The changing route to the last mile

In most European countries telecommunications service providers have rolled out either copper or fiber networks as far as the street cabinets or drop points from which connections are made to customer premises. These connections cover what is referred to as the 'last mile'—the final route taken by a cable from the street to the subscriber. The last mile to the customer is, in most European countries, a copper network, but replacing copper with fiber—or fiber to the home (FTTH)—is being actively considered across the continent. In particular, the so-called Digital Agenda, presented by the European Commission as one of the seven pillars of the Europe 2020 Strategy, suggests that new services such as high definition television or video conferencing need much faster internet access than is generally available in Europe. It proposes that Europe needs download rates of 30 Mbps for all of its citizens and at least 50% of European households subscribing to Internet connections above 100 Mbps by 2020. FTTH is seen as a way of achieving this.

This, however, may be easier said than done. Fiber is replacing copper in many networks but the closer you bring fiber cable to the customer the more expensive it gets, partly because you eventually have to penetrate the customer's premises. However, many high data rate services are only effective at close range. They include VDSL (Very-high-bit-rate digital subscriber line), which uses frequencies of up to 30 MHz to provide data rates exceeding 100 Mbps simultaneously in both the upstream and downstream directions. This is now in its second generation. Another is G.Fast a digital subscriber line (DSL) standard for local loops shorter than 50m, with performance targets between 150 Mbps and 1 Gbps, depending on loop length. In both cases (but especially G.Fast) the shorter the distance between the fiber and the home the better.

On the face of it, FTTH seems inevitable. And, in the longer term it probably is. However, present-day demand is not strong, installation costs are high for the supplier, and possibly also the customer, and disruption at the customer end—drilling holes to insert new cables, for example—could be severe. If additional work is required at the premises end, due to failure or disruption, more work in the premises could be required.

A better approach therefore is not wholesale change but a managed migration to an all-IP (internet protocol) network, using last mile copper where possible. The groundwork for this is already being put in place. The last mile is getting shorter as carriers bring switching equipment and distribution systems closer to street cabinets nearer the home. These street cabinets are housing more sophisticated equipment as last mile copper is asked to do much more.

Fiber, meanwhile, is also coming closer to the home. In fact not just fiber to the curb (FTTC) but fiber to the drop point or distribution point (FTTDP) allow fiber terminations within very close range of customer premises and the retention of the copper connection into the customer premises. This allows carriers to get the maximum value from their installed copper network and even supply all-IP over the last mile.

This, however, not only requires fiber to get even closer to the premises, but equipment that can work with both the existing and developing street cabinets or drop points, and both present-day networks and future all-IP networks. This will demand a high level of flexibility. The components used in street cabinets need to be in place before all-IP so that they can help to speed the transition to all-IP services. They also need to be modular enough to be enhanced or swapped out with minimum disruption to existing services. They need, ideally, to bring different services, billed at different rates, to as many customers as possible from one cabinet. Finally, connectors in particular will need to be smaller and denser than before to save space in street cabinet.

This is the challenge at present. In the next section of this paper we describe a connectivity offering that plays an important role in helping carriers to bring VDSL and, in the longer term the higher bandwidth (but much closer to the premises) G.Fast to customers in an efficient way that avoids the cost and disruption of fiber to the home deployment. In the third and final section we explain how this connectivity offering can be made part of all-IP migration.

