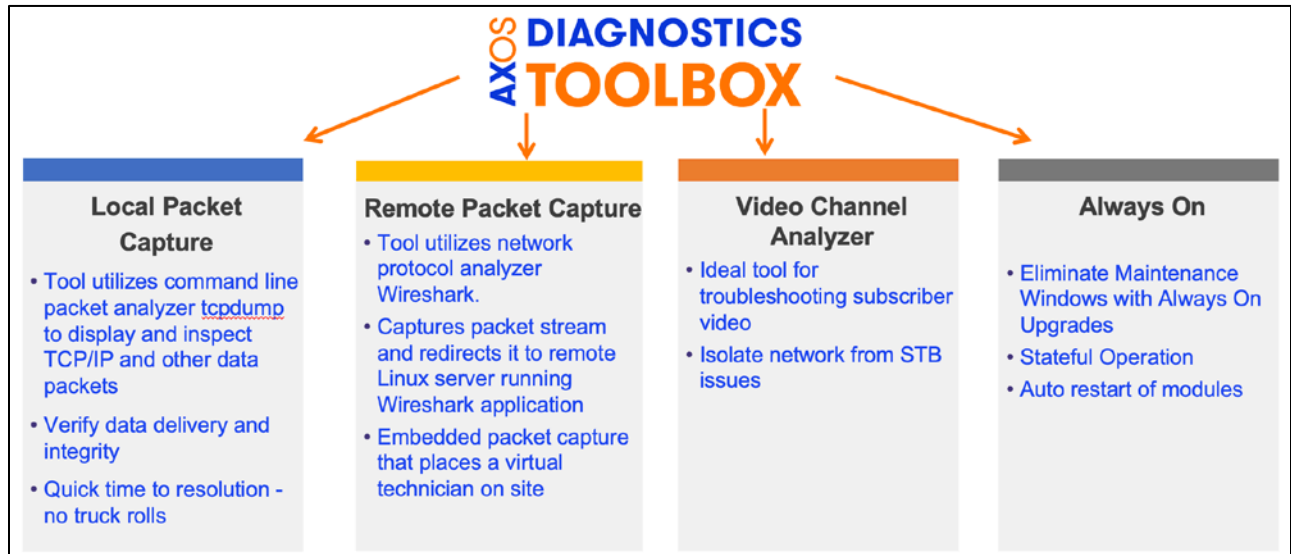
Intelligent Access EDGE Systems

Calix welcomes the opportunity to propose our XGS-PON solution for ConnectSuperior. Customers who deploy our solutions range from Tier 1 providers like Verizon, focused on the reduction of OPEX costs by 80% through a unified network, to municipal utilities like BrightRidge, to power utilities like WWZ, ensuring they can build and operate their network with an 87% reduction in turn-up time. Our solutions benefit organizations of every scale, and our experience will extend to ConnectSuperior.

The Network Innovation Platform, AXOS is implemented runs on our E-Series family of modular, non-blocking systems including the E9-2, E7-2, and E3-2. As not all deployments are created equal, the systems are designed to meet the requirements of the location they are deployed into:

Large Substations / Data Centers serving larger cities and towns in data centers typically with temperature controlled elastic network systems, enabling the addition of capacity through easy rack installation, and compute power by cabling additional systems together.

Small Substations / Remote Cabinets serving lower density locations through compact systems (typically at least 1RU in a cabinet). It is also critical that airflow in these locations be side-to-side as the back of the cabinet is typically very tight in space and heat rises.

Remote Nodes serving even lower density locations, where cabinets do not already exist. The installation location may be a pole, a "doghouse" or a wire strand. In this very remote location, the system must be void of parts that require servicing.

Data Center / Headend
- Controlled Environment
- Stackable / Easily Expandable
- Front to Back Airflow

Central Office / Remote Cabinet
- Temperature Hardened
- Designed for Small Spaces – 1RU
- Side to Side Airflow

Remote Node / Strand / Pole
- Outdoor Installation
- Pole, Wire, Dog House
- No Fans Required

E9-2 Intelligent Edge System

To aggregate the proposed E7-2 systems, we propose the Calix E9-2 Intelligent Edge System with the Aggregation Services Manager (ASM3001). The E9-2 with the ASM3001 is an independent network element designed for aggregating Layer 2 and Layer 3 networks, and also leverages AXOS, the same platform that powers the proposed E7-2 OLTs. This means ConnectSuperior can extend operational Methods of Procedure based on AXOS to the aggregation network, greatly simplifying the operation of the (combined) access and aggregation network.
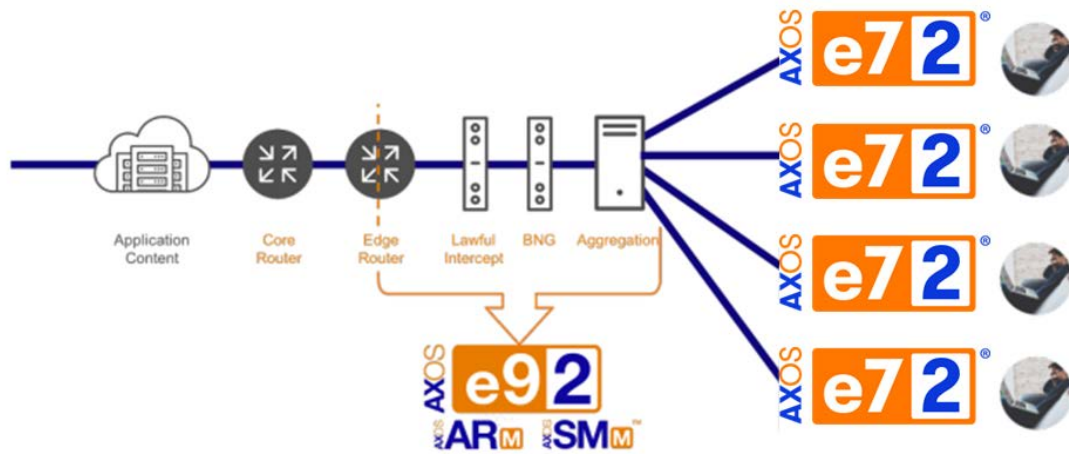
Aggregation Services Manager (ASM3001)

The E9-2 ASM3001 is designed to aggregate traffic from existing distributed access deployments and connect directly to the existing MPLS or routed edge network. By moving key subscriber and service-related functions such as: policy, performance monitoring, Authentication Authorization Accounting (AAA), Hierarchical QoS, Security, and IPv4 / Ipv6 IP address assignment closer to the subscriber, the network is dramatically simplified and more efficient at critical functions including security and reduced latency. By collapsing these network functions into a single platform, the ASM3001 with the Advanced Routing module (ARm) is highly versatile and efficient in its application.
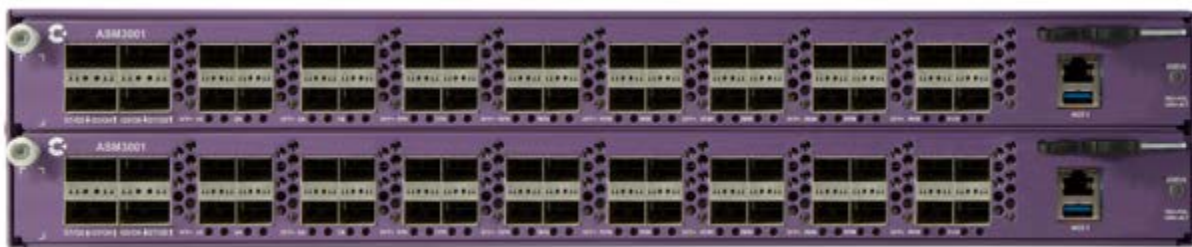
The E9-2 has two slots enabling two E9-2 ASM3001 cards to be installed, providing full network and equipment redundancy in a single shelf. Each ASM3001 card has 4 QSFP-DD ports and 32 x 1G / 10G SFP+ ports. The system is designed to be deployed in the data center or central office of the service providers.

E7-2 Intelligent Modular System

The Calix E7-2 Intelligent Modular System is proposed for ConnectSuperior's XGS-PON deployment, providing a high-density, highly scalable system that is designed to meet the fast-moving demands of the network architectures of the future. With the E7-2, service providers can rapidly deploy new capabilities and very high bandwidth services to meet the increasing demands of subscribers today.

