Nelson County Broadband Authority (NCBA)

Request for Proposals - Network Operations

RFP#: NCBA20170105SR

This Request for Proposals is issued pursuant to the Competitive Negotiations Process provided in Section 2.2-4302.2 of the Virginia Public Procurement Act and is issued to procure the professional services of a third party to manage the network operations of The Nelson County Broadband Authority (NCBA) or Owner.

To obtain a copy of the RFP, please contact the Nelson County Administrator’s Office at (434) 263-7000; email: cmcgarry@nelsoncounty.org, or visit www.nelsoncounty-va.gov.

Responses are to be sealed with the RFP number clearly marked on the outside of the envelope. Responses must be received by NCBA prior to the due date and time of February 3, 2017 at 4:00 PM local prevailing time. Responses are due at the Nelson County Administrator’s Office, 84 Courthouse Square, P.O. Box 336, Lovingston VA 22929. Fax or email responses will not be accepted. Vendors are encouraged to confirm receipt of their response submission prior to the due date.

Please contact Susan Rorrer at 434-263-7120 or srorrer@nelsoncounty.org with any technical questions you have regarding this RFP. If you wish to be provided answers to technical questions; please advise Susan Rorrer of how you wished to be provided this information.

All answered technical questions regarding the RFP will be disseminated by 5:00 PM, local prevailing time on January 27, 2017. All questions should be sent via email to Susan Rorrer at the address listed above.

The Nelson County Broadband Authority is a public authority of Nelson County, Virginia, and the successful respondent will be required to meet typical public contractual terms for insurance, liability, venue, etc.
Sealed proposals will be received at the Nelson County Administrator’s Office until 4:00 p.m. on Friday, February 3, 2017 at which time the receipt of proposals will be closed. Six (6) hard copies of your proposal signed by an authorized representative, along with one (1) copy in digital format must be addressed to: Nelson County Broadband Authority, County Administrator’s Office, P.O. Box 336, 84 Courthouse Square Lovingston, Virginia 22949. Envelopes must be clearly marked “RFP #NCBA20170105SR” and be identified with the firm’s name. The Certification Page should be completed and returned with proposal.

Comments and questions concerning this solicitation should be addressed to:

Stephen A. Carter
County Administrator
P.O. Box 336
84 Courthouse Square
Lovingston, VA 22949

email: scarter@nelsoncounty.org
phone: (434) 263-7000

Technical and or logistical questions should be addressed to:

Susan Rorrer
Director of Information Systems
P.O. Box 336
84 Courthouse Square
Lovingston, VA 22949

email: srorrer@nelsoncounty.org
phone: (434) 263-7120
NELSON COUNTY, VIRGINIA
REQUEST FOR PROPOSAL (RFP)
NCBA NETWORK OPERATIONS

ISSUE DATE: January 5, 2017
RFP #: NCBA20170105SR

TITLE: NCBA Network Operations

ISSUED BY: Nelson County Broadband Authority
County Administrator’s Office
P.O. Box 336
Lovingston, VA 22949

Sealed Proposals Will Be Received Until 4:00 p.m. Local Time Prevailing on February 3, 2017 For Furnishing the Services Described Herein.

All Inquiries For Information Should Be Directed To: Stephen A. Carter  Phone: (434) 263-7000

IF PROPOSALS ARE MAILED, SEND DIRECTLY TO ISSUING DEPARTMENT SHOWN ABOVE, IF PROPOSALS ARE HAND DELIVERED, DELIVER TO: Nelson County Courthouse, 84 Courthouse Square, County Administrator’s Office, Lovingston, Virginia.

Offerors shall ascertain prior to submitting a response that all Addenda issued have been received and shall acknowledge receipt and inclusion of all Addenda here:

Addendum No._______ Date: ____________ Addendum No._______ Date: ____________

In Compliance With This Request For Proposal And To All The Conditions Imposed Therein And Hereby Incorporated By Reference, The Undersigned Offers And Agrees To Furnish The Services In Accordance With The Attached Signed Proposal Or As Mutually Agreed Upon By Subsequent Negotiations.

Name and Address of Firm:

__________________________________________________________
Date: ____________________________

__________________________________________________________
By: ______________________________
    (Signature in Ink)

__________________________________________________________
Name: ____________________________

__________________________________________________________
Zip Code: _________________________
Title: ____________________________

FEI/FIN NO.: ______________________
Telephone Number: (___)_________
Fax Number: (___)______________

RETURN THIS PAGE WITH PROPOSAL SUBMISSION
Overview

NCBA is soliciting proposals from qualified vendors to operate an Open Access, Active Ethernet and GPON, Fiber Optic Network.

The NCBA network consists of approximately 39 miles of fiber backbone and laterals with approximately 350 existing customers. The fiber distribution system consists of Calix E7 1Gb Active Ethernet and GPON components housed in a central network facility and four remote shelters or cabinets.

The scope of services includes managing the Calix system configurations including provisioning circuits at the request of NCBA ISPs, generating reports for system evaluation, processing new customer requests from setup through provisioning, monthly billing and generating monthly financial reports, technical support of the SPs, monitoring the network for failures and disconnects, and engineering support for unique situations, network enhancements and infrastructure changes.

General Information

NCBA is a public authority of Nelson County authorized by the County to operate an Open Access gigabit fiber network serving Nelson County. The network was installed under the terms of a U. S. Federal Government BTOP grant and has been in operation for four years.

Requirements in terms of services expected, technical capabilities, and performance metrics are described in the RFP along with criteria to be used for proposal evaluation purposes.

Open Access means that access to network services and end points is not restricted except to technical and financial capabilities. NCBA is a wholesale Ethernet transport provider.

Independent Service Providers qualify to offer Internet or other network services over the NCBA infrastructure to customer endpoints on the NCBA network.

We seek proposals from vendors capable of operating an open network. Vendors supporting partial solutions are encouraged to respond (e.g. only NOC services for 24/7 monitoring).

NCBA may choose to take services from more than one vendor. Vendors should clearly indicate if their responses are partial and which services are included in their response.

Vendors should be able to demonstrate core competency and certifications for Calix systems as well as supporting network components such as DC rectifiers.

The primary roles are to operate, monitor, and manage the network meaning to configure to order using the management systems of Calix, capture and report network outages and anomalies including traffic throughput issues, and manage projects for the continued enhancement of the network as required by the NCBA. Other roles include monthly billing of SPs and generating monthly billing and other financial reports to be provided to NCBA.
Most of this effort can be accomplished by remote access. The ability to deliver resources on-site from time to time for project execution is an advantage.

NCBA will select one or more qualified vendors to operate and manage the NCBA network (this RFP is not a request for equipment).

**Response Contents**

To aid us in the evaluation of hardware and software responses, we ask that your response follow this outline:

Note: This is a public proposal. Do not include confidential information. NCBA cannot guarantee the confidentiality of information in your response.

1. **Cover Letter:** indicating your firm’s interest in the project, and highlighting key points of your response.

2. **Company Overview:** including company history, number of employees by discipline and servicing locations.

3. **Services Overview:** A brief description of the services you intend to offer, the location of office(s) where services will be delivered, and length of time your firm has provided similar services. Include here your statement that your response includes the expert technical capability to provide the services, the manpower to execute the services either on-site or remotely, and the systems and certifications to operate the network.

4. **Proposed Team:** List the names of team members expected to provide services to NCBA, their bona fides, and management hierarchy.

5. **Experience:** Indicate your level of experience with Active Ethernet and GPON Fiber Optic Broadband networks, particularly your certifications and/or vendor partner level with Calix. Also indicate your level of experience with computer networking and indicate any certifications you may have.

6. **Describe your approach, methods, tools, and how you will meet the Network Operations Requirements.**

7. **List the software and/or systems for networks operations required for your service delivery.** Include reporting, monitoring, remote access, asset management and any other with vendor and package name. Indicate cost of software to NCBA, location for servers, ownership of licenses and intellectual property contained in servers.

8. **Time Schedule:** Indicate a timeline for your ability to assume responsibility for the network.

9. **Pricing:** Indicate your proposed pricing for the Services or Software defined in your response. Include a Service Level Agreement, if applicable. Include a cost rate for staff required for ad hoc or out of contract service.
NOTE: NCBA will give preference to a flat monthly fee to deliver the defined services.

10. References: Please provide a minimum of three (3) references where your firm and/or your proposed project team have deployed a similar service. Please include client’s name, address, phone number, e-mail address, and description of work.

11. Financial Statements: Include information relevant to your financial stability: financial statements, revenues over the past three (3) years, any pending lawsuits or legal actions against your company, and contact information for your financial institution. Include your coverage for general liability, workers comp, professional liability and errors & omissions insurances.

**Selection Process**

Respondents are asked to submit written proposals which present their qualifications and understanding of the work to be performed. The NCBA reserves the right to contact any and all vendors prior to contract award for clarification or definition. The NCBA does not discriminate against any vendor on any basis.

Per Section 2.2-4302.2 of the Code of Virginia, regarding Competitive Negotiation, selection shall be made of two or more offerors deemed to be fully qualified and best suited among those submitting qualifications, on the basis of the factors involved in this Request. Discussions shall then be conducted with such offerors in which they shall be encouraged to elaborate on their qualifications and expertise pertinent to the proposed project. Non-binding estimates of price for professional services and total project costs may be discussed at this point.

At the conclusion of discussion outlined hereinafore, on the basis of evaluation factors published in the RFP and all information developed in the selection process to this point, the NCBA shall select in order of preference two or more offerors whose professional qualifications and proposed services are deemed most meritorious. Negotiations shall then be conducted with the offeror ranked first. If a contract satisfactory and advantageous to the NCBA can be negotiated at a price considered fair and reasonable, the award shall be made to that offeror.

Otherwise, negotiations with the offeror ranked first shall be formally terminated and negotiations conducted with the offeror ranked second, and so on until a contract can be negotiated at a fair and reasonable price. Should the NCBA determine in writing and in its sole discretion that only one offeror is fully qualified, or that one offeror is clearly more highly qualified and suitable than the others under consideration, a contract may be negotiated and awarded to that offeror.

Per Section 2.2-4359 (D), the NCBA is not required to furnish a statement of the reasons why a particular proposal was not deemed to be the most advantageous. Additionally, per Section 2.2-4319 of the Code of Virginia, the NCBA may cancel this Request for Proposals or reject any and all proposals and the reason for such cancellation or rejection shall be made part of the contract file.
Selection Criteria

The Respondents will be evaluated on the following criteria:

• Clarity of response and adherence to format. (5%)

• Total non-binding cost of proposed services (20%)

• The Respondent’s demonstrated capabilities and certifications with the Core Network deployed by NCBA. (30%)

• Respondent’s NOC location and ability to provide on-site support as needed. (15%)

• Features and flexibility of the Respondent’s technical solution for network monitoring, reporting, control, and specific support of NCBA’s business operations. (30%)

Qualifications of Offerors

NCBA may make such reasonable investigations as deemed proper and necessary to determine the ability of the Offeror to perform the work/furnish the item(s) and the Offeror shall furnish to NCBA all such information and data for this purpose as may be requested. NCBA reserves the right to inspect Offeror’s physical facilities prior to award to satisfy questions regarding the Offeror’s capabilities. NCBA further reserves the right to reject any proposal if the evidence submitted by or investigations of such Offeror fails to satisfy NCBA that such Offeror is properly qualified to carry out the obligations of the contract and to complete the work/furnish the item(s) contemplated therein.

Debarment Status

By submitting its proposals, Offeror certifies that it is not currently debarred from submitting bids or proposals on contracts by any county or NCBA agency nor is it an agent of any person or entity that is currently debarred from submitting bids or proposals on contracts by any county or NCBA agency.
Anticipated Schedule

- January 5, 2017 - Issue Request for Proposal
- February 3, 2017 - RFP Responses due at 4:00 PM local prevailing time at County Administrator’s Office, 84 Courthouse Square (PO Box 336), Lovingston, VA 22949
- February 17, 2017 – Proposal Evaluations Complete
- February 20 - 24, 2017 – Vendor Interviews Conducted
- March 3, 2017– Contract Awarded

Protest of Award or Decision to Award

Any offeror who desires to protest the award or decision to award a contract by NCBA shall submit such protest in writing to the County Administrator no later than ten (10) days after the award announcement or the decision to award, whichever comes first. No protest shall lie for a claim that the selected offeror is not a responsible offeror. The written protest shall include the basis for the protest and the relief sought. The County Administrator shall issue a decision in writing within ten (10) days stating the reasons for the action taken. This decision shall be final unless the bidder appeals within ten (10) days of the written decision by instituting legal action as provided in Section 2.2-4364 of the Code of Virginia. Nothing in this paragraph shall be construed to permit a bidder to challenge the validity of the terms or conditions of the Invitation to Bid or Request for Proposal.
Definitions

The following definitions are used in the RFP:

**Access Network** - Optical delivery network from the NOC to the Customer End Point. The Access Network is Calix E7 Active Ethernet and GPON. The CPE is Calix 716GE-I ONT. The network is gigabit capable.

**Authority** - The Nelson County Broadband Authority (NCBA) “Owner”

**Circuit** - An NCBA circuit is an Active Ethernet or GPON fiber connection between an ONT installed at a customer end point to the NCBA network facility in Lovingston (NOC). At the NOC, traffic is handed to the SP responsible for the circuit.

**Contract** - The agreement between the successful Vendor and NCBA for the technology partnership.

**Core Network** - The Primary network hardware components combining to deliver Ethernet transport.

**CPE** - Customer Premise Equipment residing at the customer location (business, institution or residence). Primarily Calix 716GE-I ONT. Other Calix ONT could be deployed in future projects.

**Cabinet** - Throughout this document “Cabinet” refers to an outside plant telecom equipment enclosure. Details on the cabinet can be found in the network equipment attachments.

**FTTP** - Fiber-to-the-Premises network

**NCBA** - The Nelson County Broadband Authority “Owner”

**Network Customer** - a customer of the Authority that uses the Network. These include DSA’s Service Providers, Dark Fiber Lessees, and Tower Lessees.

**Network Equipment** - All of the equipment for the hardware, software, and support systems in the network. This may include an automated service provisioning system and end-user portal for self-registration and service activation.

**NOC** - The NCBA network facility located in Lovingston that houses the NCBA Core Network and Service Provider equipment.

**Open Access (open access)** - Technology and policy that enables NCBA to provide Ethernet transport to multiple Service Providers or other users so they may deliver unique, competing, any-play services or use the network to augment their own facilities. The Owner provides an infrastructure only network, and the Service Providers deliver the consumer and business services.

**Operator (or Network Operator)** - The entity hired by NCBA to configure, monitor, manage and enhance the NCBA Network.

**Response/Bid** - The document and information prepared by the Vendor in response to this RFP.

**Service Provider (SP)** - An independent business that provides any network or IP service(s), such as voice, video, and/or internet access across the NCBA fiber network or uses the NCBA network for transport.
Network Map

Red and Green Lines = NCBA Backbone

The NCBA network consists of 144 strand or 96 strand fiber backbone that extends from Colleen in the southern portion of the County along Routes 29, 6 and 151 north to the County line in Afton. The network also extends north along Route 6 in Afton and south from the intersection of Route 6 and 151 into through Nellysford.

The Core Network consists of Calix E-7 equipment located in the NOC in Lovingston and at four remote sites.
Service Providers connect to the Calix E-7 and may inject 802.1q VLANs or untagged IP (Internet Protocol) into the NCBA Network.

Where more than one E7 Frame is needed in a location, the E7s are stacked and their traffic consolidated. Note in the table below the location and current configuration of the Calix equipment.

Each Calix ONT deploys four 1Gb Ethernet ports that can be individually provisioned for different classes of service or different Service Providers.

