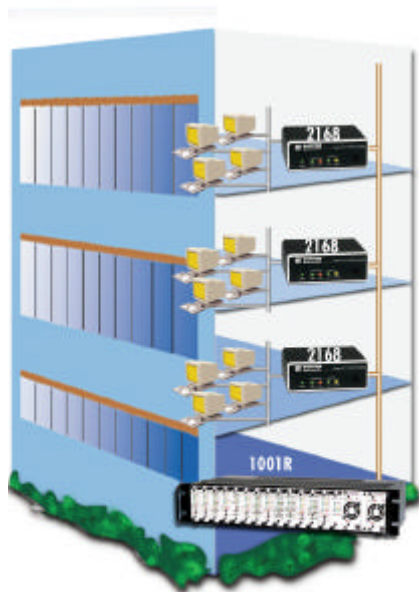


**Applications****What is the primary application for the Model 2168 Multi-Rate CopperLink Ethernet Extender?**

Used in pairs, the Patton Model 2168 establishes a high-speed (up to 16.67Mbps) communications link inter-connecting two geographically separated LANs or network enabled devices. Operation is simple: packets destined for the remote LAN are sent transparently, at full line rate, to the peered LAN. CopperLink Ethernet Extenders utilize ordinary voice-grade wire thus eliminating the cost and common barriers associated with installing new cable or expensive fiber.

In this application, the multi-rate Ethernet Extenders are being used to bridge Ethernet spans inside buildings that are beyond the 328-foot (100-meter) distance limitations of Ethernet.

For example, connecting workgroups located on different floors in a building no longer requires expensive switches or the installation of low capacitance cable.

Other Applications include:

- MTU/MDU Internet Services
- Network Backbones
- Remote Workstations and Equipment
- ISP Last Mile Extension

**Product Related Questions****How is the CopperLink connection established?**

Four steps are required to establish a communications link between the two Model 2168 Ethernet Extenders (Local and Remote) and the respective network devices.

- 1) Connect the 10/100Base-TX devices to the Ethernet port of each 2168 unit.
- 2) Connect each end of the twisted-pair wire to the CopperLink port of each 2168 unit.
- 3) Plug the 2168 power supplies into a suitable power source.
- 4) Plug the output jack of each power supply to the rear power jack of each 2168 unit.

Once powered up, a communications link is established between the two 2168 units and the CopperLink LED on each 2168 unit will glow solid green.

NOTE: If line rates are changed from their original settings, both L (Local) and R (Remote) units must be set to the same line rate/dip switch settings.

**Does the Model 2168 include any management capabilities or test modes?**

No, the Model 2168 does not have any management capabilities or test modes. However, it does feature five status LED indicators to provide operational status at a glance and assist with troubleshooting.

**Why does the Model 2168 VDSL QOL/error light occasionally flash?**

When the QOL/"error" LED flashes it signifies that error correction is taking place and data integrity is maintained. It is possible for the error light to be constantly lit and the link will still function with data intact. However, when the QOL/Error LED is continuously lit, the 2168's are approaching their maximum distance capabilities under the current environment and line rate. When the QOL is constantly lit, we recommend switching the modem to a lower line rate to ensure the most reliable connection.

**What are the distance limitations of the Model 2168 using different gauge wires?**

At the default setting of 12.5 Mbps symmetrical, using 24 AWG (0.5 mm) wire, the Model 2168 is capable of providing Ethernet extensions up to 4,656 ft (1.42 km) including the potential 328 ft (100 m) Ethernet connections on both ends of the communications link. Using 26 AWG (0.4 mm) wire, the Model 2168 is capable of providing Ethernet extensions up to 3,856 ft (1.18 km). Actual distance and link performance will vary based on the environment (cross talk/noise) and type/gauge of wire used. The chart below shows an example of how the gauge of wire affects the distance.

Approximate Distances at 12.5 Mbps (Default Setting)	
Wire Gauge: AWG (mm)	Distance: Feet (km)
26 AWG (0.4 mm)	3856' (1.18 km)
24 AWG (0.5 mm)	4656' (1.42 km)
22 AWG (0.64 mm)	5256' (1.60 km)
20 AWG (0.81 mm)	5556' (1.69 km)
18 AWG (1.00 mm)	5756' (1.75 km)
16 AWG (1.29 mm)	5856' (1.78 km)

\*NOTE: Distances are based on a minimum to no cross talk environment. This distance table includes the potential 328ft (100 m) Ethernet connections on both ends of the communications link.

**Can the line rate be altered on the Model 2168 to achieve lower bandwidths and/or longer distances?**

Yes, the line rate can be altered via dipswitches on the underside of the 2168 Standalone or on the top side of the front card on the 2168RC. Distances will increase or decrease depending on the line rate selected. The chart below shows the possible configurations.

**Can the line rate be altered on the Model 2168 to achieve lower bandwidths and/or longer distances?**

Yes, the line rate can be altered via dipswitches on the underside of the 2168 Standalone or on the top side of the front card on the 2168RC. Distances will increase or decrease depending on the line rate selected. The chart on the next page shows the possible configurations.

