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Extended Ethernet

Ethernet Transmission over Coaxial or UTP cable

By Iain Deuchars

Ethernet over non-standard Copper Cabling

As the security and surveillance market continues its shift towards IP based technology, the ability for integrators and installers to utilise different cabled transmission mediums gains significance.

Within Ethernet networking, the structured cabling standards offer twisted pair cabling up to a distance of one hundred meters between active devices and then optical fibre for distances up to the limitations of the optical technology. While these rules work well for the standard office location, the market can find itself in different physical environments and facing different challenges.

A large number of IP CCTV installations will be migrations from analogue solutions where coaxial cable was used and in other cases, due to the nature and location of CCTV systems, twisted pair beyond one hundred meters and low grade cable such as telephone CAT3 cable could be the preferred or possibly the only solution available. In an environment such as this you need to have a scope of transmission solutions that cover all the possible copper mediums and at the same time support the requirements of modern IP systems such as Power over Ethernet (PoE).

In the transmission arena different technologies exist that enable Ethernet signals to be sent over non-standard cable or extended distances over standard twisted pair cable. The technologies will have different performance criteria and it is these coupled with the medium type that dictates the product selection. ComNet has a range of different technologies available but this document shall focus on its Copperline range.

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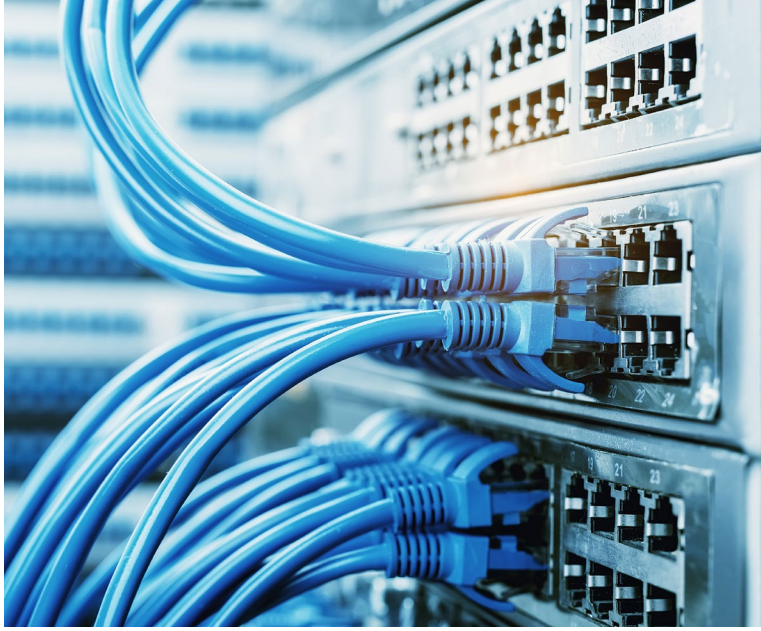
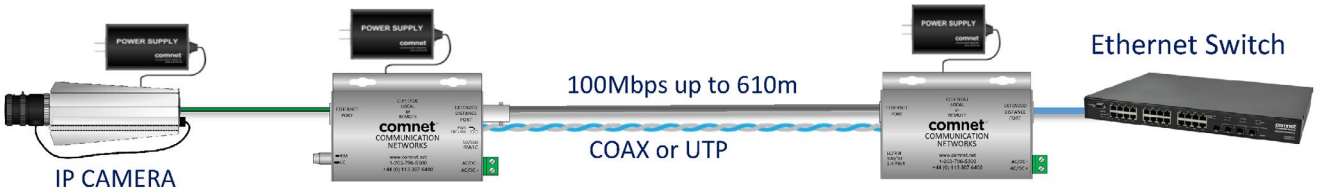
Maintaining Network Integrity

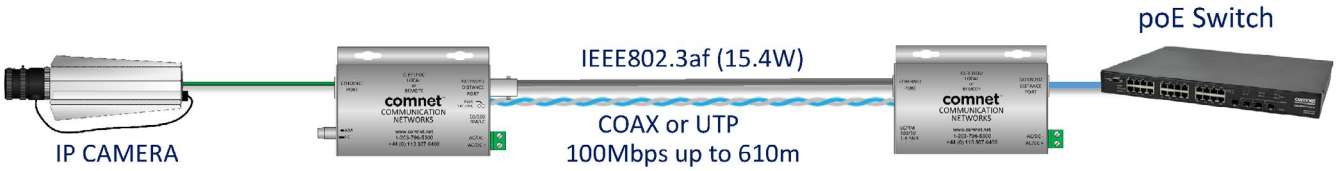
One important feature for a copper extension product could be to maintain the network integrity. This ensures that the network speed (wire speed) of the link is maintained at either 100Mbps or 10Mbs and that the connection is fully symmetrical. By doing this it is possible to integrate units into an Ethernet network with complete confidence that the links in no way degrades the performance of the network as they operate at the chosen wire speed. It should also be added at this stage that the line speed selected does not have to be the data rate your traffic must pass at but rather the maximum data rate that the transmission path will support.





