

Over the last 20 years, the fibre optic cable industry has experienced some 100 different styles of fibre connectors. We have seen screw threads, bayonets, push-fits, simplex, duplex, straight tips and angled tips in just about every combination. This is great for competition and for maintaining that certain fibre mystique, but frustrating and baffling to the installer and end user.

The simple life

To make life simpler, the various cabling standards bodies agreed to specify one single connector type for use at the customer's work area interface. Until recently, the unanimous choice was the SC connector, a simple push-pull square profile device, developed in Japan by NTT. The SC has the advantage over the more popular ST bayonet connector, in that it is keyed and can be duplexed so that the correct polarity is guaranteed when mated with a patch cord assembly.

The SC connector was a good choice for the work area, but not much better than any of its rivals when installed in racks or cabinets, for one reason - density. In its structured cabling standard, the

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Small but beautifully formed

The fibre optic sector of the network cabling industry has witnessed the introduction of a number of different types of connectors, with small form factor (SFF) connectors being a relatively recent addition to the market. John Kellow of The Siemon Company charts the history of SFF connectors, the different types on offer and the standards relating to their use.

Telecommunication Industries Association (TIA) recommends that rack-mountable optical fibre cross-connects should have a density of at least 144 fibre terminations over 14U (approximately 620 mm). By extending that figure, we can begin to understand one of the factors that have inhibited the widespread adoption of fibre to the desk. The universal adoption of the eight position modular RJ-45 jack for copper cable termination has meant that we are now seeing up to 48 unshielded twisted pair (UTP) cables being terminated in a 1U space. What was needed was a fibre connector with a similar high packing density.

Enter the small form factor (SFF) connectors. A small platoon of small form factor connectors from various manufacturers has come to our rescue in recent years. Although different in design from each other, they have the common feature of being considerably smaller than their predecessors. So who are the main players?

Connecting events

The mechanical transfer registered jack (MT-RJ) was developed by AMP/Tyco and Corning around an original Japanese (NTT) specification and supported by over 30 manufacturers.

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This is a small duplex connector featuring two pre-polished fibre stubs. Termination is carried out by inserting the two cleaved fibres into the connector, where they are aligned and butted up via a v-groove. Interstices are filled with index matching gel to improve attenuation and return loss performance and an internal clamping device holds the fibres in position. At one point the MT-RJ looked like becoming the new standard for SFF. In 1998, the American EIA/TIA TR41.8 committee gave it a 59 per cent vote, just short of the required amount. By the way, the 'RJ' part of the name refers

to its uncanny resemblance to an eight-position modular copper connector.

Lucent Technologies' own connector - the LC connector - is best described as being like a half size SC connector that uses the traditional 'glue and polish' terminating technique. Generally rated as being one of the higher performing SFF connectors, it accommodates singlemode as well as multimode fibres. A pre-terminated 'quick-crimp' version is also available.

The Volition VF-45 is part of the 3M Volition range. This connector is radically different than the others in that it does not use ferrules but relies on field polished fibres being held in position by v-grooves. A temporary mechanical splice is created when the connector is mated with a patch cord assembly and an integral door protects the fibre ends when the connector is not in use. The VF-45 is suitable for both singlemode and multimode fibres.

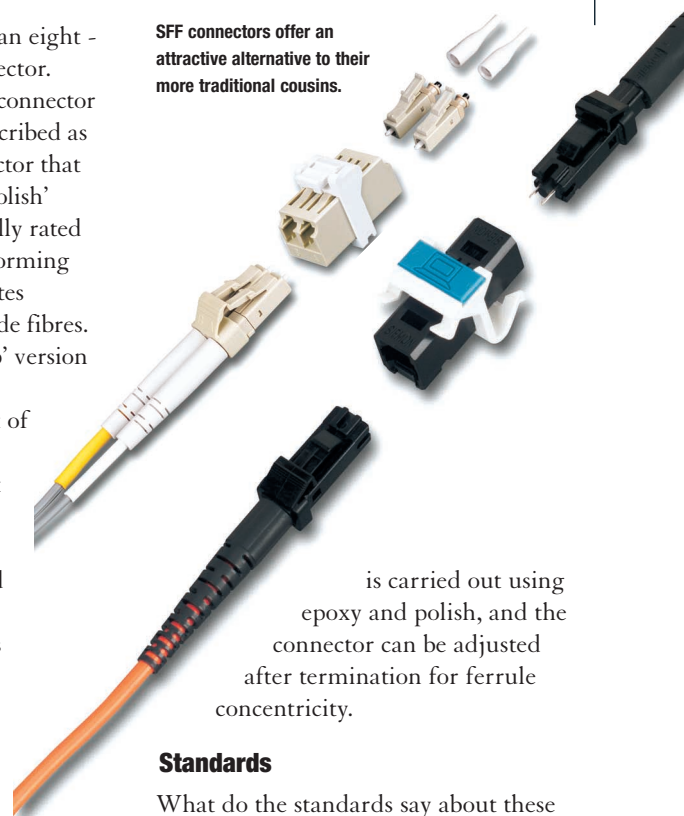
Panduit's Opti-Jack was the first SFF to the market. It is a duplex design that uses the ST/SC style 2.5mm ferrule. The original Opti-Jack relies on traditional terminating techniques but a

pre-polished crimp-style version is now also available. The Opti-Jack range accommodates both singlemode and multimode fibre.

The SC-DC (dual contact) or SC-QC (quarto contact) is a Siecorm/IBM product. These connectors are styled like a simplex SC connector but accept two or four fibres in line in a standard 2.5mm ceramic ferrule. The termination method is similar to that of the MT-RJ.

