The Meeting of Elevators and Technology

Not too long ago it was “good enough” for elevators to just shuttle people and goods from one floor to the other. Those rides were no frills, no thrills but a safe ride ascending and descending throughout the bowels of buildings across the world. Elevator components included the necessary basics to accomplish their mission in the vertical transportation industry. Wires and cables only had to carry power and signals for fans, lights, buttons, phones, doors and parts critical to safe operation. Those days are quickly disappearing.

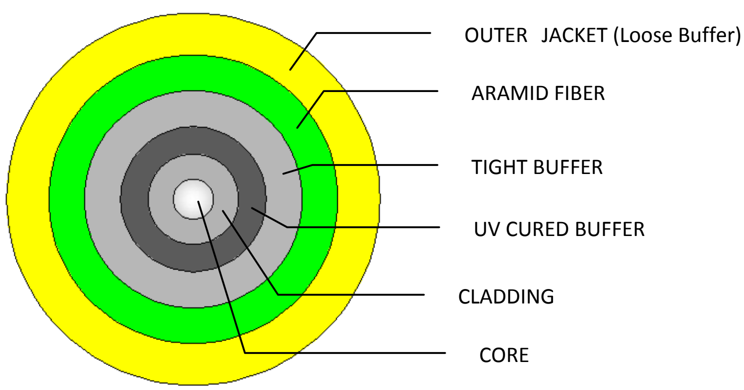
The migration of modern technology into the elevator cab began with security. The need arose to monitor the happenings inside the elevator cab. This was, and still is in many cases, done through closed circuit television (CCTV). CCTV cameras posed as a deterrent for vandalism and even more serious crimes within the confines of the elevator cab. Along with CCTV came access control and card readers which can control where people are allowed to go throughout the building. The signals for these forms of security and technology were able to travel along coaxial cable or shielded twisted pair within the traveling cables that run from the machine room to the elevator cab. Long story short, as data transmission requirements evolve these traditional cable components are challenged to meet the requirements.

In the past decade we have seen a vast and fast advance in technology. We are requiring more and more data to be transferred to and from the car. These data signals are carrying wireless internet (WI-FI), video, voice, security and control instructions just to name a few. The birth of “Category” rated cables ushered in the ability to carry much broader bandwidths and support greater data transfer rates. These cables are constructed to carry the greater bandwidths at greater speeds. Their construction, however, is also their downfall. Let’s look at Cat6 cables for a moment. They can support 10 Gigabit Ethernet (10GBe) and are rated up to 100 meters (328 ft.) in ideal conditions. We all know there is no such thing as “ideal conditions.” There will always be lights, motors, wires carrying current to outlets and just inherent installation obstructions in any installation. These cables are also prone to crosstalk. This is the condition of signals bleeding from one pair to the other. In fact, in a good installation environment Cat6 can be limited to as little as 36 meters (120 ft.). Now imagine Cat rated cables in a traveling cable for elevators. You have current carrying conductors supplying power to motors, lights, fans, phones, buttons and whatever else needs power in the cab. Then you have the movement of the cable up and down the shaft. Combine all this and you now have multiple sources of electromagnetic interference (EMI) or Radio Frequency Interference (RFI). These interferences are caused when conductors move through the magnetic or electric fields of adjacent conductors. EMI and RFI cause signal distortion and degradation.

Not only are Cat cables not recommended for use in traveling cables they are not allowed in North America by National Electrical Code (NEC). The code states that nothing smaller than 20 AWG can be used in elevator traveling cables. Most Cat rated cables are 22AWG or smaller.

The growing need for data transmission in the elevator traveling cable can easily be handled by a thin strand of glass. Yes, "*I said glass!*" This glass is known as Fiber Optic Cable. When you think of glass your first thought is probably "will it bend without breaking?" The answer is yes. You will find that fiber is more flexible than copper. It is also much lighter and can carry many times more data. Remember that little thing called EMI? It has no effect on fiber at all. Fiber is also allowed to be used in elevator traveling cable. In fact, we have been putting fiber optic components in our traveling cables and hoistway cables for more than 20 years with zero reported failures and they are covered by the same Draka exclusive Lifetime warranty offered on our round Super-Flex® traveling cable.

Let's take a brief look at the construction of fiber used in elevator cables. This is not the same as you would find in your average telephone wiring. The outer jacket is a little more robust to protect the inner components during the movement of the traveling cable as the elevator cab makes its journey.



The core is the pure glass portion in the center of the fiber optic strand. This is the area that the light signals travel through. Covering the core is the cladding. This coating is 125µm thick and helps to contain the light signals to the core. Next in line is the UV cured buffer. This coating improves the strength and handling capabilities of the fiber member. The tight buffer provides a tight protective coating on the fiber that also helps with flexibility. It is typically a PVC coating. Aramid fiber is used in the next layer as added protection and a strength member of the fiber conductor make up. This is the stuff bullet proof vests are made of. Finally the outer jacket, also known as the loose buffer, keeps the fiber package nice and neat.