The E7-2 is a modular two-slot, 1RU chassis with a 100 Gbps non-blocking backplane that delivers any mix of GPON, Active Ethernet or 10G PON services. The unique design provides the best aspects of a large "carrier grade" chassis while offering the "pay as you succeed" flexibility.

The E7-2 provides all the benefits of redundant network, management, and power connections that one would expect from a highly reliable "five 9s" system.

Built to be deployed in non-temperature-controlled environments, the E7-2 environmentally hardened design is ideally suited to a distributed access network that leverages street cabinets or huts. Due to its unique service-delivery flexibility, the E7-2 can deliver any number of native Ethernet services across a variety of applications, from mobile backhaul with 10GE transport to advanced business and residential services - any card, any slot, any combination.

E7-2 XG1601 Line Card

The Calix E7-2 XG1601 is a 10G PON line card that supports high-density XGS-PON across all deployment environments. BSPs can deploy the line card utilizing XGS-PON optics into any E7-2 chassis providing up to 32 ports of XGS-PON per chassis. To assist with the transition from GPON, the XG1601 line card also supports standard GPON OIM optics as well as Multi-PON Module (GPON + XGS-PON) optics.

Key Attributes

- **AXOS:** Utilizing AXOS, the only true SDA (Software Defined Access) architecture, the E7-2 XG1601 line card enables service providers to maintain an always on network.

- **PON optics:** Service providers have the flexibility to choose the PON technology that meets their needs. The XG1601 supports dual-density XGS-PON, XGS- PON, GPON, or MPM modules (XGS + GPON) based on the optics inserted into the PON ports.

- **Flexible service delivery:** Utilize layer 2 Open Access service delivery for residential/ business services based on your specific needs with carrier class network redundancy options.

Intelligent Access EDGE Software

The Network Innovation Platform, AXOS is a modular architecture where the modules themselves have APIs that enable them to be incorporated into the platform as needed. This enables the service provider to incorporate additional capabilities that could make sense for their specific network architecture.

Advanced Routing Module (ARm)

ARm is designed for service providers seeking to bring Layer 3 intelligence to their access network including MPLS capabilities and L2/L3 VPN services. ARm provides the benefits of a routed network including the security and ability to move caching and other edge compute closer to the subscriber without impacting other functions in the network. BSPs can reduce provisioning overhead costs, failure groups, transport costs and simplify service and subscriber turn up.

Routing Protocol Module (RPm)

RPm is designed for service providers seeking to bring Layer 3 intelligence to their access network, but already have an MPLS solution or do not need an MPLS solution. RPm provides the benefits of a routed network including the security and ability to move caching and other edge compute closer to the subscriber without impacting other functions in the network. Service providers can reduce provisioning overhead costs, failure groups, transport costs and simplify service and subscriber turn up.

Subscriber Management Module (SMm)

SMm is a software module that brings subscriber management capabilities to the access network such as authentication, authorization, accounting of subscriber sessions, address assignment, policy management, security, and Lawful Intercept, which is short for Lawfully Authorized Electronic Surveillance for Internet Access and Services. With SMm, service providers get unprecedented visibility into the traffic entering the network, enabling subscriber management and the use of policy and filters to prevent network attacks.

Premises Systems

The Calix platform transforms existing business models, taking advantage of the power of software to deliver hardware independence with a modular containerized architecture that supports the integration of new value-add applications. We offer a wide range of premises systems that support ConnectSuperior's business needs.

Indoor ONT + Gateway Solution

GigaSpire BLAST u4xg (Indoor ONT)

For ConnectSuperior, Calix is proposing the GigaSpire BLAST u4xg indoor solution. The GigaSpire BLAST u4xg integrates XGS ONT and residential gateway functionality into a single system. It supports XGS WAN, while providing 802.11ax (Wi-Fi 6). On the LAN side, Wi-Fi and two (2) Gigabit Ethernet interfaces are available for customer multi-media devices.

Besides supporting broadband connectivity of data and video services, the GigaSpire BLAST u4xg provides switching and routing functions that support multi-Gigabit throughput for IPTV video and data services.

All GigaSpire BLAST systems are powered by the Calix Innovation Experience Platform. This container-based platform allows service providers to quickly change and adapt their services to embrace new technologies and offer new, value-added services. This approach can generate recurring revenue and increase subscriber satisfaction.

Subscriber ONTs

The Calix family of ONTs enable residential and business subscribers to receive Gigabit broadband service on a single fiber. Calix solutions provide flexible deployment options to deliver the right service to the right subscriber at the right time. We also provide information on the following ONTs:

GP4201X GigaPoint (Outdoor ONT)

The Calix GP4201X is an outdoor, 10 Gbps high performance XGS-PON ONT that features an XGS-PON WAN, one 10 Gigabit Ethernet (10GE) LAN, three 1 Gigabit Ethernet (GE) interfaces and two voice interfaces.

GP1100X and GP1101X GigaPoint (Indoor ONT)

For small/residential deployments, the GP1100X and GP1101X GigaPoint systems extend network access and the service provider's demarcation inside the subscriber's home. The GP1100X and GP1101X GigaPoint enable residential subscribers to receive gigabit broadband data and IP video on a single fiber and establish a strategic network termination point for the delivery and control of broadband services.

The GP1100X and GP1101X are XGS-PON network access devices providing Layer 2 bridged services and is managed by SMx. It is intended to be deployed as an access service demarcation solution for broadband service providers delivering data services, including High-Speed Internet (HSI), IPTV video, and VoIP. SMx fully manages the GP1100X for Layer 2 services.

Residential Gateways

Calix offers a full portfolio of GigaSpire BLAST systems, all powered by the Calix Experience Innovation Platform, allowing ConnectSuperior subscribers to get the ideal system, based on their unique requirements. BLAST systems provide a platform for delivering compelling, value-added applications through a managed system that results in fewer truck rolls and customer calls.

We offer a wide range of residential gateways. By deploying a powerful EDGE System, you can offer your subscribers an Ultimate Wi-Fi Experience alongside appealing new services and applications. We also provide information on the following GigaSpire BLAST Wi-Fi 6 systems:

	GigaSpire BLAST u6.1 (GS4220E)	GigaSpire BLAST u6.2 (GS4227E)	GigaSpire BLAST u6xw (GS4227W)	GigaSpire BLAST u4hm (GM1028H)
Description	6 x 6 antenna array and 1GE WAN	6 x 6 antenna array and 2.5 GE WAN	5 configurations (10 GE, GPON, Active Ethernet (1G and 10G), and XGS-PON	Outdoor Wi-Fi 6 Mesh satellite
Wi-Fi PHY Rate (Gbps)	3.0	3.0	3.0	1.8
WAN	1 x GE	1 x 2.5GE	SFP+ supporting GPON, XGS-PON, copper (1 or 10 GE) or Active Ethernet (1 or 10 GE)	1 x GE WAN/LAN
LAN	4 x GE	4 x GE	4 x GE (1 LAN port can become WAN if no SFP module is inserted)	

	GigaSpire BLAST u6.1 (GS4220E)	GigaSpire BLAST u6.2 (GS4227E)	GigaSpire BLAST u6xw (GS4227W)	GigaSpire BLAST u4hm (GM1028H)
Voice	2 (VoIP)	2 (VoIP)	2 (VoIP)	
2.4 GHz	2x2	2x2	2x2	2x2
5 GHz	4x4	4x4	4x4	2x2
DL/UL MU-MIMO w /Beamforming	Yes	Yes	Yes	Yes
USB	2.0 Type A	2.0 Type A	2.0 Type A	

Calix Clouds

The Calix Cloud solution is a set of persona-based clouds built on a common infrastructure platform with a single view into the service provider's business. The combination of all three clouds ensures that the teams acquiring subscribers, the teams managing individual subscriber support calls, and the teams managing operations from the subscribers through the network have all the data and insights they need to help the service provider simplify their operations, excite subscribers, and grow their business.