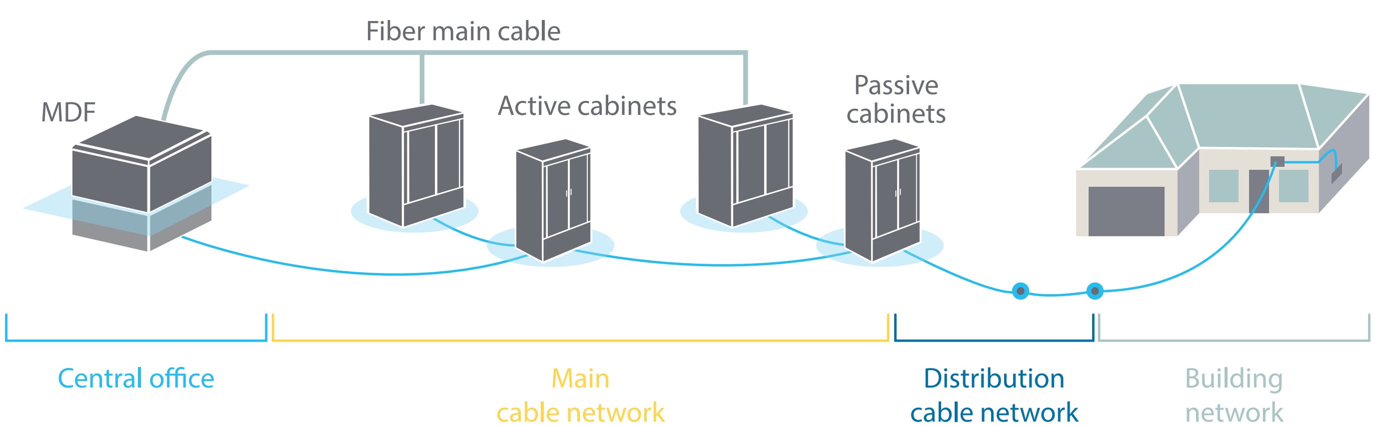


Figure 1: Street cabinets provide the base for migration from DSLAM to MSAN and house connectivity points for copper and fiber cables

Connectivity

A way to both get maximum value from last mile copper networks and to begin network migration to all-IP already exists. Central to this approach is a copper connectivity module. As we have already noted, switching equipment and distribution systems are being increasingly moved out of central exchanges and re-located closer to customers—in street cabinets, for the most part. This development of existing networks, along with expanded service portfolios of carriers and the eventual implementation of all-IP services, requires additional space in the network structures in the last mile to subscribers. Here, the priority is to achieve the highest degree of flexibility, reliability and circuit density with simultaneous overvoltage protection in place to protect sophisticated active equipment in vulnerable areas like street cabinets where lightning strikes or crossovers with the power grid could be problematic. The LSA-PLUS HDS® copper connectivity module can meet all these demands.

LSA-PLUS HDS technology enhances the existing copper connection to the home, paves the way to next generation copper broadband services and bridges the gap to an all-fiber future. It has already been tested and accepted by one major European carrier and is poised to demonstrate its benefits to many others.

This new LSA-PLUS HDS copper connectivity module consists of an eight-pair base part and eight single-pair plugs as the upper part, dividing the subscriber side and system side in a way that enhances effectiveness. The eight-pair lower part is permanently connected to the system cable of the IP DSLAM (or, over time, the more efficient MSAN). It can be used as a piece part for the manufacturing of pre-connectorized cable harnesses to speed installation time in the street cabinet. Alternatively, it can be installed on-site using the LSA-PLUS® insertion tool.

To achieve the best transmission performance and minimize near-end cross talk, the module features wire bundle holes for strain relief as well as a star-quad arrangement of connected cable. The lower part of the module is installed on an LSA-PLUS HDS backmount frame. The integrated earth bar makes direct connection to the frame.

The upper part of the module is formed by eight single-pair plugs with integrated IDC contacts to connect jumper wires. The module is suitable for use in all communication networks (POTS, DSL and IP networks), is VDSL2 and vectoring compatible and has built-in surge voltage protection.

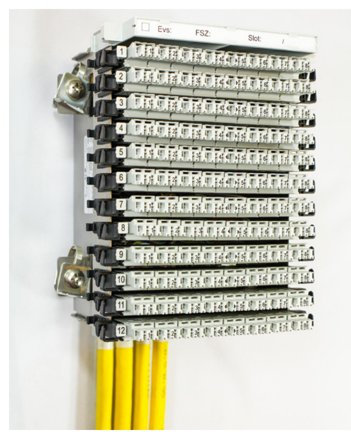
Density is another key attribute of the module. It offers optimum circuit density with 13.5 mm mounting grid dimensions; this increases available space. This matters because the active cabinets contain the connectivity, as well as the active equipment (MSAN). A high density, flexible connector will enhance efficiency and save space.

