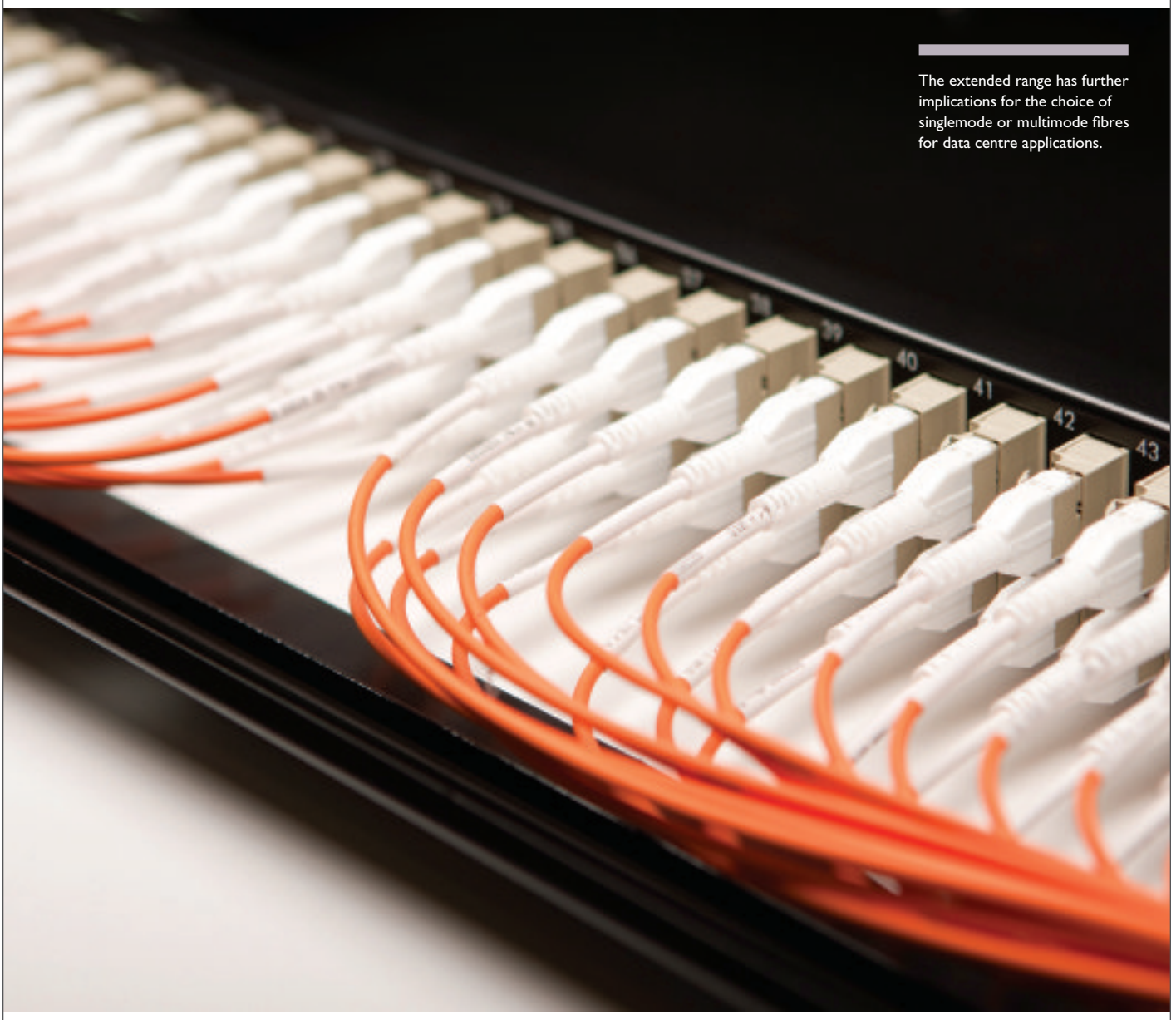


The extended range has further implications for the choice of singlemode or multimode fibres for data centre applications.

Above and beyond

Joost Grillaert of **Nexans Cabling Solutions** explores the impact of reach capabilities for 40 Gigabit Ethernet over multimode fibre.

Whilst traffic increases as a result of the greater capacity offered by FTTH, the supporting infrastructure also requires an upgrade to higher speeds. First of all, data centres that handle FTTH traffic must be enabled to handle these higher volumes. To achieve that, migration to 40 Gigabit Ethernet is required. Although many data centre operators are wondering whether they shouldn't jump straight to 100, 40 Gigabit Ethernet seems to be the first step for mainstream data centres, as more efficient solutions for 100 Gigabit Ethernet are being developed.