CalixCloud® MARKETING

Service Provider Marketers

- Reduce Churn
- Maximize Profit
- Boost Marketing ROI
- Grow Business

CalixCloud® OPERATIONS

Network / Subscriber Operations

- Remote Troubleshooting
- Optimized and Automated workflow
- Proactive Network Health and Monitoring
- SLA Monitoring and Assurance

CalixCloud® SUPPORT

Customer Care / Support

- Lower Average Talk Times
- Improve First Resolution Call (FCR)
- Reduce Truck Rolls
- Proactively Prevent Calls

Services

Calix Services offer an array of purpose-built business services that range from advisory solution development, planning, and expert execution to put your plan into action, to provide comprehensive support and management of your networks, to building up your team's internal expertise through advanced technical learning. Calix has proposed the following services for ConnectSuperior:

Deployment Services

E9-2 Layer 3 Deployment

Leverage Calix experts to help you rapidly plan and deploy the E9-2 Node utilizing Layer 3 and associated functions. Our teams have decades of experience in helping existing and new service providers design, deploy and maintain best-in-class broadband access networks

Network Design and Turn Up

Network Design and Turn Up gives you the peace of mind that your Calix platform is deployed and working in accordance with the latest Calix best practices.

A Calix Professional Services Network Systems Engineer will create a low level network design for your E7-2 or E9-2 network that includes Layer 1 through 3 diagrams, detailed configuration and provisioning information, and a physical and logical network architecture and connectivity design and document that in a Network Engineering Specification Book.

The Calix Network Systems Engineer will then remotely access the network to turn up and configure the new equipment and perform a battery of tests on both the system and associated services to ensure proper subscriber operation.

Network Management Activation and Upgrade Service

Calix Professional Services will help you plan, install, and activate your AXOS SMx network management software in your network. Customers can also use this service to upgrade their existing network management software to the latest release.

The Calix Services Network Systems Engineer will also verify all network management software process are running properly with the customer's operating environment.

Support Services

Premier Support

Calix Premier Support is designed for Service Providers who want to improve subscriber experience and get a faster resolution of service impacting problems through a higher level of partnership with Calix Support. With Premier Support, your technical team will be speaking and interacting directly with a Calix Support Engineering Specialist in thirty minutes or less for all service effecting issues, no matter the severity. The Calix Technical Assistance Center (TAC) provides 24-hours-a-day, 7-days-a-week coverage by our experienced staff of system engineers to help with critical hardware and software issues on all Calix products. Premier support allows you to contact the TAC immediately via the Calix Service Station online support center.

References and Company Information

Corporate Information

Calix Contacts

Calix employs a customer engagement model unique to the telecom industry. It is our goal to ensure there is always someone available to offer you live and immediate attention when you require assistance. Our teams are comprised of professionals responsible for a defined geographical territory for our customers. Each member of the Calix team for the City of Superior has the professional background and expertise to deliver a level of customer satisfaction that is unmatched in the market today.

Our address is: Calix, Inc.
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The Calix team for the City of Superior consists of the following professionals:

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matt.glosson@calix.com

Company Background

Calix was incorporated in August 1999. We are a leading global provider of a broadband delivery platform (cloud, software, and systems) and managed services that enable service providers of all types and sizes to innovate and transform their businesses.

Our original Unified Access portfolio consisted of carrier-class hardware and software products that have over the years enabled many of our customer service providers to evolve their networks and service delivery capabilities at a pace that balances their financial, competitive and technology needs. In 2007, we introduced the E-Series systems, forming the basis of our proposed platform-driven solutions that are deployed by many service providers today.

As our Broadband Service Provider (BSP) customers reach a critical time of increasing competition from over-the-top device providers as they expand their reach, we have evolved and invested in the development of our platforms. Today, our strategy is to position Calix as the key partner providing cloud and software platforms, systems, and services to enable and facilitate the transformation of BSP networks into networks that utilize real-time data generated in the access network and subscriber home network in order to provide an exceptional broadband experience for their subscribers.

Our Calix platforms, which include Calix Cloud, Revenue EDGE, and Intelligent Access EDGE, gathers, analyzes, and applies machine learning to deliver real-time insights to key business functions. Our customers use these data and insights to simplify their business operations to deliver experiences that excite their subscribers. This enables BSPs to grow their brand through increased subscriber acquisition, loyalty, and revenue, creating value for their businesses and the communities they serve.

This is our mission: to enable BSPs of all sizes to simplify, excite and grow.
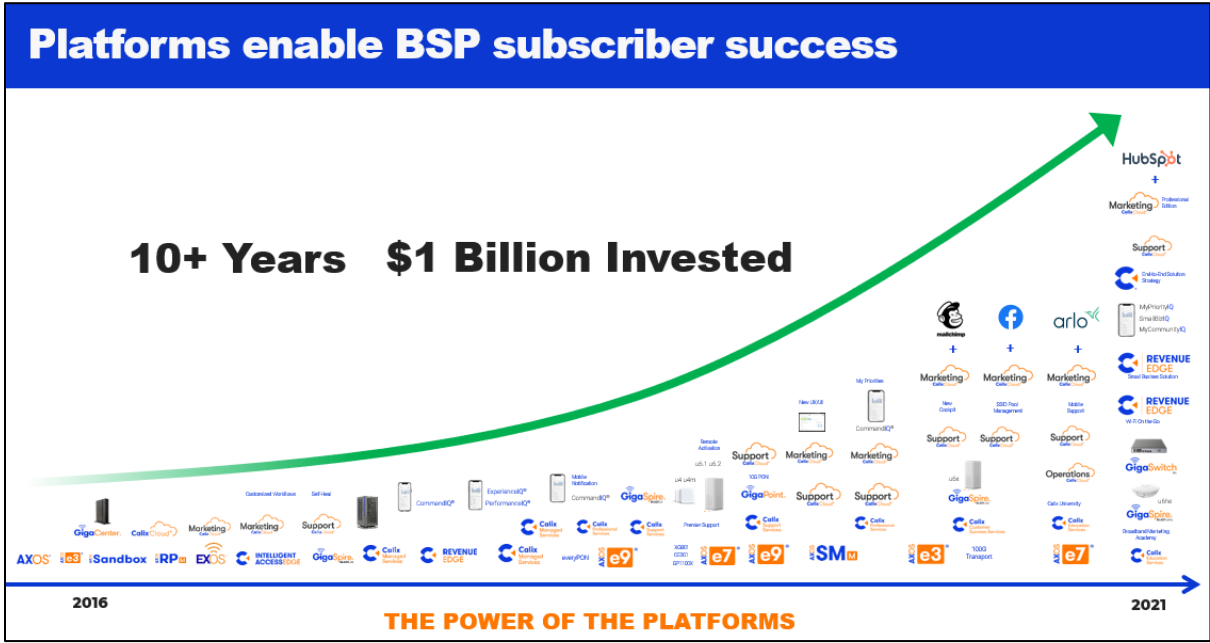
Ownership and Financial Strength

Calix is a publicly traded company, listing our common stock on the New York Stock Exchange (NYSE) and trading under the symbol CALX. Our financial information is found under the Investor Relations section of our website, http://www.calix.com.

Revenue, 2Q22 - 2Q23
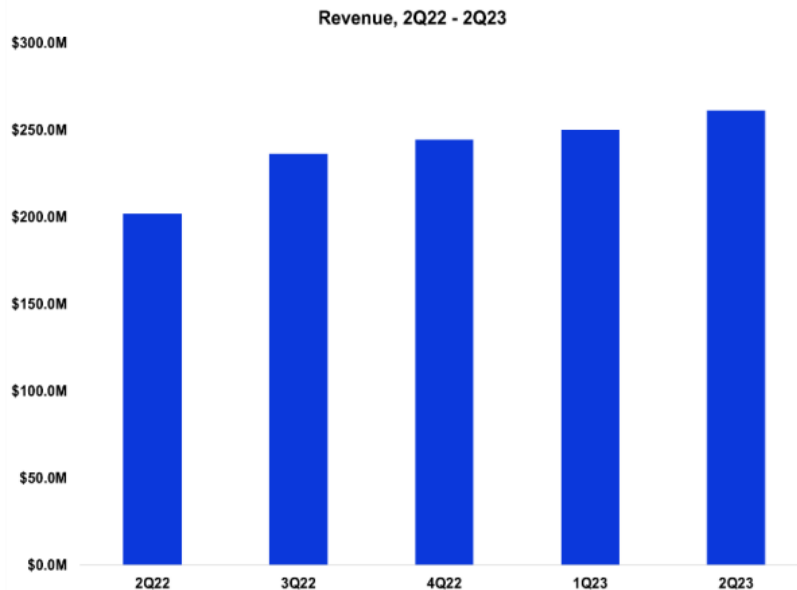
Our financial position is strong as we execute on our multi-year strategy that aligns our solutions with growing network demands and changing subscriber behaviors. We are well positioned as exhibited by our recent results, marking **three consecutive years of reported results meeting or exceeding expectations.**

Strong demand for our platform and managed service offerings led to our ninth quarter of sequential revenue growth. We achieved a record quarter for the Intelligent Access EDGE with revenue up 14% from the prior quarter and increasing by 107% compared with the year ago quarter, driven by the technology upgrade cycle to consolidated networks and 10 Gigabit PON.

