

Ethernet Extenders and their benefits

Ethernet extenders currently occupy a unique position in the IP networking world. However, they have not become mainstream, are not well known or understood but have the potential to save companies thousands of pounds in cabling and installation costs. In this article, we discuss the practical use of Ethernet Extenders and highlight their ability to save you money or make previously impossible tasks a reality.

Installers, system integrators and OEM manufacturers could combine a little imagination with the concepts in this article to find innovation for their future product or service offering.

Ethernet extenders use DSL (Digital Subscriber Line) technology to extend Ethernet links up to 10km over a single pair of low-grade copper wires. The units operate transparently as part of an Ethernet network with no drivers to install or complex setup procedures. All 'IP' traffic that could be sent across a standard patch cable can be sent across an Ethernet Extender link.

Physically, an Ethernet Extender comprises of a small metal or plastic box with an RJ45 Ethernet connection, a DC input for power and a screw terminal or RJ11/45 for connecting to the twisted-pair copper connection. Many installers prefer the screw terminal connection to avoid crimping cables in the field.

Enclosures are either stand-alone, DIN-rail or panel mounted and are available in standard and extended operating temperature variants. To keep costs low, installers often use a wide temperature variant in the field connecting back to a standard temperature model in the air-conditioned office.



Operation

The concept of using a pair of copper wires to deliver high bandwidth data has been driven by the home broadband market. If you have an ADSL modem or router at home, you are already using the technology that underpins the operation of Ethernet Extenders. In a domestic environment, DSL is used to carry IP traffic from your home router to the DSLAM (Digital Subscriber Line Access Multiplier) at your local telephone exchange. As a rule, the closer you live to the exchange, the faster the broadband service you can receive. DSL technology's evolution has been sculpted by the primary limiting factor in the home broadband setup – the telephone line. Many lines have been in place for decades with variable quality of connection and typically just a single pair of wires over which to deliver bi-directional data. Based on these constraints, communications experts continue to refine the capabilities of DSL giving rise to very fast broadband connections and as a bi-product of this mass market, very fast Ethernet Extenders.

Modern Ethernet Extenders often use the VDSL or SHDSL variants of Digital Subscriber Line technology to deliver data rates up to 50Mbps and distances of up to 10km. It is important to note that there is always a trade off between line-rate (data rate) and distance so it is not currently possible to achieve 50Mbps at 10km. The table below shows the capabilities of a typical VDSL extender. Note that SHDSL variants would be used to achieve greater distances at lower line rates.

Data rate	Distance
1Mbps	1,900m
3Mbps	1,800m
5Mbps	1,600m
10Mbps	1,400m
15Mbps	1,200m
20Mbps	1,000m
25Mbps	800m
30Mbps	700m
40Mbps	600m
50Mbps	300m

The Benefits of Ethernet Extenders

Ethernet extenders can eliminate the need for installing expensive switches and CAT5 cable. Ethernet extenders use copper twisted-pair cables to transparently send packets to a peered LAN or IP based device up to 10km away. While networks typically deploy Ethernet extenders within a limited geographical area, this area need not be limited to one building. Ethernet extenders can create effective bridged-Ethernet connections across streets or over a college or enterprise campus and between Ethernet LANs or devices up to five miles apart.

Ethernet Extenders maintain a list of MAC addresses that are 'local' to the device in much the same way as a layer 2 switch does. This means that traffic that does not need to be sent across the DSL link is not transmitted thus conserving bandwidth. Most Ethernet Extenders are also capable of extending VLAN and QoS schemes.

Ethernet extenders are cost-effective alternatives to more complicated and expensive wiring installations such as CAT5 cable. Ethernet extenders are plug-and-play devices that can be quickly installed to take advantage of existing copper twisted-pair network infrastructure. Depending on the required data rate, some Ethernet extender models can increase the distance of an Ethernet link extension up to 10km.

Some extenders feature Auto-rate adaptation to ensure the highest speed possible across long and electrically noisy cable runs. Extenders with auto-rate adaptation can be set for multiple data rates and require no difficult configuration when connecting to LANs at different distances.

The main commercial advantage of Ethernet Extenders is the saving in cost of cable, installation time and network infrastructure equipment. If you can remove these costs from your quote but a competitor cannot, you're chances of winning a project bid are greatly increased.

Cost-saving applications

The potential to save money using Ethernet Extenders becomes very apparent when they are used instead of a fibre-optic link or a wireless bridge. An old pair of telephone wires or some defunct RS485 cabling from a security camera can suddenly become a very precious commodity on a site that requires long-range Ethernet connections. Even in simple applications where a run of Cat5 cable exceeds the 100m distance limit for Ethernet, Ethernet Extenders can be deployed to save the cost of signal repeaters, power supplies and associated housings for the equipment.