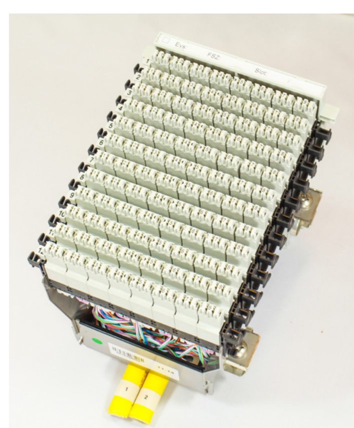
This module has a number of other important attributes: they include CAT5 capabilities, insulation displacement contacts on front and rear, star quad cable management guides for assembly of reliable, robust cable harnesses, and compatibility with all wiring practices.

However, what really makes this module different from similar products in the market is its singlepair plug. This makes the module more than just a copper cross-connect interface. With this plug it becomes a future-proof universal adapter into which many different functionalities can be integrated. They include, as we have noted, integrated overvoltage protection. But they also make it easier to offer different services, contracts and payment schemes tailored for every customer in one cabinet. Moreover the module is now available as a simple pass through plug as well as a plug with VDSL splitter capabilities. In the all-IP migration scenario this splitter functionality will play a significant role.

8-Pair modules

Standard tooling





Flexible cable heads

All-IP migration

Migration to all-IP will not be a smooth or universal process. There will usually be an interim period where the central office supplies the voice service while the broadband service will simultaneously be supplied by the DSLAM (or increasingly the MSAN) located in the street cabinet. Hence the splitter referred to earlier, which puts both services together and can deliver to the subscriber a mixed voice and data or broadband signal.

Of course all-IP servers will eventually offer everything—voice and data or broadband—from the DSLAM or MSAN. But to avoid disruption, one platform that can adapt and be used for the complete period of the migration or transition is the ideal. Such a platform would allow a modular, flexible approach that involves quick component upgrades or swap-outs rather than lengthy service interruption for full-scale replacement. The same platform could then be used for the complete transition time, from mixed DSLAM and voice services up to the final stage where all-IP services are supplied from the DSLAM or MSAN in the street cabinet.

Which brings us to all-IP and a connectivity system called the All-IP migration kit, of which the copper connectivity module discussed previously is a central part. The kit consists of three products: a KRONE® LSA-PLUS HDS all-front access splitter block for 16 subscribers, LSA-PLUS HDS singlepair splitters and custom DSLAM cable extension kits. The splitters and the block's constructions are both based on the new KRONE LSA-PLUS HDS copper connectivity module.

The splitter cable head and the single-pair splitters will allow selective service of customers who are not ready to go all-IP. In fact the splitter feature allows carriers to enable selected subscribers to still receive central office-driven services. But where an eventual upgrade from DSLAM to MSAN is the aim, the custom-tailored cable extensions help the carrier to exchange outdated DSLAM hardware with new state-of-the-art MSAN equipment without severely interrupting service delivery to the subscribers.

An MSAN, along with all-IP services delivered from cabinets ever closer to the subscriber premises, will be necessary to pave the way for next generation copper-based broadband services such as G.Fast. The All-IP migration kit aims to speed up that process.

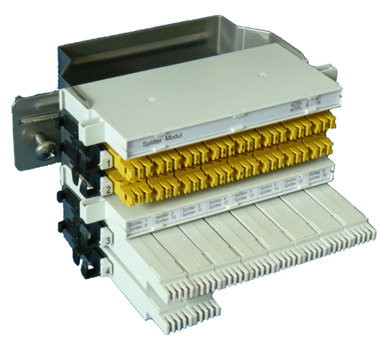
It's worth noting that LSA-PLUS HDS can be installed in multiple places in the copper network—from the central office to the subscriber's access point. However, the All-IP migration kit is used to upgrade active cabinets that are fed by a fiber and a copper main cable. The aim is that outdated active equipment will eventually be exchanged and new MSANs put in place. In this scenario All-IP/VDSL services can be cross-connected from the MSAN to a copper cross-connect field to feed the subscriber lines. The MSAN is then accessed over a newly created HDS cross-connect field.

Once all customers in a cabinet receive all-IP services from the local MSAN, the copper main cable coming from the central office is no longer needed as all services are then coming from the MSAN. Realistically, however, there will be legacy, central office-driven services that may continue for some while.

