Selecting the Right Fiber Optic Cable

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BICSI CONFERENCE

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Milan

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Fiber vs Cable

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Fibre and Cable

Optical fibre is a flexible, transparent fiber made by drawing glass to a diameter slightly thicker than that of a human hair. Optical fibers are used most often to transmit light between the two ends of the fiber.

Optical fibre cable is an assembly containing one or more optical fibers. The optical fiber elements are contained in a protective tube suitable for the environment where the cable is used.

Fiber optic is the transmission medium itself, while the fiber optic cable is the physical medium used to protect and transport the fiber optic strands.

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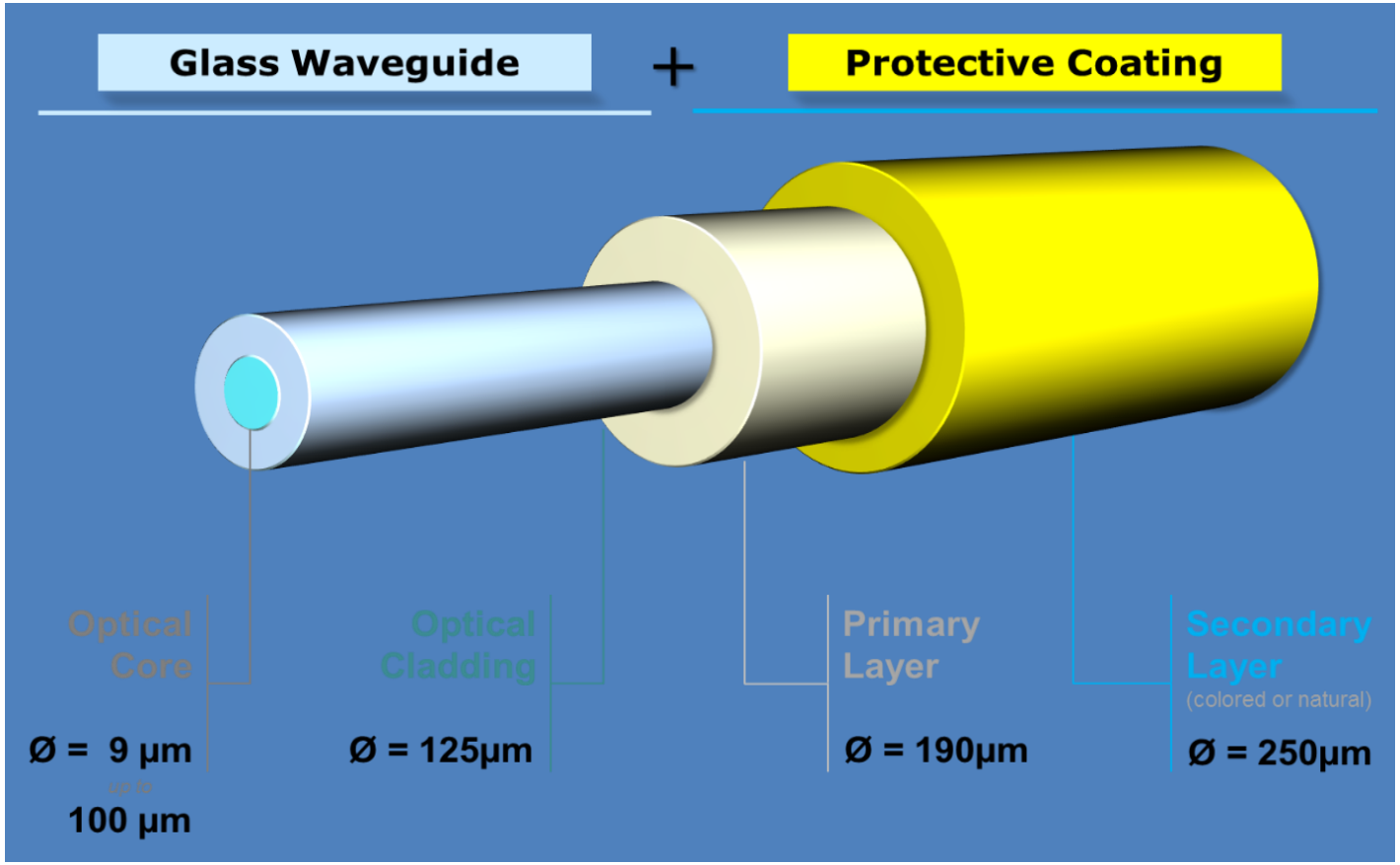
What is the fibre?