The ComNet CopperLine range operates in this very way and supports extended distance transmission over either coaxial or twisted pair cable, with the coaxial medium specified at RG59 or better and the twisted pair CAT5 or better. At 100Mbps distances extend to over six hundred meters on the minimum grade cable and if data rates are set to 10Mbps distances can be up to fifteen hundred meters on RG59 coaxial cable. The coaxial cable solution provides a simple migration path for analogue end users with legacy coaxial installations who can run their new IP systems over the existing installed infrastructure. It is fundamental to the successful operation of the system that the cable parameters and quality meets or exceeds the type stipulated by Comnet. CAT5 cable must meet the ANSI/TIA/EIA-568 standard and RG59 coaxial should be of a quality construction. Standards in coaxial cable can be many and varied and care should always be taken when looking to operate across it.

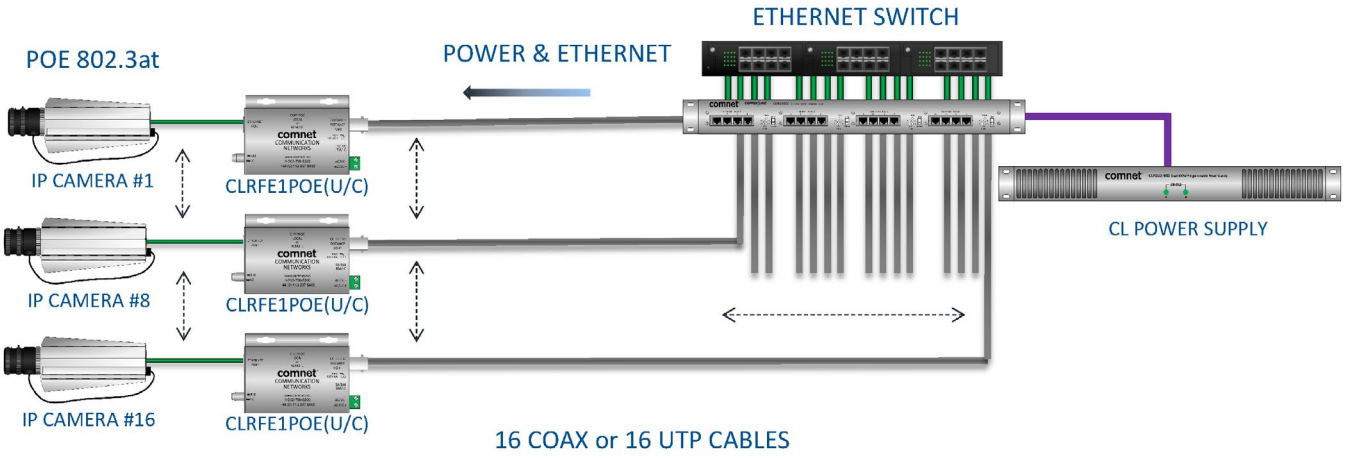
Along with the data CopperLine also provides support for PoE at either the 15.4W (IEEE802.3af) or the 30W (IEEE802.3at) power levels[1]. Unfortunately passing power through copper cables is governed by the laws of physics[2] and there is an inverse relationship between the distance and the power level that can be maintained across the link. At the 15.4W level CopperLine operates in a pass-through mode, where the devices outside of the CopperLine units (in the example below an Ethernet switch and IP camera) function as the PSE (Power Sourcing Equipment) and PD (Powered Device) respectively. CopperLine units can either be externally powered or via the PSE.



These powering options provide total flexibility, by offering the simplest installation with everything powered from the central PoE switch or the ability to deliver maximum power levels to the camera by externally powering the CopperLine devices. The ability to provide the correct power levels at the PD will be dictated by the type and quality of the cable being used and also the voltage level present at the PSE.