The power of our platform and managed services model continued to drive strong demand. We continue to focus on finding strategically aligned customers of all types and sizes that recognize the need for business transformation enabled by our platform and managed service offerings. We have added over 100 new ISP customers per year for the past three years.

Our unique platforms, a growing ecosystem of managed services and our 91-day cadence of innovation uniquely positions us to help ISPs be technology and experience leaders in their markets.

Employees

We employed 1,426 employees globally as of December 31, 2022, with 930 employees located in the United States and 496 outside of the United States.

Organization Chart

We have provided a larger copy of the Calix Organization Chart below in the Addenda section of this response, highlighting the Calix account team for the City of Superior. The account team is supported by our executive leadership, along with marketing, product management and customer success personnel. We believe that our direct customer engagement approach provides us with significant differentiation in the customer sales process and customer engagement programs by aligning us more closely with our customers' changing needs and successful implementation of our solutions.

Calix Organization Chart and City of Superior Account Team

- City of Superior Core Account Team

Michael Weening
President and Chief Executive Officer

Cory Sindelar	Parul Kapoor	Mark Dressler	John Durocher	Shane Eleniak	Martha Galley	Matt Collins	Doug McNitt
Chief Financial Officer	SVP Talent and Culture	Chief Revenue Officer	Chief Customer Officer	Chief Product Officer	EVP Corporate Social Responsibility	Chief Commercial Operations Officer	EVP General Counsel

Gayla Harris – VP Small and Medium Business
Gregory Hlebasko – VP Sales Engineering
Dan Bloch – VP Sales
Ken Grelck – SVP North America Sales
Jerry Cederlund – SVP Global Customer Supply Chain

Lily Woodard – Sr Manager Inside Sales and Business Development
Eddy Boujaoude – AVP, Sales Engineering
Lonny Maler – VP Revenue Edge Sales Engineering
Jim Lal – RVP Sales
Jason Bailey – AVP Sales
Mark Johnson – VP Sales
Michael Combs – Sr Director Order Mgmt, Customer Ops & Fulfillment

Mark Emslie – Senior Regional Account Executive
Brian Schuldt – RVP, Sales Engineering
Dennis Budke – RVP Sales Engineering
Stephen Hughes – Senior Manager Sales Engineering
Chris Walker – RVP Sales
Keith Carlson – AVP Sales
Sandra Jaime – Senior Manager Customer Operations

Dave Warnke – Senior Sales Engineer
Matt Glosson – Senior Sales Engineer
Matt Devine – Solutions Specialist Services
Dan Rubin – Regional Cloud Manager
Bret McElwee – Strategic Sales Leader
Carol Sanders – Senior Customer Operations Representative

Proprietary and Confidential

1

Implementation Experience

Calix has over 1,900 Broadband Service Provider (BSP) customers worldwide. Our customer success stories highlight best practices among Calix service provider customers. Each of these BSP profiles provide a first-hand look into the many ways that our customers leverage our platforms and solutions to overcome challenges and capture opportunity.

Below is a small sample set of BSPs leveraging our platforms, systems, and software to transform their networks, simplify their operations, excite their subscribers, and grow their value. We provide other case studies in the Addenda section, and video testimonials in the Success Stories section of our website, https://www.calix.com/about-calix/success-stories.html.

Open Access Customers

Calix welcomes the opportunity to act as an intermediary for ConnectSuperior. We respect our customers' Personally Identifiable Information and can provide such information under separate cover.

Silver Star Communications

Established in 1912, Silver Star Communications is the leading regional broadband service provider (BSP) covering western Wyoming and eastern Idaho. Today, Silver Star connects more than 15,000 subscribers in rural communities across the region to major cities in adjacent states over a company-owned fiber network spanning more than 1,800 miles. Silver Star's mission is to enrich lives through exceptional customer experiences and innovative uses of technology. A Calix customer for more than a decade, Silver Star delivered the first 10G service in the state of Wyoming in 2018 with an XGS-PON network. To differentiate their service offerings, Silver Star adopted the comprehensive Revenue EDGE solution in 2019, rolling out the GigaSpire BLAST family of Wi-Fi 6 certified systems to deliver blazing-fast performance and lay the foundation for a range of value-added, enhanced services.

Going into 2020, Silver Star was focused on continuing its planned 10-year/$100 million fiber-optic network expansion and further enhancing the subscriber experience, with a goal of deploying GigaSpire BLAST systems in 700 households. However, the regional BSP soon faced new challenges with the onset of the global health crisis.

As the world closed its doors and borders and everything went online—work, school, healthcare, entertainment, shopping, staying in touch with family and friends—subscribers relied more than ever on Silver Star broadband services to stay connected. At the same time, Silver Star sought innovative approaches to provide the high level of service that their subscribers had come to expect while managing pandemic-related issues, such as restrictions in access to premises for installation and repairs.

In 2023 Silver Star began deploying Fiber to the Home in two communities utilizing an open access model. They have chosen COS Systems Business Engine to power their open access business in both Jackson, Wyoming and in partnership with the City of Rexburg, Idaho. See lightbridgefiber.com and silverlight-fiber.com (these are actually just two separately branded Marketplace operated by one COS Business Engine instance)

STRATA Networks (UBTA-UBET Communications)

UBTA-UBET Communications, dba STRATA Networks, has been a Calix customer since 2008. STRATA Networks is a community-focused communications cooperative based in Northeastern Utah with services that span parts of three western states. It was founded more than half a century ago and has evolved from being a local telephone network to a leading provider of differentiated broadband experiences.

STRATA Networks is at the forefront of deploying fiber networks for multiple municipalities across Utah. Recognizing the growing demand for high-speed connectivity, the company is actively working to establish robust fiber infrastructure, providing reliable and lightning-fast internet access to both urban and rural communities. This forward-thinking approach positions STRATA Networks as a pioneer in bridging the digital divide and enabling Utah residents to thrive in the digital age.

STRATA Networks has also leveraged the entire Calix Revenue EDGE solution and developed a comprehensive set of best practices for differentiating the STRATA branded Wi-Fi 6 experience for their members. After introducing the BLAST Systems to members in 2020, STRATA pivoted quickly to enhancing and customizing the STRATA-branded Wi-Fi 6 experience with EDGE Suites, leveraging the real-time behavioral insights from Calix Marketing Cloud to target members who would benefit from these new experiences. As a result of their targeted marketing campaign, STRATA has seen a 60 percent increase in the adoption of STRATA Hub (their branded CommandIQ app), and a 59 percent increase in downloads of the EDGE Suites; ProtectIQ, for enhanced virus and malware protection of the member's Wi-Fi network, and ExperienceIQ, for parental controls.

"We developed the ultimate Wi-Fi experience to differentiate from simple managed Wi-Fi offerings, and Calix has enabled us to build on that foundation and push that experience forward," said Bruce Todd, CEO for STRATA Networks. "Fast, reliable connectivity into and throughout the home was just the start, but to grow our business, we need to continue to differentiate our offering by making the in-home broadband experience unbeatable. With the simplicity of the mobile app and value-adds of full network security and management offerings, Calix delivers everything we need to continue to excite our members and grow our business."