- Optical fibres, in general, are made up of **glass** (silica).
- Light guiding structure is formed by: a concentric glass **core** and glass **cladding**.
- The **refractive index** of the cladding being lower than that of the glass core.
- It has 2 coatings: a **primary** acrylate coating and a **coloured secondary** acrylate coating which offers **mechanical protection**.
- Optical fibers are used in many applications: telecommunications systems, industrial applications, medical field, data centres, military applications, etc.



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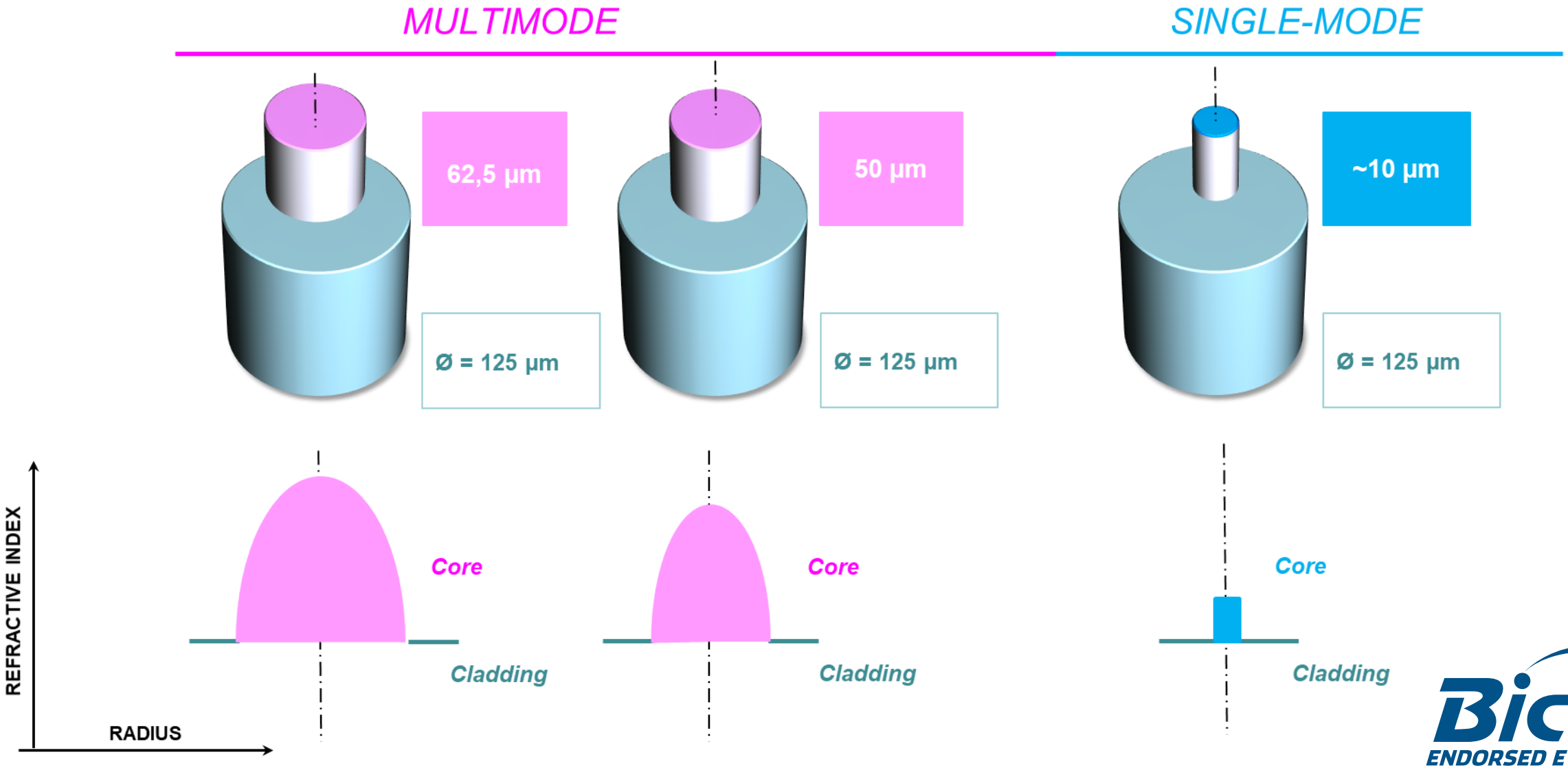
What is the fibre?