When it comes to Ethernet switches that can operate as PSE devices the ability to increase the voltage level at the Ethernet port could be very useful. If the voltage levels can be increased, then there can be voltage drop in the cable but the voltage at the PD location could still be enough to power the connected device. In the case of IEEE802.3af the required minimum voltage at the PD is 37Vdc and the maximum voltage allowed at the PSE is 57Vdc. If the switch is one with a mains power input then it will tend not to have that ability and the level will be set at 48Vdc but if ComNet switches with dc input are used and the power supply can be increased on some models up to 57Vdc then the switch in turn will provide those levels.

When the PD requires IEEE802.3at 25.5W power levels and a minimum voltage of 42.5Vdc then the game changes significantly. The ability to deliver 25.5W at 42.5Vdc from a central PSE offering 48Vdc at distances above 100m is impossible and so the design rational must change to that of the lower af levels. To accommodate this CopperLine PoE+ devices operate as PSE and PD devices through the link to negotiate with the Ethernet switch and camera respectively in the example shown.



By configuring in this way, either of the CopperLine devices can be used as a power injector with voltage levels up to 57Vdc allowable at the device. For example, if the local (switch end) CopperLine unit was powered with 57Vdc it would supply passive PoE to the remote CopperLine device that would then fully negotiate with the connected PD to supply power.

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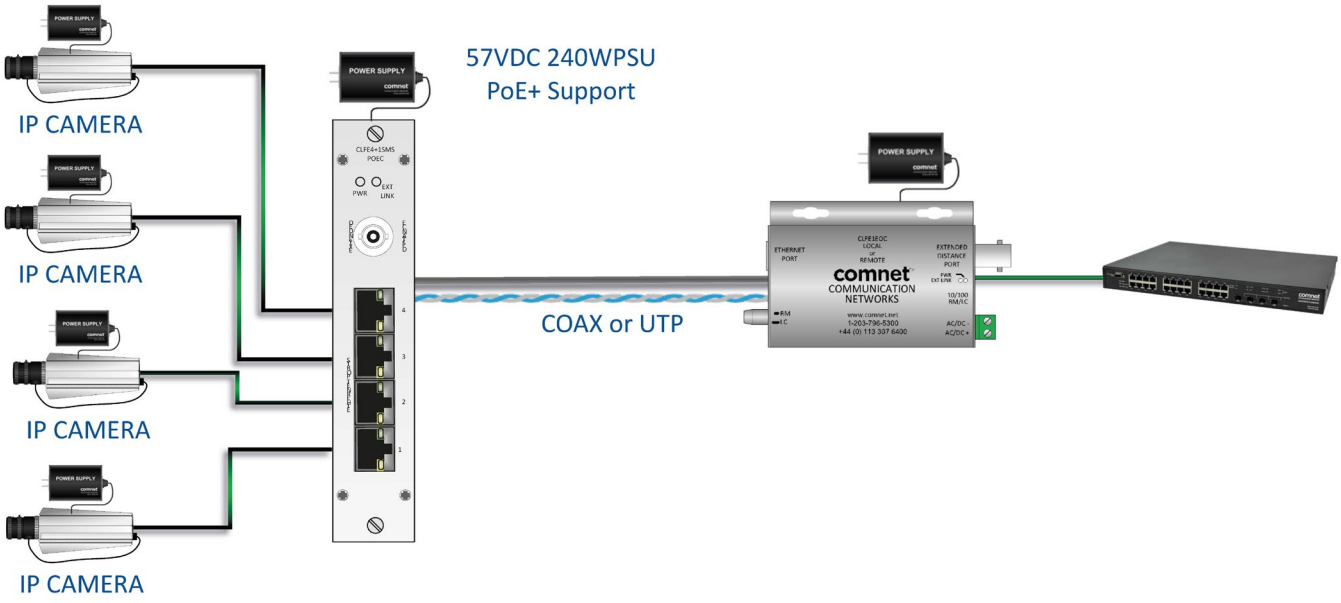
Copperline Range