<table>
<thead>
<tr>
<th>Site</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOC Center (NOC)</td>
<td>94 Courthouse Square, Lovingston VA 22949</td>
</tr>
<tr>
<td>2x Calix E7, 3x 10GE-4 Card</td>
<td></td>
</tr>
<tr>
<td>1x GPON-4 Card</td>
<td></td>
</tr>
<tr>
<td>Colleen (ODC-100 Cabinet)</td>
<td>476 Cooperative Way, Arrington, VA 22922</td>
</tr>
<tr>
<td>1x Calix E7, 1x 10GE-4 Card</td>
<td></td>
</tr>
<tr>
<td>40AH Battery Systems and Generator Connector</td>
<td></td>
</tr>
<tr>
<td>Martin Store (Shelter)</td>
<td>5509 Rockfish Valley Hwy, Afton, VA 22920</td>
</tr>
<tr>
<td>2x Calix E7, 2x 10GE-4 Card</td>
<td></td>
</tr>
<tr>
<td>1x GPON-4 Card</td>
<td></td>
</tr>
<tr>
<td>DC rectifier shelf and Batteries</td>
<td></td>
</tr>
<tr>
<td>TrangoLINK GigaPlus 6-40 GHZ link to Devils Knob Tower</td>
<td></td>
</tr>
<tr>
<td>Rockfish Valley (Shelter)</td>
<td>11156 Rockfish Valley Hwy, Afton, VA 22920</td>
</tr>
<tr>
<td>2x Calix E7, 2x 10GE-4 Card</td>
<td></td>
</tr>
<tr>
<td>1x GPON-4 Card</td>
<td></td>
</tr>
<tr>
<td>DC rectifier shelf and Batteries</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Description</td>
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<td>----------</td>
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</tr>
<tr>
<td>Devils Knob Tower (Shelter)</td>
<td>DC rectifier shelf and Batteries</td>
</tr>
<tr>
<td></td>
<td>TrangoLINK GigaPlus 6-40 GHZ link From Martin Store Tower</td>
</tr>
<tr>
<td></td>
<td>TrangoLINK GigaPlus 6-40 GHZ link to Massies Mill Tower</td>
</tr>
<tr>
<td>Massies Mill Tower (Cabinet)</td>
<td>Alpha FBE2322 Enclosure</td>
</tr>
<tr>
<td></td>
<td>TrangoLINK GigaPlus 6-40 GHZ link From Devils Knob Tower</td>
</tr>
<tr>
<td>19 Fern Circle</td>
<td>Roseland, VA 22967</td>
</tr>
<tr>
<td>961 Tan Yard Road</td>
<td>Roseland, VA 22967</td>
</tr>
</tbody>
</table>
Customer Premise

NCBA installs Calix 716GE-Indoor ONT as the CPE.

The NCBA network interfaces one Single Mode Fiber strand to the managed residential CPE (Calix 716GE-I). The CPE contains four Ethernet ports (copper 1000BaseT) capable of delivering and managing disparate services. One port may deliver untagged traffic to a home gateway for basic Internet service while another port(s) may deliver a Metro Ethernet connection over a specifically provisioned NCBA VLAN. The CPE also contains two POTS ports (SIP).

Service Provider Interface

A Service Provider maintains their own equipment in the NOC, typically an edge router and/or managed switch and their own connectivity from a carrier to the Internet. NCBA itself does not provide Internet Service. Service Providers cross connect to the Calix E-7 NOC on either 1GB or 10GB ports.

The network topology and architecture is transparent to Service Providers. They simply know that a connection exists between an available port at their connection location and the client’s CPE. Service Providers may provide untagged traffic for Internet services or may provide (802.1q) tagged traffic for specific services or for specific customers.

The NCBA network is intended as an Ethernet Layer 2 network where data traffic is transported between the NOC and an available Ethernet port on an end point CPE (ONT). Data is transported on a specific NCBA VLAN assigned to a Service Provider.

Service Separation

In order for the network to support multiple services, Service Providers, and customers, the network needs a way to separate services and to multiplex and demultiplex the traffic.

In the access layer (from the CPE devices into the access ports on the local switches), VLANs (virtual local access network) are used to provide the services.

Each Service Provider is assigned a range of NCBA VLANs to separate their and their customer’s traffic. For each service to which a customer subscribes, the CPE terminates the service and provides a port on the CPE device. The ports on the CPE device are capable of passing tagged or untagged traffic as well as providing bandwidth management features such as ingress/egress, traffic policing, or shaping. But, typically, NCBA will tag traffic coming from a service provider with either the default NCBA VLAN for the SP or a specific VLAN assigned by the Service
Provider to their customer within the Service Provider range. When the Ethernet Frame exits the NCBA network at the CPE end, the NCBA tag is removed leaving whatever Service Provider and/or end customer tags.

It is the service provider’s responsibility to provide the Layer 3 next-hop (in the case of Internet services) or any other network service they are providing to the customer.

**Network Operations Requirements**

The following sections describe the responsibilities and expectations of the Authority for the Operator:

The Operator will have network-engineering resources certified to high levels to manage and operate the Calix system and perform the following services. Vendor certification is important to insure that NCBA qualifies for support services from the vendors at preferred rates.

**Provisioning**

The Operator will be required to provision new Services or new Service Providers on the NCBA network.

Services will be standard, pre-defined transport of bandwidth and quality/priority service level. For existing service providers the general provisioning process will require provisioning CPE equipment utilizing Calix CMS and provisioning the CPE port(s) to allow specific services over that subscriber’s edge port.

New Service Providers on the network will require defining templates for that Service Provider in the Calix CMS system.

**Order Management (OM)**

The Operator will be required to deliver order management for new service orders, disconnects, and configure any new Service Providers. It is expected to provide an Order Management process and supporting system. The minimum functionality for Order Management is an order entry front end configured for NCBA and/or service provider offerings, a ticket-generating component that alerts all parties, including the Outside Plant Contractor, to the order, a status function, and an order completion notification. The OM system should generate and maintain discrete order numbers and assign circuit IDs.

The OM System should support pre-provisioning of an order for a circuit to an ONT that has not been brought live on the network yet.
The Network Operator is expected to respond to provisioning orders within 4 business hours and complete provisioning of services within 24 hours (excepting weekends) of an order.

The order management system shall be accessible remotely by NCBA for viewing current customer information.

**Service Provider/Network Customer Support and OSP**

The Network Operator will provide support to NCBA Service Providers troubleshooting end customer issues. The SP delivers support to their customers, troubleshooting and remediating service issues. In the event that issues are upstream of the SP, the Network Operator is responsible for support by remote access, phone, and email as appropriate.

In the event of a fiber cut or service interruption, the Network Operator will dispatch the outside plant contractor to make required repairs.

The Network Operator is expected to provide a call ticket system. The minimum functionality for the call ticket system is a front end configured for NCBA and/or service provider access, a ticket-generating component that alerts all parties to the support ticket, a status function, and a ticket completion notification. The call ticket system should generate and maintain discrete ticket numbers and produce periodic reports on support call status and metrics.

The Network Operator will provide a system with the capability of receiving and responding to tickets from Network Customers for emergency repair service 24 hours a day, 7 days a week, 365 days a year. The Network Operator shall respond to the ticket within 30 minutes.

The Network Operator will provide a phone number routed to a live operator that is capable of receiving and responding to calls for emergency repair service 24 hours a day, 7 days a week, 365 days a year. A phone number routed to a pager will be considered.

An emergency is defined as a disruption that disrupts or otherwise interferes with the functioning of the NCBA fiber backbone, dedicated business or wide area LAN services or the service to ten or more end users.

**Remote Access and Monitoring**

The Operator provides 24/7 monitoring of the Network.

The Operator is responsible for providing remote access bandwidth sufficient to actively monitor the network. The NOC is served by two backhaul providers, Mid-Atlantic Broadband Communities Corporation and Lumos Networks.

Monitoring consists of remotely tracking the availability of all components of the network. The Operator will be responsible for maintaining the Network to a high quality standard in line with carrier industry standards.
The Operator will deploy a set of tools to manage network traffic and quality to foresee congestion issues and mitigate in advance.

The Calix E7 frames and blades should be specifically monitored for error conditions and pending or existing failure. The E7s are powered by Eltek/Valere Rectifiers with monitoring ports.

**Reporting and Service Restoration**

The Operator will be responsible for reporting outages and supporting Service Restoration.

Reports of disconnected ONT’s will be made to Service Providers for their customers. Notifications may include fault identification and OSP dispatch in the event of a fiber cut. On service restoration, the Operator will be required to follow up with any dispatches and update the Ticketing system with all actions taken.

The Operator will deploy a capability of identifying ONT provisioned for higher tiers of service and actively report disconnections to the associated SP.

**Change Management**

The Operator is responsible for providing a change management process and documentation for all network repairs or replacements.

The Operator will have a procedure in place to schedule maintenance that is potentially service disabling during non-peak, non-business hours and to notify Service Providers and other key partners.

**Network Maintenance and Updates**

The Operator will periodically perform equipment software updates as recommended by the manufacturer and deemed urgent or necessary by the Operator or the NCBA.

**Security**

The Operator is responsible for establishing the security of the NCBA network, monitoring the network for intrusion or malicious activity, and reporting potential or actual security breaches. The Operator will maintain the systems to the manufacturers recommended (stable) software/firmware levels and deploy carrier industry best practices for access control.

NCBA will maintain service and support contracts on all hardware.
Backups

The operator will be responsible for maintaining backup configurations of all network elements and systems after each change with a copy maintained locally and a copy offsite. The network operator will configure and document all log-in access to NCBA network systems.

Inventory Management

The Operator will be responsible for updating the inventory log during hardware deployments, replacements, and managing replacement plans for aging or defective equipment. The Operator will also stay up to date on current network capacity and identify any additional equipment or network components that are necessary.

Billing

The Operator will be responsible for managing billing data, and the process of creating and mailing wholesale invoices for the Network on a monthly basis, including the implementation of new, or use of the current, billing software. NCBA billing data is currently maintained with QuickBooks accounting software and must be input into the new system. Software must be provided by the Operator. NCBA prefers read only electronic access to charges and receivables information as well as the ability to print reports. In lieu of read only access, monthly reports may be provided. The billing platform must provide for application of penalty/interest on late payments and accommodate amortized and up-front installation charges. The Operator will need to bill NCBA Service Providers and other network customers on a monthly basis. NCBA is a wholesale transport network and therefore will not have a billing relationship with each end user. However, NCBA allows payment of installation expense over time. The installation expense is billed to NCBA Service Providers. The Operator will be responsible for tracking the balance of amortized installation expense and maintaining ISP customer detail to document balances.

At a minimum, the billing system will include Service Provider, Service Order and/or Circuit ID, service level, provisioning date, term ending date, amortized or direct bill installation charges, penalty and interest charges, and any reductions to rates including service credits due to network outages or other promotional credits. Billing data is generated at the first of every month.

The Operator shall provide billing services as follows:

- Send monthly invoices and/or statements to Network Customer
- Maintain an accounts receivable ledger
- Receive and deposit payments to the deposit account provided by the Authority.
- Provide monthly income and accounts receivable reports to the Authority.
• Provide detailed accounting reports as requested.

• Provide NCBA electronic access to charges and receivables information including ability to print reports (preferred).

The Network Operator will reconcile Outside Plant invoices with customer contracts to ensure that charges from the Outside Plant Contractor and charges to customers are accurate. (Negotiable)

**Reporting**

The Operator will provide a monthly network performance report to the NCBA to include details of Network status, incidents and current customer numbers broken down by Service Provider during the reporting period.

**Fiber Management**

The Operator shall, using a fiber management system in use by the Authority, manage the assignment of fiber strands throughout the Authority’s network. The Authority currently utilizes NexusWorx for fiber management and has had the original fiber build data converted and input into the system. The Operator shall be responsible for bringing the data contained in the system up to date and completing all future fiber updates with the assistance of NCBA and the OSP contractor. NCBA will consider alternatives to the use of the NexusWorx system.

**VUPS**

The Operator shall update the Virginia Utility Protection Service (VUPS) detailing all new fiber installations as provided by the Authority or the Authority’s Outside Plant Contractor and ensure that the corresponding update is correctly reflected in the VUPS system. The Operator shall also serve as the VUPS mapping contact.

**NOC Operations**

The NCBA fiber backbone terminates in patch panels in the NOC and all of NCBA’s network traffic is consolidated there. Service Providers rent space for their switchgear and routers to cross connect their service to the NCBA network. Long haul carriers rent space in the NOC to cross connect their services to SPs and other NOC customers.

The Network Operator’s role in managing the NOC is minimal. Designated Operator staff will have access to the NCBA NOC.
The Operator’s role may be ad hoc for purposes of supporting facility change or installing optics, cross connects, or other network systems.

**Property**

Any and all information, system files, configuration data, billing reports, etc. generated during the course of the Network Operator’s services for NCBA are the property of NCBA regardless of the system in which they are created and will be delivered to NCBA in a suitable format when requested.
1. **Contracting**

   The provisions contained in Sections 2.2-4367 through 2.2-4377 of the Virginia Public Procurement Act as set forth in the 1950 Code of Virginia, as amended, shall be applicable to all contracts solicited or entered into by the NCBA. By submitting their proposals, all Offerors certify that their proposals are made without collusion or fraud and that they have not offered or received any kickbacks or inducements from any other Offeror, supplier manufacturer or subcontractor in connection with their proposal, and that they have not conferred any public employee having official responsibility for this procurement transaction any payment, loan, subscription, advance, deposit of money, services or anything of more than nominal value, present or promised, unless consideration of substantially equal or greater value was exchanged.

2. **Nondiscrimination**

   During the performance of this Agreement, Offeror agrees as follows (Code of Virginia, Section 2:2-4311):

   A. Offeror shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability or other basis prohibited by state law relating to discrimination in employment except where there is a bona fide occupational qualification, reasonably necessary to the normal operation of the Offeror. Offeror agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

   B. Offeror in all solicitations or advertisements for employees placed by or on behalf of Offeror, shall state that such Offeror is an equal opportunity employer.

   C. Notices, advertisements and solicitations placed in accordance with Federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

   Offeror shall include the provisions of the foregoing paragraphs of this section in every subcontract or purchase order of over $10,000.00 so that the provisions will be binding upon each subcontractor or vendor.
3. **Drug Free Workplace to be Maintained by the Offeror**

   During the performance of this Agreement, Offeror agrees as follows (Code of Virginia, Section 2:2-4312):

   A. Offeror shall provide a drug-free workplace for all of its employees. Offeror agrees to post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession or use of a controlled substance or marijuana is prohibited in the workplace and specify the actions that will be taken against employees for violations of this prohibition.

   B. Offeror, in all solicitations or advertisements for employees placed by or on behalf of Offeror shall state that such Offeror maintains a drug-free workplace.

   C. Notices, advertisements and solicitations placed in accordance with federal law, rule of regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

4. **Faith Based Organizations**

   The NCBA does not discriminate against faith-based organizations.

5. **Immigration Law**

   Offeror covenants that it does not, and shall not during the performance of this Agreement for goods and services in the Commonwealth, knowingly employ an unauthorized alien as defined in the federal Immigration Reform and Control Act of 1986.

6. **Anti-Trust**

   By entering into a contract, the Offeror conveys, sells, assigns, and transfers to NCBA all rights, title and interest in and to all causes of the action it may now have or hereafter acquire under the antitrust law of the United States and Nelson County, relating to the particular goods or services purchased or acquired by NCBA under said contract.

7. **Oversight of Contractor's Performance**

   The NCBA will oversee the logistical and technical aspects of the Network Operator’s performance with the support of County Staff as necessary. The NCBA staff will ensure that the Contractor is meeting the contract specifications in a manner that is consistent with the timely and accurate provision of the contract deliverables.

8. **Testing and Inspection**

   NCBA reserves the right to conduct any test/inspection it may deem advisable to assure services conform to the specification.
9. Force Majeure

If either party to this Agreement shall be prevented, hindered, or delayed in the performance or observance of any of its non-monetary obligations hereunder by reason of any cause or causes beyond such party’s reasonable control, including without limitation, acts of God, fire, explosion, vandalism, cable cut, adverse weather conditions, war, revolution, civil commotion, acts of public enemies, terrorism or national emergency, governmental action or inaction (such acts including without limitation any regulatory or administrative decisions making said performance or obligation economically or technically unfeasible); labor difficulties or strikes, or failure of any third party (including any other carrier or supplier) to provide services, facilities or equipment required for such performance or obligation (or any other act or omission by said third party) and such delay could not have been prevented by reasonable precautions and cannot reasonably be circumvented by the party through the use of commercially reasonable alternate sources, work-around plans, or other means, then such party shall be excused from any further performance or observance of the obligation(s) so affected for as long as such circumstances prevail and such party uses it best efforts to recommence performance or observance whenever and to whatever extent possible without delay. Either party’s invocation of this clause shall not relieve Offeror of its obligation to pay for any services actually provided to the Offeror.

10. Insurance

A. Offeror will carry during the Term the insurance listed in Attachment A.

B. Each Party hereby grants to the other a waiver of any right to subrogation which any insurer of a Party may acquire against the other by virtue of the payment of any loss under such insurance. Each Party agrees to obtain any endorsement that may be necessary to effect this waiver of subrogation, but this provision applies regardless of whether a Party has received a waiver of subrogation endorsement from its insurer.

C. Offeror shall immediately notify the NCBA in writing of any material changes or terminations of any of the coverages required in this Agreement. If requested to do so by a NCBA, the Offeror shall provide NCBA with an Acord certificate of insurance which shall have attached thereto the appropriate endorsement, coverage form, or binder, as the case may be.

11. Indemnification

The Offeror shall indemnify, defend, and hold harmless (collectively, “Indemnify”) the NCBA from any and all claims, (whether made, asserted, or threatened), actions, judgments, damages, liabilities, costs, and expenses, including without limitation reasonable attorneys’ fees, consultants’ fees and experts’ fees (all such claims collectively referred to herein as “Claims”) arising from or in connection with damage to tangible property, personal injury, or death caused by the Offeror’s negligence or willful misconduct. In addition, Offeror shall Indemnify NCBA from any and all Claims of third parties of any nature.
whatsoever arising from or in connection with this Agreement and Offeror’s use of the NCBA Network. This provision shall survive the termination or expiration of this Agreement.