CityFibre (United Kingdom)

CityFibre has been a Calix customer since 2015 and is building an end-to-end fiber network that is revolutionizing the country's digital infrastructure. CityFibre operates the U.K.'s second largest fiber network and expects to build out its "full fiber" network to a third of the U.K. by 2025. This includes connecting 8 million homes across more than 285 towns and cities.

A wholesale open access model was the lynchpin in CityFibre's strategy, along with building a fiber network that CityFibre embraced back in 2018. Today, CityFibre's network already serves over 3 million homes, with services to most of those premises delivered exclusively over Calix GPON technology. More recently, they announced the deployment of XGS-PON across their footprint.

With over 30 ISP partners serving residential and retail markets, plus over 1,500 partners in the business channel (including government and education segments), CityFibre's network needed to be agile enough to flex with the needs of their partner ecosystem. A fiber network can do this, but it takes strong technology partners to understand how to position it beyond just the physical infrastructure.

To bring this vision to life, CityFibre worked with Calix to build one of the world's first software-defined access networks. This network is built on Calix Intelligent Access EDGE—using the E9-2 Intelligent EDGE system and the E7-2 —and powered by the Calix Network Innovation Platform (AXOS). Leveraging this architecture, CityFibre provides its wholesale customers with unprecedented levels of network programmability, intelligence, and automation—enabling them to offer advanced products and services to their end users.

The right technology partner is someone who understands the culture that depends on that network. For a market challenger like CityFibre, that partnership is critical to enable their success and to compete with the incumbents. It must do more than just work for the partners using the wholesale open access model and for the residents that subscribe to it. It must elevate and simplify end-to-end—all the way to the premises. For its long-term vision, CityFibre requires a long-term partner that's reliable, trusted, and used to taking on the big players in fresh ways.

"As true market challengers, we don't just look at the next three years. We look at a five- or ten-year perspective and ask, who we can trust to help us build the U.K.'s most intelligent full fiber network? We then evolve that network over time as we accelerate to serve a third of the U.K. market and beyond. To do this, we need forward-thinking partners like Calix that are innovative, agile, and able to adapt technically to help us achieve our mission," CityFibre's CTO, David Tomalin, states. "Getting it right delivers a win-win for CityFibre, Calix, its ISP partners and the U.K. economy at large."

Project Experience

Program and Project Management has been a key strength for Calix for as long as we have deployed communications systems. Our history shows a broad experience in running large and complex projects. Working closely with BSP staff, Calix creates plans to include clear division of tasks and responsibilities that reflect objectives of your business plan, maintaining agreed upon schedules and targets.

Program and Project Management

Project success ultimately hinges on selecting a single-source integrator who can manage and complete each project on schedule and within budget. Calix Program and Project Managers are experienced in large-scale implementations to ensure comprehensive project planning, anticipate critical project milestones, and oversee project details.

Our years of experience have allowed us to retain lessons learned and implement best practices on subsequent projects. Using best practices from the Body of Knowledge (PMBoK) and tools (MS Project), Calix develops project plans with linkages and dependencies to the overall project schedule. The PM will be the single point of contact and will manage adherence to the schedule, performance metrics, resource allocation and utilization, risk and change management and interface with material logistics.

Point by Point Response

Calix has provided a point by point response to the ConnectSuperior Fiber Network Equipment and Services RFI 23-39-IT. All responses are prefaced with "Calix Response:" and provided in blue font.

SECTION 1	INTRODUCTION

1.1 Purpose

The City of Superior, Wisconsin, is seeking information from qualified value-added resellers (**VARs**) to provide network hardware, software, and installation services to implement a new **fiber to the premise** network. The **City** has begun implementation of its Broadband Business Plan for **ConnectSuperior**, which provides for construction of a carrier-class fiber network passing approximately 15,000 commercial and residential premises. The **City** is seeking a turnkey go-live ready system including all required hardware, software, installation materials, and professional services to implement the **ConnectSuperior** network described in this **RFI**. The City's goal is to receive information from VARs on the best open-access, multi-provider broadband solutions that exist in the market today.

ConnectSuperior will be built as an open-access, multi-provider network that is owned and operated by the City, while retail internet (and other) services are supplied by ISPs. The City will own the physical fiber infrastructure, including backbone, distribution and drops, as well as all equipment to support connectivity to ISPs. The City will provide only wholesale access services to ISPs on the network who will in turn retail their services to customers that sign up for service on the ConnectSuperior network.

The City is soliciting vendor solutions and pricing for the network hardware, software and professional services for installation. The City contemplates either passive optical or active ethernet access platforms to provide the wholesale services. VARs should provide the best solutions available to achieve the City's goals.

The **City** desires to establish, where possible, a direct relationship with all equipment and software manufacturers in the **Proposed Solution**. Therefore, any components in the **Proposed Solution** that are available for direct purchase by the **City** from the manufacturer must be quoted to allow for direct purchase. All manufacturer lead times for equipment must be included in the **Proposed Solution**.

The **City** wishes to contract with a **Seller** able to provide the turn-key go-live ready system specified in this **RFI**. Scope of work service requirements are more particularly identified in Section 4 of this RFI. Specifications and compatibility requirements are more particularly identified in Section 5 of this RFI.

Calix Response: Read and understood.

1.2   Overview of the RFI Process

This **RFI** is designed to provide **Sellers** with the information necessary to develop a **Proposed Solution**. The **RFI** process is for the **City's** benefit and is intended to provide the **City** with competitive information to assist in a future procurement for equipment and services. It is not intended to be comprehensive. Each **Seller** is solely responsible for determining all factors affecting the design, configuration, and implementation of a comprehensive Submission that will accomplish the technical and business goals described by this **RFI**.

Calix Response: Read and understood.

1.3   RFI Schedule

The **City** will make every effort to adhere to the following schedule below; however, this schedule is subject to change. **Sellers** will be notified of significant schedule changes:

Action	Responsible Party	Target Date
Issuance of RFI	City	9/1/2023
Submission of Questions	Sellers	9/19/2023
Submission of Information	Sellers	10/3/2023

Calix Response: Read and understood.

1.4   Submission

The **Seller** shall submit a digital copy of their completed information to the City no later than 5:00 p.m. CT on the designated due date to darwinj@ci.superior.wi.us. Information received after the deadline for submission of Submissions as stated herein shall not be considered and shall be returned to the late proposer unopened.

Calix Response: Comply.

SECTION 2	ADMINISTRATIVE INFORMATION

2.1   Questions, Requests for Clarification, and Suggested Changes

Sellers are invited to submit written questions and requests for clarifications regarding the **RFI**. Sellers may also submit suggestions for changes to the specifications of this **RFI**. The questions, requests for clarifications, or suggestions must be in writing and received by Jane Darwin, Contract Analyst, via email at darwinj@ci.superior.wi.us on or before the date and time listed within the **RFI**. Oral questions will not be permitted. If the questions, requests for clarifications, or suggestions pertain to a specific section of the **RFI**, **Seller** shall reference the page and section number(s). The **City** will send written responses to questions, requests for clarifications, or suggestions received from **Sellers** before the date listed within the **RFI**. The **City's** written responses will become an addendum to the **RFI** and be provided to all potential **Sellers**.

The **City** assumes no responsibility for oral representations made by its officers or employees unless such representations are confirmed in writing and incorporated into the **RFI** through an addendum.

Calix Response: Read and understood.

2.2   Costs of Preparing the Submission

The costs of preparation and delivery of the Submission are solely the responsibility of the **Seller**.

Calix Response: Read and understood.

2.3   No Commitment to Contract

This RFI is purely for informational purposes and the City is not obligated to consider or select any **Seller** in this or future procurements.

Calix Response: Read and understood.

2.4 Reference Checks

The **City** reserves the right to contact any reference to assist in the evaluation of the Submission, to verify information contained in the Submission and to discuss the **Seller's** qualifications and the qualifications of any subcontractor identified in the Submission.

Calix Response: Read and understood.

2.5 Information from Other Sources

The **City** reserves the right to obtain and consider information from other sources concerning a **Seller**, such as the **Seller's** capability and performance under other contracts, the qualifications of any subcontractor identified in the Submission, the **Seller's** financial stability, past or pending litigation, and other publicly available information.
Calix Response: Read and understood.

