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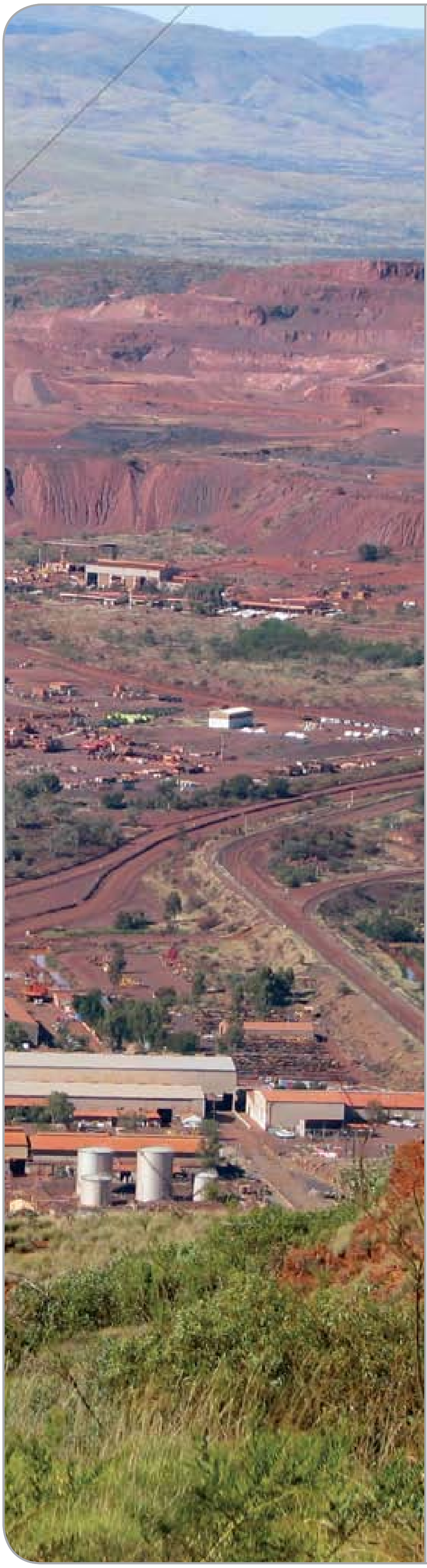

Communications and entertainment cabling for accommodation villages

ADC KRONE

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When planning a network for providing 'triple play' services to accommodation villages it is important to consider whether a copper network, a fibre network or hybrid network (a combination of fibre and copper) will be most appropriate. Copper cabling has been used in these networks for the past couple of decades, mostly because optical fibre and optical active equipment was too expensive during that time.

Pilbara Rail Line

Whilst copper networks have performed with some success, they do have some drawbacks. The first is that two separate networks have to be deployed if both MATV (video) and telephony/data are required.

MATV services are delivered via RF coaxial (coax) cable. To deliver an acceptable picture quality the network designer must consider the signal strength and losses over the coax as well as connectors, splitters and taps. Amplifiers can counter these losses by boosting signal power and, when located in the field, these amplifiers must be housed and provided with a power source.

It is essential to determine the route length of all cables in order to achieve a good coax design. Sometimes, during the actual installation, it will be necessary to make local changes to things such as cable length if conduit pathway routes are altered. However, if these changes lead to the actual cable lengths being different to those used to calculate the design, a recalculation will be required. This can often mean that components must be changed to ensure performance is maintained. If the signal strength is not consistent to all parts of the installation then picture quality will vary, so it is essential to be fastidiously correct at this stage.

There are multiple active and passive components dispersed throughout the site, which complicates maintenance during the life of the installation. It is important that each cable be permanently identified to ensure the correct connections are maintained. For example, mixing up connections on a tap could change the loss values causing signal power imbalance on cable segments. You can avoid this by creating clear records – including original and 'as constructed' design plans –if additions or changes are required.

Copper cabling for telephony in accommodation villages is relatively simple and has been successfully deployed using the same components and techniques as those used in suburban and commercial deployments. However, telephony requires a different cabling infrastructure to MATV cabling. Pathways such as conduits may be shared between the cable types, but may require increased conduit size and/or numbers of conduits.

Although telephony over copper is simple, a higher performance solution is needed because Internet and other Internet Protocol (IP) services must also be delivered to rooms. Category 5e is the minimum standard required if Ethernet is to be deployed via copper cabling. A Digital Subscriber Line (DSL) solution with basic voice grade copper cabling may seem attractive, but its inherent bandwidth limitations make it an ineffective option.