BMS Systems

One of the main early adopters of this technology is the building controls sector. BMS system controllers were traditionally connected together using RS485 cabling to provide slow but reliable site-wide communication. With the transition to Ethernet based controllers and general convergence on IP based systems in industry, many system integrators found themselves having to re-install a communication network based on CAT5(E) cabling to support high speed Ethernet links. By using Ethernet Extenders, existing RS485 cables can be used giving a system integrator a huge commercial advantage over a competitor whose bid contains a substantial 'cable installation' fee.

IP CCTV systems

A common element of large CCTV systems is the PTZ camera – a camera with Pan, Tilt and Zoom control allowing the operator to move the focal point to wherever surveillance coverage is needed. For many years, PTZ control was achieved using protocols based on 2-wire RS485 links.

As the CCTV market moves to IP based systems, these existing 2 wire links are a perfect transmission medium for use in conjunction with Ethernet Extenders.

This means that no new cable needs to be installed and the wires can now be used to deliver PTZ, audio and video – 3 elements of a pair of wires that could previously only carry one!

Transportation

Road and Rail systems are becoming increasingly intelligent with more real-time data being captured and displayed to improve the quality and efficiency of the traveller's experience. The transport sector is another that has been moving to an Ethernet and TCP/IP based architecture and Ethernet Extenders are very well suited to the long linear shape of roads and railways. Many transportation subsystems such as VMS signs, intercoms and passenger information displays are now using Ethernet Extenders to lower the cost of implementation compared with fibre-optic and wireless links.

Factory Automation

Many PLCs have used RS485 based 2-wire fieldbus protocols such as Modbus to communicate process data with other PLCs and SCADA systems. This gives rise to a huge installed base of 2-wire cabling that can be leveraged by Ethernet extenders. Not only can these links be used for data communication between PLCs, but other devices such as VoIP phones, wireless access points and IP cameras will also be able to take advantage of the upgraded network infrastructure.

A recent example of Ethernet Extender use in conjunction with PLCs is highlighted by the team at Basford Plant Ltd – a company specialising in design, manufacture and installation of concrete batching plant and associated equipment.

Basford were required to implement a concrete batching system based around a Mitsubishi PLC with an Ethernet interface. The control PC was located in the site office some 400m away from the batching system. Installing fibre to connect PC and PLC would have been costly and complicated so an Ethernet Extender solution was chosen instead. A pair of Model 2172s were deployed in conjunction with 400m of CAT5 cable to provide a 40Mbps Ethernet link quickly and very cost-effectively.



Elvis mansion case study

Down in Memphis, the opulent former residence of a certain legendary rockstar is more than a mere tourist attraction. For many adoring fans, this historic estate serves as a memorial shrine to the late celebrity (though some say he lives on). The mansion has become a museum, and devotees often make "The King's" former "castle" a destination for pilgrimage. With the advent of virtual technology, today's cyber-fans can even use the Internet to keep a watchful eye on the old home turf of their dearly departed idol.

For a monthly fee, members of the celebrity's online club, can view live and in real-time - what their hero used to see from his bedroom window in Memphis, Tennessee. The web site features live shots from a web-enabled camera, aimed from the star's bedroom window at the estate front lawn. Yet things weren't always this way.

When the museum's network administrator first made plans to install the webcam in the mansion's bedroom window, he discovered it was beyond reach. The nearest Ethernet port on the Museum's LAN was more than 107m away. But the Ethernet technology limits the distance of each segment to 100m over standard CAT-5 cable.

Ripping up the former star's bedroom to install CAT-5 or fibre-optic cables was completely out of the question. Construction on the premises would break local planning rules in addition to violating the memorial museum's policies. The technical team needed an innovative solution, one that could reach beyond Ethernet distance limitations while transcending the physical constraints of traditional Ethernet media. The network administrator considered deploying a wireless link. Yet testing showed electromagnetic interference from nearby equipment would make the radio-frequency connection unacceptably unstable.

By installing Ethernet Extenders he could use the existing telephone wiring already installed through the mansion to create an Ethernet link to the webcam. Just plug each Ethernet Extender into the nearest phone socket. Within days the new webcam was up and running.

And so it is - even though the star has ascended beyond the physical world, star worshippers in the cyber world can still view with adoration his virtual living lawn - all thanks to Ethernet Extenders!

Summary

Ethernet Extenders represent a very innovative application of DSL technology ideally suited to industrial applications affected by the migration from serial to Ethernet based communications.

Due to their niche market and somewhat intangible nature, remarkably few people are aware of their capabilities despite the fact that they can massively reduce cabling, installation and hardware costs when deployed in appropriate projects.

Get on the bandwagon now and you may just earn yourself a promotion!

If you would like to learn more about Ethernet Extenders please visit [Amplicon's Ethernet Extenders web section](#).

Also you can watch Amplicon's Ethernet Extenders video demonstration by [clicking here](#).