SECTION 3	FORM AND CONTENT OF SUBMISSIONS

3.1   Instructions

These instructions prescribe the format and content of the Submission. They are designed to facilitate a uniform review process. Failure to adhere to the Submission format may result in the rejection of the Submission.

Calix Response: Read and understood.

3.2   Proposed Solution

The Seller shall submit an electronic copy of their **Proposed Solution** as a pdf, including:

- an executive summary of the **Proposed Solution**

Calix Response: Comply. Please refer to the Executive Summary and Solution Description.

- a diagram of the **Proposed Solution** showing the components, connectivity, and link speeds

Calix Response: Comply. Please refer to the Solution Description.

- proposed rack elevations showing equipment power connections and breaker requirements

Calix Response: Comply. Product dimensions, power requirements and installation guidelines are provided in the E9-2 and E7-2 Installation guides, provided in the links below and also provided in the Appendices section:
- Calix E7-2 Installation Guide
- Calix E9-2 Installation Guide

- A detailed bill of materials and cost estimates for the **Proposed Solution** including all hardware, software, professional services and ongoing licensing agreements

Calix Response: Comply. Please refer to the Bill of Materials and Cost Estimates section.

- a description of the **Proposed Solution** including data sheets, diagrams, and training catalogs

Calix Response: Comply. Please refer to the Solution Description and Appendices.

- references and contact information

Calix Response: Comply. Please refer to the References and Company Information section.

A digital copy of the Submission shall be included with the submission in the most appropriate format of each item including MS Word, MS Excel, MS Visio, and/or Adobe Acrobat formats. All Exhibits required in the submission shall be completed and submitted in the format they were provided in the RFI. Sellers are required to submit electronic copies via email to darwinj@ci.superior.wi.us.

Calix Response: Comply.

3.3 References and Contact Information

The **City** requires sufficient corporate, financial, and reference information to adequately assess the qualifications of the **Seller** to sell, install, and support the **Proposed Solution**. The reference information will be used by the **City** to differentiate between **Sellers** with similar **Proposed Solutions**, and shall be provided in a separate document including the following information:

Corporate Information
The **Seller** shall provide an overview of their corporate structure. The overview should address the following specific items:

- Name, address, and contact information of the Company and representative
- Company History and Formation
- Ownership (Public or Privately Held)
- Number of Employees
- Organizational chart of the management and implementation teams for a proposed project

Calix Response: Comply. Please refer to the References and Company Information section of this response for detailed information. Calix is publicly traded (NYSE: CALX) so all GAAP and Non-GAAP financial information is disclosed to the SEC (sec.gov) and the investor relations site within calix.com.

Implementation Experience

ConnectSuperior will operate in a competitive marketplace as an open-access network, therefore the **Seller's** experience implementing and supporting **open-access** networks will be crucial to the successful launch and ongoing operation of **ConnectSuperior**. To this end, the **Seller** shall provide a brief summary of their experience implementing and supporting carrier-class open-access networks. The summary should address the following specific experience:

- Implementations of municipal and/or commercial **open-access** networks
- Implementations of similar network architectures
- List of certifications relative to the **Proposed Solution** held by the implementation team
- List of partner certifications relative to the **Proposed Solution** held by the **Seller**

Calix Response: Comply. Please refer to the References and Company Information section. We at Calix directly develop, manufacture, market and sell the hardware, software and service solutions proposed for ConnectSuperior.

Sellers with specialization in the proposed equipment manufacturers' service provider architecture are preferred. Copies of formal manufacturer-conferred certifications including the certification name, description, requirements, and date of award/renewal should be provided in the **Seller's** response.

Calix Response: We at Calix directly develop, manufacture, market and sell the hardware, software and service solutions proposed for ConnectSuperior.

The **Seller** shall submit a list of three (3) **open-access** references who have deployed similar architectures within the last five (5) years. The reference information shall include the company name with dates of implementation along with the name, address, and phone number of the individual(s) that may be contacted at the company. S**eller** shall omit all homogenous enterprise IT deployments (i.e., private corporate-centric networks) from their response and references.

Calix Response: Compliant. Please refer to the References and Company Information section for information on the following open access references:

- Silver Star Communications; Calix Customer since 2013
- Strata Networks (UBTA-UBET Communications); Calix Customer since 2008
- City Fiber LTD; Calix Customer since 2015

Calix welcomes the opportunity to act as an intermediary for ConnectSuperior. We respect our customers' Personally Identifiable Information and can provide such information under separate cover.

SECTION 4	SOLUTION SPECIFICATIONS AND SCOPE OF WORK

The **Seller** shall provide the **Proposed Solution** (hardware) and services to the **City** in accordance with the requirements as provided in this Scope of Work (SoW). The **Proposed Solution** must include professional services to fully commission the network.

4.2 Solution Specifications

The **ConnectSuperior** network will pass up to 15,000 premises with either a XGS-PON centrally split distribution system or 10 Gigabit Active Ethernet system connecting two access points of presence (POP) to a central data center for access to ISPs. The City's intent is to evaluate both PON-based and Active Ethernet based distribution systems to assess overall functionality and cost. Seller should provide their best solution to meet the City's needs.

Calix Response: Calix is responding with an XGS-PON solution equipped to service 15,000 subscribers inclusive of a Wi-Fi 6 home gateway, as well as a centrally located Aggregation router equipped with 100GbE redundant links to the three (3) access network POPs and 10GbE redundant links to three (3) ISPs.

The physical outside plant (**OSP**) architecture consists of multi-count single mode fiber rings connecting the data center, its collocated access POP, and remote access POPs to optical distribution networks (ODN) serving subscriber premises. POPs will be prefabricated shelters contain a -48v DC power system, 7' x 19" equipment racks, HVAC, cable ladder, and fiber distribution panels (FDPs) with SC/APC connector profiles.

Calix Response: Read and understood.

- **Core and Aggregation**
  - Core electronics capable of supporting up to 15,000 residential and commercial customers. ConnectSuperior will maintain 2-3 POPs with 5,000 - 6,000 subscribers per POP.

Calix Response: Calix has configured capacity to support 3 POPs each serving 5,000 subscribers.

  - 10 and 100 gigabit access facing interfaces

Calix Response: The ASM3001 is equipped for redundant 100GbE connections to each of the three (3) POPs where the E7-2 access nodes reside.

    o   100 gigabit cross-connect interfaces between core devices

Calix Response: Supported and equipped.

    o   10 and 100 gigabit service provider facing interfaces (for connection to retail ISPs)

Calix Response: Equipped for 10GbE; support for 100GbE.

    o   Support for SR-MPLS, EVPN and VRF

Calix Response: Compliant on E9-2 ASM3001 platform.

    o   Support for LAG and MC-LAG

Calix Response: Compliant for LAG; cross module LAG also supported.

    o   Full QOS and traffic management solution

Calix Response: The AXOS operating system has been architected to support this. The E9-2 offers a comprehensive hierarchical QoS (HQoS) solution as part of the unified Access network, with both residential and business services able to effectively share the same PON without compromise for the QoS. The system has a very flexible architecture in allocating queueing resources at both subscriber and service levels.

The E9-2 implements QoS using the following components:

- Class map – Specifies how traffic should be classified into flows for further QoS treatment by a policy map.
- Policy map – Defines QoS treatment to apply to all or specific flows for packets entering an IP service. The policy map supports:
    - Ingress metering
    - Egress metering
    - Egress shaping

The E9-2 supports applying a policy map to Access interfaces for ingress policing and egress shaping. The policy map is applied to the S-VLAN on the ONT Ethernet interface.

The E9-2 supports HQoS to prioritize traffic forwarding at multiple levels simultaneously: per service, per subscriber (ONT Ethernet interface), or per traffic class (flow).

Downstream QoS Model

Incoming packets coming into the WAN on Aggregation Card flow directly into the Line card, with no congestion. At the line card, packets are stored in an external buffer and forwarded to the PON based on the subscriber policy map.

Additionally, the E9-2 implements service-based Enhanced Priority Mode (EPM) QoS with various models with combinations of Strict Priority (SP), Weighted Round Robin (WRR), and SP+WRR combinations.