12. Assignment

Offeror may not assign its rights and obligations under this Agreement to an unrelated third party without the express prior written consent of NCBA. Offeror shall have the right to assign, or otherwise transfer this Agreement, in whole or in part, to any parent, subsidiary, or affiliate of Offeror which shall control, be under the control of, or be under common control with Offeror, provided such assignee assumes in writing all of the rates, terms, and conditions of this Agreement and such Assumption is delivered to NCBA prior to the effective date of such permitted assignment.

13. Confidentiality

Except as provided by law, specifically including the Virginia Freedom of Information Act ("FOIA"), or as necessary to fulfill the terms and obligations set forth herein, or in obtaining the assistance of their respective attorneys, accountants, auditors, regulators, or to comply with a court order, the Parties agree that they shall not publish, communicate, disclose or cause to be published, communicated, or disclosed in any manner whatsoever or to any person whatsoever, information acquired or generated about Network Customers or other confidential information of the other. In connection with any proprietary information for which Offeror seeks protection from disclosure under FOIA, Offeror shall provide written notice to NCBA listing such information and the grounds for withholding. This provision shall survive the termination or expiration of this Agreement.

14. Payment to Subcontractors

In accordance with Virginia Code Section 2.2-4354, a contractor awarded a contract under this solicitation is hereby obligated:

1. To pay the subcontractor(s) within seven (7) days of the contractor's receipt of payment from NCBA for the proportionate share of the payment received for work performed by the subcontractor(s) under the contract; or

2. To notify NCBA and the subcontractor(s), in writing, of the contractor's intention to withhold payment and the reason.

3. Unless otherwise provided under the terms of the contract, interest shall accrue at the rate of one percent per month. The date of mailing of any payment by U.S. Mail is deemed to be payment to the addressee. These provisions apply to each sub-tier contractor performing under the primary contract. A contractor’s obligation to pay an interest charge to a subcontractor may not be construed to be obligation of NCBA.
15. **Non-Approval of Funds**

All funds for payments of items ordered under this agreement are subject to the availability of funds for this purpose. Payments during subsequent fiscal periods are dependent upon the same action. In the event of non-approval of funds by the Nelson County Broadband Authority for the items under this contract, NCBA will terminate this contract. Written notice will be provided to the contractor as soon as possible after such action is completed.

16. **Default**

In case of failure to deliver goods or services in accordance with the contract terms and conditions, NCBA, after due oral or written notice, may procure them from other sources and hold the Contractor responsible for any resulting additional purchase and administrative costs. This remedy shall be in addition to other remedies which NCBA may have.

17. **Termination**

Subject to the provisions below, the contract may be terminated by NCBA upon ninety (90) days advance written notice to the other party.

18. **Termination for Convenience**

In the event that the contract is terminated or canceled upon request and for the convenience of the NCBA, without the required ninety (90) days advance notice, then the NCBA shall negotiate reasonable termination costs, if applicable.

19. **Termination for Cause**

Termination by NCBA for cause, default or negligence on the part of the Offeror shall be excluded from the foregoing provision; termination costs, if any, shall not apply. The ninety (90) days advance notice requirement is waived in the event of Termination for Cause.

20. **Records Retention and Availability**

Contractor agrees that NCBA, the County, the State Auditor, or any of their duly authorized representatives at any time during normal business hours and as often as they may reasonably deem necessary, shall have access to and the right to examine, audit, excerpt, and transcribe any books, documents, papers, records, etc., which are pertinent to the accounting practices and procedures of Contractor and involve transactions relating to this Agreement. Contractor agrees to maintain these records for a period of three (3) years from the date of termination of this Agreement.
21. **Waiver of Contractual Right**

The failure of either party to enforce any provision of this Agreement shall not be construed as a waiver or limitation of that party’s right to subsequently enforce and compel strict compliance with every provision of this Agreement.

22. **Successors**

This Agreement shall inure to the benefit of and be binding on the Parties, and their heirs, successors, assigns and legal representatives, but nothing contained in this section shall be construed to permit an assignment or other transfer except as specifically provided herein.

23. **Severability**

If any provision of this Agreement shall be held to be invalid or unenforceable for any reason, the remaining provisions shall continue to be valid and enforceable. If a court should find that any provision of this Agreement is invalid or unenforceable, but that by limiting such provision it becomes valid and enforceable, then such provision shall be deemed to be written, construed, and enforced as so limited.

24. **Counterparts**

This Agreement may be executed in one or more duplicate originals, each of which taken together shall be deemed one and the same instrument.

25. **Amendment**

This Agreement may not be modified or amended unless the amendment is made in writing and is signed by both parties.

26. **Applicable Law**

The laws of the Commonwealth of Virginia shall apply in the construction and enforcement of this Agreement without regard to any laws that might be applicable under principles of conflict of laws. The sole venue for any proceeding between the Parties regarding this Agreement shall lie in the Circuit Court of Nelson County, Virginia.

27. **Disputes**

Contractual claims, whether for money or other relief, shall be submitted in writing no later than sixty (60) days after final payment; however, written notice of the contractor's intention to file such claim shall have been given at the time of the occurrence or beginning of the work upon which the claim is based. Nothing herein shall preclude a contract from requiring submission of an invoice for final payment within a certain time after completion and acceptance of the work or acceptance of the goods. Pendency of claims shall not delay payment of amount agreed due in the final payment. A written decision upon any such claims will be made by NCBA within thirty (30) days after submittal of the claim and any practically
available additional supporting evidence required by NCBA. The Contractor may not institute legal action prior to receipt of NCBA’s decision on the claim unless such decision is not rendered within 90 days of the submission of the claim. The decision of Purchasing Agent or other signatory on the Contract shall be final and conclusive unless the Contractor within six (6) months of the date of the final decision on a claim, initiates legal action as provided in Section 2.2-4364 of the Code of Virginia. Failure of NCBA to render a decision within 90 days shall be deemed a final decision denying the claim by the NCBA and shall not result in the Contractor being awarded the relief claimed nor shall it result in any other relief or penalty. The sole result of NCBA’s failure to render a decision within 90 days shall be the contractor’s right to immediately institute legal action. No administrative appeals procedure pursuant to Section 2.2-4365 of the Code of Virginia has been established for contractual claims under the Contract.

28. Entire Agreement

This Agreement contains the entire agreement of the Parties and there are no other promises or conditions in any other agreement whether oral or written. This Agreement supersedes any prior written or oral agreements between the Parties. In the event of any conflict between provisions contained herein and those appearing in an Exhibit, the provisions of the document deemed by the NCBA to be most favorable to the NCBA shall prevail.

Nelson County Broadband Authority will provide a Professional Services Agreement with these specified terms and conditions. Nelson County Broadband Authority may, but is not required to, negotiate contract terms and provisions to which the Respondent makes exception, and to negotiate requested or required additional terms and provisions.

The Professional Services Agreement as finally agreed upon must be in form and content acceptable to NCBA.
Attachments

Attachment A - Insurance Requirements

Attachment B – Detailed Network and Equipment Information
Attachment A - Insurance Requirements

Workers compensation insurance shall be as required by Federal, State, and Municipal laws for the protection of all contractors’ employees working on or in connection with this contract, including broad form all states and voluntary compensation coverage and employers’ liability coverage. The Contractor shall, during the performance of the Agreement, keep in force at least the following minimum limits of insurance:

<table>
<thead>
<tr>
<th>Type of Insurance</th>
<th>Each Person</th>
<th>Each Occurrence</th>
<th>Aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worker’s Compensation</td>
<td>Statutory</td>
<td>Statutory</td>
<td></td>
</tr>
<tr>
<td>Public Liability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property Damage</td>
<td></td>
<td></td>
<td>$1,000,000</td>
</tr>
<tr>
<td>Bodily Injury</td>
<td>$1,000,000</td>
<td>$1,000,000</td>
<td></td>
</tr>
<tr>
<td>Contractor’s</td>
<td>$1,000,000</td>
<td>$1,000,000</td>
<td></td>
</tr>
<tr>
<td>Protective Public Liability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contractor’s Protective</td>
<td></td>
<td></td>
<td>$1,000,000</td>
</tr>
<tr>
<td>Property Damage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contractual Liability</td>
<td>$1,000,000</td>
<td>$1,000,000</td>
<td></td>
</tr>
<tr>
<td>Contractual Property</td>
<td></td>
<td></td>
<td>$1,000,000</td>
</tr>
<tr>
<td>Damage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed Operations</td>
<td>$1,000,000</td>
<td>$1,000,000</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>And Products Liability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle Liability</td>
<td>$1,000,000</td>
<td>$1,000,000</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>Bodily Injury/Property Damage</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The General Liability Insurance Shall Include the Following Coverage:

- Comprehensive Form
- Premises-Operations
- (XCU) Explosion and Collapse Hazard
- Underground Hazards
- Products/Completed Operations Hazard
- Contractual Liability Insurance
• Broad Form Property Damage, Including Completed Operations
• Independent Contractors (Contractor’s Protective Liability)
• Personal Injury (all insuring agreements), deleting the employee exclusion.
Attachment B - Network Equipment Information

**Network Diagrams:**

- Calix L1 Network Diagram
- Calix L2 Network Diagram
- Calix L3 Network Diagram

**Network Equipment:**

- Calix E7-2 (Ethernet Access Platform)
- Calix E7-2 GE12 (Ethernet 12 Line Card)
- Calix E7-2 GPON-4 (GPON 4 Line Card)
- Calix GE10-4 (Ethernet 4 Line Card)
- Calix 740GE – ONT (Outdoor)
- CyberShield UPS (For Outdoor ONTs)
- Calix Single Family Unit (SFU) ONT Enclosure (Outdoor)
- Calix ODC-100 Outdoor Cabinet
- Calix 716GE-I ONT (Indoor)
- Calix/Dell CMS Appliance
- Valere DC Power Rectifier (For Calix E7-2 switches)
PRODUCT DATASHEET

Calix E7-2 Ethernet Service Access Platform

PRODUCT OVERVIEW

The Calix E7 Ethernet Service Access Platform integrates IP service delivery and Ethernet transport into a compact, high availability, carrier-class modular system that delivers high-performance, scalable network solutions for service providers. The 1RU E7-2 platform delivers Gigabit Passive Optical Network (GPON) and point-to-point Gigabit Ethernet (GE) services with redundant 10-Gigabit Ethernet (10GE) transport and aggregation within a single integrated 2-slot chassis. The E7 enables service providers to deliver differentiated triple play services, advanced business services, and mobile backhaul from a single converged network that revolutionizes the economics of networking by enabling new services and market expansion with a flexible, scalable, pay-as-you-grow solution.

E7 PRODUCT DESCRIPTION

ETHERNET SERVICES ACCESS NETWORK:
Residential and business services are converging as more subscribers work from home offices, and internet “over the top” video services consume an increasing percentage of both enterprise and service provider network capacity. IP and Ethernet are the dominant network and transport protocols, and all services — voice, data, and video — are rapidly migrating to a packet-based architecture. High performance applications demand high performance solutions; the Calix E7-2 Ethernet Service Access Platform meets the demanding requirements of Ethernet services access networks.

The Calix E7 delivers a wide array of high performance applications, including 10GE Ethernet transport, delivery of high density residential triple play services over GPON and point-to-point Ethernet, Metro Ethernet Forum (MEF) compliant business services, mobile backhaul, and protected GE aggregation of Calix E7, C7 and E5 platforms.

HIGH DENSITY SUBSCRIBER ACCESS: With two cards per system, the E7-2 provides flexible, high density subscriber access options in a 1RU shelf:
- 8 GPON and 16 GE ports (528 ONTs)
- 24 point-to-point GE ports (24 ONTs)

With Multi-dwelling unit (MDU) ONTs, the subscribers per 1RU system can exceed several thousand.

CHASSIS FEATURES IN A STACKABLE FORMAT:
The Calix E7-2 combines the most advantageous attributes of a small form factor product with a large chassis-based system, while eliminating the disadvantages of each:
- 1RU design can expand from a single slot, for very low first install cost, to multiple chassis, to add subscriber growth yielding a near linear cost curve
- Twenty line cards are managed as a single chassis for operational efficiency
- Mix and match line cards in a common chassis — no common control equipment required
- Line cards can be added or replaced without uninstalling/installing power, alarms, or cables — reducing MTR from hours to minutes
- Subscribers are easily aggregated and network resources efficiently shared across protected trunk facilities
- Hardened 1RU system delivers GPON and Ethernet with 10GE transport from CO, cabinet or pole mount
- Resilient, hot-swappable line cards and fan tray

With the E7-2, service providers no longer need to decide between a single service product and a high growth chassis solution. E7-2 provides low first install cost, operational efficiency and near linear incremental cost per subscriber, enabling Calix customers to maximize their business return.
**FULL SPECTRUM OF SERVICES:** The E7 delivers a full spectrum of access services over GPON and Point-to-Point Ethernet using the family of Calix 700 ONTs, including Single Family Unit (SFU), Small Business Unit (SBU), Multi-Dwelling Unit (MDU), and rack-mount models.

- IPTV – broadcast and Video on Demand (VoD)
- MEF compliant business services
- High-Speed Internet (HSI) access
- Voice – Native SIP/VOIP and TDM Gateway support
- T1 services
- CATV video: RF video overlay with RF return

Calix 700GX ONTs support auto sensing GPON and GE network interfaces, allowing service providers to manage service changes without subscriber onsite technical support.

**DELIVERING “QUALITY OF EXPERIENCE”:** The E7 provides per-subscriber and per-service hierarchical QoS to deliver uncompromised triple play and business services. A powerful collection of classification, policing, queuing and scheduling algorithms let operators manage per-subscriber and per-service traffic flows to maintain priority/delay/loss service differentiation within the E7 network.

**SCALABLE IPTV SUPPORT:** IPTV services are by far the most demanding in terms of quality, and user expectations are very high. The E7 supports industry standard IGMP snooping to identify and replicate multicast video sent between the set-top box and the video distribution network, providing efficient, scalable, high-quality IPTV distribution on both GPON and Ethernet interfaces.

**INTEGRATED HIGH-CAPACITY AGGREGATION:**

The E7 is built on a core Layer 2 and Layer 3 switch capable of full-duplex, line rate forwarding at all frame sizes and traffic types across all interfaces. This capacity makes the E7 ideal for aggregation and transport of IP/Ethernet services across the access network. The E7 platform supports industry standard pluggable modules for all service and network interfaces, including ITU G.984 compliant GPON, Small Form-Factor Pluggable (SFP) Gigabit Ethernet, XFP 10GE ports, and SFP+ 10GE ports.

**NETWORK RESILIENCY:** The Calix E7 supports a flexible set of standards-based network topology protocols for use in aggregation, ring-based transport, and uplink applications.

- ITU G.8032 Ethernet Ring Protection Switching (ERPS)
- IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)
- IEEE 802.3ad/802.1AX Link Aggregation

**SERVICE AWARE MANAGEMENT:** The E7, along with the Calix Management System (CMS), allows operators to manage services while understanding their relationship to the network infrastructure. Service-oriented management includes rapid service provisioning, service templates and policies, and service assurance. Comprehensive network management tools let operators create physical and logical topology maps, engineer traffic flows, and manage network commissioning and software upgrades. Network inventory, alarm surveillance and PM collection are enabled by the E7 system. The E7 provides locally hosted Web GUI, CLI, and SNMP interfaces.
# Specifications

## Calix E7-2 Ethernet Service Access Platform

### Subscriber and Network Ports

Subscriber and network port count is determined by the line cards placed in the E7-2’s two universal card slots.

