Miniaturisation and the space races

Cable miniaturisation in FTTH deployments: choosing the right 200-micron fibre for outside plant networks, by Vanesa Diaz, Corning

One major factor that currently inhibits fibre to the home (FTTH) roll-outs is that the current access network infrastructure in many European countries is crowded and the level of investment required to install new plants in the ground is still very high (amounting to as much as 56 per cent of the overall deployment costs[1]). As a result, incumbents and alternative operators are looking at new technologies that can minimise the cost of new deployments and/or maximise use of their current infrastructure capabilities to deliver a more positive FTTH business case.

The miniaturisation of cables and fibre infrastructure in FTTH deployments

To alleviate the high levels of investment required to deploy a FTTH network and to maximise current conduit usage, many operators are opting for the miniaturisation of materials and installation equipment. Microtrenching technologies, alongside microducts and small diameter cables (so-called minicables) are some of the most relevant examples of these technologies.

In new deployments, microtrenching claims to reduce civil costs by 80 per cent[2] by replacing traditional trenches with a narrow slit that is sawn in the surface of the road, into which microducts with narrow, vertical cross-sections are placed. Microducts sub-divide the internal duct space into smaller compartments into which minicables are installed, allowing efficient sharing of overall duct-space and leasing of spare ducts. This technology also allows the addition of increased network capacity in the future by installing new minicables in spare microducts. In greenfield deployments, this enables a lower initial level of investment and later 'pay-as-you-go' upgrades of the network infrastructure. In brownfield networks, the smaller, lighter, and more flexible design of minicables makes them perfect to be

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air-blown into existing, crowded ducts that otherwise would be deemed full.

Fundamentally, miniaturisation is only made possible by the smaller, tighter designs of minicables. Until recently, the cable industry had managed to deliver some modest reductions in cable size using standard G.652 fibres while still meeting industry-required cable performance. However, a new generation of single-mode optical fibres with a smaller coating diameter has recently been developed, making it possible to reduce cable size even further.

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Introducing 200-micron diameter fibres

ITU-T Recommendations G.652 and G.657 describe the geometrical, mechanical, and transmission attributes of single-mode optical fibres[3]. Although these fibres have evolved greatly since the first commercially-viable product was introduced by Corning back in 1970, their geometrical dimensions have always remained the same. Core (9µm) and cladding (125µm) trap the light using the principle of internal reflection while a 250µm diameter coating protects the glass fibre from mechanical damage and stress. This coating also protects the light-carrying capability of the glass by shielding it from mechanical forces that otherwise could cause small deviations in the axis of the core, leading to loss of optical power through the mechanism known as microbending.

To enable tighter packing of fibre in the cable, the coating diameter of the new generation of single-mode fibres has been reduced from 250µm to 20µm while still retaining the same 125µm cladding diameter of conventional single-mode fibres (see Figure 1). To compensate for the reduced coating thickness that could lead to more microbend loss, a ITU-T Recommendations G.657 compliant glass design is used as these fibres provide enhanced microbend resistance as well as superior macrobend performance. Further, the use of a superior coating provides resistance to microbend inducing external stresses – even when applied at the lowest thickness.

There are three sub-categories defined by the ITU-T Recommendation G.657 (G.657.A1 or 'bend -improved' fibres, G.657.A2 or 'bend- tolerant' fibres and G.657.B3 fibres or bend- insensitive fibres). As might be expected, the macrobend performance of each category is also reflected in the microbend tolerance. This leads to a selection decision for network owners wanting to take advantage of 200 micron fibres – what category of bend resistance is sufficient to ensure low- loss installation? G.657.A1 fibre is intended for use in outside plants and has been enthusiastically adopted by network owners[4]. G.657.A2 and G.657.B3 compliant fibres are more commonly used inside the building where much tighter bends on low fibre-count cables are often encountered and an improved bend performance may be required as a consequence.

Furthermore, the optical core profile design that is frequently used to yield outstanding bend performance of G.657.A2 and G.657.B3 fibres can result in difficulties when attempting to splice in high volume in the outside plant when using established splicing programs and installation practices. Complimented by a suitably resilient coating material, G.657.A1 200µm fibre can deliver enough microbending resistance for outdoor applications to overcome challenges presented by the thinner coating application.

Based on this understanding, Corning has developed ClearCurve 200 fibre: a full-spectrum single-mode fibre with enhanced G.657.A1 macrobending performance and a mechanically strippable, UV-cured, Corning CPC acrylate protective coating, perfect for outside plant applications.

Making the most of 200-micron fibres

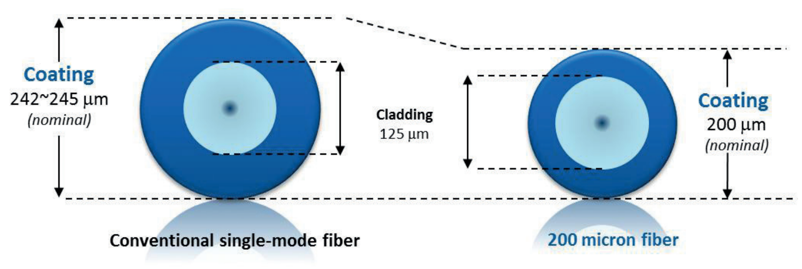
The smaller cross-sectional area of 200 micron fibres can enable either higher fibre count in the same cable cross-section or smaller cable cross-section maintaining the same fibre in a lighter package, both delivering practical benefits for operators:

- Increased fibre capacity within the existing duct infrastructure;
- Re-utilisation of the duct infrastructure to avoid expensive additional trench digging;
- Reduced costs for operators that lease ducts based on space occupied by the cable; and
- Extended blowing distances and reduced installation time in already crowded ducts.

Telecom Italia, for example, has opted for these reduced coating 200-micron fibres, recognising their potential to develop high-density cables without increasing the external diameter, therefore remaining compatible to current minicables and microducts[5] and avoiding trenching. While incumbent operators will mostly benefit from 200-micron fibres by reusing partially filled ducts, alternative operators can use 200-micron fibres to reduce duct leasing costs. In many European countries, regulatory bodies oblige their incumbents to provide access to their duct infrastructure, yet leasing prices are expensive. In some cases, duct rental is actually based on cross sectional area, in Europe this is the case in Portugal[6] and France[7]. Based on published data about duct leasing fees in Portugal[8] a 50 per cent smaller cross-sectional area obtainable using 200 micron fibres could deliver cost savings of typically up to €800 per cable km (NPV of 25-year savings in duct leasing fees).

Conclusion

200 micron fibres have an important role in the trend for miniaturisation of FTTH hardware and cable. The smaller and higher density cable designs that these fibres enable can have significant benefits in CapEx and OpEx network cost for both incumbents and alternative operators. The bend resistance of G.657.A1-based 200 micron fibres is sufficient for a wide range of outside plant cable designs and applications, and their optical core profile technology makes these fibres compatible with existing G.652.D legacy networks and standard installation practices.



Cross sections of conventional and 200-micron fibres

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