The E9-2 also supports traffic shaping, hierarchical scheduling, traffic metering, and discard policies.

- o Full power and CPU redundancy

Calix Response: Supported in E7-2/E9-2.

- o Support for syslog, SNMP, trap and performance management in OSS software

Calix Response: Supported in SMx.

- o Support for out-of-band management and monitoring

Calix Response: Supported and equipped.

- o 24x7x365 next-business day hardware and software maintenance on critical components

Calix Response: Available as an enhanced service; Configured for Return to Factory service supported by a sparing strategy.

- **Access**
  - o Access electronics capable of supporting up to 15,000 residential and commercial customers. ConnectSuperior will maintain 2 POPs with 6,000 subscribers per POP.

Calix Response: Configured to support 15,000 subscribers across 3 POPs.

- o Sub-gigabit, 1 gigabit and 10 gigabit subscriber services, scalable to 100 gigabit

Calix Response: Subscriber services range from 10 Mbps/100 Mbps/1 Gbps/100Gbps. 100Gbps connections would be a direct UNI/NNI connection from the subscriber to a 100gbps port on the E9-2 ASM3001.

- o 10/100 gigabit interconnection with ISPs

Calix Response: Equipped in this response with redundant 10GbE 10km optics for 3 ISPs on the ASM3001; 100GbE available on ASM3001.

o   XGS-PON or Active Ethernet access technology for subscriber-facing services

Calix Response: Calix proposes XGS-PON; symmetrical 10Gbps.

o   Active Ethernet overlay to support dedicated customers, including community anchor institutions and large enterprises

Calix Response: Equipped with (60) 10GbE business class interfaces via the E7-2 XG1601 modules.

o   Layer 2 segmentation technology provide separate VLANs/VPNs for each ISP and its customers on the open-access network

Calix Response: Support for multiple VLAN configuration scenarios common in Open Access (S+MAC or S+C or S+C+MAC switching). Each ISP is logically segmented within the Operator network.

o   Full QOS and traffic management solution

Calix Response: Supported and equipped.

o   Full power and CPU redundancy

Calix Response: Supported and equipped.

o   Support for syslog, SNMP, trap and performance management in OSS software

Calix Response: Supported and equipped.

o   Support for out-of-band management and monitoring

Calix Response: Supported and equipped.

o   24x7x365 next-business day hardware maintenance on critical components

Calix Response: Available as an enhanced service; Configured for Return to Factory service supported by a sparing strategy.

- **Subscriber ONT**
  - XGS-PON or Active Ethernet per vendor's solution

Calix Response: Calix is proposing XGS-PON for ConnectSuperior.

  - Support for indoor and outdoor options

Calix Response: Calix proposes the GigaSpire BLAST u4xg indoor solution. Outdoor support is provided by the GP4201X GigaPoint, XGS WAN, 2 POTS, 1 10GE LAN, 3 GE LAN- AM Power Adapter.

  - 1GE LAN port

Calix Response: The GigaSpire BLAST u4xg supports (2) 1GbE LAN ports.

  - 1 POTS line

Calix Response: The GigaSpire BLAST u4xg supports 1 POTS line. Carrier grade SIP client included.

  - Wireless gateway for all-in-one ONT+Gateway functionality

Calix Response: The GigaSpire BLAST u4xg is an integrated ONT/RG/Wi-Fi.

  - Out-of-band management and monitoring

Calix Response: Configured and supported via the Extended Web Interface (EWI) as well as in-band management.

  - Support for syslog, SNMP, trap and performance management in OSS software

Calix Response: Supported via TR-69, SNMP.

  - Support for out-of-band management and monitoring

Calix Response: Configured and supported via the Extended Web Interface (EWI) as well as in-band management.

Additional ONTs available:
- GP1100X GigaPoint, 1 2.5GE, 1 POTS -AM Type A Power Adapter
- GP1101X GigaPoint, 1 10GE, 1 POTS -AM Power Adapter;
- GP4201X GigaPoint, 2 POTS, 1 10GE, 3 GE - AM Power Adapter. Outdoor rated w/ enclosure.

- **Dedicated ONT**

    o   For large enterprise and community anchor organizations

Calix Response: Though not included as part of the proposed configuration, Calix offers the GigaPro GPR8802x, including XGS SFP+ module XGS WAN interface for this scenario. The GigaPro GPR8802x offers full PoE capability for powering Access Points, cameras, or any other PoE supported device.

    o   1, 10 and 100 Gigabit interfaces, both network and customer facing

Calix Response: Two (2) ports of 10 Gbps, Six (6) ports of 1/2.5Gbps, PoE+ 802.3bt capability (380 Watts total).

    o   Support for syslog, SNMP, trap and performance management in OSS software

Calix Response: Supported.

    o   Support for out-of-band management and monitoring

Calix Response: Supported.

    o   24x7x365 next-business day hardware and software maintenance on critical components

Calix Response: Available as an enhanced service; Configured for Return to Factory service supported by a sparing strategy.

- **Element Management System**

Calix Response: SMx is included and provides this functionality. Provisioning can be done within SMx or via automated API to external system (i.e., COS Systems).

    o   Support for syslog, SNMP, trap and performance management in OSS software

Calix Response: Supported.

    o   Full user interface and dashboards for alarm management, traffic management, capacity planning, inventory and reporting

Calix Response: Supported.

- o Provisioning for all subscriber services, including residential single-family, multifamily, commercial and community anchor

Calix Response: Supported via API to COS Systems or alternatively directly via Calix SMx.

- o Subscriber usage reporting to support bill generation

Calix Response: Within Calix Support Cloud, a user may generate traffic reports for usage, rate, monthly applications, and top application traffic. This information can be exported as a .CSV or .PDF. Reports can also be generated with user input custom date ranges.

- **Self-Provisioning Features**
  - o Subscriber self-provisioning system, allowing a customer to select their ISP, speed and package and switch ISPs, start and stop service

Calix Response: Supported via Partner (COS Systems) platform via a Dynamic API in Calix SMx. Entries in COS System Operator/ISP/Subscriber portals will be sent to the relevant Calix ONT to reflect the requested subscriber provisioning.

4.3   Professional Services Scope of Work

4.3.1   Pre-installation Planning (Onsite)

- Review readiness of sites for equipment installation and power
- Make arrangements for site access
- Evaluate rack elevations
- Evaluate power, distribution, and receptacle types
- Evaluate fiber distribution panel locations and connector profiles
- Identify required fiber strands/ports
- Develop a list of installation materials and procurement plan
  - o Fiber and copper jumper cables
  - o Equipment power wiring, fusing, and grounding components
  - o Equipment mounting hardware
  - o Determine sourcing for procurement
  - o Assist **City** in creating BoM for procurement of installation materials

Calix Response: Section 4.3.1 read and understood and available for $36,500 option as part of on-site installation/deployment assistance.

4.3.2   High Level Configuration Design – (Remote)

- Conduct interactive design sessions with **City** and its service providers
- Define OTT video and VoIP integration requirements if any
- Define **City** subscriber services and QoS requirements
- Define requirements for open-access architecture and integration
- Define requirements for layer 2 services and BNG architecture
- Define subscriber service profiles for access network
- Define business network and OSS requirements
- Create high level design using inputs from interactive network design session
- Validate and finalize high level design with **City**

Calix Response: Included in the response Bill of Materials. Calix will work with the City to implement according to best practices for our equipment and the specific type of deployment (Open Access).

4.3.3   Equipment Installation and Configuration Loads – (Onsite)

- Rack/Stack/Power equipment
- Install fiber jumpers and cabling as required by the low-level design
- Coordinate with ISPs for installation
- Develop low level configurations and documentation
- Install latest stable release software
- Create and load individual device configurations
- Validate and test low-level design and device configurations
- Install out-of-band management and telemetry systems

Calix Response: Section 4.3.3 read and understood and available for $36,500 option as part of on-site installation/deployment assistance.

4.3.4   Acceptance Testing Plan (ATP) – (Onsite)

- Deploy local speed test server on business network VM
- Verify performance of network relative to the low-level design
- Simulate component and link failures to ensure proper operation of hardware and software redundancy mechanisms
- Verify operations of services failover and high availability functionality
- Perform end-to-end testing to validate network performance through gateways
- Verify performance of subscriber CPE and services

Calix Response: Section 4.3.3 read and understood and available for $36,500 option as part of on-site installation/deployment assistance.