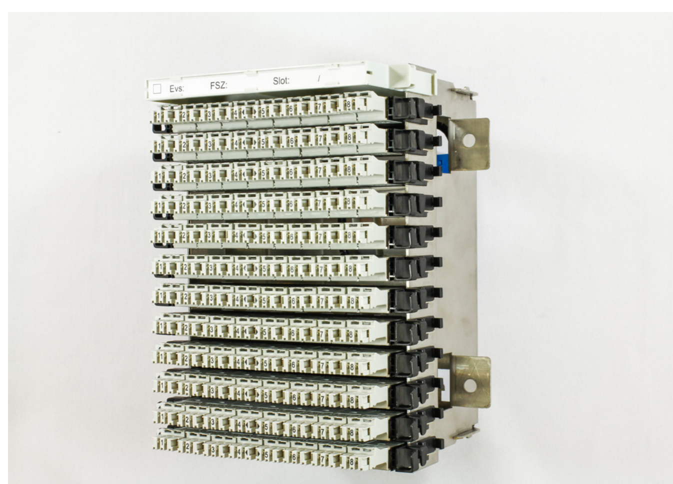
At all times during any migration, however, the focus must be to keeping the impact on subscribers as small as possible while upgrading the cabinet infrastructure. Service downtimes must be minimized. Ensuring that the cabinet (and ideally all customers) goes fully all-IP in the future should be something that is carried out quickly and smoothly with as few stages and as little manpower as possible.

As and when the total migration of customers to all-IP finally takes place, the DSL splitters and respective wiring can be removed and the affected customers can easily be rerouted to the protective LSA-PLUS HDS system cable head. In this scenario the main copper cable coming from the central office has no remaining function (a fiber cable will take over) and can be left buried and unused. At this point the splitter plug can be removed and an OVP-plug put in its place to protect equipment (MSANs by this stage) from excessive voltage surges in case of a power crossing in the network or a lightning strike.

Single-pair splitters



Splitter blocks



Cable heads

The copper connectivity module referred to earlier, can be supplied as a preconfigured plug-andplay cable head. In this context, the LSA-PLUS HDS cable head functions as a universal adapter between the active equipment and the copper subscriber lines. The modular design of the module enables installers to keep more than half of the cabling in place when a technology switch on the system side makes it necessary to exchange the pre-equipped base part of the cable head. All cabling from the LSA-PLUS HDS system patch field can be removed by the use of the single-pair plugs. There is no need to touch the cabling on the customer's side. The base part can then be exchanged with a new one (that is differently configured, with a different cable type), the plugs get inserted in the new base and the work is done.

Again, modularity and flexibility are key here. Compared to an exchange of a non-modular cable head where all the customer side termination cross-connects need to be touched and rewired, this approach offers an enormous saving in installation time, not to mention a saving in components. The OVP single-pair modules remain where they are. No additional CapEx is needed. A profile mount version of the LSA-PLUS HDS cable head, designed to carry 48 copper pairs, is now part of the All-IP kit. This too offers overvoltage protection. Preconfiguring with system cables is an option here too.

If a protector needs to be exchanged only one plug will be replaced—not a set of protectors as it would be the case when magazines of multiple protectors are installed. The same, of course, goes for the exchange of a faulty splitter unit. Conversely you can add protectors or splitters when you add customers.

The CapEx and OpEx benefits of being able to protect exactly those lines that need protection and only invest for subscribers that are already there are clear: this flexibility enables carriers to selectively migrate customers to other services without having to double their capacity proactively.

Conclusion

This is not the only solution on the market proposing a way towards all-IP using enhanced copper connectivity. However it is, we believe, more flexible, efficient and future-proof than any other solution.The drive by carriers to bring cabinets or drop points closer to subscribers, along with fiber connectivity from the central office to the cabinets, and MSANs to replace DSLAMs will mean ever-changing demands on last mile connectivity to the subscriber. However, technology now being installed to serve that last mile could need replacing in a very short time. The LSA-PLUS portfolio can migrate with the equipment it serves, ensuring that all-IP next generation copper broadband services reach the customer as smoothly and quickly as possible.

WP-111224-EN (03/17)