<table>
<thead>
<tr>
<th>E7-2 Card</th>
<th>Line Cards per E7-2</th>
<th>GPON Ports</th>
<th>GE SFP/CSFP Ports</th>
<th>10GE XFP Ports</th>
<th>10GE SFP+ Ports</th>
<th>VDSL2/AD SL2+</th>
<th>POTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>10GE-4</td>
<td>2</td>
<td>0</td>
<td>12</td>
<td>2</td>
<td>2</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>GPON-4</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>GE-12</td>
<td>2</td>
<td>0</td>
<td>12</td>
<td>0</td>
<td>2</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>GE-24</td>
<td>2</td>
<td>0</td>
<td>24</td>
<td>0</td>
<td>2</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>VDSL2-48</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>48</td>
<td>Splitters</td>
</tr>
<tr>
<td>VDSL2-48C</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>48</td>
<td>48</td>
</tr>
</tbody>
</table>

### Backplane Bandwidth

100 Gbps between slots

### Slots

2 universal line card slots
1 FTA slot

### Dimensions (W x H x D)

17.5 x 1.7 x 11.45 inches
44.5 x 4.3 x 29.1 cm
Height is 1 RU

### Weight

5.9 lb (2.7 kg) E7 shelf
7.4 lb (3.4 kg) shelf with Fan Tray

### Operating Environment

- **Temperature:** -40 to +65°C (-40°F to +149°F)
- **Humidity:** 10 to 95% (non-condensing)
- **Operating altitude:** 10,000 ft (3,049 m)

### Storage Environment

- **Temperature:** -40 to +85°C (-40°F to +185°F)
- **Humidity:** 5 to 95%

### Management Support

Calix CMS network management
Calix CLI and Web GUI for local management interface
SNMP v2c AND v3 performance and fault monitoring

### Management Interfaces

- Ethernet 10/100 (RJ-45 connector on Calix E7-2 Fan Tray)
- Ethernet 10/100 (RJ-45 connector on back of Calix E7-2)
- RS-232 (RJ-11 connector on Calix E7-2 Fan Tray)

### Synchronization

Synchronization is enabled by the E7-2 line cards as required
External reference timing
Built-in Stratum-3 clock
Hardware-ready to support Synchronous Ethernet

### Alarm I/O Interfaces

Wire wrap pin access on E7 back
User definable alarm
inputs: 7; outputs: 1

### Fiber Interfaces

All optical ports use pluggable optics (SFP, XFP, SFP+)
LC or SC connectors on modules

### Analog/Metallic Interfaces

Two standard 25-pair RJ-21 connectors per slot

### Timing I/O Interfaces

Access through wire wrap pins on the back of the Calix E7
BITS clock (sink and source)

### Standards Compliance

- NEBS Level 3 compliance (GR-63-CORE, GR-1089-CORE, GR-3028)
- UL 60950
- FCC Part 15 Class A

### Power Feeds

Integrated power management on Calix E7-2 line cards
Redundant −48/60 VDC battery feeds (A and B)
Input Range: -42.5VDC to -72VDC
Fuse: 7.5 Amps (A and B)
S P E C I F I C A T I O N S

Calix E7 Ethernet Service Access Platform

F A N T R A Y A S S E M B L Y

FANS
4 fans housed in fan tray
Resilient design maintains system cooling with one fan failure

MANAGEMENT INTERFACES
Ethernet 10/100 (RJ-45 connector)
RS-232 (RJ-11 connector)

SYSTEM INFORMATION
7-segment LCD display
System Controller (MGT) - GREEN

SHELF ALARM INDICATOR
Critical (CR) - RED
Major (MJ) - RED
Minor (MN) - AMBER
Alarm Cut-Off (ACO) button

POWER SPECIFICATIONS
Typical CO Environment
Power: 22 Watts
Heat dissipation: 6 Watts
RT Environment
Power: 65 Watts
Heat dissipation: 18 Watts

MAINTENANCE
Field-replaceable air filter
(not used in RT locations)
Hot-swappable fan tray assembly

O R D E R I N G I N F O R M A T I O N

CALIX E7 ETHERNET SERVICE ACCESS PLATFORM
000-00372......................... E7 Chassis with Fan Tray Assembly and Installation Kit

CALIX E7 LINE CARDS
100-01771......................... E7 10GE-4 (2x10GE XFP, 2x10GE SFP+, 12xGE SFP)
100-01772......................... E7 GE-12 (12xGE SFP, 2x10GE SFP+)
100-01773......................... E7 GPON-4 (4xGPON OIM, 8xGE SFP, 2x10GE XFP, 2x10GE SFP+)

CALIX E7 FAN TRAY ASSEMBLY
100-01451......................... E7 Fan Tray Assembly
000-00228......................... E7 Fan Tray Assembly Filter, Package of 10 units

CALIX PLUGGABLE TRANSCIEVER MODULES

The E7-2 supports pluggable modules for all service and network interfaces. Refer to the Calix Optical Transceiver Modules Datasheet (#250-00191) for a complete list of modules and specifications.

CSFP Option 2.................... 1GE optical dual-port Compact Small Form-factor Pluggable (CSFP) Option 2 modules
SFP.................................. 1GE and 2.5GE optical and copper Small Form-factor Pluggable (SFP) modules
SFP+................................. 10GE optical Enhanced Small Form-factor Pluggable (SFP+) modules
Direct Attach..................... Multi-rate copper Small Form-factor Pluggable (SFP/SFP+) cables
XFP................................. 10GE optical Small Form-factor Pluggable (XFP) modules
GPON OIM......................... 2.5Gbps GPON (Class B+ ODN with minimum 28dB link budget, up to 1:64 splits)
ER-GPON OIM..................... 2.5Gbps Extended Reach GPON (up to 40 km with 1:8 split)

Notes: For GPON OIM, 10GE XFP, 10GE SFP+ pluggable transceivers, Direct Attach cables, and all transceivers used in CSFP Option 2 sockets, only products purchased directly from Calix are supported.
- SFP modules may also be used in CSFP Option 2 sockets, and in SFP+ sockets at 1GE rate.
- Copper Direct Attach cables can operate in SFP, CSFP Option 2, and SFP+ sockets at 1GE, 2.5GE, and 10GE data rates as supported by the card type.
DESCRIPTION
The Calix E7-2 GE-12 line card provides twelve Gigabit Ethernet (GE) interfaces, along with two ports of integrated 10-Gigabit Ethernet (10GE) using SFP+ technology. The SFP+ ports can be operated at GE rates, providing up to 14 GE ports per card, or 28 per E7-2 shelf. The GE-12 card can be plugged into one or both of the two universal slots within a Calix E7-2 shelf, to support up to 24 point-to-point Ethernet Optical Network Terminations (ONTs) per TRU E7-2 chassis. The GE-12 card can also be used along with the E7-2 10GE-4 or GPON-4 cards to provide additional point-to-point Ethernet service drops in mixed-application configurations.

CALIX E7-2 GE-12 KEY ATTRIBUTES

POINT-TO-POINT ETHERNET: Point-to-point Ethernet is a complimentary network design to point-to-multipoint GPON fiber access networks. As a dedicated service, point-to-point Ethernet allows service providers to provide individual customers with very high-bandwidth, dedicated symmetric services. It also has the greatest deployment flexibility and OSP simplicity, with the tradeoff of requiring additional fiber management in the CO and OSP.

The Calix E7-2 GE-12 card provides multiservice capability over IP/Ethernet-based networks. Each GE-12 card provides twelve GE ports and can be paired to serve up to 24 point-to-point Ethernet ONT subscribers per 1RU E7-2 chassis.

The GE-12 card includes two 10GE ports supporting industry standard SFP+ modules for use as uplink or transport for the local E7-2 system, or as part of the stacking ring within an E7-2 Modular Chassis. Multiple E7-2 systems can be linked together using low cost 10GE SFP+ copper cables, resulting in a high-density point-to-point Active Ethernet configuration of 200 ONT subscribers in as little as 8RU space.

INTEGRATED HIGH-CAPACITY SWITCH: The E7-2 GE-12 card is built on a core Layer 2 and Layer 3 switch capable of full-duplex, line rate forwarding at all frame sizes and traffic types across all interfaces.

INTERFACE OPTIONS: Industry standard pluggable modules are used for all E7-2 GE-12 service and network interfaces, including Small Form-Factor Pluggable (SFP) optical and copper Gigabit Ethernet, and SFP+ 10GE transceiver modules. SFP+ ports also support 1GE SFP modules, extending the versatility of the SFP+ ports to allow additional GE services or GE transport flexibility.

IP SERVICES DELIVERY: The Calix E7-2 GE-12 card delivers a full spectrum of IP access services over Point-to-Point Ethernet networks.

- IPTV – broadcast and Video on Demand (VoD)
- MEF compliant business services
- High-Speed Internet (HSI) access
- Voice – Native SIP/VoIP and TDM Gateway support
- T1 services

NETWORK RESILIENCY: All Calix E7-2 cards support a flexible set of standards-based network topology protocols for use in aggregation, ring-based transport, and uplink applications.

- ITU G.8032 Ethernet Ring Protection Switching (ERPS)
- IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)
- IEEE 802.3ad/802.1AX Link Aggregation

DELIVERING "QUALITY OF EXPERIENCE": The GE-12 provides per-subscriber and per-service hierarchical QoS to deliver uncompromised triple play and business services. A powerful collection of classification, policing, queuing and scheduling algorithms let operators manage per-subscriber and per-service traffic flows to maintain priority/delay/loss differentiation within the E7-2 network.

SCALABLE IPTV SUPPORT: The GE-12 supports industry standard IGMP snooping to identify and replicate multicast video sent between the set-top box and the video distribution network, providing efficient, scalable, high-quality IPTV distribution on all Ethernet interfaces.
# Specifications

## Calix E7-2 GE-12

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CALIX 700 ONTs

The E7-2 GE-12 card supports operation with the Calix 700GE and 700GX family of ONTs, including Single
Family Unit (SFU), Small Business Unit (SBU), Multi-Dwelling Unit (MDU), and rack-mount models.

ORDERING INFORMATION

CALIX E7-2 LINE CARDS

100-01772.......................... E7-2 GE-12 card (12xGE SFP, 2x10GE SFP+)

CALIX PLUGGABLE TRANSCEIVER MODULES

The E7-2 supports pluggable modules for all service and network interfaces. Refer to the Calix Optical
Transceiver Modules Datasheet (#250-00191) for a complete list of modules and specifications.

SFP........................................ 1GE and 2.5GE optical and copper Small Form-factor Pluggable (SFP) modules
SFP+................................. 10GE optical Enhanced Small Form-factor Pluggable (SFP+) modules
Direct Attach.......................... Multi-rate copper Small Form-factor Pluggable (SFP/SFP+) cables

Notes:
- For 10GE SFP+ pluggable transceivers and Direct Attach cables, only products purchased directly from Calix
  are supported. The use of 10GE SFP+ pluggable transceivers and Direct Attach cables not purchased
directly from Calix is not supported and will void all product warranties covering the Calix equipment to which
such third-party materials are connected.
- SFP modules may also be used in SFP+ sockets at 1GE rate.
- Copper Direct Attach cables can operate in SFP and SFP+ sockets at 1GE and 10GE data rates as supported
  by the card type.
DESCRIPTION
The Calix E7-2 GPON-4 line card provides four ITU G.984-compliant Gigabit Passive Optical Network (GPON) interfaces and eight Gigabit Ethernet (GE) interfaces, along with four ports of integrated 10-Gigabit Ethernet. The E7-2 GPON-4 line card can be plugged into one or both of the two universal slots within a Calix E7 shelf. Each PON supports up to 64 Optical Network Terminations (ONTs) for a total of 512 GPON plus 16 point-to-point Ethernet subscribers per 1RU E7 chassis. The E7-2 GPON-4 card supports a full set of Ethernet services and network topology protocols on the Ethernet ports and can be used interchangeably with other E7-2 line cards to create a redundant system configuration.

KEY ATTRIBUTES
GPON AND POINT-TO-POINT ETHERNET: The Calix E7-2 GPON-4 card provides multiservice capability over IP/Ethernet-based networks. Each GPON-4 provides 4 GPON OLT ports that subend up to 64 ONTs each, for a card capacity of 256 GPON ONTs, 512 per E7-2 1RU chassis. An additional eight GE ports per card can provide high-bandwidth, point-to-point Ethernet services to individual subscribers or be used to aggregate other Ethernet devices.

Multiple E7-2 shelves can be linked together using low cost, industry standard 10GE SFP+ copper cables, resulting in a high-density configuration serving over 1000 GPON ONT subscribers in as little as 2RU space (1:64 split). GPON-4 card features and capabilities include:
- Based on ITU G.984 GPON family of standards
- GPON: 2.488 Gbps downstream, 1.244 Gbps upstream
- GEM (Ethernet) based GPON
- Interoperable with Calix family of 700 ONTs
- Integrated 10GE and GE aggregation and transport
- Class B+ ODN, +28 dB link budget, up to 1:64 splits
- Extended reach GPON up to 40 km with 1:8 split
- Hardened for central office and remote terminals

INTEGRATED HIGH-CAPACITY AGGREGATION:
The E7-2 GPON-4 card is built on a core Layer 2 and Layer 3 switch capable of full-duplex, line rate forwarding at all frame sizes and traffic types across all interfaces. Each GPON OLT port has a dedicated 2.5Gbps switch interface. Industry standard pluggable modules are used for all interfaces, including ITU G.984 compliant GPON, GE SFP, 10GE XFP, and 10GE SFP+. The SFP+ ports also support SFP modules, extending their versatility.

IP SERVICES DELIVERY: The Calix E7-2 GPON-4 card delivers a full spectrum of IP access services over GPON and Point-to-Point Ethernet networks.
- IPTV – broadcast and Video on Demand (VoD)
- MEF compliant business services
- High-Speed Internet (HSI) access
- Voice – Native SIP/VoIP and TDM Gateway support
- T1 services
- CATV: 1550nm RF video overlay; 1610nm RF return

NETWORK RESILIENCY: All Calix E7 cards support a flexible set of standards-based network topology protocols for use in aggregation, ring-based transport, and uplink.
- ITU G.8032 Ethernet Ring Protection Switching (ERPS)
- IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)
- IEEE 802.3ad/802.1AX Link Aggregation

MOBILE BACKHAUL: With integrated network synchronization, hierarchical QoS and support for T1 services, the GPON-4 card transport uncompromised mobile broadband traffic while also supporting triple play residential and MEF certified business services from a single platform. A powerful collection of classification, policing, and scheduling algorithms let operators manage per-subscriber and per-service traffic flows to maintain priority/delay/loss service differentiation within the E7 network.

SCALABLE IPTV SUPPORT: The E7 supports industry standard IGMP snooping to identify and replicate multicast video sent between the set-top box and the video distribution network, providing efficient, scalable, high-quality IPTV distribution on both GPON and Ethernet interfaces.
SPECIFICATIONS

Calix E7-2 GPON-4

MINIMUM SYSTEM REQUIREMENTS
Calix E7-2 shelf support only, two GPON-4 line cards per shelf
Calix E7 Software Release 1.0

PORTS
4 GPON OLT ports
8 SFP ports for optical GE and 100/1000BaseT copper modules
2 XFP ports supporting 10GE
2 SFP+ ports supporting 10GE and GE modules

PACKET SWITCHING CAPACITY
Wire speed forwarding across all Ethernet and GPON OLT ports
32,000 MAC addresses per system
9,000 byte jumbo frames
1500 byte frames over GPON
4,096 VLANs
800 IGMP Multicast channels

QUALITY OF SERVICE
Service classification based on port, SVLAN-ID, CVLAN-ID, p-bit
Port and flow-based policing to 1Mbps increments
8 CoS queues per port
Strict priority scheduling with minimum bandwidth guarantee
Congestion avoidance: Tail Drop

STANDARDS AND RFC SUPPORT
TR101 VLAN Service models
IEEE 802.1ag Connectivity Fault Management (G.8032 support)
IEEE 802.1D Rapid Spanning Tree
IEEE 802.1p CoS Prioritization
IEEE 802.1 MAC Bridges
IEEE 802.1Q VLAN tagging
IEEE 802.1ad VLAN stacking (Q-in-Q) support
IEEE 802.1w RSTP
IEEE 802.3ad/802.1AX Link Aggregation
RFC 2236 IGMP v2
RFC 2376 IGMP v3
RFC 3046 DHCP Relay Agent Information Option ("Option 82")
RFC 4541 IGMP snooping
RFC 4553 Structure-Agnostic Time Division Multiplexing (TDM) over Packet (SAToP)
ITU-T G.8032 Ethernet Ring Protection Switching (ERPS)/Enhanced EAPS
ITU-T G.984 GPON

SYNCHRONIZATION
Synchronization enabled by E7 line cards
External reference timing
Built-in Stratum-3 clock
Hardware-ready to support Synchronous Ethernet

COMPLIANCE
NEBS Level 3 compliance
( GR-63-CORE, GR-1089-CORE, GR-3028)
UL 60950
FCC Part 15 Class A

POWER SPECIFICATIONS
GPON-4 power/heat dissipation: 75 Watts

OPERATING ENVIRONMENT
Temperature: -40 to +65°C
(-40°F to +149°F)
Humidity: 10 to 95% (non-condensing)

STORAGE ENVIRONMENT
Temperature: -40 to +85°C
(-40°F to +185°F)
Humidity: 5 to 95%
CALIX 700 ONT

The E7-2 GPON-4 card supports a family of Calix 700 ONTs, including Single Family Unit (SFU), Small Business Unit (SBU), Multi-Dwelling Unit (MDU), and rack-mount models. Calix 700GX ONTs support auto sensing GPON and GE network interfaces, allowing service providers to manage service changes without subscriber onsite technical support.