4.3.5   Training – (Onsite and/or Remote)

- Basic network training on:
    - Hardware and software configuration
    - high-level troubleshooting techniques
    - in-band and out-of-band management access
- Basic subscriber and service training on:
    - creation and modification of subscribers
    - creation and modification of service packages
    - management of subscriber gateways
    - high-level subscriber and CPE troubleshooting
    - interconnection with ISPs
- Business network training on:
    - firewall management
    - overview of business network software
    - DDI configuration and management
    - network and service performance monitoring

Calix Response: Onsite, over the shoulder training is available as part of the remote/on-site installation/deployment assistance. We also offer instructor-led training on the specific proposed products.

Students enroll in a class, and then log into a specific machine (E7-2, E9-2, etc.), and complete a formalized curriculum with instructor guidance and assistance. Typical class size is 8 students. Classes are typically multi-day in 4-hour increments. The lab machine is available to the student for the duration of the course.

Access to the entire Calix Academy learning environment is available for $2,940 per learner, per year. Learner renewals are $1,200 per year. Learners can sign up for individual instructor led courses for $425. Certification exams are $295. Basic network (IP/GPON/XGS-PON, Wi-Fi/Routing) classes are available at no cost as E-learning courses for Calix Customers. More advanced E-learning courses are available for $250. All E-learning is also included in the Calix Academy annual subscription.

4.3.6   Documentation – (Deliverables)

- Cable, panel, and equipment labeling
- Provide comprehensive documentation (format to be determined)
- Rack elevations
- Power, fiber, copper cross-connects
- Detailed layer 1 and 2 network diagrams
- Shelf level diagrams
- IP address and subnet assignments
- Electronic backups of all element configurations on portable media

Calix Response: Provided in both remote (included in bid) and on-site services.

For purposes of this Submission, tasks marked "Onsite" should include travel in the professional services pricing. City reserves the right to coordinate with the Seller to modify the services and their delivery to reduce their overall cost.

Bill of Materials and Cost Estimates

Bill of Materials and Cost Estimates

Calix has provided pricing estimates for the following solution components:

Core and Aggregation

- • E9-2 with ASM3001, configured capacity to support 3 POPs each serving 5,000 subscribers.

Access

- E7-2 with XG1601 XGS-PON line card, configured to support 15,000 subscribers across 3 POPs.

Subscriber ONT

- GigaSpire BLAST u4xg (GS2128XG), dual band 2x2 Wi-Fi 6, XGS-PON WAN, 2 GE LAN, AM power adapter

Other ONTs and Residential Gateways

- GigaPoint GP1100X, GP1101X, GP4201X

- GigaSpire BLAST Wi-Fi 6 systems, u6.1, u6.2, u6xw, u4hm

Software Licenses

- AXOS Framework (SMx) per Subscriber Annual Term License Up to 15,000 Subscribers

- AXOS Advanced Routing Module (ARm) Annual Term License

- Calix Cloud Foundation Annual Term Subscription up to 15,000 Subscribers

Systems Support

- Intelligent Access EDGE Premier Support Annual up to 15,000 Subscribers

- Revenue EDGE Systems Support Annual Term Subscription up to 15,000 subscribers

Services

- E9 Layer 3 Deployment Service

- Network Design, Turn up

- Network Management Software - Turn up or Upgrade Remote Assistance

#	Part Number	Part Description	Quantity
		E7-2 using XG 1601/U4XG 15,000 subscribers 718362A-2	
1	000-00372	E7-2 Field Install Package (CO & ODC/RT): Shelf with Blank Card, FTA, and Field installation Kit	**15**
2	100-05770	E7-2 XG1601 XGS-PON (2XQSFP-DD, 2XSFP+, 8X XGS-DD/MPM OIM)	**30**
3	100-05729	XGS-PON SFP-DD, DUAL CHANNEL 10G/10G, CLASS N1, 1577/1270NM, 20KM, LC, I-TEMP, OLT	**235**
4	100-05587	QSFP28 to QSFP28 100GE Direct Attach Cable (DAC), 1m, 30AWG, I-Temp, passive	**14**
5	100-04744	QSFP28 100GE Single Mode Optical Transceiver 10km, 1310nm, Dual LC, C-Temp	**8**
6	100-05811	GigaSpire u4xg, GS2128XG, dual band 2x2 Wi-Fi 6, XGSPON WAN, 2 GE LAN, AM power adapter	**15000**
7	000-00916	E9-2 System Package (Shelf, 4 Fan Modules, Fiber Management, Installation Kit)	**1**
8	100-05123	E9-2 ASM3001 Aggregation Services Manager (4xQSFP-DD, 32xSFP+)	**2**
9	100-01512	10GE SFP+, Single Mode dual fiber transceiver, 10Km, 1310nm, LC, I-temp	**6**
10	130-00491	AXOS Framework (SMx) per Subscriber Annual Term License Up to 15,000 Subscribers	**1**
11	000-01281	AXOS ARm (Advanced Routing Module) Annual Term License	**1**
12	110-01621	Intelligent Access EDGE Premier Support Annual up to 15,000 Subscribers	**1**
13	000-01213	Calix Cloud Foundation Annual Term Subscription up to 15,000 Subscribers	**1**
14	110-01619	Revenue EDGE Systems Support Annual Term Subscription up to 15,000 subscribers	**1**
15	110-01518	E9 Layer 3 Deployment Service	**1**
16	110-01525	Network Design, Turn up - L2 - Add 1 E9 Node	**1**
17	110-01340	Network Design, Turn up - L2 - 1 Node Base Remote Assistance	**1**
18	110-01341	NETWORK DESIGN, TURN UP - L2 - ADD E7, E3, C7 NODE	**14**
19	110-01370	Network Management Software - Turn up or Upgrade Remote Assistance	**1**
		Total:	**$3,998,910.07**
		Options	
1	100-05463	GP1100X GigaPoint, 1 2.5GE, 1 POTS -AM Type A Power Adapter	
1	100-05638	GP1101X GigaPoint, 1 10GE, 1 POTS -AM Power Adapter	
1	000-01175	GS4220E GigaSpire BLAST u6.1, GE WAN, 4 GE LAN, dual band Wi-Fi 6, 2 POTS, 1 USB, AM Power Adapter	
1	000-01174	GS4227E GigaSpire BLAST u6.2, 2.5G WAN, 4 GE LAN, dual band Wi-Fi 6, 2 POTS, 1 USB, AM Power Adapter	
1	000-01204	GigaSpire u6xw, GS4227W, XGS SFP+ module, Package, Dual Band 4x4 + 2x2 Wi-Fi 6, 4GE, 2 POTS, AM Power Adapter	
1	100-05839	GigaSpire u4hm, GM1028H, hardened dual band 2x2 Wi-Fi 6, GE WAN	
1	100-05880	GP4201X GigaPoint, 2 POTS, 1 10GE, 3 GE - AM Power Adapter	

Calix Appendices

RFI Response References

COS Systems RFI Response

Calix Organization Chart

Equipment Data Sheets

E9-2 Intelligent Access Edge

E9-2 Aggregation Services Manager (ASM3001)

E7-2 Intelligent Modular System

E7-2 XG1601 Line Card

GigaSpire BLAST u4xg Datasheet

GigaPoint GP1100X

GigaPoint GP1101X

GigaPoint GP4201X

GigaSpire BLAST u6xw Datasheet

GigaSpire BLAST u6.1 Datasheet

GigaSpire BLAST u6.2 Datasheet

GigaSpire BLAST u4hm Datasheet

Installation Guides

E9-2 Installation Guide

E7-2 Installation Guide

Software Solution Briefs

Subscriber Management Connector (SMx) Solution Brief

Advanced Routing Module (ARm) Solution Brief

Services

E9-2 Layer 3 Deployment Service Description Document

Network Design and Turn Up Service Description Document

Network Management Turn up or Upgrade Service Description Document

Calix Support Policy: Premier Support

Calix Education Services Solution Brief