## Can the line rate be altered on the Model 2168 to achieve lower bandwidths and/or longer distances?

Yes, the line rate can be altered via dipswitches on the underside of the 2168 Standalone or on the topside of the front card on the 2168RC. Distances will increase or decrease depending on the line rate selected. The chart below shows the possible configurations.

Asymmetrical		
Line Rates		Distance (24AWG)
Upstream (Mbps)	Downstream (Mbps)	
1.56	4.17	6,656' (2.03km)
1.56	9.38	5,756' (1.75km)
2.34	16.67	5,556' (1.69km)

Symmetrical		
Line Rates		Distance (24AWG)
Upstream (Mbps)	Downstream (Mbps)	
6.25	6.25	4,956' (1.51km)
9.38	9.38	4,806' (1.46km)
<b>12.50†</b>	<b>12.50</b>	<b>4,656' (1.42km)</b>
16.67	16.67	3,956' (1.21km)

†=Default setting

\*NOTE: Distances are based on a minimum to no cross talk environment. This distance table includes the potential 328ft (100 m) Ethernet connections on both ends of the communications link.

## What is the difference between Asymmetrical and Symmetrical modes?

In Symmetrical mode, data travels upstream (to the Internet or data source) and downstream (from the internet or data source) at the same rate. Symmetrical services are commonly used in applications requiring high speeds in both directions, which is ideally suited for business applications. Increasingly, symmetrical applications, which began with enterprise networks, are now also required by both small and medium enterprises and residential customers. Leading the list of symmetrical applications are video conferencing, interactive videos, and telecommuting.

In Asymmetrical mode, data travels downstream (from the Internet or data source) at a different rate than it travels upstream (sending to the Internet or data source). Asymmetrical services are typically faster downstream than upstream because they were designed for residential users who typically spend most of their online time downloading information. Residential users typically send a relatively small file request to the Web or video server, and then download very high volume files.

## Can the Model 2168 be configured for symmetrical or asymmetrical transmission from the field?

Yes, the Model 2168 can be configured for either symmetrical or asymmetrical transmission via dipswitch settings. The dipswitches can be found on the underside of the 2168 standalone and on the front card topside of the 2168RC. Please see the chart above for the various settings and corresponding achievable distances.

**Does the Model 2168 operate in pairs?**

Yes, the Model 2168 must operate in pairs. For each link, a Local (2168/R or 2168/L) and Remote (2168/R or 2168/L) unit is required. For concentrated applications, the 2168RC and 2168 standalone can be used to operate with the future VDSL Concentrator (Model 3324).

**Which end of the link should the "L" Local unit and "R" Remote unit be located?**

The Model 2168/L and 2168/R should be located according to their descriptions. The 2168/L unit should be placed at the Central Location and the 2168/R should be placed at the Remote Location due to special filtering requirements for each application.

**Does the Patton Model 2168 support VLAN?**

The Model 2168 will support VLAN (802.1Q) by passing the larger sized packets transparently. The Model 2168 does not have configuration commands to add a VLAN tag to a packet.

**Does the Patton Model 2168 pass higher layer protocol such as TCP/IP packets?**

Yes, the Model 2168 does pass higher layer protocols such as TCP/IP. The Model 2168 does not read the TCP/IP packets, but will pass the packets on transparently.

**Is the Model 2168 capable of bridging?**

Yes, the Model 2168 will automatically learn, age, and filter 32 source addresses. Destination addresses of incoming frames are compared with the Source Address in the address table and discarded if an entry exists; otherwise, they are forwarded over the VDSL link.

**Can voice and data be used simultaneously?**

Yes, voice and data can be used simultaneously.

## **Ethernet (10 or 100Base-T) Interface**

### **What devices typically connect to the Ethernet 10/100Base-TX port?**

Devices that typically connect to the Ethernet port are Ethernet Hubs/Switches, Remote PC's, and any other network enabled device.

### **How is the Ethernet port configured to accept 10 or 100Base-TX?**

The Ethernet port automatically senses 10 or 100Base-TX Ethernet connections.

### **Does the Ethernet port require configuration for full or half-duplex connections?**

The Model 2168 will automatically sense full or half-duplex Ethernet connections. To fully utilize the 100Base-TX Full-Duplex feature, your network-enabled devices must support 802.3x flow control (pause packets). A switch setting is provided on the Model 2168 to transparently lock out the 100Base-TX full duplex communication if your network enabled devices do not support 802.3x flow control (pause packets). This feature will only allow Ethernet connections in 10Base-T full/half duplex or 100Base-TX half duplex and transparently avoid the 802.3x issue without degrading link performance.

## **Power Supply**

### **What are the power supply options for the Model 2168's?**

The Model 2168's come standard with an external 120VAC or UI (100-240VAC) power supply. -48, -24, or -12VDC power supplies are optional and ordered separately.