ORDERING INFORMATION

CALIX E7 LINE CARDS

100-01773.......................... E7-2 GPON-4 (4xGPON OIM, 8xGE SFP, 2x10GE XFP, 2x10GE SFP+)

CALIX PLUGGABLE TRANSCEIVER MODULES

The E7-2 supports pluggable modules for all service and network interfaces. Refer to the Calix Optical Transceiver Modules Datasheet (#250-00191) for a complete list of modules and specifications.

SFP........................................... 1GE and 2.5GE optical and copper Small Form-factor Pluggable (SFP) modules
SFP+......................................... 10GE optical Enhanced Small Form-factor Pluggable (SFP+) modules
Direct Attach.............................. Multi-rate copper Small Form-factor Pluggable (SFP/SFP+) cables
XFP.......................................... 10GE optical Small Form-factor Pluggable (XFP) modules
GPON OIM................................. 2.5Gbps GPON (Class B+ ODN with minimum 28dB link budget, up to 1:64 splits)
ER-GPON OIM............................. 2.5Gbps Extended Reach GPON (up to 40 km with 1:8 split)

Notes:
- For GPON OIM, 10GE XFP, 10GE SFP+ pluggable transceivers and Direct Attach cables, only products purchased directly from Calix are supported.
- SFP modules may also be used in SFP+ sockets at 1GE rate.
- Copper Direct Attach cables can operate in SFP and SFP+ sockets at 1GE, 2.5GE, and 10GE data rates as supported by the card type.
**PRODUCT DATASHEET**

**Calix E7-2 10GE-4**

**DESCRIPTION**

The Calix E7-2 10GE-4 card combines four 10-Gigabit Ethernet (10GE) ports with twelve Gigabit Ethernet (GE) ports to provide high-speed Ethernet transport with integrated aggregation of lower-speed Ethernet devices. The E710GE-4 line card can be plugged into one or both of the two universal slots on a Calix E7-2 shelf to create a compact, high availability (HA) Ethernet transport switch ideal for aggregation and delivery of IP services across the access network. The E7-2 10GE-4 supports a full set of Ethernet services and network topology protocols and can be used interchangeably with other E7-2 line cards to create a redundant system configuration.

**HIGH AVAILABILITY ETHERNET TRANSPORT:** The Calix E7 system bridges the gap between traditional IP service access nodes and Ethernet aggregation switches. Designed to provide transport and aggregation for any Ethernet-based access network, the E7-2 10GE-4 card is the core element of the E7 Ethernet networking solution.

The 10GE-4 card includes four 10GE ports for use as uplink and transport for the local E7 system; or to subend additional E7-2 chassis from the primary E7 system. Multiple E7-2 shelves can be linked together using low-cost 10GE SFP+ copper cables, resulting in a high-speed 10Gbps transport ring with aggregated, high-density GPON and point-to-point Ethernet subscriber services.

Each 10GE-4 card provides 12 GE ports that can be used to:
- Build GE access rings
- Aggregate Calix E7, C7 and E5 platforms
- Provide business services and point-to-point Ethernet

**INTEGRATED HIGH-CAPACITY SWITCH:** The E7-2 10GE-4 card is built on a core Layer 2 and Layer 3 switch capable of full-duplex, line-rate forwarding at all frame sizes and traffic types across all interfaces. This capacity makes the E7 ideal for aggregation and transport of IP/Ethernet services across the access network.

**INTERFACE OPTIONS:** Industry-standard pluggable modules are used for all E7-2 10GE-4 service and network interfaces, including Small Form-Factor Pluggable (SFP) optical and copper Gigabit Ethernet, XFP 10GE, and SFP+ 10GE modules. SFP+ ports also support GE SFP modules, extending the versatility of the SFP+ ports to allow additional GE services or GE transport flexibility.

**METRO ETHERNET BUSINESS SERVICES:** The E7 can be used to deliver Metro Ethernet Forum (MEF) certified business services. The E7-2 10GE-4 supports up to 4,092 Ethernet Virtual Connections (EVCs) and can be configured for E-Line and E-LAN business services. The 10GE-4 can also deliver a full spectrum of ONT-based IP services over Point-to-Point Ethernet, including IPTV, High-Speed Internet (HSI) access, Voice (SIP/voIP and TDM Gateway support), and T1 services (asynchronous clear channel).

**NETWORK RESILIENCY:** All Calix E7 cards support a flexible set of standards-based network topology protocols for use in aggregation, ring-based transport and uplink applications.
- ITU G.8032 Ethernet Ring Protection Switching (ERPS)
- IEEE 802.1w NOCid Spanning Tree Protocol (RSTP)
- IEEE 802.3ad/802.1AX Link Aggregation

With multiple 10GE interfaces, the 10GE-4 card acts as the central aggregation point for 10Gbps ERPS rings with Link Aggregation RSTP-protected uplink to network services.

**DELIVERING “QUALITY OF EXPERIENCE”:** The E7 provides per-subscriber and per-service hierarchical QoS to deliver uncompromised triple play and business services. A powerful collection of classification, policing, queuing and scheduling algorithms let operators manage per-subscriber and per-service traffic flows to maintain priority/delay/loss differentiation within the E7 network.

**SCALABLE IPTV SUPPORT:** The E7 supports industry standard IGMP snooping to identify and replicate multicast video sent between the set-top box and the video distribution network, providing efficient, scalable, high-quality IPTV distribution on both GPON and Ethernet interfaces.
Calix E7-2 10GE-4

MINIMUM SYSTEM REQUIREMENTS
Calix E7-2 shelf supports only, two 10GE-4 line cards per shelf
Calix E7 Software Release 1.0

DIMENSIONS (W x H x L)
14 x 10.1 x 0.78 inches
35.6 x 25.7 x 2 cm

WEIGHT
2.06 lbs. (0.93 kg)

PORTS
2 XFP ports supporting 10GE
2 SFP+ ports supporting 10GE and GE modules
12 SFP ports for optical GE and 100/1000BaseT copper modules

PACKET SWITCHING CAPACITY
Wire speed forwarding across all 10GE and GE ports
32,000 MAC addresses per system
9,000 byte jumbo frames
4,096 VLANs
800 IGMP multicast channels

QUALITY OF SERVICE
Service classification based on port, SVLAN-ID, CVLAN-ID, p-bit
Port and flow-based policing to 1 Mbps increments
8 CoS queues per port
Strict priority scheduling with minimum bandwidth guarantee
Congestion avoidance: Tail Drop

STANDARDS AND RFC SUPPORT
TR101 VLAN Service models
IEEE 802.1ag Connectivity Fault Management (G.8032 support)
IEEE 802.1D NOC id Spanning Tree IEEE 802.1p CoS Prioritization
IEEE 802.1 MAC Bridges
IEEE 802.1Q VLAN tagging
IEEE 802.1ad VLAN stacking (Q-in-Q) support
IEEE 802.1w NOC id reconfiguration of Spanning Tree (RSTP)
IEEE 802.3ad/802.1AX Link Aggregation
RFC 2236 IGMP v2
RFC 2376 IGMP v3
RFC 3046 DHCP Relay Agent Information Option ("Option 82")
RFC 4541 IGMP snooping
ITU-TG.8032 Ethernet Ring Protection Switching (ERPS)/Enhanced EAPS

COMPLIANCE
NEBS Level 3 compliance (GR-63-CORE, GR-1089-CORE, GR-3028)
UL 60950
FCC Part 15 Class A

POWER SPECIFICATIONS
10GE-4 power/heat dissipation: 55 Watts

OPERATING ENVIRONMENT
Temperature: −40 to +65°C (−40°F to +149°F)
Humidity: 10 to 95% (non-condensing)

STORAGE ENVIRONMENT
Temperature: −40 to +85°C (−40°F to +185°F)
Humidity: 5 to 95%
SPECIFICATIONS

Calix E7-2 10GE-4

CALIX 700 GX ONT

The E7-2 10GE-4 card supports operation with a family of Calix 700GX ONTs, including Single Family Unit (SFU), Small Business Unit (SBU), Multi-Dwelling Unit (MDU), and rack-mount models.

ORDERING INFORMATION

CALIX E7 Line cards

100-01771 ....................... E7-2 10GE-4 (2x10GE XFP, 2x10GE SFP+, 12xGE SFP)

CALIX Pluggable Transceiver Modules

The E7-2 supports pluggable modules for all service and network interfaces. Refer to the Calix Optical Transceiver Modules Datasheet (#250-00191) for a complete list of modules and specifications.

SFP .................................. 1GE and 2.5GE optical and copper Small Form-factor Pluggable (SFP) modules
SFP+ ............................... 10GE optical Enhanced Small Form-factor Pluggable (SFP+) modules
Direct Attach .......................... Multi-rate copper Small Form-factor Pluggable (SFP/SFP+) cables
XFP .................................. 10GE optical Small Form-factor Pluggable (XFP) modules

Notes: For 10GE XFP, 10GE SFP+ pluggable transceivers, and Direct Attach cables only products purchased directly from Calix are supported. The use of GPON OIM, 10GE XFP, 10GE SFP+ pluggable transceivers, and Direct Attach cables not purchased directly from Calix is not supported and will void all product warranties covering the Calix equipment to which such third-party materials are connected.

SFP modules may also be used in SFP+ sockets at 1GE rate. Copper Direct Attach cables can operate in SFP and SFP+ sockets at 1GE, 2.5GE, and 10GE data rates as supported by the card type.
740GE Optical Network Terminals

DESCRIPTION
Calix 740GE Optical Network Terminals (ONTs) are 2.5 Gbps GPON and 1.0 Gbps Active Ethernet (AE) devices that deliver a wide array of business services over fiber. These high-performance ONTs provide two electrical or optical (SFP) Gigabit Ethernet (GE) interfaces for Gigabit-speed data services and two POTS lines via integrated VOIP or TDM gateway. T1/E1 business applications are supported by two optional T1/E1 ports that feature pseudowire emulation (PWE3) for TDM over IP networks. The Calix 740GE ONT family integrates extensive business services functionality into four models that are environmentally hardened and can be deployed indoors or outdoors.

The 740GE ONT models are designed for the industry-leading Calix C-Series, E-Series, B-Series and AE platforms. Calix 740GE ONTs terminate GPON or AE fiber links at the subscriber's location and provide industry-standard interfaces for business services equipment. The ONTs enable businesses to receive optical Gigabit Ethernet, PWE3 T1 and VOIP or TDM gateway voice on a single fiber. At the ONT, the optical signal is converted to the appropriate signals for transmission over the business' existing twisted pair, CAT5, and fiber optic cables.

740GE ONTs are easy to install, activate, and maintain. Featuring innovative software management tools, the ONTs can be configured, activated and upgraded quickly from a remote location. Extensive troubleshooting capabilities, remote software downloads, and easy-to-use service profile menus ensure that services are delivered and ONTs are maintained without needless truck rolls and hardware upgrades. Employing 740GE ONTs enables service providers to install a device once and support network upgrades with a simple, remote software download.

Remote activation is one example of an innovative software tool from Calix. Remote activation simplifies business services installation and turn-up by using a basic handset to configure and activate the ONT at the business premises. The craftsoperson can install and turn up an ONT without assistance from the central office or use of special equipment.

Calix has also expanded the reach of GPON beyond the traditional 20 km boundary. Extended reach GPON supports business links of up to 40 km (AE to 50 km). This additional coverage allows service providers to edge-out their GPON networks and economically serve isolated and satellite businesses without adding remote cabinets.

Calix ONTs are environmentally hardened to withstand the outside elements. When mounted outdoors the devices are housed in environmentally sealed enclosures that protect them from the elements. For indoor installations that do not require an enclosure, they can be mounted on a bracket specifically designed for wall-mount and structured wiring enclosure applications.

Outdoor and indoor installations use a 120 Volt, 60 Hz AC power supply that provides battery backup of lifeline POTS in the event of local AC power loss. Battery charge and battery life are monitored and reported through the Calix Management System (CMS).
740GE Optical Network Terminals

KEY ATTRIBUTES

- Standards-based Full Service Access Network (FSAN), ITU-T GPON and IEEE 802.1AE compliant
- 2.5 Gbps GPON and 1.0 Gbps AE, with auto-detect optics enables a seamless transition between WAN interfaces
- Two optical (SFP) or electrical Gigabit Ethernet (GE) interfaces with symmetrical GE bandwidth for and data services
- A variety of configuration options provide:
  - Two VOIP or TDM POTS, via SIP, H.248, MGCP or GR-303/TR-08 mode II/GR-57 TDM gateway
  - Two 10/100/1000 BASE-T Ethernet electrical or two 1000 BASE-X optical interfaces; fully independent for service separation, auto-negotiating
  - Two optional PWE3 T1/E1 ports for TDM/PWE3-based services
- Indoor and outdoor applications:
  - Outdoor installation features a small, environmentally hardened enclosure that withstands the rigors of the outside plant environment; Telcordia GR-49 compliant
  - Indoor installation offers a range of mounting options including: the standard enclosure for added security and protection and a wall-mount bracket for indoor cabinets and indoor wall mounts
- Lifeline service power source with battery backup and alarm monitoring
- Complete OAM&P support via Calix Management System (CMS)
- Supports multiple data service profiles
- Traffic Management and Quality of Service (QOS):
  - 802.1Q VLANs
  - 802.1P Service Prioritization
  - Q-in-Q Tagging
  - Multiple VLANs
  - Per-Port Rate Shaping
  - Rate Limiting
  - L2 Control Protocol Filtering
- MEF-UNI support for Ethernet demarcation applications:
  - MEF EVCs for E-Line and E-LAN
  - L2-VPNs using MEF service models
- OAM
  - Y.1731
  - MEF 17
  - 802.3 ah
  - 802.1 ag
  - RFC-2544

SERVICES SUPPORTED

Calix 740GE ONTs deliver high-speed data, POTS, and PWE3 T1 services

- Supports voice, data, and PWE3 T1/E1 services on a single fiber
- Voice: Two VOIP or TDM POTS lines, via SIP, H.248, MGCP or GR-303/TR-08/GR-57 TDM gateway, full lifeline telephony support (CLASS and E911)

- Data: Two 10/100/1000 BASE-T Ethernet electrical or two 1000 BASE-X Ethernet optical ports with service separation and GE bandwidth
- PWE3 T1/E1: Available with two optional PWE3 T1/E1 ports
SPECIFICATIONS
740GE Optical Network Terminals

MECHANICAL—OUTDOOR ENCLOSURE
Height: 12 in (30.48 cm)
Width: 10 in (25.4 cm)
Depth: 4 in (10.16 cm)
Outdoor installed height: 50–60 in
(1.3 to 1.5 m) above ground
Installed weight: 4 lbs (1.76 kg)

RECOMMENDED OUTDOOR CLEARANCES
Left side: 12 in (30.48 cm)
Right side: 6 in (15.24 cm)
Front: 36 in (91.44 cm)
Standing room
Rear: None

PON CHARACTERISTICS
Max. split: 64 GPON
Max. reach: 40 km (25 miles)
Maximum Attenuation:
GPON – Class B+ 28 dB
1490 ± 10 nm optical receiver:
-27.0 to -8.0 dBm
1310 ± 50 nm optical transmitter:
0.5 to 5.0 dBm

POINT-TO-POINT (AE) CHARACTERISTICS
Max. reach: 50 km (31 miles)
1490 nm optical receiver:
-27.0 to -8.0 dBm
1310 nm optical transmitter:
-4.5 to 0.0 dBm

INTERFACES
Telephony: Binding post
Data: 10/100/1000 BASE-T Ethernet ports, RJ-45 connectors; or two 1000 BASE-X optical SFP ports (SFPs purchased separately)
T1/E1: RJ-45 connector
AE/PON: Single 9/125 μm (single mode) fiber, SC/APC connector, minimum 50 dB return loss
Power: Screw-down terminal block plug

TELEPHONY
General: POTS via SIP, H.248, MGCP or TDM gateway
Number of lines: 2
REns per line: 5 maximum
REns per unit: 10 maximum
Subscriber premises—physical connection: 22 or 24 AWG to twisted pair binding posts;
premises isolating RJ-11 test jack (one per line)
Drop length: Maximum 1000 feet
(305 m) using 26 AWG wire
Input impedance: 600 Ohms
DSO Output: 25 mA
Ring Voltage: 56–84 VAC

DATA
Drop length: Electrical: 328 feet
(100 m) maximum using CAT5 cable, Optical: SFP dependent
Auto MDI/MDIX crossover for
1000 BASE-T, 100 BASE-TX,
and 10 BASE-T electrical ports
Traffic Management and QoS:
802.1Q VLAN; 802.1P Voice,
Video, Data and Management Priorities; Q-in-Q tagging; Per-Port Rate Shaping; Rate Limiting

T1
Pulse amplitude: 3 V base to peak
Line coding: AML, B8ZS
Frame formats: ESF, SF, Unframed
Line build-out: Short haul: 0 to 660 feet (0 to 201.2 m)

E1
Line coding: HDB3
Frame formats: Unframed, G.704
Impedance: 120 Ohms balanced / 75 Ohms unbalanced
## SPECIFICATIONS