To the limit

Most switch suppliers are currently already offering 40 Gigabit Ethernet solutions. However, migrating to 40 Gigabit Ethernet isn't as easy as it may seem. Ever since the 40 Gigabit Ethernet standard was approved in 2010, data centre owners and installers have been expressing their concerns about one

It would appear there may well be two kinds of 40 Gigabit Ethernet solution in the near future.

specific drawback: the limited operational distances as described in the specification. The relatively short distance offered by the 40 Gigabit Ethernet standard using multimode fibre has a number of consequences for data centre and FTTH network design, as more complex configurations are simply not possible.

Why not 100Gb now?

100Gb currently requires more than 2x10 fibres which today is economically not viable and technically rather difficult to implement. Standards work is taking place with the aim of replacing this by 2x4 fibres, as is the case with 40Gb, but this is still in its early stages. Using 100Gb transceivers with 20 fibres, in line with the current standard, would be very expensive since 10 VCSELS on each side would be required, as opposed to just four on each side for 40Gb and the new upcoming standard for 100Gb.

For existing data centres this could even mean a redesign is in order, as channel lengths are decreased and the number of cross connects is limited.

Data centres are often split across different rooms within a single building, either by design or simply because the building's architecture dictates a specific layout. Sometimes, the SAN isn't located in the server room. In other cases, a data centre might be located in multiple adjacent buildings. The required cabling distances really add up very quickly.

There is, however, hope: in practice new networking products will be able to potentially solve any problems imposed by increased distances. As a consequence, installers might not be as limited by the new standard as originally believed...

Quadruple distance

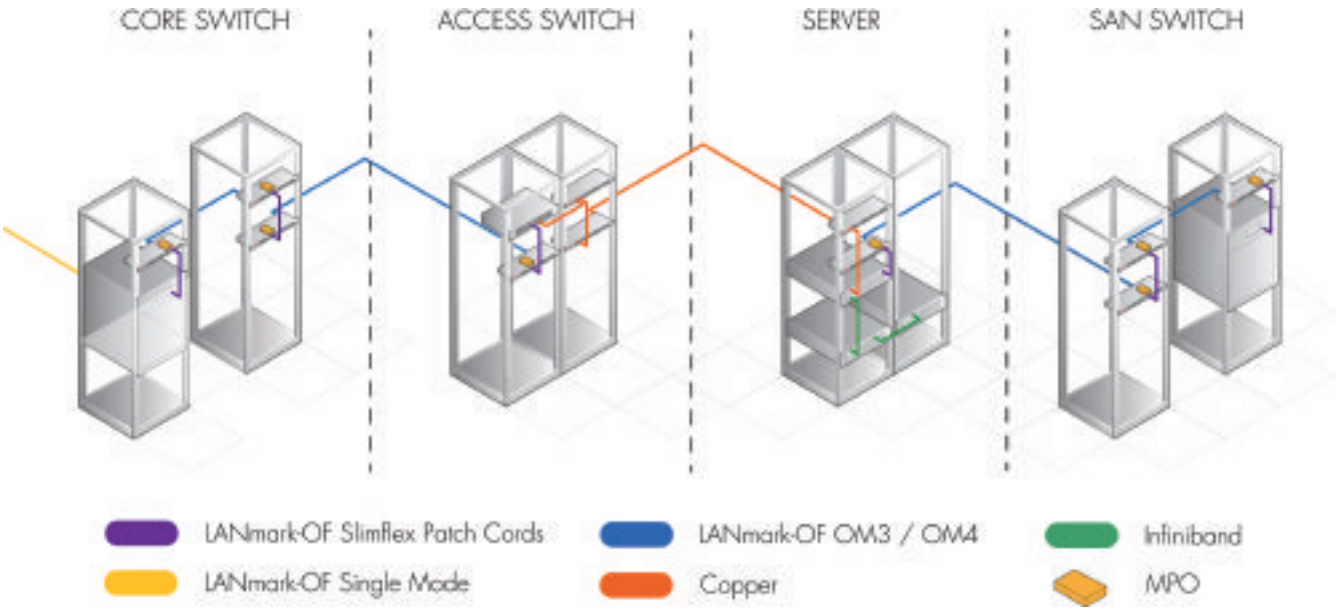
The 40 Gigabit Ethernet specification guarantees effective data transport up to a distance of 150m. However, tests carried out at Nexans Data Communications Competence Centre (DCCC) in the USA, show that far greater distances – in excess of 600m – can be realised using pre-terminated fibre assemblies with nine MPO connectors. That's more than four times the reach, with more than four times the connectors specified by the IEEE. During the 100 Gigabit Ethernet frame testing with a seven connector channel, a distance reach of 500m was successfully achieved. The performance boundaries of pre-terminated optical fibre assemblies were extensively tested using a variety of configurations and platforms. To make sure test results were relevant to real world applications, multiple connection points were used to test the links between switches.