Pre-terminated fibre cables from the FL2000 Distribution Rack connect to the Fibre Entrance Cabinet for splicing to outside plant cables

MATV video services have usually been deployed on traditional RF coax networks. Deploying video via IP over DSL is inadequate even for standard video. The much greater bandwidth required for future deployment of HDTV over IP makes it essential to choose a higher-bandwidth solution.

While VDSL2 offers the prospect of up to 100 Mbs (Megabits per second) over voice grade copper, this technology is best saved for existing sites where re-cabling with optical fibre is not feasible. It is important to ensure the technology and business case is sound over the long term and no other solution is feasible before choosing this solution.

Regardless of which copper cabling system is deployed, an over voltage protection system is required whenever copper cabling is run underground.

IP over Copper

The common method of deploying IP services over copper in accommodation villages has been to use Unshielded Twisted Pair (UTP) cable. Traditionally this has been achieved by placing the active equipment switches in locations that fall within the length limit required by the AS/NZS 3080 Standard and 'star wiring' or 'home running' UTP cable to the active equipment. This brings a variety of challenges, each of which must be addressed.

Firstly, according to AS/NZS performance standards for UTP, the total channel length of the cable must be limited at 100 metres. This includes the length of patch cords at both ends. However, in an accommodation village with many freestanding buildings this distance limitation requires some active equipment (such as network switches) to be deployed out in the field, away from the main communications room to reach areas further than 100 metres away.

Each of these deployments of active equipment is called a Node. The main communications room containing the active equipment is considered as the Central Office (CO).

The accommodation site's CO should be designed to house active equipment in a stable environment, protected against high and low temperatures, water damage, excessive humidity, insects, rodents and power fluctuations. Creating a Node that replicates a communications room environment in the field is expensive. In all but the smallest of accommodation villages several Nodes may be required to ensure each room is within the 100-metre channel limit.

It is to possible to partially overcome the temperature issue by sourcing environmentally hardened active equipment. It is still necessary to protect the equipment against weather, insects and rodents and provide a suitable power supply.

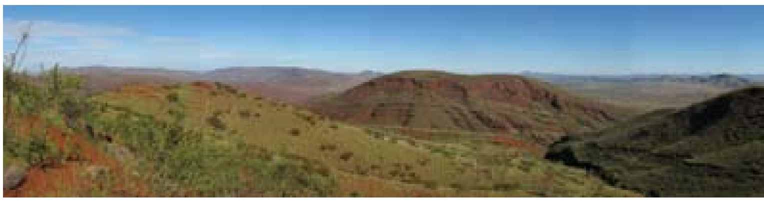
Termite mounds are a typical pest in mining camps

The second challenge is ensuring the cable selected to connect the nodes to the buildings housing the residents' rooms is suitable. The UTP cable needs to be rated for underground use. Some cables are marketed as indoor/outdoor, meaning they are designed to be installed between buildings above ground in self-draining conduits or on cable trays. Many of these cables are not specifically designed to be used underground where they may be subjected to constant submersion in water. Even conduits that are dry when initially installed usually end up with water in them due to ingress through joints, pit flooding or condensation. It is critical that the cables chosen are specifically designed to cope with this type of environment. Because of the design challenges faced by cable manufactures there tend to be more underground Category 5 UTP cables available than underground Category 6 UTP cables.

Cables should also be protected against termites, particularly if the accommodation village is located in a termite-prone area. Termites can cause significant damage to cable buried underground. Hard jacketed cables covered with nylon should be installed. The very smooth, hard finish prevents the termites gaining a purchase on the cable so they cannot gnaw their way through. A sacrificial PVC sheath over the nylon will protect the jacket from being scratched during installation, which would create a potential weak point.

Pre-terminated sacrificial sheath cable is used to prevent termite damage

The third consideration for utilising UTP underground is the issue of overvoltage protection. Copper acts as a conductor, creating a patch for induced voltage to post a hazard, so overvoltage protection is required for all metallic services that are run underground, whether through copper cabling or coax. Overvoltage protection is available for coax, voice and UTP cabling.



Due to the high lightning activity in some regions overvoltage protection and good grounding/earthing must be installed wherever conductors enter buildings or equipment enclosures from underground.

This creates significant cost in the case of UTP cabling, which have large numbers of conductors (4 pairs per outlet) to be protected. There is also the operational cost and risk of downtime caused by a significant overvoltage event as consumable components in highly active overvoltage devices may need to be replaced.

It is important to note that overvoltage protection devices will only provide adequate protection if both ends of the cable have the devices installed and the protective devices are properly earthed. In the instance of a direct or a very close lightning strike, even properly installed overvoltage protection will pass damaging voltage due to the magnitude of the energy disbursed.

