THE INSTALLATION OF BLOWN FIBRE NETWORKS WITHIN BUILDINGS

by

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ABSTRACT

This paper discusses the planning and quick installation of an optical fibre network within a commercial building, using the blown fibre technique. Completion of this trial installation demonstrated the inherent flexibility of the blown fibre system.

(1) INTRODUCTION

The 'blown fibre' technique was invented at British Telecom Research Laboratories (BTRL) in 1982. Developments of the blown fibre system have been reported widely in the technical press (Refs 1-3), and recently the system was introduced into the British Telecom local network as a means of installing optical fibre links. In parallel to external network development, the blown fibre portfolio has been expanded for use as a purely intra-building optical network medium. Modern communication networks within buildings now include an increasing requirement for optical fibre cable. Indeed in future, there will be a likely requirement of an even larger fibre content up to and including a 100% fibre option.

Current in-building cabling systems with a fibre content tend to incorporate the optical fibre in the vertical element of the network only. In the more comprehensive systems envisaged in the future, fibre will be needed in the horizontal element as well. Network flexibility and the ability to easily reconfigure will also be a strong user requirement. Blown fibre offers a high degree of flexibility and is an ideal method for installing fibre networks in buildings. The fibre unit can then be installed as and when required, allowing flexibility of routing, minimum disruption to building occupants and a reduction in the immediate capital expenditure on optical fibre.

This paper describes the installation of a blown fibre network in a commercial building in London. This installation constituted an early use of blown fibre, as a purely in-building cabling medium. Completion of the trial has yielded much information on aspects of; planning, installation, termination and commissioning of a blown optical fibre building network.

(2) BLOWN FIBRE TECHNOLOGY

The equipment needed to install a blown fibre network (see Fig 1) is similar to that used externally[1,2], except a smaller (electrically driven) compressor is necessary because of the shorter cabling distances. Major components are fibre unit [3] (a number of optical fibres held together with an expanded polyethylene skin), a blowing head and control box, compressed air supply, and, finally the microduct tube network (a network of interconnected polyethylene tubes sheathed in fire retardant PVC).

In operation, the fibre unit is fed through the blowing head under control of the operator into the microduct tube. The viscous drag of air over the fibre unit results in a distributed installation force. Consequently many tight bends and awkward in-building cabling runs can be negotiated and up to 500 metre lengths can be cabled in one operation.

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The first stage in the process is to install empty twin tube microduct in the building connecting the major access points. The tube network is terminated at tube flexibility points (see Fig 1) which allow tubes to be re-routed as desired. Microduct flexibility points are incorporated at the interface of the vertical and horizontal networks. Thus tubes can be reconfigured from one floor to another or one part of a floor to another. The standard tube currently in use has a 6mm bore. Future systems will offer a range of tube sizes including 3mm bores. A graph of blowing distance verses tube size for a range of air pressures is shown in figure 2, where it can be seen that lengths of tubing of 500 metres or more can be accommodated easily.

Once the dedicated tube network has been defined, continuous fibre links can be blown in end to end. Finally, the optical fibre can be terminated by use of in-situ field terminable connectors. Thus, in total an inexpensive reconfigurable optical cable network is provided.

(3) TRIAL SITE

The trial site (see Fig 3) was chosen to be a four story commercial building situated in the centre of London. Data multiplexing equipment on each floor was to be interconnected via fibre links. On each floor, adjacent to the riser outlet, there was a communications closet. The host systems were sited in a communication room on the first floor, 15 metres away from the building riser. Optical fibre communication links were to be made within several parallel local area networks in the building. The plan was that a blown fibre backbone would be installed linking the main communication room to each of the communication closets. This would require 14 fibres to to be used to each floor.

(4) INSTALLATION

Thirty metre lengths of twin tube microduct were cabled from the central communications room to each of the closets. Minimum bend criteria (100 mm radius) of the microduct was adhered to, and time trials showed that the microduct could be pulled in quickly and easily by non-skilled staff. The ends of the microduct were temporarily sealed to ensure that no dirt could enter the tubes during installation.

Once the microduct was installed, the second process of blowing the fibre unit in could begin. Installation of fibre unit was started from the first floor communication room. It is worth noting however, that the inherent flexibility of the blown fibre system allows fibre unit to be installed from any convenient point in the network.

The blowing head, control box and compressor were set up. Six lengths of fibre unit (each containing seven multimode fibres) were blown in. The total blowing process for this particular installation was completed within half a day. Fibre unit was installed at a rate of up to 30 metres per minute. The blown fibre equipment developed for In-building use was compact enough to fit into an estate car, and in operation quiet enough so as not to interrupt the occupants of the building.

Once the fibre unit was blown in, the individual fibres were 'fanned out' at the termination and cross connection points with a device termed a breakout unit (see Fig 4). Each fibre was threaded into a 1mm diameter loose tube which provided the necessary ruggedisation to protect the fibres in the patch panel and facilitated the use of field terminable connectors.

The connectors used were of the 905 SMA type. These had ceramic front ferrules, allowing a simple epoxy, cleave and dry polish, and, interchangeable rear parts allowing connection to both tight and loose jacket cable. Test results showed that an average termination time per connector was 12 minutes.