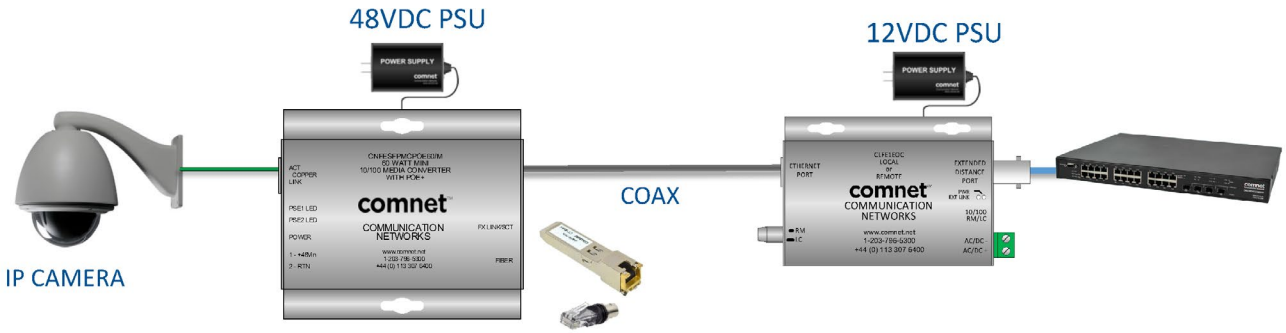
ComNet offers Copperline products in different permutations to simplify network integration. The af and at level PoE supporting products are available from single channel up to sixteen channels, with all units having equal numbers of in and out ports as point-to-point links only are configured. A miniature pass through or non PoE version is offered for remote locations where the smallest possible form factor is required. This could be direct mounted within the camera enclosure or edge device if required.

For locations where more than one Ethernet connection is required in the field, Comnet Self Managed Switch (SMS) technology with integrated Copperline port offers simple solutions. The SMS switch provides four standard 10/100 ports with the options for PoE levels up to 30W and the fifth port being either a twisted pair or coaxial Copperline connection. The Copperline port can be configured for 10Mbps or 100Mbps operation depending on the cable type and distance required.



The range also has a SFP module in twisted pair configuration that can be located in any MSA compliant SFP housing. This module gives great flexibility to network implementation as the design radius around any Ethernet switch is now greatly increased by the integrated CopperLine technology. Via a simple converter cable or adapter, the module presents a BNC connector and enables coaxial cable runs to terminate directly on the Ethernet switch. Another possible use for the SFP module could be in a 60W PoE media converter that ComNet can supply. If used with these devices a 60W IP camera can be installed with the Ethernet signal passing over legacy coaxial cabling or extended twisted pair runs.

The transmitter unit at the camera can also support IEEE802.3at PoE and act as a PSE.