To summarise: the recent test results demonstrate that high quality enhanced OM3 and OM4 cables consistently exceed the IEEE Standard for both 40 and 100 Gigabit Ethernet by a substantial margin. The DCCC results are particularly noteworthy, not only for the distances achieved, but also due to the utilisation of frame error rate testing instead of the more commonly used bit error rate testing. Also, frame error tests ran hundreds of times longer than the industry requires.

Double standards

When taking the test results into consideration, it would appear there may well be two kinds of 40 Gigabit Ethernet solution in the near future. One family of products will be 'standards compliant', and another will actually surpass these levels. Many of the components available today are significantly better than the existing specifications. The higher quality of the current generation of transceivers plays an important part in this. Manufacturers will be able to release products which guarantee performance levels which exceed the standard. That is a totally new and rather exciting development within our industry. The extended reach capabilities clearly demonstrate what can be achieved when you combine outstanding quality optical cable and connectors in support of next generation communications technologies.

So exactly how is the greater range achieved, from a technology point of view? The spectral width of a light signal in a 10 Gigabit Ethernet system is 0.25 nanometres (nm). However, for 40 Gigabit Ethernet, this is significantly greater, at 0.65nm. As the width of the signal is larger, it can't travel as



> *40 Gigabit Ethernet seems to be the first step for mainstream data centres, as more efficient solutions for 100 Gigabit Ethernet are being developed.*

far without introducing interference between adjacent bits. Each single bit may interfere with the bits directly before and after it. However, by using advanced transceivers, the spectral width can be reduced and the possible transmission distance can be significantly and reliably extended. In fact, it becomes possible to narrow down the given 0.65nm down to the 0.25nm spec of 10 Gigabit Ethernet, allowing light signals to travel greater distances without interference.

Single or multimode?

The extended range has further implications for the choice of singlemode or multimode fibres for data centre applications. Forty Gigabit Ethernet multimode cabling is more complex than 10 Gigabit Ethernet, because you need to use multimode parallel optics with an MPO connector. However, for 40 Gigabit Ethernet singlemode, you need only one single fibre to transmit data and another to receive. This is a relatively inexpensive solution. On the other hand, singlemode transceivers rely on very complex wave division multiplex techniques, making them extremely expensive. In fact, the cost can be four to six times higher in comparison to a multimode solution. To summarise: the huge transceiver cost for singlemode transceivers make this a viable solution only for very long distances.

Other important points in the migration from 10 Gigabit Ethernet to 40 Gigabit Ethernet are the fact that 40 Gigabit Ethernet requires a greater amount of fibre than 10 Gigabit Ethernet. With 12 fibres, you can operate six 10 Gigabit Ethernet ports, but you can only operate one single 40 Gigabit Ethernet port. Clients need to work out to the best of their ability how many ports they will probably need in future. In some cases it is fairly easy to add fibres at a later stage, but for other – possibly critical – data centres expansion might not be all that simple. Clearly, it pays to think ahead.

Working with MPO connectors means clients need to be extra attentive and careful, to avoid contamination, which is a key problem with fibre. This can present quite a challenge initially, but, once they're aware of how the connectors should be used correctly, it's really quite straightforward. At present, we're seeing the first 40 Gigabit Ethernet transceivers and switches from all major suppliers reaching the markets. Of course, we are now still only in the very first development phase for 40 Gigabit Ethernet and we need to see how the market will develop and what having two different levels of performance might imply for warranties and compliance.

Viable solution

In short: the 40 Gigabit Ethernet protocol places constraints on data centre layout, limits the number of cross-connects and decreases channel length, when looking at the official specifications. Split data centre rooms are a particular concern. However, recent tests have conclusively shown that networks can deliver a performance guaranteed to be higher than the specification implies. As data centres feel the pressure to upgrade in order to meet the growing requirements imposed by vast FTTH uptake, it would appear that migrating to 40 Gigabit Ethernet is a far more plausible solution than it may originally have seemed.

Joost Grillaert is fibre product manager at Nexans Cabling Solutions and has been at the company since 2007. Prior to joining Nexans, Joost worked in technical marketing for Cabot Microelectronics Corporation.