This document outlines the standard service delivery for E-Line/EPL

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Arvig’s E-Line/EPL Service is a carrier grade transport making it possible to meet bandwidth demands with a cost effective, scalable alternative to legacy connectivity solutions such as TDM, SONET, ATM and Frame Relay networks. EPL Service delivered over our own network is a managed Ethernet solution connecting your LANs within the same metropolitan area or across regions using an optical fiber transport. Our network provides you with fiber optical service for flexible high bandwidth options ranging from Fast Ethernet to Gigabit Ethernet and even to 10 Gigabit Ethernet to help you meet your growing Ethernet application needs.

EPL provides basic Layer-2 point-to-point WAN connectivity where Ethernet is carried over our fiber allowing your network services and applications to be efficiently and economically delivered between two locations. It is an end-to-end Ethernet network service where you attach your LAN to a User-Network Interface (UNI) using standard Ethernet port interfaces to access the Arvig network. An Ethernet Virtual Connection (EVC) is used to connect two UNIs to enable the transfer of Ethernet service frames between them.

**EPL & EVPL SERVICES**

E-Line is a point-to-point service with two general flavors; 1) Ethernet Private Line (EPL), 2) Ethernet Virtual Private Line (EVPL). This service description focuses on EPL.

Arvig EPL is characterized as a port-based “transport” service providing payload transparency with no service multiplexing. This port-based service is also referred to as All-to-One Bundling since a single EVC is used to connect two UNIs and all untagged and priority tagged service frames are mapped to this single EVC. With EPL, a single point-to-point Ethernet virtual connection links two UNIs to deliver transparent LAN interconnection.

EVPL is characterized as having service multiplexing capability (can have multiple EVCs) with one or more EVCs profiling service attributes such as bandwidth, Class of Service, VLAN switching. EVPL is also characterized as VLAN-based and enables one or more VLAN IDs to be mapped to one or more EVCs. Unlike EPL, this requires Arvig and the customer to agree on VLAN IDs used at the UNI and the mapping between each VLAN ID and EVC. With EVPL, multiple Ethernet virtual connections can link two UNIs to provide connectivity for multiple VLANs.

**E-LINE / EPL SERVICE SUMMARY**

Arvig’s EPL is a simple point-to-point E-Line service connecting two locations. Ethernet packets are delivered over an economic and efficient fiber optic cable and offers large bandwidth capabilities. Bandwidth upgrades are carried out easily on the same Ethernet interface since no physical work is required.

EPL service is comprised of two UNI Ethernet interfaces interconnected by a logical circuit known as an Ethernet Virtual Circuit (EVC). This service is a highly transparent and flexible means to interconnect two locations utilizing your standard, very cost effective IEEE-compliant Ethernet interfaces found on a variety of platforms.
EPL is an ideal replacement for existing leased line service and requires little to no coordination between you and Arvig. It is a point-to-point service connecting two sites. Only one EVC is used (or permitted) to connect the non-multiplexed UNI ports on either side for enabling the transfer of Ethernet service frames between them.

All customer traffic is mapped to a single EVC (all-to-one-bundling) making circuit setup and delivery simple and ensures Ethernet packets entering the ingress are the same when they egress providing payload transparency.

EPL uses dedicated, non-multiplex UNI ports with a transparent point-to-point EVC for connecting two locations. A location connected to a second location via EPL needing to connect to another (i.e. hub-and-spoke fashion) would do so using a separate EPL circuit. The hub site will have a dedicated port for each branch location. You may want to consider EVPL service over EPL for hub-and-spoke configurations with several locations since the hub location can connect to all the remote locations over a single multiservice port.
ROUTE PROTECTION – CORE-NETWORK

Protected Service
The Arvig metro core infrastructure deploys MPLS-FRR, G.8032 or REP Ethernet Ring Protection Switching providing a SONET-like resiliency and high capacity with protected optical circuits, high availability, and failover capability without the higher cost of SONET technology.

In metro areas, buildings not located on the main core may be grouped together into collector rings. In the event of a failure such as a fiber break, continuous service will be provided using failover protection within switches to divert traffic via service protect path within sub-second time-frames. Wherever we have an Ethernet ring capable of Fast Re-route, EVCs transversing the ring will be network protected.
ROUTE PROTECTION – LOCAL NETWORK

Unprotected
A single unprotected lateral (single pair of fiber) coming in through a single entrance into the customer building is the standard configuration over which Ethernet services are delivered. This provides a reliable, cost effective solution; however, in the unlikely event of a fiber or equipment port failure, service will be interrupted.

Optional Standard Protection
Additional local network route protection can be added by provisioning a second redundant lateral. The two linear fiber pair are dual-homed to a core-network switch and is managed using Link Aggregation Control Protocol (LACP). Link Aggregation provides for Layer 2 traffic rerouting pending failure of either uplink trunk port, core switch port, or connecting fiber laterals. This option does not provide additional bandwidth beyond the purchased bandwidth.