The MU connector is a Japanese designed product from NTT. Like Lucent's LC connector, it resembles the SC connector in appearance, but uses a 1.25mm diameter ferrule. Termination

SFF connectors offer an attractive alternative to their more traditional cousins.



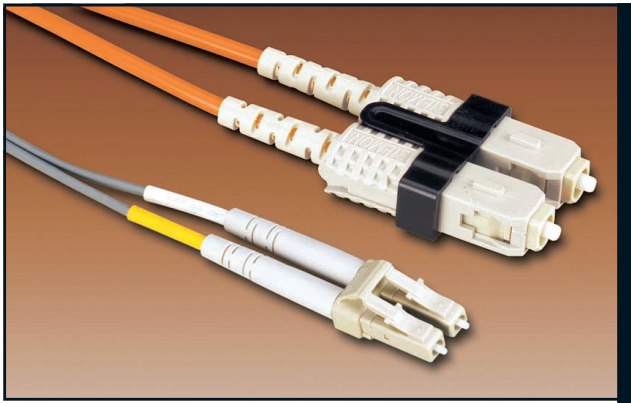
is carried out using epoxy and polish, and the connector can be adjusted after termination for ferrule concentricity.

Standards

What do the standards say about these new connectors? The physical designs are specified in a series of TIA Fibre Optic Connector Intermateability Standards (FOCIS). If FOCIS approved, they qualify for the ANSI/TIA/EIA-568-B.3 standard, provided they meet this standard's performance criteria. As far as the TIA is concerned, approved SFF connectors may be used in any part of a structured cabling system.

The international standards bodies are less generous and the soon to be released update of ISO/IEC 11801 standard will only approve the use of SFF at the rack or cabinet end, not at the customer's work area. It is debatable whether this restriction will be taken too seriously.

Most of the connectors offer a traditional epoxy or glue and polish option that should be easy for experienced fibre installers to undertake. The challenge comes with the pre-polished connectors in which the success of the termination is dependent on good cleaving techniques and positive mating of the fibre ends. Connector suppliers and established training establishments should be willing and able to offer the necessary extra training and so make the difference between an easy transition to the new technology and a disaster.



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Teething problems

It's no secret that certain SFF connectors suffered from early teething problems in the field. It is very difficult to insert two fibres side-by-side into a small lead-in tube and be sure that both fibres are fully butted up to the internal stubs. A very neat solution is to use a visual fault locator (VFL). This device allows the installer to inject a low powered red laser light into the connector, causing the translucent parts of the connector casing to glow. As soon as the fibre ends are fully mated within the connector, the light is transmitted away down the fibre and the glow at the connector diminishes considerably. Field experience of this technique shows it to be extremely successful.

The fibre optic component industry is predicting that by the year 2009,

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global consumption of SFF connectors will be over 300 million, so is now the right time for us to be adopting them in our own cabling systems? The factors to consider include performance, value for money, compatibility and availability.

When considering connector performance, it is worth remembering that the maximum total optical power budget for Gigabit Ethernet is only 2.5dB for 62.5/125 micron fibres. Currently, the maximum permissible connector loss is 0.75 dB. Throw in a

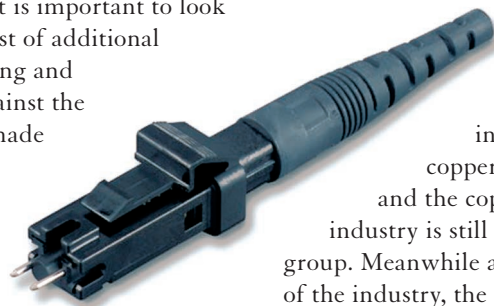
decent length of cable and a few splices and it becomes clear that there is not much headroom to play with. The chosen SFF connector must have a performance that at least meets that of the more traditional types.

The price is right?

At the moment, there is a wide price range

across the SFF spectrum and most are more expensive than SC or ST connectors. Is this extra cost justified? Straightforward price doesn't paint a true picture and it is important to look at this plus the cost of additional tooling and training and measure them against the possible savings made through faster installation times and smaller space requirements.

The choice of connector type is also influenced by its compatibility with the rest of the network. Do several manufacturers of both passive and active components support it? This is important when considering the useful life of the cabling. Are you



associated equipment and consumables readily available? Do you have the choice of several suppliers, or will you be tied down to only one? Market leaders are emerging and it is worthwhile snooping around on the Internet and in the trade magazines to see which connectors are supported by the largest number of vendors. The answer will soon become apparent.

The upshot

SFF connectors have plenty going for them. There is no doubt that their space saving capabilities have the potential to encourage the wider adoption of fibre to the desk. Whether they become the deciding factor is debatable. Active

fibres optic hardware is still perceived to be expensive in comparison with copper based solutions and the copper cabling industry is still a very large lobby group. Meanwhile another large sector of the industry, the broadband providers, is showing a large interest in fibre connectors that offer an aesthetically pleasing interface in the home and broadband equipment already comes with connections for the more popular SFF styles.

In the short term, the SFF connectors offer us an attractive alternative to their more traditional cousins and, over time, as prices are inevitably driven down, the bulky traditional connectors will become a distant memory.

looking for a manufacturers warranty on the cabling system? They will almost certainly require the use of their own connector type. Will you need to use hybrid patch cords, MT-RJ to SC for instance? This could add cost and reduce the overall flexibility of the system.

We have all seen the announcement of new products that turn out to be figments of a marketing team's fertile imagination. Is your chosen connector, and all the

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