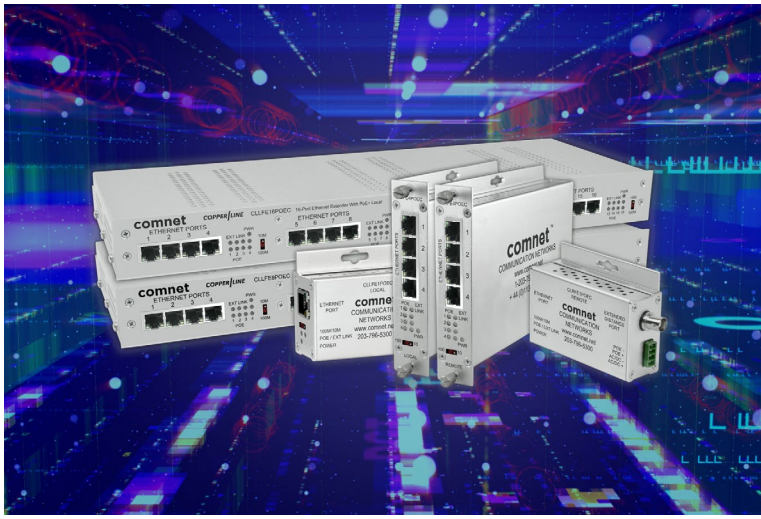


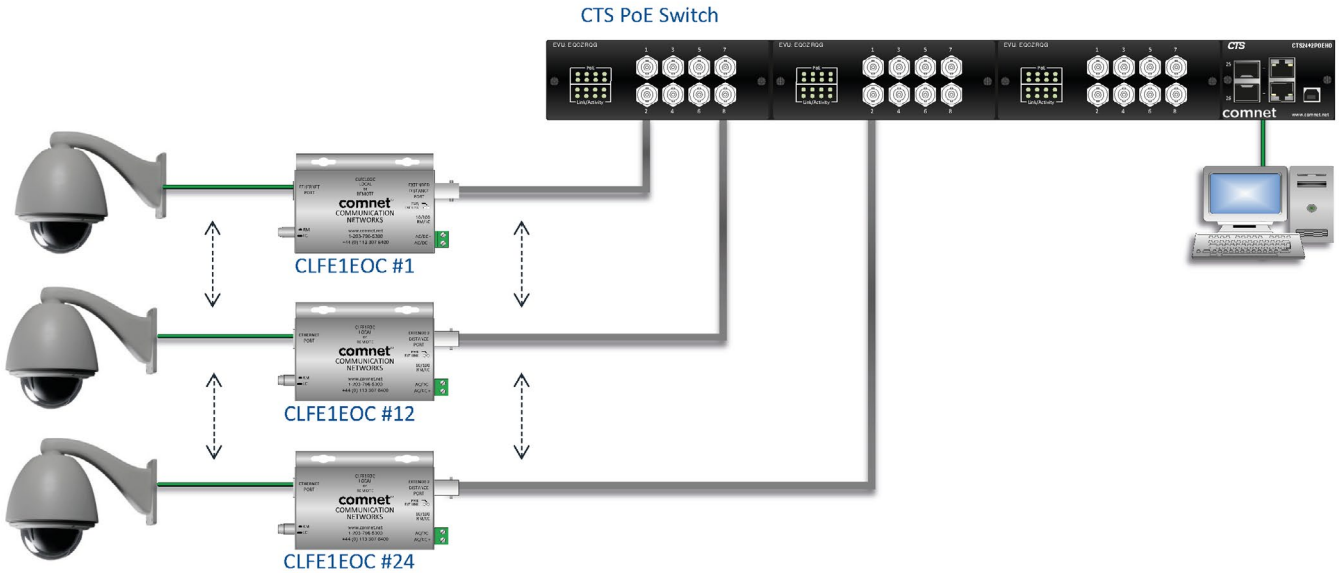
Copperline SFP installed in the media converter

CTS Ethernet Switch

To this point the Copperline solution has been viewed as autonomous to the switch fabric of the network at the central point. In most projects; 19" communication cabinet real estate is at a premium, electrical power requirements need to be minimised and removing costs where possible is an absolute must. The CTS L2 Ethernet managed switch reduces 19" used rack space, lowers power requirements and significantly reduces head end costs by integrating the Copperline "central" equipment and a Layer 2 managed Ethernet switch. The CTS provides 2 combo gigabit uplink ports and 24 off 100mbps coaxial Copperline or twisted pair Copperline. The switch can provide up to 400W of PoE power budget from the integral power supply and offer that power across all the 24 Copperline ports.

In space terms the 24 Copperline ports available on the CTS switch will require 1U of rack space. In comparison a traditional Copperline design would require 3U f rack space plus the interconnect cabling from Copperline units to the switch. Additional power is required as you would have three individual devices rather than one. Importantly a 35% saving would be experienced by using the CTS switch against individual Copperline devices and a separate L2 managed Ethernet switch.





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Conclusion

IP security & surveillance systems will be deployed in locations based on the operational requirements of the end user. The majority of these deployments will be outside of the typical office or building environment and as a result, standard structured cabling solutions may not always be available or provide the best answer.

With their range of Extended Ethernet solutions, ComNet are providing network operation over non-standard copper mediums as a reliable, proven option for end users. The benefits of utilising existing infrastructure in any project can be significant from a financial and time perspective and those alone make it a solution that cannot be over-looked. In the case of no alternative, the ability to send Ethernet signals over very low grade twisted pair, coaxial or extended CAT5 or better could be the catalyst that enable a project to move forward.

When you add to this a -40 to +75°C operating temperature and Lifetime Warranty, the solutions provided by ComNet offer a very interesting proposition as part of your IP network.

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[1] Power levels with respect to the Power Sourcing Equipment.

[2] Georg Ohm published his research in 1827 and today his work on the relationships between voltage, current, and resistance in a circuit are what we know as Ohms Law. In any copper conductor there is a resistance, defined as ohms/m that will grow as the cable distance increases. The current in the cable is based on the starting voltage present at the PSE but due to the resistance the voltage at the PD will be less. This results in a power loss at the PD due to the voltage drop.

Having served an engineering apprenticeship with the Ministry of Defence and read for his degree in electronic systems at the Royal Military College of Science, Iain Deuchars worked for a number of years on satellite communications projects for the UK military. Following this he moved to the commercial sector and became involved in optical communications primarily in the security and surveillance markets. Iain has held senior positions in a number of electronic communication companies and is currently General Manager for ComNet, where he is involved in both technical and commercial aspects for the Company.

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