Enhanced Protection
Enhanced local network protection such as dual building entrances and/or diverse lateral paths will be considered on an individual case basis.
DEMARCATION

The demarcation is the User Network Interface (UNI), which is a Arvig installed Cat-6 patch panel or Fiber Distribution Panel (cross-connected to Arvig transport equipment – ie. Ethernet switch) located in the Minimum Point of Entry (MPOE) for the facility. Customers are responsible for extending the demarc to their wire/LAN closet, office suite, colocation, etc. Customer facing ports will be configured for full-duplex operation.

A wide-range of standard interfaces are supported for handoff to customer equipment.

<table>
<thead>
<tr>
<th>Port Size</th>
<th>Medium</th>
<th>Connection Type</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>10Mbps</td>
<td>Electrical Copper</td>
<td>10BASE</td>
<td>RJ45 jack on Cat-6 patch panel</td>
</tr>
<tr>
<td>100Mbps</td>
<td>Electrical Copper</td>
<td>100BASE</td>
<td>RJ45 jack on Cat-6 patch panel</td>
</tr>
<tr>
<td>1Gbps</td>
<td>Electrical Copper</td>
<td>1000</td>
<td>RJ45 jack on Cat-6 patch panel</td>
</tr>
<tr>
<td>1Gbps</td>
<td>Optical MMF; SMF</td>
<td>1000BASE</td>
<td>FC/PC or SC type connector into FDP</td>
</tr>
<tr>
<td>10Gbps</td>
<td>Optical MMF; SMF</td>
<td>10GBASE</td>
<td>FC/PC or SC type connector into FDP</td>
</tr>
</tbody>
</table>

For copper demarcs, the Cat-6 patch panel will be patched in a straight-through configuration. The maximum distance for extending the copper demarc is approximately 300 ft. Fiber distance from the demarc is approximately 1,600 feet.
ARVIG EQUIPMENT

Switches deployed within customer building for service delivery will utilize one UNI per customer. Two or more customers will not share the same UNI port.

It is expected for Arvig equipment to be installed within established telecom closets. Arvig provided equipment has versatile mounting options for installing in racks or backboards with AC or DC power options.

Backup power (i.e. UPS) may be installed at Arvig’s discretion to help safeguard against power outages on Arvig provided equipment.

CUSTOMER PREMISE EQUIPMENT

Customer is responsible for providing their own premise-based equipment. Arvig does sell and manage customer premise-based equipment through our Managed Services product. Contact Arvig for details on this service.

TRAFFIC MANAGEMENT

FIXED BANDWIDTH

Standard bandwidth is provided at a fixed-rate basis, meaning there is no bursting component. Customers are charged a single flat-rate based on a Committed Information Rate – i.e. the upper limit the traffic information rate may not exceed.

<table>
<thead>
<tr>
<th>Port</th>
<th>Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>100Mbps FastE</td>
<td>10, 20, 30, 40, 50, 100Mbps</td>
</tr>
<tr>
<td>1000Mbps GigE</td>
<td>100, 200, 300, 400, 500, 600, 700, 800, 900, 1000Mbps</td>
</tr>
<tr>
<td>10Gbps 10GigE</td>
<td>1, 2, 3, 4, 5, 10Gbps</td>
</tr>
</tbody>
</table>

The default service profile will be to rate-limit the customer’s selected bandwidth on the UNI port based on EVC profile.

BURSTING BANDWIDTH

A burstable bandwidth option is available and offers Committed Information Rate (CIR), plus the opportunity to use additional bandwidth (Excess Information Rate-EIR) beyond the CIR up to an agreed upon limit. Service is “Best Effort” for bandwidth above the agreed to CIR.
### TRAFFIC MANAGEMENT

<table>
<thead>
<tr>
<th>Port</th>
<th>Bandwidth (CIR)</th>
<th>Max Burst Possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>100Mbps FastE</td>
<td>10, 20, 30, 40, 50, 100Mbps</td>
<td>90, 80, 70, 60, 50, 0Mbps</td>
</tr>
<tr>
<td>1000Mbps GigE</td>
<td>100, 200, 300, 400, 500, 600, 700, 800, 900, 1000Mbps</td>
<td>900, 800, 700, 600, 500, 400, 300, 200, 100, 0Mbps</td>
</tr>
<tr>
<td>10Gbps 10GigE</td>
<td>1, 2, 3, 4, 5, 10Gbps</td>
<td>9, 8, 7, 6, 5, 0Mbps</td>
</tr>
</tbody>
</table>

Bursting is billed and calculated at the 95th percentile. How it works:
+ Every month, customer commits to a given level of usage.
+ Every 5-minutes, a polling system checks usage (both sent and received).
+ At the end of the month, the samples are sorted smallest to largest.
+ The highest 5% of samples are discarded.
+ The top remaining value is used in determining bursting rate.