The fourth item for consideration in a UTP deployment is the connection of the active equipment deployed in the field back to the CO. This is called the backbone cabling. This would typically be optical fibre as it does not have distance limitations or require overvoltage protection. Optical fibre also has a large amount of bandwidth ensuring the best form of future proofing currently available.

Deploying CO signals via optical fibre to an active switch in the field and then to the rooms via UTP copper is a Fibre to the Node (FTTN) solution. The video signals can be deployed on either a separate RF coax system (with two networks deployed) or, if the active equipment is designed for IP video streaming, the video signals may be deployed on the IP network.

Hybrid Fibre Coaxial network

A Hybrid Fibre Coaxial (HFC) network is similar to the FTTN UTP solution. In this case the active equipment in the CO delivers video and IP signals via optical fibre to the node. Active equipment in the node delivers these downstream signals from the node to the rooms and return upstream signals back to the CO via an RF coaxial cable.

Historically HFC systems have been deployed by cable TV operators and require specialised knowledge. Installers with a conventional MATV background may not have the experience to successfully deploy or maintain an HFC network.

When assessing an HFC network for deployment in accommodation villages the fact that these sites are often in remote areas needs to be taken into account. Finding local companies that have staff with a suitable skill set may be a challenge. The overvoltage protection and termite issues for deploying underground copper cables also need to be taken into account.

The question is: if copper has this many issues then is optical fibre the answer all the way to the residents' rooms?

The answer essentially is YES. However, once the fibre reaches each multiple-room building there are economies in converting back to copper for the internal building cabling.

Fibre Solutions

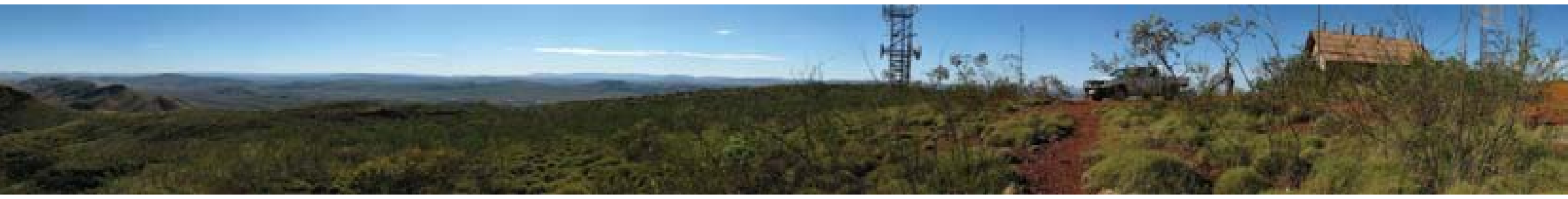
Fibre can deliver high bandwidth over long distances so no active equipment (devices requiring power and temperature control) needs to be deployed between the CO and the accommodation building. This principle is known as a Passive Optical Network (PON). This has the advantage of greatly simplifying design, deployment and maintenance of the system.

Another advantage of PON access networks is that they are vendor agnostic. In other words, as long as the active equipment of the vendor suits topology of the PON, you can change the boxes at either end without changing the fibre.

Because PONs are access networks, they must be designed to be highly reliable in an Outside Plant (OSP) environment.

When providing triple play services, reliability is absolutely mandatory, particularly in a remote location where television and Internet may be the only forms of entertainment and distraction. Trying to adapt fibre products derived from Local Area Network (LAN) solutions to deploy in this environment will not result in a satisfactory outcome, so proven a solution derived from a carrier environment are necessary.

PONs should also be flexible and capable of incorporating inevitable changes. Often the extra benefits of designing for flexibility come without significant cost penalties.



FTTX, or Fibre to the X (where X equals the destination point), solutions utilise singlemode, low water peak optical fibre to ensure that the wavelengths required for FTTX technologies are available in the cable. Connectors for all FTTX designs should be SC format Angle Polished (SC/APC). This ensures minimal loss over the connector and minimises connector reflection issues. Conversion from SC/APC to other connector formats that may be native to the active equipment should only ever be done via the equipment connection patch cords.

Two PON topologies are suited to creating a fibre network to deliver triple play services in the accommodation village environment.

The first is point to point (P2P), where each accommodation building has one or more unique optical fibre cores that are 'home run' all the way back to the CO. Each fibre has a corresponding active port to deliver signals to the active device plugged into the fibre at the accommodation building end. This remote active device is called an Optical Network Unit (ONU).