Now let's talk about the 2 primary types of fiber, Single Mode (SM) and Multi-Mode (MM). **Single Mode** has the smallest core of the group. It is commonly referred to as 9/125µm. This means that it has a core that is 8.3 to 10µm in diameter and a cladding that is 125µm in diameter. SM gives the user a higher transmission rate and up to 50 times the distance than MM, but it costs more. SM requires a light source with a very narrow spectral width (basically a laser). The equipment used to transmit, receive and convert the signals of SM fiber will be the primary source of the increased cost.

Multi-Mode's most common core sizes are 50 and 62.5µm with a cladding of 125µm. 50/125µm is becoming the most popular MM fiber. MM fibers larger core allows for multiple paths of light propagation as opposed to the single path through SM. This has its advantages and disadvantages. The greatest advantage is equipment cost is much lower. The disadvantage is transmission distance is a bit less than SM.

Now comes one of the big questions. "*Which type of fiber do I need?"* Since we are talking about elevators here let's think about rise. How tall is the building? How long is my traveling cable? What is going to be transferred on the fiber?

If we put a little thought into what is going on in the elevator cab we can make the choice easy. One of the reasons we see fiber needed in this application is to get Wi-Fi to the car. This is seen a lot in hospital and healthcare applications. Another reason is security. Security devices such as cameras and card readers have advanced to the point that they need the stability that connection fiber offers in traveling cables. Next there is advertising. It is becoming more common to see television monitors in the elevator car for advertising, information or entertainment purposes. Advances have been made that allow control of signal functions such as buttons and phones to be done over fiber.

What is OM? OM stands for Optical Multi-mode. OM1 refers to 62/125µ MM fiber. That's the old, but still effective, stuff that was the American Standard of MM fiber for decades. The European standard from back then is known as OM2, 50/125µ MM. For these two fiber types LEDs are used as a light source. The problem with using an LED to create the light pulses necessary for transmission is they are limited to how fast they can turn on and off. To overcome these limitations Laser Optimized Multi-Mode Fiber (LOMMF) was developed (OM3 and OM4). As mentioned previously laser equipment for fiber transmission can be costly. To dodge this cost the Vertical-Cavity Surface-Emitting Laser (VCSEL) was developed. The VCSEL is a semiconductor based laser diode that emits a highly efficient optical beam. That's a fancy way of saying it is a laser that is not a laser. VCSELs allow the LOMMF to transfer much more data at much higher rates over longer distances. In summary, for most elevator applications MM fiber is sufficient for use. In Appendix 1 you can see that it is possible to transmit 10 GBIT over OM3 at a range of 300 m (980 ft.). See Appendix 1 for link length of different LAN applications.

Now that we have our fiber in our traveler make a connection. There has to be a means of connecting this tiny piece of glass to the transmission equipment or devices at each end. This is where we will talk about some of the connectors used in the industry.

ST Connector: The ST connector utilizes a bayonet twist-lock connection with 2.5mm ferrule. Available in single-mode and multimode, the ST connector features reliable and durable field installation. This connector is under spring tension to maintain connection. If the cable gets tugged on it may cause optical disconnect.

SC Connector: The SC is a non-optical disconnect connector with a 2.5mm pre-radiused zirconia ferrule. Available in simplex and duplex styles, this connector features a push-pull connection design for quick patching of cables into rack or wall mounts.

LC Connector: The LC connector licensed by Lucent Technologies provides a pull-proof design and small size perfect for high-density applications. Available in simplex or duplex versions, the LC connector is provided with a 1.25mm zirconia ferrule. The LC also incorporates a unique latching mechanism providing stability in system rack mounts. Its compact size, ease of installation and reliability is quickly making it the connector of choice.

Now that we have information on connectors we need to figure out how to get them on the fiber. Let's talk a bit about termination styles.

Heat cure epoxy and polish. This termination style was the original fiber-optic termination, which is still popular with high-volume installation or factory assembly houses due to its low cost, low loss, overall dependable and stable performance. This style is typically too cumbersome for field use, and unless done in a controlled environment, the yield will be low. This style of termination also requires the most supervised skills training, especially for polishing.

Easy cure epoxy and polish (hot-melt, anaerobic, etc.). This termination style is popular with contractors who have gotten accustomed to this type of termination. While field installable and relatively low cost, low loss, dependable and stable in most environments except those experiencing very hot temperatures, they still require polishing, offer less than 100 percent yield, and are relatively time consuming.