Monthly Charge = $Committed Rate + ( [ Bursting Rate - Committed Rate ] x $Bursting Charge )

### VLANS

EPL services allow customers to send untagged frames in addition to VLAN tagged frames. Customer VLANs are preserved and customers are free to assign any VLAN IDs they want. All untagged and tagged frames are assigned to the single EVC connecting the customer’s two UNIs in a transparent manner.

### CLASS OF SERVICE / DATA PRIORITIZATION

EPL service provides full-duplex communication between a customer’s two sites. By default, a customer’s traffic is not prioritized and is sent as best effort using first-in, first-out queuing. Customers may add-on a Class of Service (CoS), allowing prioritization of traffic.
Class of Service mapping for Arvig Priority levels are:

<table>
<thead>
<tr>
<th>Arvig Priority Level</th>
<th>Layer-2 Class of Service</th>
<th>Layer-3 DiffServ (DSCP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority 1</td>
<td>5</td>
<td>5 (40-47)</td>
</tr>
<tr>
<td>Priority 2</td>
<td>4</td>
<td>4 (32-39), 6 (48-55), 7 (56-63)</td>
</tr>
<tr>
<td>Priority 3</td>
<td>2, 3</td>
<td>2 (16-23), 3 (24-31)</td>
</tr>
<tr>
<td>Priority 4</td>
<td>0, 1</td>
<td>0 (0-7), 1 (8-15)</td>
</tr>
</tbody>
</table>

CoS is applied to individual EVCs where 802.1p priority bits within the subscriber’s 802.1Q VLAN tags will be used. Layer-3 IP precedence (DiffServ) classification may also be specified. For IP traffic classification, the IP precedence value within incoming subscriber packets will be used. Customers are responsible for shaping their traffic to conform to their chosen priority levels. In other words, they are responsible for setting 802.1p or ToS bits within their network equipment.

**ETHERNET FRAMES**

Supported Ethernet frames include Ethernet Version 2 (Ethernet II frame / DIX frame) or IEEE 802.3 with LLC header. Ethernet frames will be delivered with MAC addresses and frames unchanged. Unicast, multicast and broadcast frames will also be forwarded. The Maximum Transmission Unit (MTU) is 1508 bytes (excluding 802.1q header) for 10/100Mbps port and 9000 bytes (excluding 802.1q header) for 1000Mbps/10Gbps ports.

**SHARED / COMMITTED BANDWIDTH**

Default service delivery for EVPL is Best Effort, meaning bandwidth may be shared with other customers. Arvig engineers monitor and manage network traffic to ensure optimum performance for all customers. All bandwidth size options are available with standard Shared service. Committed bandwidth reserves the customer’s selected bandwidth across the entire Arvig network. Arvig may architect committed bandwidth using an internal EVC CoS or SONET or DWDM. For example, if a customer procures 1Gbps committed bandwidth, that bandwidth is reserved and cannot be used by any other customer traffic. The following bandwidth is available for Committed service:

<table>
<thead>
<tr>
<th>Port</th>
<th>Committed Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>100Mbps FastE</td>
<td>100Mbps</td>
</tr>
<tr>
<td>1000Mbps GigE</td>
<td>100, 200, 300, 400, 500, 600, 700, 800, 900, 1000Mbps</td>
</tr>
<tr>
<td>10Gbps 10GigE</td>
<td>1, 2, 3, 4, 5, 10Gbps</td>
</tr>
</tbody>
</table>

**IP ROUTING / SWITCHING**

Customer is responsible for their own IP routing between service locations.

**IP ADDRESSING**

Customer controls their internal IP addressing.
SERVICE LEVELS

INSTALL INTERVAL
+ On-Net: 45 business days
+ Near-Net: 90 – 120 days typical

NETWORK SERVICE LEVEL AGREEMENT
+ Network Availability (up-time): 99.5% (unprotected) | 99.95% (protected)
+ Latency: > 15ms within 500 fiber miles
+ Packet Loss: < 0.01%
+ MTTR: 8 hours (unprotected) | 4 hours (protected)

PERFORMANCE MONITORING / REPORTING
Arvig has several Network Control Centers and proactively monitors Ethernet services and performs maintenance and repair twenty-four (24) hours per day, seven (7) days per week, three hundred sixty-five (365) days per year. In addition to monitoring services, Arvig proactively manages the network by performing routine and scheduled equipment hardware and firmware upgrades.

A comprehensive database of all relevant information associated with fiber routes and equipment are maintained to ensure prompt identification and appropriate response to routine and corrective maintenance situations. The database identifies and documents the Arvig network and all facilities installed in the Arvig network including customer’s fiber optic cable type, number and color coding of fiber strands, origin and destination of each fiber strand, identification of in-use cables, technical requirements and specifications.