Active devices may require two fibre cores, one to transmit signals (Tx) and one to receive signals (Rx). Active devices specifically designed for FTTX deployment, however, tend to use only one fibre core per ONU, with both the send and receive signals transmitted within the one core at two different wavelengths.

As every fibre is 'home run', P2P systems are the most flexible of all of the fibre PON topologies. Yet the investment in fibre and active equipment is considerable. P2P is therefore best utilised in small deployments where savings in the active infrastructure compared with that required for other types of PON topologies outweigh the cost of the additional fibre.

A variation of P2P is to locate the head end equipment and routers in the CO and distribute active switches around the village. The housing, power and cooling issues that apply to copper nodes also apply to fibre deployments utilising this distributed node topology. Care and maintenance of active equipment in remote sites is further complicated when the active equipment is distributed throughout multiple locations.

When designing a P2P PON it is important to consider a number of practical issues

As each ONU is represented by at least one fibre core (often two cores per device are required for P2P) in the CO, the number of fibres – and hence congestion leading to manageability problems – must be addressed. The answer is to use an Optical Distribution Frame (ODF) designed for high density.

FiberGuide® Cable Raceway System

Each fibre from the field should be presented on a termination panel in the CO. In a well designed network there will be a cross-connect patching field in the CO to enable flexible and orderly connections between active equipment ports presented on one section of the Optical Distribution Frame (ODF) and the field fibre on another section of the ODF.

If considering a design without a cross-connect field then careful consideration needs to be given to the patching between field ports and active equipment ports.

Simple but important details regarding optical fibre patch cords need to be addressed to establish and maintain the reliability of the network. Providing FiberGuide pathways for the patch cords ensures they are protected from damage and have a dedicated pathway between the ODF and equipment racks. Patch cord slack storage must be incorporated into the ODF and possibly the active equipment racks. This has the dual advantage of keeping the installation tidy while also allowing a minimal number of standard length patch cords to be used for all cross-connect/interconnect patches.

Supplying standard patch cord lengths eliminates the need to supply an appropriate mix of patch cord lengths, avoids the risk of running out of certain lengths and reduces costs as the total number of patch cords only needs to match the number of used ports.

Another important feature for fibre management is a good, logical, easy to read labeling system built into the termination panel design. These principles, when combined, ensure the patching field remains orderly and user friendly throughout the life of the installation.

The cables entering the CO will be of loose tube construction and need to be spliced to pigtails for connection to the termination panel adaptors. To minimise congestion in the FDF, it is best to locate a Fibre Entrance Cabinet (FEC) designed for high density splicing on a wall within the CO with factory pre-terminated stub cables plugged into the termination panels in the ODF and routed to the FEC.

Splicing occurs away from the termination area and active equipment so technicians can splice at the same time as the ODF is being populated. Testing may commence on completed links while splicing continues on others because the two work areas are separate. Active equipment can also be fitted into the racks and completed links patched. The flexibility to undertake multiple tasks simultaneously means the onsite labour is not bottlenecked by a congested design.

Considering costs

When assessing which technology to deploy the whole cost of deployment needs to be considered. This should include the cost of delivering the following to each room:

- Internet/IP
- MATV

Voice services (or the upgrade cost if not initially required)

In the physical layer the cost assessment for each topology option should include all cost implications to the whole project, i.e. the costs for materials, installation and supporting infrastructure.

For a copper network the assessment should include:

- UTP cabling to the accommodation building for each outlet, including overvoltage protection;
- Coax cabling required for the MATV system;
- Optical Fibre backbone cabling;
- Active equipment;
- Communications rooms/cabinets required in the field because of the 90 m link length limitation, including cooling and UPS costs.

The assessment for an FTTX deployment should include:

- Fibre cabling to each accommodation building;
- Optical Fibre backbone cabling to each aggregation/splitter location;
- Remote FDH (Fibre Distribution Hub) cabinets;
- Passive Splitters and Wave Division Multiplexing (WDM) modules;
- Active equipment;
- The cost reduction because fewer communications rooms/cabinets are required in the field.