### 740GE Optical Network Terminals

#### ENVIRONMENTAL
- **Operating temperature:** Indoor ambient temperature -40 to 149°F (-40 to 65°C), Outdoor ambient temperature with Calix enclosure -40 to 114°F (-40 to 46°C) plus solar load
- **Rate of change in operating temp:** 15°F (8.3°C) per hour maximum
- **Shipping and storage temperature:** -40 to 140°F (-40 to 60°C)
- **Operating/storage relative humidity:** 0 to 95% non-condensing
- **Altitude:** -200 to 10,000 feet (-61 to 3,048 m) above sea level
- **Misc:** Salt fog resistant; wind-driven rain protection; anti-dust enclosure

#### POWER
- Screw-down terminal block plugs for 7-wire alarms and power interface

#### CERTIFICATION AND COMPLIANCE
- **Emissions:** FCC Part 15 Class B, IC ICES-003 Class B
- **Safety:** UL 60950 and UL 1697 approved
- **Telcordia:** GR-1089, GR-49
- **IEEE:** 802.3, 802.3AB, 802.3U, 802.1P, 802.1Q
- **ITU-T:** G.823 (E1)
- **ITU-T:** G.824 (T1)
- **MEF:** 9.14 and 17

#### BATTERY BACKUP
- **Battery backup source (local):** UPS mounted at business
- **Power termination:** Maximum length of 70 feet (21.3 m) DC power and alarm cable with seven 16/24 AWG conductors connected to a UPS
- **Input voltage:** 12 VDC (nominal)
- **Input current:** 750 mA (nominal)
- **Battery backup time rated capacity:** 8 hours based on Telcordia GR-909 calculation methods using recommended UPS. Contact Calix for recommended UPS

### ORDERING INFORMATION

**Calix 740GE Business Service Terminals**
- **741GE ONT (100-01961)...** 2 POTS, 2 Gigabit Ethernet
- **742GE ONT (100-01962)...** 2 POTS, 2 Optical (SFP) Gigabit Ethernet
- **743GE ONT (100-01963)...** 2 POTS, 2 Optical (SFP) Gigabit Ethernet, 2 T1/E1
- **744GE ONT (100-03308)...** 2 POTS, 2 Gigabit Ethernet, 2 T1/E1

**Calix 700 Enclosures and Wall Mount Bracket**
- **ENCL-ST (100-01578)...** Enclosure with Splice Tray
- **ENCL-ST-PP (100-01580)...** Enclosure with Splice Tray and Primary Protection
- **ENCL-OA (100-01579)...** Enclosure with OptiTap Adaptor
- **ENCL-ST (100-01581)...** Enclosure with OptiTap Adaptor and Primary Protection
- **SLACK STRG-NG (100-01307)...** Slack Storage Enclosure SFU-NG
- **SFU SWEB (100-01409)...** ONT Wall Mount Bracket

**Calix SFP Modules**
- **(100-01660)...** 1 GE SFP, Multi-Mode, LC, 850nm, 500m, I-Temp
- **(100-01662)...** 1 GE SFP, Single Mode, LC, 1310nm, 10Km, I-Temp
- **(100-01666)...** 1 GE SFP, Single Mode, Single Fiber, BIDI, LC, Tx 1310nm, 10Km, I-Temp
- **(100-01667)...** 1 GE SFP, Single Mode, Single Fiber, BIDI, LC, Tx 1550nm, 10Km, I-Temp
- **(100-01956)...** 1 GE SFP, Single Mode, Single Fiber, BIDI, SC, Tx 1310nm, 10Km, I-Temp
- **(100-01668)...** 1 GE SFP, Single Mode, Single Fiber, BIDI, LC, Tx 1310nm, 20Km, I-Temp
- **(100-01669)...** 1 GE SFP, Single Mode, Single Fiber, BIDI, LC, Tx 1490nm, 20Km, I-Temp
- **(100-01957)...** 1 GE SFP, Single Mode, Single Fiber, BIDI, SC, Tx 1310nm, 20Km, I-Temp

**Calix E1 RJ45 to BNC Adaptor Cable**
- **(100-02108)...** E1 RJ45 to BNC Female Cable

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UNINTERRUPTIBLE POWER SOLUTIONS FOR:
- FTTH/P Networks
- Wireless Local Loop Networks
- VoIP and VoDSL
- Cable Telephony
- MTU / MDU
- SOHO Network Communication

PRODUCT FEATURES:
- Universal input voltage
- Microprocessor-based intelligent control
- Communication interface
- Optional extendable runtime
- Audible Alarm signals utility failure, low battery and replace battery
- Temperature compensated charging
- Cold Start Capable

Dependable Products
CyberShield DC power supplies are the products you can trust. No recalls; no unnecessary truck rolls. Dependable products designed specifically for all broadband applications.

Quality
- State-of-the-art manufacturing and design facilities,
- Rigorous quality control tests
- Maintenance-free products and easy installation

Safety
- UL, cUL, FCC, CE safety tested
- Products exceed Telcordia standards
- Proven track record of quality and dependability

Intelligence
- Easy-to-read LEDs; audible alarms
- Self-diagnostic tests
- Hot swappable batteries

Product Availability
- MRP Inventory control
- Inventory trend forecasting
- Proper inventory and safety stock levels

Customer Service
- Live, professional technical support
- NO automated menus
- All questions answered promptly

Expandability
- Continual product enhancements
- New product development
- Extended battery packs
**Cybershield Application**

Cybershield delivers uninterrupted power to network communications and telephony. Along with providing stable 12VDC or 48VDC power, our units are supplemented with battery backup modules to ensure clean, continuous power, even through power loss. Cybershield products plug directly into network interface units, cable telephony modules, wireless base stations, and fiber to the premise interface modules or integrated access devices.

**Technical Specifications**

<table>
<thead>
<tr>
<th>Model Number</th>
<th>CS24U12V</th>
<th>CS24U12V-12</th>
<th>CS24C12V2-E</th>
<th>CS24U12V-XL</th>
<th>CS30U12V-20</th>
<th>CS16U48V-8</th>
<th>CS50U48V</th>
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<tbody>
<tr>
<td>Operation</td>
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<td></td>
<td></td>
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<td>Area of use</td>
<td>Interior</td>
<td>Interior</td>
<td>Exterior</td>
<td>Interior</td>
<td>Interior</td>
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<td>RoHS Compliant</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Input</td>
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<tr>
<td>Voltage Range</td>
<td>85Vac - 264Vac (Universal Input)</td>
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<td>Frequency Range</td>
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<td>Output</td>
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<td>On Battery Output Voltage</td>
<td>12Vdc</td>
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<td>Continuous Power Capability</td>
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<td>Output Power Maximum</td>
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<td>Battery</td>
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<tr>
<td>Sealed, Maintenance Free Lead-Acid Battery</td>
<td>7.2AH/12V</td>
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<tr>
<td>Intelligent Charging</td>
<td>Unit evaluates battery temperature and adjusts the charging cycle accordingly</td>
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<td>Typical Charge Time (Hours)</td>
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<tr>
<td>User Replaceable</td>
<td>Yes, Hot Swappable</td>
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<td>Warning Diagnostics</td>
<td>Audible Alarm: Utility Failure, Low Battery</td>
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<td>LED Indicators</td>
<td>AC, Output, Battery</td>
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<td>Management</td>
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<td>Auto-Charge</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Communication Interface</td>
<td>On Battery, Replace Battery, Battery Missing, Low Battery</td>
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<td></td>
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<tr>
<td>Environment</td>
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<tr>
<td>Operating Temperature</td>
<td>32°F to 104°F (0°C to 40°C)**</td>
<td></td>
<td></td>
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<tr>
<td>Operating Humidity</td>
<td>0% - 95% non-condensing</td>
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<td>Maximum Operating Elevation</td>
<td>10,000ft (3,000m)</td>
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<tr>
<td>Storage Temperature</td>
<td>5°F to 113°F (-15°C to 45°C)</td>
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<tr>
<td>Maximum Storage Elevation</td>
<td>60,000h (15,000m)</td>
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<tr>
<td>Physical</td>
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<tr>
<td>Unit Dimensions (in)</td>
<td>9 ½ x 6 ½ x 3 ½</td>
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<tr>
<td>Weight (lbs)</td>
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<td></td>
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<td>Carton Dimensions (in)</td>
<td>14 x 14 x 4 ½</td>
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<td>Carton Weight (lbs)</td>
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</table>

**For more information, visit CyberPower's Web Site at www.cyberpowersystems.com or call 1-877-CY-POWER**

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The Calix Single Family Unit (SFU) Enclosure is a next generation product that features a redesigned splice tray and additional refinements that make it easier to install and use. Among these refinements are an additional cable tie-down tab, a cable clamp option, and a ground stud.

The SFU ONT Enclosure is a compact, molded thermo-plastic housing that holds one 700 SFU ONT. It is an environmentally sealed enclosure that can be mounted outdoors or indoors. Protective rubber grommets provide a seal around incoming and outgoing service and power cables. For additional security, an ONT tool is required to open the enclosure's lockable security door.

Four SFU ONT Enclosure models are available. The standard SFU ONT Enclosure has a drop-cable bracket and splice tray that accommodates loose fiber storage. The second model is the same as the standard enclosure with the addition of a telephone primary protection module for lightning protection. The third SFU ONT Enclosure includes an OptiTap® adaptor for terminating pre-connectorized drop cable. The final model is the SFU ONT Enclosure with OptiTap® adaptor and a telephone primary protection module.

**KEY ATTRIBUTES**

**COMPACT DESIGN:** The SFU ONT Enclosure has a compact, neutral-colored design that easily blends into the local environment.

**IMPROVED SPLICE TRAY:** The redesigned Calix Splice Tray has an open fiber storage area that makes fiber splicing, routing, tie-down and storage quick and easy. The clear splice tray cover provides additional protection for the splice tube and fiber. The splice tray comes installed in the standard SFU ONT Enclosure and the SFU ONT Enclosure with Primary Protection. SFU ONT Splice Trays can be ordered separately for replacements or for use with Structured Wiring Enclosure Brackets (SWEBs) and other Calix enclosures.
**Fiber Protection:** The enclosure provides additional protection for the fiber by using the 700 ONT electronics module as a security door. This security door allows easy access to diagnostic LEDs and test ports while denying access to sensitive fiber. Additional openings have been added to the ONT guard wall that separates the protected area from the general access area. These openings can be used to pass wires for primary protection of telephone circuits, power, and general cable management.

**Grounding and Fiber Drop Cable Bracket:**
This bracket is used to provide a ground connection for the 700 ONT electronics and to secure the incoming fiber drop cable. Two types of ground brackets are available.

The standard bracket secures drop cables that require splicing. This bracket has a tie-down tab for securing the drop cable with plastic tie-wraps. A slot is provided for connecting and grounding a drop cable with a metallic sheath nut and bolt assembly. The slot also supports an optional Calix cable clamp. The standard bracket features a second ground stud for metallic sheath and general purpose grounding.

The OptiTap® bracket and OptiTap® adaptor are factory installed in the 700 ONT OptiTap® Enclosures. This bracket securely retains the OptiTap® adaptor and drop cable. Also available is a 700 ONT Slack Storage Enclosure that is used for storing excess OptiTap® drop cable.
PRODUCT DATASHEET

Calix ODC-100 Outdoor Cabinet

DESCRIPTION
The Calix ODC-100 broadband enclosure has been designed with the philosophy of modularity and flexibility, while maintaining a maximum heat dissipation capability. It is designed to accommodate the smaller form factor E-Series products and provide all the powering, protection and cable management to serve up to 96 subscribers. As with all Calix enclosures, the ODC-100 supports 100% density of narrowband and broadband services.

Key attributes

MODULARITY: Calix cabinets are designed to easily scale from a minimal configuration to the maximum capacity of the cabinet. Design consideration has been taken to enable the customer to field install and scale common options such as line protection, cooling, and cross-connect modules. The cabinet can be configured for as low as 48 lines with the option of scaling up to the maximum capacity of 96 lines for the E-Series products.

FLEXIBILITY: The ODC-100 has been designed to accommodate a variety of standard options that are expected in remote cabinets, such as the battery base, battery warmers, integrated cross-connect, and field changeable doors that can easily upgrade the cooling capacity. The cabinet supports the installation of third party equipment, as well as the ability to connect to the network via either protected copper or fiber uplinks.

POWER OPTIONS: The ODC-100 enables service providers to power the cabinet using either standard AC power but also has the ability to be powered remotely using +/- 190 DC from a remote power node or a remote power shelf in the CO. This enables service providers to easily deploy services to subscribers via a remote cabinet. Time gaining the required right-of-way to install power at a location is often costly, and therefore remote powering an ODC-100 enables the service provider to deploy services more cost effectively.

EQUIPMENT ACCESS: The ODC-100 provides unique doors to the cabinet that enable easy access to the rear of the equipment that is installed into the cabinet. This feature makes the ODC-100 stand out in the industry amongst small cabinets. Other small cabinets do not allow rear access to equipment, but force the removal of the equipment in order to work on the rear of the equipment. In addition, the unique door on the ODC-100 also enables the installation and use of the integrated cross-connect as well as access to the cables feeding the cabinet.

ADVANCED COOLING: The ODC-100 cabinet has been designed from the ground up to address heat dissipation issues associated with the deployment of high-speed services from remote terminal locations. Cooling is achieved via a door-mounted air-to-air heat exchanger that is either factory- of field-installable. The ODC-100 has a base door with no heat exchanger to provide for the very low cost option as well as high-capacity heat exchanger door.
SPECIFICATIONS

Calix ODC-100 Outdoor Cabinet

WIRED CAPACITY
Copper: Up to 96 lines of Overlay or 192 lines of ADSL/POTS Combo
Fiber: Up to 192 lines, SC termination

DIMENSIONS
24 inches (width) x 18 inches (depth)
x 37 inches (height) without battery base
24 inches (width) x 18 inches (depth)
x 48 inches (height) with battery base

WEIGHT
135 lbs. without battery base (two
E5-100 with cables, rectifier shelf
with two modules, cross-connect
modules with cables)
150 lbs. with battery base (equipped
with four 40 AH batteries: 262 lbs)

COLOR
Warm gray

ENVIRONMENTAL
Ambient temperature: −40°C to
+46°C (per GR-487)

COOLING
300 Watt door-mount heat
exchanger

MOUNTING OPTIONS
Pre-Cast Pad, Pour-In-Place
Template, Pole Mount, Wall
Mount, Adjunct mount onto host
cabinet, Vault/Raiser

POWER OPTIONS
AC Power feed: 110–240 VAC
single phase, 30 Amp service with
UL listed service disconnect
Low voltage DC disconnect (~42
Volts)
High power AC surge protection
(Joslyn)
Remote Power feed: +/-190 VDC
Redundant -48 VDC feeds to E-
Series Product

DC RECTIFIERS
Valere Compact Power System
2 rectifier modules maximum,
autosenses and adjusts for low
and high AC input.
Low input (100–185 VAC): Max.
total power output 2500 Watts;
Max. total current 50 Amps (2
modules, non-redundant)
High input (185–264 VAC): Max.
total power output 3000 Watts;
Max. total current 60 Amps (2
modules, non-redundant)

DC-DC CONVERTER
Lineage Power CPS2500D ±190Vdc
Downstream Power System
10 converter modules maximum; 2
channels per converter
25 Amp (1300 Watt) max. total
capacity

CABLE MANAGEMENT
Copper plant OSP connectors:
MS2 and 710
Integrated cross-connect option:
150-pair or 300-pair

BATTERY BACK-UP
Preferred battery: Northstar 40 AH
Calix Port number 100-01246
One string per cabinet

COPPER PROTECTION PANELS
Standard 5-pin protection blocks—
modular in 50-pair increments
Up to four (4) 50-pair protection
blocks (200 pairs total for 96 ports
overlay)

SAFETY
UL-60950, Standard for Safety,
Issue1, April 1, 2003
CAN/CSA-C22.2 No. 60950
EMC
FCC Part 15 Class A
ICES-003 Class A

EQUIPMENT SUPPORTED
E5-100, E7-2 and B6-001 Products;
two shelves, any combination

FIBER MANAGEMENT OPTIONS
12-Position Fiber Splice Tray
(default), upgradeable to 36
position
Support for in-cabinet GPON and
Active-E fiber management:
Up to 192-Position Fiber Distribution
in 48-port or 96-port increment
assemblies; SC connector
Fiber spool and routing facilities
Integrated Nx 1:32 PON Splitters
(option)

GENERATOR CONNECTOR
OPTIONS
30 Amp NEMA twist lock with
breaker and interlock

COMPLIANCE
Telcordia, GR-63-CORE, NEBS
Telcordia, GR-487, Generic
Requirements for Electronic
Equipment Cabinets
SPECIFICATIONS

Calix SFU ONT Enclosure

MECHANICAL
Height: 12 in (30.5 cm)
Width: 10 in (25.4 cm)
Depth: 4 in (10.2 cm)
Installed height: 50–60 in
(1.3–1.5 m) above ground

INSTALLED WEIGHT
4 lbs (1.8 kg)

RECOMMENDED CLEARANCES
Left side: 12 in (30.5 cm)
Right side: 6 in (15.2 cm)
Front: 36 in (91.4 cm) standing room
Rear: None

ORDERING INFORMATION

CALIX 700 ONT ENCLOSURES
SFU ENCL-ST (100-01578) ......................SFU ONT Enclosure with Splice Tray
SFU ENCL-ST-PP (100-01580) ...............SFU ONT Enclosure with Splice Tray and Primary Protection
SFU ENCL-OA (100-01579) ......................SFU ONT Enclosure with OptiTop® Adaptor
SFU ENCL-OA-PP (100-01581) ...............SFU ONT Enclosure with OptiTop® Adaptor and Primary Protection
700 SLACK STRG-NG (100-00986) ..........700 ONT Slack Storage Enclosure SFU-NG
ONT ST-NG (100-01582) ......................ONT Splice Tray SFU with SC/APC Adaptor - NG
PRODUCT DATASHEET

716GE-I Indoor Optical Network Terminal

DESCRIPTION

The Calix 716GE-I optical network terminal (ONT) is an indoor, 2.5 Gbps GPON and 1.0 Gbps Active Ethernet (AE) auto-detect ONT that delivers business and residential services to the subscriber. This high-performance ONT sets the standard with four Gigabit Ethernet (GE) interfaces that provide unmatched IPTV video and data services. The versatile 716GE-I ONT also features two POTS lines via an integrated VOIP or TDM gateway.