(5) COMMISSIONING THE SYSTEM

Commissioning of the blown fibre network was carried out using a number of simple stages. The first stage was a visual inspection of the fibre ends of each link. The second stage consisted of measuring each link for optical attenuation in both directions at 850nm, using a simple portable power source and detector. In the trial all 42 links were tested and functioned correctly. The measured results from the trial are shown in figure 5. The arithmetic mean of the results is 0.75dB per link with a standard deviation of 0.29dB. The data fits a normal distribution using a 5% significance test [4].

Since each fibre was relatively short (approximate length of 30 metres) and the loss of each fibre prior to installation measured 3 dB per km, it could be assumed that the majority of the measured loss was due to the presence of connectors. The results in figure 5 therefore represent a typical (acceptable) connector loss spread. These results show that the network loss in total was well within the system power budget of 10dB. In order to assess connector intermateability, a second set of 28 measurements was made using another test lead. The results from the two tests showed that the system would give a good performance over the envisaged service life of the network.

(6) CONCLUSIONS

British Telecom has been developing the Blown Fibre system for a number of years. It is now being used for In-building applications as well as in the local external network. In this paper, the results for an In-building trial installation are discussed. The blown fibre network was planned and installed in a quick and effective manner. Commissioning was achieved using only basic optical test equipment with simple step-by-step operation. Fibre runs of 30 metres were achieved, however the system is inherently capable of installing up to 500 metres in one operation.

Completion of the trial network demonstrates the achievements in the areas of network flexibility and the simple field termination of fibres. Splice-free optical networks are now possible using the blown fibre system.

In summary, the results from the trial suggest that blown fibre is a cost effective solution to optical in-building wiring requirements.

(7) FUTURE DEVELOPMENTS

Development work continues at British Telecom Research Laboratories to evaluate new products for inclusion into the blown fibre portfolio for In-building use. This includes investigating the use of alternative microduct tube sizes, a range of fibre unit sizes, and use of low cost connectors, and, finally investigations into suitable cable management systems.

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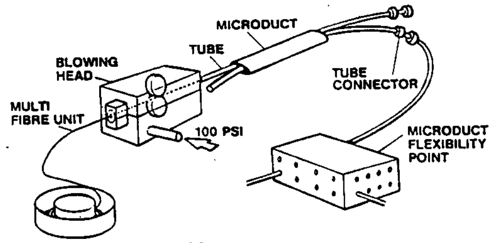

FIGURE 1.
INSTALLATION EQUIPMENT

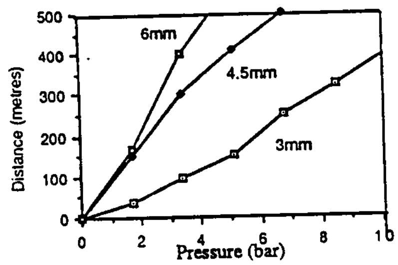

Figure 2 - Pressure/distance profiles for a range of tube bores.

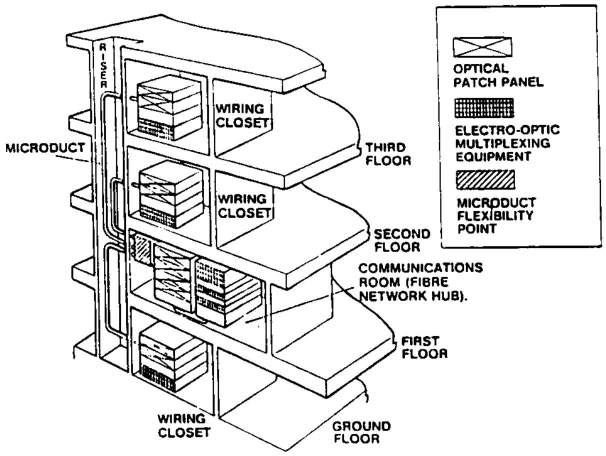

FIGURE 3. TRIAL SITE FIBRE NETWORK

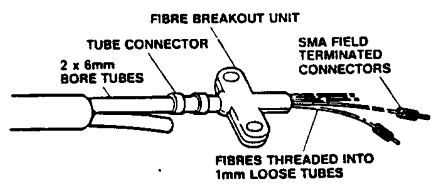

FIGURE 4.
FIBRE BREAKOUT UNIT

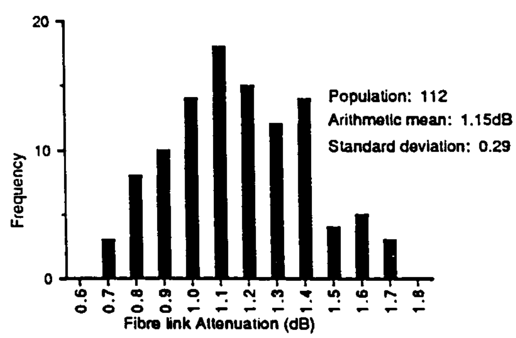

Figure 5. Optical fibre losses (Average lengths of 30m)