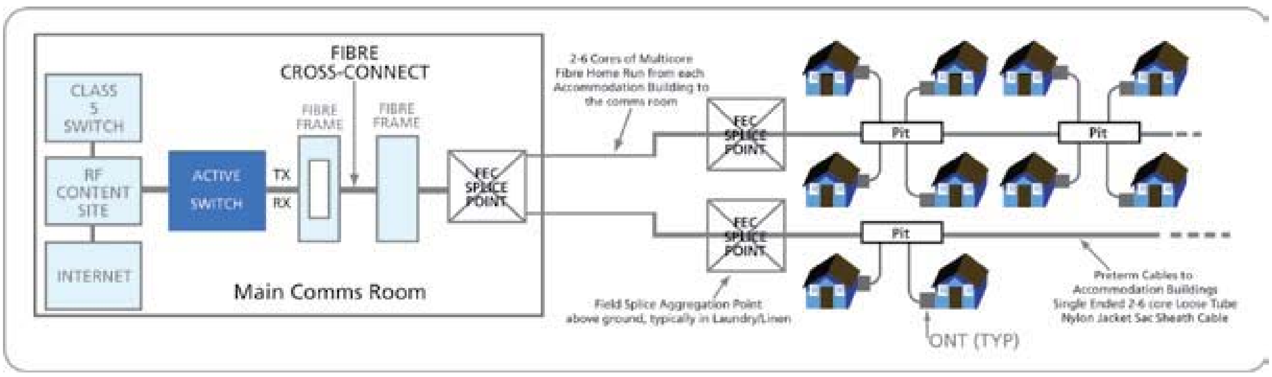
If the village is likely to be expanded over time then the technology expansion costs should also be considered. If future expansion cost differences are significant then this should be included in the initial cost evaluation.

Point to Point (P2P)

In a P2P topology all fibres from the accommodation units are 'home run', either to the main communications building or to one or more additional communication buildings if the site is large.

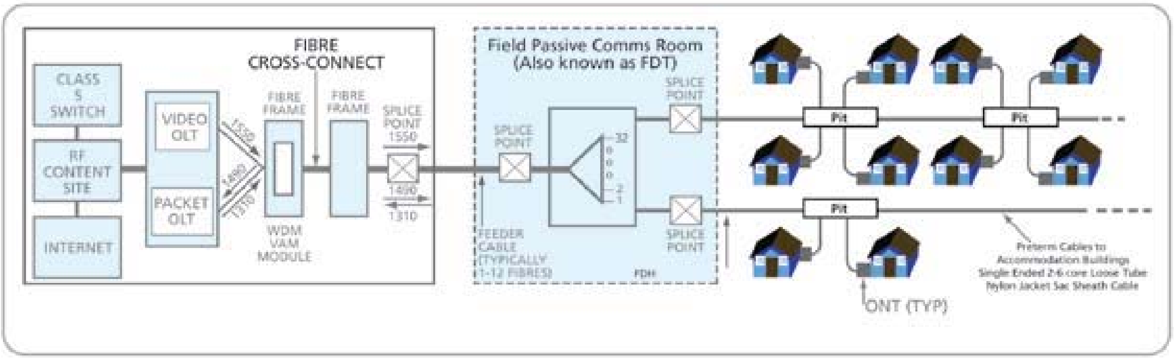
Each accommodation unit has a unique set of cores that are presented on a Fibre Distribution Frame for connection to Ethernet switch ports. Typically an eight-port hardened switch is deployed at each accommodation unit to connect to the incoming fibre and the UTP outlets in the rooms.

The video content is usually delivered via IP and if this is Pay TV it adds a level of complexity as the content needs to be encoded and decoded, requiring set top boxes in each room. Alternatively a separate fibre can be used to broadcast RF with RF-to-Optical and Optical-to-RF equipment.



Point to Multi Point (P2MP)

Using G-PON technology and optical splitters, P2MP topology is widely adopted in FTTX deployments due to the scalability of both the passive fibre network and the active equipment. Video content can be delivered by overlaying the RF signal onto the same fibre or using an IP TV stream. Alternatively a combination of both RF-Overlay and IP Video may be employed. Having free to air and Pay TV on RF overlay and on-demand content via IP provides some redundancy, so if one video delivery method goes down the content on the other stream may still be available.



The Future

Current FTTX designs for accommodation villages tend to have one active device deployed per accommodation unit. The cabling from this device to each room is UTP copper and coax. This may change over time as ADC KRONE is already deploying Reduced Bend Radius (RBR) fibre cable in apartment buildings all the way into each apartment. If active equipment vendors can provide suitable ONUs to make this topology cost effective then this may well become the next logical step in accommodation village deployments. It will offer higher bandwidth per user and remove the need for active equipment to be mounted in external enclosures.

There are many considerations when designing communications and entertainment networks for accommodation villages. ADC KRONE has a wealth of global experience in carrier grade FTTX deployments, coupled with specific experience in Mining and Resources accommodation village deployments. To learn more about our solutions and discuss your project with us please contact your local ADC KRONE office.

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