The 716GE-I ONT is designed for the industry-leading Calix C-Series, E-Series and B-Series OLT platforms. The 716GE-I ONT terminates a GPON or AE fiber link at the subscriber's location and provides industry-standard interfaces for the customer premises equipment. The ONT enables subscribers to receive broadband data, IP video, and VOIP or TDM gateway voice on a single fiber. At the ONT, the optical signal is converted to the appropriate electrical signals for transmission over the residence's existing twisted pair, and CAT5 cables.

The 716GE-I ONT is easy to install, activate, and maintain. Featuring innovative software management tools, the ONT can be configured, activated and upgraded quickly from a remote location. Extensive troubleshooting capabilities, remote software downloads, and easy-to-use service profile menus ensure that services are delivered and ONTs are maintained without needless truck rolls and hardware upgrades. Employing a 716GE-I ONT allows service providers to install the ONT once and support network upgrades with a simple, remote software download.

Remote ONT Activation (RONTA) is one example of an innovative software tool from Calix. RONTA simplifies ONT installation and turn-up by using a basic handset to configure and activate the ONT at the customer premises. The craftsperson can install and activate the ONT without assistance from the central office or use of special equipment.

Calix also expands the reach of GPON beyond the traditional 20 km boundary. Extended reach GPON supports links between the ONT and OLT of up to 40 km. This additional coverage allows service providers to edge-out their GPON networks and economically serve sparsely populated outlying locales without adding remote cabinets.

ONT power options include a simple 120-240 VAC, 50-60 Hz to 15 VDC converter or a 120-240 VAC, 50-60 Hz AC to 12 VDC uninterruptible power supply (UPS) that provides battery backup of lifeline POTS in the event of local AC power loss. As with all Calix ONTs, battery status, charge and battery life are monitored and reported through the Calix Management System (CMS).
PRO D U CT  D A T A  S H E E T

716GE-I Optical Network Terminal

KEY ATTRIBUTES

- Standards-based Full Service Access Network (FSAN), ITU-T GPON and IEEE AE compliant
- 2.5 Gbps GPON and 1.0 Gbps AE, with auto-detect optics enables a seamless transition between WAN interfaces
- Four Gigabit Ethernet (GE) interfaces with symmetrical GE bandwidth for IPTV and data services
- 10/100/1000 BaseT Ethernet ports are auto-negotiating and fully independent for service separation
- VOIP or TDM POTS, two lines via SIP, H.248 or GR-303/TR-08 mode II/GR-57 TDM gateway
- Indoor mounting options:
  - Wall mount
  - Structured Wiring Enclosure (SWE) mount
  - Desktop mount: horizontal or vertical
- Wide temperature range for a variety of indoor locations
- Optional lifeline service power source with in-home battery backup and alarm monitoring
- AC to 15 VDC wall transformer available
- Complete OAM&P support via Calix Management System (CMS)
- Supports multiple data service profiles
- Traffic Management and Quality of Service (QOS):
  - 802.1Q VLANs
  - 802.1p Service Prioritization
  - Q-in-Q Tagging
  - Multiple VLANs
  - Per-Port Rate Shaping
  - Rate Limiting
- MEF-UNI support for Ethernet demarcation applications:
  - MEF EVCs for E-Line and E-LAN
  - L2-VPNs using MEF service models

SERVICES SUPPORTED

Calix 700GE-I ONT delivers high-speed data, POTS, and IPTV video.

- Supports voice, video and data services on a single fiber
- Voice: Two VOIP or TDM POTS lines, via SIP, H.248 or GR-303/TR-08/GR-57 TDM gateway, full lifeline telephony support (CLASS and E911)

- Video: IPTV—supports IGMP multicasting and proxy
- Data: Four 10/100/1000 BaseT Ethernet ports with service separation and GE bandwidth

Calix
SPECIFICATIONS

716GE-I Optical Network Terminal

DIMENSIONS
Height: 6.8 in (17.3 cm)
Width: 6.8 in (17.3 cm)
Depth: 1.5 in (3.8 cm)
Weight: 14 oz (4 kg)

PON CHARACTERISTICS
Max. split: 64 GPON
Max. reach: 40 km (25 miles)
Maximum Attenuation:
GPON – Class B+, 28 dB
1490 ± 10 nm optical receiver:
-27.0 to -8.0 dBm
1310 ± 50 nm optical transmitter:
0.5 to 5.0 dBm

POINT-TO-POINT (AE) CHARACTERISTICS
Max. reach: 50 km (31 miles)
1490 nm optical receiver:
-27.0 to -8.0 dBm
1310 nm optical transmitter:
-5.5 to 0.0 dBm

INTERFACES
Telephony: RJ-11
Data/IPTV: 10/100/1000 BaseT Ethernet ports, RJ-45 connectors
AE/PON: Single 9/125 μm (single mode) fiber, SC/APC connector, minimum 50 dB return loss
Power: 9-pin DIN jack

TELEPHONY
General: POTS via SIP, H.248 or TDM gateway
Number of lines: 2
RENs per line: 5 maximum
REns per unit: 10 maximum
Subscriber premises—physical connection: RJ-11 jack (one per line)
Drop length: Maximum 1000 feet (305 m)
DSO Output: 25 mA
Ring Voltage: 56–84 VAC

DATA
Drop length: 328 feet (100 m) maximum using CAT5 cable
Auto MDI/MDIX crossover for 100BASE-TX, 100BASE-TX, and 10BASE-T ports
Traffic Management and QOS: 802.1Q VLAN; 802.1p Voice, Video, Data and Management Priorities; Q-in-Q tagging; Per-Port Rate Shaping; Rate Limiting

ENVIRONMENTAL
Operating temperature: Indoor ambient temperature: -5°C to 50°C
Operating/storage relative humidity: 0 to 95% non-condensing
Altitude: -200 to 10,000 feet (-61 to 3,048 m) above sea level

CERTIFICATION AND COMPLIANCE
Emissions: FCC Part 15 Class B, IC ICES-003 Class B, CISPR-22
Safety: UL 60950 and UL 1697 approved, CE Mark
Telcordia: GR-1089
IEEE: 802.3, 802.3AB, 802.3U, 802.1p, 802.1Q
MEF: 9 and 14

POWER AND ALARMS
9-pin DIN connector with 7-conductor power and alarm cable

POWERING
Input voltage: 12 VDC (nominal), 10 VDC (min.), 16 VDC (max.)
Input current: 750 mA (nominal)
Residential battery backup source (local): UPS mounted at subscriber's residence
Battery backup time rated capacity: 8 hours based on Telcordia GR-909 calculation methods using recommended UPS. Contact Calix for recommended UPS.
ORDERING INFORMATION

716GE-I Optical Network Terminal

Calix 716GE-I Optical Network Terminal
716GE-I ONT (100-02040) .................................. Indoor ONT, 2 POTS, 4 Gigabit Ethernet

Calix 700GE-I Optical Network Terminal Accessories
PS 15V 9DIN-A (100-02042) .................... Power Supply 700GE-I Indoor 100-240 VAC 50/60 Hz to 12 VDC, 9-pin DIN, AM Type A
PS 15V 9DIN-C (100-03238) .................... Power Supply 700GE-I Indoor 100-240 VAC 50/60 Hz to 15 VDC, 9-pin DIN, EU/BR Type C
PS 15V 9DIN-G (100-03239) .................... Power Supply 700GE-I Indoor 100-240 VAC 50/60 Hz to 15 VDC, 9-pin DIN, UK Type G
PS 15V 9DIN-I (100-03240) .................... Power Supply 700GE-I Indoor 100-240 VAC 50/60 Hz to 15 VDC, 9-pin DIN, AU/NZ Type I

Indoor PWR Cord 4B (100-02063) .............. Indoor UPS Power Cord, 7-pin Connector to 9-pin DIN Male, 4' Black
Indoor PWR Cord 10B (100-02064) .............. Indoor UPS Power Cord, 7-pin Connector to 9-pin DIN Male, 10' Black
Indoor PWR NT Cord 20B (100-03296) .............. Indoor UPS Power Cord, Un-terminated to 9-pin DIN Male, 20' Black
SERVICE DATASHEET

CMS Appliance

DESCRIPTION

CMS Appliance is a Unified Access service management platform that simplifies fiber access service delivery by bundling all the hardware and software necessary for turn-key deployments on a single, fault tolerant, rack-mountable PowerEdge™ R410 Server. High availability features include dual power and four Ethernet connections with redundant hard drives. CMS Appliance can also be deployed in pairs, providing ultimate system redundancy.

CMS Appliance is preconfigured with software templates that enable zero touch activation using Calix Remote ONT Activation (RONTA), dramatically simplifying residential and commercial fiber deployments.

VALUE PROPOSITION

CMS Appliance reduces the complexity related to fiber service deployment, allowing communications service providers (CSPs) to quickly deploy revenue-generating broadband services. Key advantages include:

- **Accelerated Service Velocity**: Improve time-to-market – time-to-revenue.
  - Automated activation using Remote ONT Activation (RONTA)
  - Commercial templates bundling Metro Ethernet, VoIP, and commercial video
  - Residential service templates bundling video, SIP, and triple-play
- **Reduced Operational Expenses (OPEX)**: Automate repetitive tasks.
  - Automated logging, reporting and alarm notification tools
  - Automated database and network configuration backup
- **Business Tools and Capacity Planning**: Auto-generate pre-configured reports.
  - Export weekly reports for review, including such as bandwidth inventory and capacity utilization.

CMS Appliance includes a complete version of the latest Calix Management System (CMS) server software.
SPECIFICATIONS

CMS Appliance

BASE UNIT
Intel® Xeon® 5600-Series Processor

MEMORY (RAM)
6 GB 1333 MHz (3 x 2 GB), RDIMM

HARD DRIVE
Dual 146 GB, 15 K RPM SAS Hot-Plug Drives (RAID 1)

HARD DRIVE CONTROLLER
PERC6i SAS RAID Controller Internal with Battery

POWER SUPPLY
Redundant 500 Watts

MANAGEMENT
iDRAC6 Enterprise

MOUNTING
2/4 – Static Post Rails

OTHER FEATURES
Gigabyte Ethernet Interfaces
DVD-ROM SATA
Keyboard and Mouse, USB

OPERATING SYSTEM
Current version of CertOS, preinstalled

SOFTWARE CONFIGURATION
Current version of Calix Management System (CMS), preinstalled
All Software necessary for deploying AE and SIP services are bundled with CMS Appliance

SERVICE
Dell™ Limited Warranty
Business Hours 7 x 24
Next Business Day Onsite
Post Problem Diagnosis
3 Years

Note: Service may be provided by third-party. Technician will be dispatched if necessary following phone-based troubleshooting. Subject to parts availability, geographical restrictions and terms of service contract. Service timing dependent upon time of day call placed to Dell. U.S. only.

<table>
<thead>
<tr>
<th>Calix Part #</th>
<th>Part Description</th>
<th>Warranty</th>
<th>Extended Warranty</th>
<th>Maximum Years</th>
<th>Manufacturer’s Datasheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-01913</td>
<td>CMS Appliance Dell R410 Server configured with OS, CMS, DHCP, FTP, TFTP, SFTP, NTP, and Syslog server software</td>
<td>3 Years</td>
<td>Contact Dell</td>
<td>Contact Dell</td>
<td>Dell™ PowerEdge™ R410 Server Datasheet at <a href="http://www.dell.com">www.dell.com</a></td>
</tr>
</tbody>
</table>

FOR HARDWARE ISSUES, CONTACT DELL
Technical Product Support
Toll-Free: 1-800-456-3355
Dell will ask for the 7 or 8 alphanumeric system identifier located on the back of the server.

FOR CMS ISSUES, CONTACT CALIX
Technical and RMA Support
Toll-Free: 1-877-766-3500
FAX: 1-707-283-3772; RMA 766-3773
E-mail: tech.support@calix.com
E-mail: rma@calix.com
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1 Safety and Recommended Practices

1.1 General Practices

For use in restricted access locations only. Suitable for mounting on concrete or other non-combustible surfaces. This equipment is intended for rack mounting. Refer to the method of mounting detailed in the installation instructions to reduce the risk of operator access to hazardous energy during installation.

This product accepts an AC Voltage between 90 and 264 VAC, 47 to 63 Hz, and produces a regulated output of 42-56 VDC capable of delivering a max of 90 Amperes DC, in an ambient operating temperature range of -40°C to +50°C (derating 2%/°C after 50°C up to 70°C). HAZARDOUS VOLTAGE AND ENERGY LEVELS ARE PRESENT WHICH CAN PRODUCE SERIOUS SHOCKS AND BURNS. Only authorized, qualified, and trained personnel should attempt to work on this equipment. Refer to datasheets for full product specifications.

Observe all local and national electrical, environmental, and workplace codes.

Each power shelf should be fed from a dedicated AC branch circuit of a TN power system.

If a line cord(s) is (are) used as the AC connection means, the plug end of the cord is considered to be the primary disconnect means, and reasonable access must be given to the plug and receptacle area. The receptacle must be fed with a breaker and wire sizes according to Table 3.

For hard-wired AC connections, a readily accessible disconnect device shall be incorporated in the building installation wiring. Select a wall breaker and wire sizes according to Table 3.

CAUTION: ALL RECTIFIERS EMPLOY INTERNAL DOUBLE POLE/NEUTRAL FUSING

Use single or double hole, UL listed lugs for the bulk DC connections, based on shelf circuit, to prevent lug rotation and inadvertent contact with other circuits. Terminal strip connections are compression screws.

Class 1 wire is recommended for all DC connections. Minimum wire sizes are shown in Table 4 and Table 5. In practice, loop voltage drop considerations will usually dictate larger than Minimum safe wire size.

The alarm contacts are rated for a maximum voltage of 60 VDC and a maximum continuous current of 0.5 A.

Connection and mounting torque requirements are listed in Table 6.

Valere does not recommend transporting or shipping the power shelf with the rectifiers installed. Rectifiers should be shipped in separate boxes provided by Valere Power.
1.2 FCC Compliance Statement

Note: This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

1.2.1 Warning

Changes or modifications to this unit not expressly approved by the party responsible for the compliance could void the user's authority to operate this equipment.
2 Product Section

2.1 Rectifier Specifications

Table 1 shows the DC voltage range and max current for each model of rectifier for this system.

<table>
<thead>
<tr>
<th>Model</th>
<th>AC Input Range(Nominal)</th>
<th>Voltage Min/Max</th>
<th>Rated Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>J0600A1</td>
<td>100VAC-240VAC</td>
<td>42VDC-56VDC</td>
<td>12amps</td>
</tr>
<tr>
<td>J1500A1</td>
<td>100VAC-185VAC</td>
<td>42VDC-56VDC</td>
<td>25amps</td>
</tr>
<tr>
<td>J1500A1</td>
<td>185VAC-264VAC</td>
<td>42VDC-56VDC</td>
<td>30amps</td>
</tr>
</tbody>
</table>

Table 1 - Rectifier Specifications

2.2 Heat Dissipation

Table 2 displays the typical and maximum heat dissipation for the Valere Power rectifiers. “Typical” is calculated at AC 240 V, and typical DC voltage and current values for the rectifier. “Maximum” is calculated at AC 180 V and maximum DC voltage and current values for the rectifier.