No-epoxy/no-polish connectors (pre-polished connectors with mechanical splice).This method of fiber-optic termination is the fastest and easiest to install, making it a popular choice for anyone who needs to terminate optical fiber in the field. Latest advancements in this type of connector have improved yield, and little or no training is required. The downside is that these connectors are relatively expensive, and although no-epoxy/no-polish connectors are dependable, factory fusion splices are more robust. Proprietary tooling is required, and there is the possibility of back reflection issues with some single-mode applications.

Fusion splice connectors (no-epoxy/no-polish/fusion splice). This termination style is popular with telcos, long-distance carriers, and the military due to the fact that its performance is as good as a factory pre-terminated connector with very low back reflection. The equipment that makes these connections is very easy to operate and can be learned in a very short time. Once someone is comfortable with the equipment, handling the fiber, and using the tools, connections can be made in under a minute. Due to the reliability of these connections they are the most recommended for the elevator industry.

With all of the connectors ready to connect and the fiber ready to propagate the light signals let's talk about the transmission equipment. At each end of the fiber we use a data converter to convert from electrical signals to light signals or vice-versa. These data converters provide the interface between fiber optics and electronics. As mentioned previously, multiple devices can be run over fiber. Keep in mind that in most cases you will want two way communications.

Draka has invested in the equipment and training to make fusion connections. We now have the ability to train the field in this type of fiber termination. We can offer this training in a classroom environment and make it available for the elevator mechanics to get their required training credits. Draka also offers fiber optic tools, equipment, and data converters.

For more information feel free to contact Draka Elevator Products at +1-877-372-5237.

http://www.draka-ep.com/

Link length for different LAN applications

Appendix 1

Application	**Link length**	**Draka fibre data sheet**
10 Mbit IEEE 802.3 and ISO/IEC 8802-3 10Base-FL and FB (850 nm)	OM1: 62.5 µm: 2000 m OM2: 50 µm: 1514 m OM3: 1514 m OM4: 1514 m	**C02** C01a, **C23**, **C34** C12, **C31** C11, **C32**
100 Mbit IEEE 802.3 and ISO/IEC 8802-3 100BaseFX (1300 nm)	OM1: 62.5 µm: 2000 m OM2: 50 µm: 2000 m OM3: 2000 m OM4: 2000 m	**C02** C01a, **C23**, **C34** C12, **C31** C11, **C32**
1 Gbit IEEE 802.3 1000Base SX (850 nm)	OM1: 62.5 µm: 275 m OM2: 50 µm: 550 m OM3: 1000 m OM4: 1100 m	**C02** C01a, **C23**, **C34** C12, **C31** C11, **C32**
1 Gbit IEEE 802.3 1000Base LX (1300 nm)	OS2: 5000 m OM1: 62.5 µm: 550 m OM2: 50 µm: 550 m OM3: 550 m OM4: 550 m	**C03e, C06e, C24** **C02** C01a, **C23**, **C34** C12, **C31** C11, **C32**
10 Gbit IEEE 802.3ae 10GBASE-SW/SR (850 nm)	OS2: - OM1: 62.5 µm: 33 m OM2: 50 µm: 82 m OM3: 300 m OM4: 550 m *see note1*	 **C02** C01a, **C23**, **C34** C12, **C31** C11, **C32**
10 Gbit IEEE 802.3ae 10GBASE LX4 (1300 nm)	OM1 62.5 µm: 300 m OM2 50 µm: 300 m OM3: 300 m OM4: 300 m	**C02** C01a, **C23**, **C34** C12, **C31** C11, **C32**
10 Gbit IEEE 802.3ae 10GBASE-L (1310 nm)	OS2: 10000 m	**C03e, C06e, C24**
10 Gbit IEEE 802.3ae 10GBASE-EW/ER (1550 nm)	OS2: 30000 m OS2: 40000 m	**C03e**, C06e, C24 **C06e, C24**
40 Gbit IEEE.ba 40GBASE-SR = 4 x 10 Gbit (850 nm)	OM3: 100 m OM4: 150 m	C12, **C31** C11, **C32**
40 Gbit IEEE.ba 40GBASE-LR4 = 4λ x 10 Gbit	OS2: 10000 m	**C03e, C06e, C24**
100 Gbit IEEE.ba 100GBASE-SR = 10 x 10Gbit (850 nm)	OM3: 100 m OM4: 150 m	C12, **C31** C11, **C32**
100 Gbit IEEE.ba 100GBASE-ER4 = 4λ x 25 Gbit 100GBASE-LR4 = 4λ x 25 Gbit	 OS2: 10000 m OS2: 40000 m	 C03e, C06e, C24 C06e, C24

Note 1: Engineered solution using a maximum total connector loss of 1.0 dB and VCSELs using a maximum spectral width of 0.29 nm.

Note 2: Although the information given in this document is believed to be accurate at the time of publishing, we take all reservation with regard the use of information and encourage users to consult the standards mentioned.