REPORTING
Customers are provided with a login to monitor their service for real-time monitoring, network alarming, statistics and notifications. This service is available with an SLA.

+ Online network statistics on performance and utilization
+ Availability and performance monitoring
+ Event & fault management
+ System warnings that are monitored to prevent outages
+ Automated phone or email notifications of faults
+ Online, real-time reporting of network performance
+ Monthly reports summarizing network events, faults, and network performance

CUSTOMER SUPPORT
Customers can contact Arvig for support 24x7x365 using the toll-free number or email.
PRODUCT BUNDLING

PRICING ELEMENTS

<table>
<thead>
<tr>
<th>Element</th>
<th>Billing Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port (UNI)</td>
<td>MRC based on port size / per location</td>
</tr>
<tr>
<td></td>
<td>NRC based on port size / per location</td>
</tr>
<tr>
<td>EVC (Shared-Bandwidth)</td>
<td>MRC based on bandwidth (only one EVC allowed)</td>
</tr>
<tr>
<td>EVC (Committed-Bandwidth)</td>
<td>MRC based on bandwidth (only one EVC allowed)</td>
</tr>
<tr>
<td>Local Network Route Protection</td>
<td>MRC based on port size / per locationDiverse Lateral ICB</td>
</tr>
<tr>
<td>Class of Service</td>
<td>MRC per defined Class of Service</td>
</tr>
<tr>
<td>Bursting</td>
<td>NRC per Megabyte overage</td>
</tr>
</tbody>
</table>

CONTRACT TERMS

No month-to-month. 1, 2, 3, 5-year terms. 5-year term may be required for lateral builds.

SERVICE SUMMARY

<table>
<thead>
<tr>
<th>Service Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-Line</td>
</tr>
<tr>
<td>Port Interface</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
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<tr>
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<tr>
<td></td>
</tr>
<tr>
<td>EVC Bandwidth (Shared)</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>EVC Bandwidth (Committed)</td>
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<tr>
<td></td>
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<tr>
<td>Bandwidth Options</td>
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<td></td>
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<tr>
<td>Bursting</td>
</tr>
<tr>
<td>Prioritization</td>
</tr>
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<td>Route Protection</td>
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<td></td>
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<tr>
<td>10Mbps</td>
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<td>10BASE-T</td>
<td>RJ45 jack on Cat-6 patch panel</td>
</tr>
<tr>
<td>100Mbps</td>
<td>Electrical Copper</td>
<td>100BASE-TX</td>
<td>RJ45 jack on Cat-6 patch panel</td>
</tr>
<tr>
<td>1Gbps</td>
<td>Electrical Copper</td>
<td>1000</td>
<td>RJ45 jack on Cat-6 patch panel</td>
</tr>
<tr>
<td>1Gbps</td>
<td>Optical MMF; SMF</td>
<td>1000BASE-SX</td>
<td>FC/PC or SC type connector into FDP</td>
</tr>
<tr>
<td>10Gbps</td>
<td>Optical MMF; SMF</td>
<td>10GBASE-SR, 10GBASE-LR</td>
<td>FC/PC or SC type connector into FDP</td>
</tr>
</tbody>
</table>

### Bursting Options

<table>
<thead>
<tr>
<th>Port</th>
<th>Bandwidth</th>
<th>Max Burst Possible</th>
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<tbody>
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<td>1000Mbps GigE</td>
<td>100, 200, 300, 400, 500, 600, 700, 800, 900, 1000Mbps</td>
<td>900, 800, 700, 600, 500, 400, 300, 200, 100, 0Mbps</td>
</tr>
<tr>
<td>10Gbps 10GigE</td>
<td>1, 2, 3, 4, 5, 10Gbps</td>
<td>9, 8, 7, 6, 5, 0Mbps</td>
</tr>
</tbody>
</table>

### Ethernet Frames

- **Support Frame Types**: Ethernet II frame / DIX frame, IEEE 802.3 with LLC header
- **MTU (excluding 802.1q header)**: 1508 bytes (10Mbps/100Mbps ports), 9000 bytes (1000Mbps/10Gig ports)
- **Layer-2 Control Protocols**: Supported

### Service Levels

<table>
<thead>
<tr>
<th>Metric</th>
<th>Service Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Availability</td>
<td>99.5% (unprotected)</td>
</tr>
<tr>
<td>Latency</td>
<td>&gt; 15ms within 500 fiber miles</td>
</tr>
<tr>
<td>Packet Loss</td>
<td>&lt; 0.01%</td>
</tr>
<tr>
<td>MTTR</td>
<td>NRC per Megabyte overage</td>
</tr>
</tbody>
</table>