<table>
<thead>
<tr>
<th>Model</th>
<th>Typical</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>J0600A1</td>
<td>243</td>
<td>373</td>
</tr>
<tr>
<td>J1500A1</td>
<td>507</td>
<td>778</td>
</tr>
<tr>
<td>(low line)</td>
<td>148</td>
<td>228</td>
</tr>
<tr>
<td>J1500A1</td>
<td>608</td>
<td>933</td>
</tr>
<tr>
<td>(high line)</td>
<td>178</td>
<td>273</td>
</tr>
</tbody>
</table>

Table 2 - Heat Dissipation

2.3 AC Input Requirements

2.3.1 AC Input Diagrams

This system utilizes a single feed AC architecture (as shown in Figure 1) via rear accessed, terminal block inputs. See Table 3 for maximum input current ratings.

The AC architecture can be determined from the model number of the shelf. The model number of the shelf can be found on the right side, near the rear of the shelf. The sticker will have a Valere Power logo on it. To determine the circuit number, find the model number, i.e. Model: JK35S-ZNL-VT. The fifth character (in this case the character S) in the first section is your AC type. The valid AC architecture is ‘S’ for single. Find the corresponding AC wiring diagram on the next page.
2.3.1.1 Single feed

A single feed architecture powers all three rectifier slots on one AC feed. Connect the feed, sized according to Table 3, onto the compression screws as seen in Figure 5. The AC terminal block on the rear of the shelf will accept wire between 24 AWG and 8 AWG connections should be torque to 4 in-lbs. A 1” knockout is provided for cable entry to the AC block. This knockout will accept either a Valere provide AC cord grip or a customer supplied conduit.

2.3.2 AC Wire Sizing

Use Table 3 to size your AC feed properly. Failure to size the AC breaker and wiring properly can result in nuisance breaker trips or even fire. If you anticipate future growth, size the AC breaker and wiring for the expected future capacity. ALWAYS FOLLOW NEC RULES AND YOUR LOCAL COMPANY PRACTICES WHEN SELECTING AC WIRING AND PROTECTION.

Follow the example below for determining AC breaker and wire sizing.

EXAMPLE:

2.3.2.1 Use section 2.3.1 above to determine the AC input type, for example a single feed.
2.3.2.2 Determine the quantity and model number of the rectifiers, for example three J1500A1 (48V, 30A).
2.3.2.3 Use Table 1 to determine the required AC input voltage. The J1500A1 rectifier will accept either low line or high line AC voltage.
2.3.2.4 Using Table 3, this system will require a 50 amp breaker with 8 AWG wire, at low line, or a 50 amp breaker with 8 AWG wire at high line.

NOTE: Under-sizing your AC breaker and wiring could cause nuisance breaker trips and system outages.
Table 3 uses a minimum nominal input voltage to determine AC current requirements. 90Vac corresponds to a nominal low line voltage of 120Vac and 180Vac corresponds to a nominal highline voltage of 208 Vac.

<table>
<thead>
<tr>
<th>Fully Equipped Shelf</th>
<th>Number of Rectifiers on each AC Feed</th>
<th>Model Number of Rectifier</th>
<th>Minimum Input Voltage</th>
<th>Maximum rated AC Current</th>
<th>Minimum circuit breaker</th>
<th>90 °C Minimum Wire Gauge to use at 30 °C ambient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use only if 1 rectifier is the maximum that will be installed on a single AC feed</td>
<td>1</td>
<td>J0600A1</td>
<td>90</td>
<td>8.1</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J0600A1</td>
<td>180</td>
<td>4.4</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J1500A1</td>
<td>90</td>
<td>16.8</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J1500A1</td>
<td>180</td>
<td>10.9</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>Use only if 2 rectifiers are the maximum that will be installed on a single AC feed</td>
<td>2</td>
<td>J0600A1</td>
<td>90</td>
<td>16.2</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J0600A1</td>
<td>180</td>
<td>8.7</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J1500A1</td>
<td>90</td>
<td>33.7</td>
<td>50</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J1500A1</td>
<td>180</td>
<td>21.9</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>Single feed</td>
<td>3</td>
<td>J0600A1</td>
<td>90</td>
<td>24.2</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J0600A1</td>
<td>180</td>
<td>13.1</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J1500A1</td>
<td>90</td>
<td>50.5</td>
<td>60</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J1500A1</td>
<td>180</td>
<td>32.8</td>
<td>50</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 3 - Recommended AC Circuit Breaker and Wire Sizes

2.4 DC Output Requirements

2.4.1 DC Circuit Drawings

The DC circuit number can be determined from the model number of the shelf. The model number of the shelf can be found on the right side of the shelf near the rear of the shelf. The sticker will have a Valere Power logo on it. To determine the circuit number, find the model on the shelf, i.e. Model: JK35S-ZNL-VT. The middle digits in the first section (in this case the number 35) are your circuit number. Valid circuits include circuit 35. Find the corresponding figure in the following sections for your circuit number.

This circuit is available with an option for a battery LVD. You can determine if a system has an LVD and shunt from the model number of the shelf. The model number of the shelf can be found on the right side of the system, near the rear. From the model number above, the third character in the second section (in this case the letter L) indicates the system has a battery LVD & shunt.
2.4.1.1 Circuit 35

![DC Wire Diagram (Circuit 35)](image)

Each system is equipped with 10 GMT fused connections and one battery circuit breaker protected fused connection with an optional battery LVD and shunt shown in Figure 2. The GMT fuse connections are made on a "lugless" terminal block with compression screws. The GMT terminal block will accept wires sizes up to 12 AWG and a max fuse of 15A. All circuit breaker connection are a double #8-32 studs with 5/8" centers. These connections have a max tongue width of 0.42". Do not connect load equipment in series with a battery LVD and shunt protected output. An extra return position is provided for a DC reference ground (See section 2.4.2). Size wires based on the total rectifier capacity and choose conductor size according to Table 5.

Note: The battery LVD and shunt have a maximum continuous current capacity of 80 amps.

2.4.2 DC Reference Ground

The Valere Power system is a fully floating system. This means that the DC return bus bar is not tied to the chassis or an earth ground. An external reference or earth ground may be connected to any return position or to the "DC reference ground" connection. The DC reference ground attachment point is internally hard wired connected to all fuse, circuit breaker, and bulk return points. As always follow your company’s guidelines for sizing and attaching a reference ground.

2.4.3 DC Wire sizing

There are two main considerations for sizing DC wire, ampacity and voltage drop. Ampacity refers to a safe current carrying level as specified by non-profit organizations such as Underwriters Laboratories and the National Fire Prevention Association, which publishes the National Electric Code. Voltage drop is simply the amount of voltage loss in a length of wire due to ohmic resistance of the conductor. DC wire may be sized for either ampacity or voltage drop depending on branch load.
loop length and conductor heating. In general, ampacity considerations will drive wire selection for short loop lengths (less than 50 feet) and voltage drop will drive wire selection for long loop lengths (greater than 50 feet). The National Electric Code table 310.16 provides ampacity values for various sizes, bundles, and insulation temperature rated wire. ALWAYS FOLLOW NEC RULES AND YOUR LOCAL COMPANY PRACTICES WHEN SELECTING DC WIRING AND PROTECTION. Table 5 shows recommended wire sizes based on ampacity.

2.4.3.1 GMT Fuses Connections

Fuse protected wires shall be based on the protector size rating. For example, using Table 4 below, a 10 A fuse requires #20 AWG wire.

| GMT fuse Rating | Wire & Lug Gauge (AWG) using 90° C wire (NEC Table 310.16) | | |
|-----------------|-----------------------------------------------------------|---|
| Amps            | AWG | mm² |
| 1               | 24  | 0.25 |
| 2               | 24  | 0.25 |
| 5               | 24  | 0.25 |
| 7.5             | 22  | 0.5  |
| 10              | 20  | 0.75 |
| 15              | 18  | 1.0  |

Single conductor in free air 30° C ambient temperature

Table 4 - Minimum Recommended DC Wire Size

2.4.3.2 Circuit Breaker Connections

Circuit breaker protected output wires shall be based on the protector size rating. For example, using Table 5 below, a 20 A breaker requires a #12 AWG wire.

| Current Protector Rating | Wire & Lug Gauge (AWG) using 90° C wire (NEC Table 310.16) | | |
|--------------------------|-----------------------------------------------------------|---|
| Amps                     | AWG | mm² |
| 5*                       | 18  | 1.0  |
| 10*                      | 16  | 1.5  |
| 20                       | 12  | 4.0  |
| 30                       | 10  | 6.0  |
| 40                       | 8   | 10.0 |
| 50                       | 8   | 10.0 |

* - Wire sizing for circuits less than 15 A are based on Table 3B - Sizes of Conductors, UL60950, “Safety of Information Technology Equipment”, Dec., 2000 for non-building wiring.

Table 5 – Minimum Recommended DC Wire Size
2.5 Torque Settings

Table 6 shows recommended torque settings for all mechanical and electrical connections according to screw or nut size.

<table>
<thead>
<tr>
<th>Screw or Nut Size</th>
<th>Torque (in-lbs)</th>
<th>Torque (n-m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-40</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>6-32</td>
<td>12</td>
<td>1.5</td>
</tr>
<tr>
<td>8-32</td>
<td>22</td>
<td>3</td>
</tr>
<tr>
<td>10-32</td>
<td>37</td>
<td>4.25</td>
</tr>
<tr>
<td>12-24</td>
<td>50</td>
<td>5.75</td>
</tr>
<tr>
<td>¼-20</td>
<td>65</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Table 6 - Recommended Torque Settings

2.6 Required Tools

Valere rectifiers are designed to be installed with a minimum number of commonly available tools:

- #1 & #2 flat blade screwdrivers
- Torque wrench
- 5/16" or 7/16" socket
- Wire and cable strippers
- Wire and cable crimpers

3 Site and Equipment Preparation

Before unpacking the DC power plant, note any physical package damage that could indicate potential damage to the contents. After removing DC Power Plant from boxes and packing material, inspect for shipping and/or other damage. Contact sales or technical support immediately if any damage is present. Have all tools, wire, cables, hardware, etc., within easy reach. To the extent possible, ensure a clean (free of debris, dust, foreign material, etc.) work environment. Care should be taken in the installation process to prevent exposure of the equipment to wire clippings. If possible, the rectifiers should remained sealed in their shipping boxes until the shelf wiring is complete. Ensure all AC and DC power sources are off and disconnected.

4 Power Plant Mounting and Wiring

4.1 Mechanical Mounting

This equipment is intended for normal operations and is to be installed in a standard 19” telecommunications rack. It is recommended that one person lift the shelf into place while another installs the supplied mounting hardware. Torque mounting hardware according to Table 6.
4.2 AC input

4.2.1 Single Feed

Remove safety cover over the AC section. Remove the knockout and install an AC cord grip or conduit to feed AC wires to the terminal block. Feed AC wires through knockout and connect wires from AC cord into the appropriate positions labeled in Figure 5. Connect your AC ground first, followed by the line/hot to Line 1, and your second line or neutral to Line 2/N. Tighten screws to 13 in-lbs and replace AC section safety cover.
4.3 DC Output

4.3.1 Circuit 35

Both GMT fused outputs and circuit breaker outputs are located on the rear of the system, while actual fuses and circuit breakers are installed on the front of the system. Place wires in the output connections labeled 1 – 10 on Figure 7 and corresponding return, and compress the screws to 4 in-lbs. Place a fuse into the corresponding position into the fuse holder in Figure 6. For the circuit breaker connection, place lugged wire on the corresponding output and return studs and secure the connection with the provided nuts and washers. Install circuit breaker in battery circuit breaker slot.

![Figure 6 - Front View Distribution Inputs (Circuit 35)](image)

![Figure 7 - Rear View DC Connections (Circuit 35)](image)

4.3.2 Alarm connections

Alarm connections are available with the TRIO included on the rear of the shelf.

The four form C contacts are available through a connector, labeled as “alarm relay cable connections”, as shown in Figure 8. The cable has a shelf mating connector (Valere side) on one end and bare tin wire (customer end) on the other. Contacts may be used in parallel in locations where alarm transport capacity is limited.
Table 7 lists the wire color code for the form C relays available with the TRIO board, based on the default profile in a system without a NIC. See DO600000201 - NIC controller manual for information on alarm relays with a NIC installed.

<table>
<thead>
<tr>
<th>Alarm Channel</th>
<th>Functional Designation</th>
<th>Wire Color</th>
<th>Alarm Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>NC</td>
<td>Orange/White stripe</td>
<td>Contact Opens On Alarm</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>Orange</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td>Orange/Black stripe</td>
<td>Contact Closes On Alarm</td>
</tr>
<tr>
<td>B</td>
<td>NC</td>
<td>Red/White stripe</td>
<td>Contact Opens On Alarm</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>Red</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td>Red/Black stripe</td>
<td>Contact Closes On Alarm</td>
</tr>
<tr>
<td>C</td>
<td>NC</td>
<td>Green/White stripe</td>
<td>Contact Opens On Alarm</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>Green</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td>Green/Black stripe</td>
<td>Contact Closes On Alarm</td>
</tr>
<tr>
<td>D</td>
<td>NC</td>
<td>Yellow/White stripe</td>
<td>Contact Opens On Alarm</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>Yellow</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td>Yellow/Black stripe</td>
<td>Contact Closes On Alarm</td>
</tr>
</tbody>
</table>

Table 7 - Alarm Cable Color Code
4.3.3 Auxiliary Input Alarms

The temperature probe ports on the TRIO are operational as auxiliary input alarms without a NIC installed and are set to accept a normally open contact closure. To use a temperature probe input port as an external alarm channel, simply connect a dry contact relay into any of the input connectors using the cable, CA210022376. The system will automatically detect a contact closure and trigger an alarm on relay D. See DO600000201 – NIC controller manual for procedure to setup temperature probe inputs for other configurations (NIC required).

4.3.4 Temperature Probes

The temperature probe ports on the TRIO are only operational with a NIC installed. The temperature probe (sold separately) consists of a cable with a two pin Molex connector on each end and a thermistor. Place the thermistor onto the batteries, and connect the temp probe wire into the thermistor. Then connect the other end into the TRIO (temp probe on Figure 8) at any open temperature probe positions pointed out in Figure 8. Repeat for additional battery string(s). The temperature probes are used to monitor temperature of the batteries and for temperature compensation. See NIC manual for procedure to setup temperature probes.

4.3.5 Ethernet Connections

Access to the NIC (Optional) can be accomplished via the rear accessed Ethernet connection (Figure 8), if a NIC is installed. Connect to the Ethernet port according to Application Bulletin 200 “Quick Start Guide: Connecting to the LAN Port”. The NIC will be installed in the slot pointed out in Figure 3 behind the front accessed distribution door. See NIC manual D0600000201 for operation instruction.

5 Test and Turn-Up

5.1 Power Up

After all input and output connections have been secured and checked, activate all input breakers. When input breakers are on, install each rectifier sequentially by sliding the rectifier into position and closing the latch as shown in Figure 9. Rectifier latches must be open for installation. Attempting to install rectifiers with latches closed can result in mechanical damage to the rectifiers and the shelf. Rectifier fans will start in high-speed mode and reduce their speed according to the ambient and plant conditions within 10 seconds. If an LVD is installed an LVD alarm may be present for 20 seconds, until the LVD contactor closes.

If a NIC is installed it will automatically recognize the rectifiers and set itself appropriately.
6 Replacement Items

The rectifiers and the NIC are designed as modular, field replaceable units. The following section outlines the procedure to replace a rectifier. The TRIO is not a field replaceable item. See DO600000201 – NIC controller manual for NIC replacement instructions.

6.1 Rectifiers

In the event that a rectifier needs to be removed, press the latch button on the front of the rectifier, and pull the handle until the rectifier slides out of the slot. With the latch open on the replacement rectifier, slide the rectifier in until it connects with the backplane. Once inserted press the latch button closed. The rectifier will power up and configure itself.

7 Troubleshooting

The modular, plug-n-play nature of this plant makes diagnostics and repair very easy. Make sure that all rectifiers are properly seated and latched into their respective slots. Make sure that all power and signal connectors are properly mated. The following table is a list of problems and solutions Table 8 is for systems without a NIC; see NIC installation manual for troubleshooting with NIC.

Note: Troubleshooting without a NIC

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Problem</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Fail and DC OK LED is extinguished</td>
<td>A rectifier has stopped outputting power</td>
<td>Replace failed rectifier</td>
</tr>
<tr>
<td>AC Fail and all LEDs are extinguished</td>
<td>Commercial power has been lost to the specified rectifiers.</td>
<td>Reset commercial circuit breaker to the dedicated AC circuit that feeds system. Seek alternative power source until power is restored.</td>
</tr>
<tr>
<td>Fuse open</td>
<td>A fuse is in an open state</td>
<td>Replace open fuse</td>
</tr>
</tbody>
</table>

Table 8 - Problems and Solutions without NIC