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Why fibre?

As compared with copper cables, fiber optic systems have many advantages:

- **ELECTROMAGNETIC IMMUNITY**
  No cross talk between adjacent fibers

- **CHEMICAL STABILITY**
  No corrosion / can be exposed to corrosive atmospheres

- **LOW WEIGHT / SMALL SIZE**
  Much smaller than a wire / coaxial cable with similar information carrying capacity
  Enables space saving in ducts

- **LOW ATTENUATION / LARGE BANDWIDTH**
  Larger data rates / ability to carry much more information over longer distances than either copper wire or coaxial wire

- **Ideal for SECURE and SAFE communication systems**
  Very difficult to tap but easy to monitor / no possibility of a spark from a broken fiber.
  No fire hazard, even in explosive atmospheres (assuming an adapted cable design)

How fiber is protected?

CABLE

Assembly containing one or more optical fibers suitable for the environment where the cable is used.

CABLE DESIGN

Depends on the application and installation.

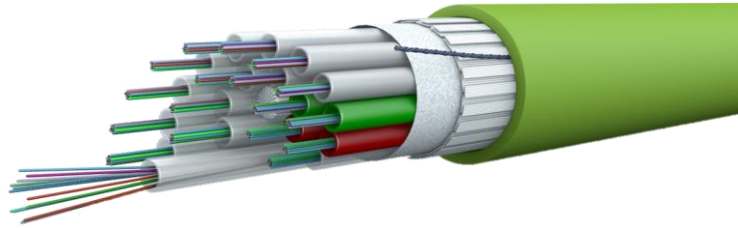
RIGHT MIX OF ELEMENTS

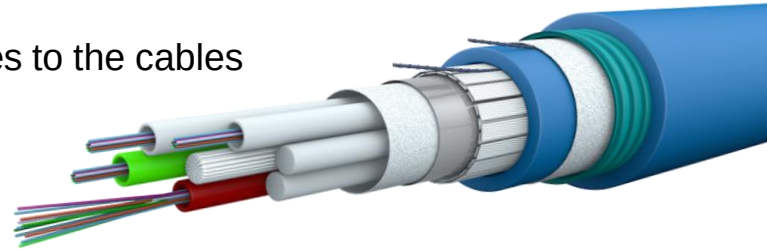
They make the right cable solution for a specific installation or/and application.

Moreover, they also keep fibres safe from us.

We have **different elements** used to protect fibres making the whole cable structure work properly, some of them are:

- Ripcords
- Plastic protective layers
- Water swellable and blocking elements
- Reinforcing elements
- Rigid elements
- Armours
- Sheaths
- Other elements to give specific properties to the cables





Most standard applications?

With right mix of elements, we can get specific solution that can be classified as:

INDOOR
Cables inside buildings

- **Light** mechanical properties.
- **Short** cable **runs** and protected from outdoor conditions.
- **Safety solutions**.
- **Human risk** related solutions.
- CPR rated

OUTDOOR
Cables installed outside buildings

- **Tough** mechanical properties.
- **Long cable runs** and direct buried installations.
- **Robust** solutions
- Long live solutions against **environmental changes**.
- Fca or not CPR rated

UNIVERSAL
Indoor-outdoor cables

- **Mix** mechanical requirements.
- **Unique solution** for indoor and outdoor environments.
- The mix between **short and long** runs is high.
- **Human risk** related solutions.
- CPR rated

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How does the cable protect us?

The cable design is not only protecting the data transmission, but it is at the same time protecting us in case of fire. That is where Construction Products Regulation (CPR) enters on the cable solutions:

ESSENTIAL CHARACTERISTICS OF CABLES ARE UNDER CPR:

- **Reaction** to fire
- ***(Resistance** to fire)*
- Release of **dangerous substances**
- These support the basis requirements for construction works:
  - Safety in case of fire
  - Hygiene, health and the environment

THE FIRE SAFETY CABLE REQUIREMENTS:

- the **generation and spread of fire and smoke** within the construction works are **limited**;
- the **spread** of fire **to neighboring** construction works is **limited**;
- **occupants can leave** the construction works or **be rescued** by other means;
- the **safety of rescue teams** is taken into consideration.

CPR

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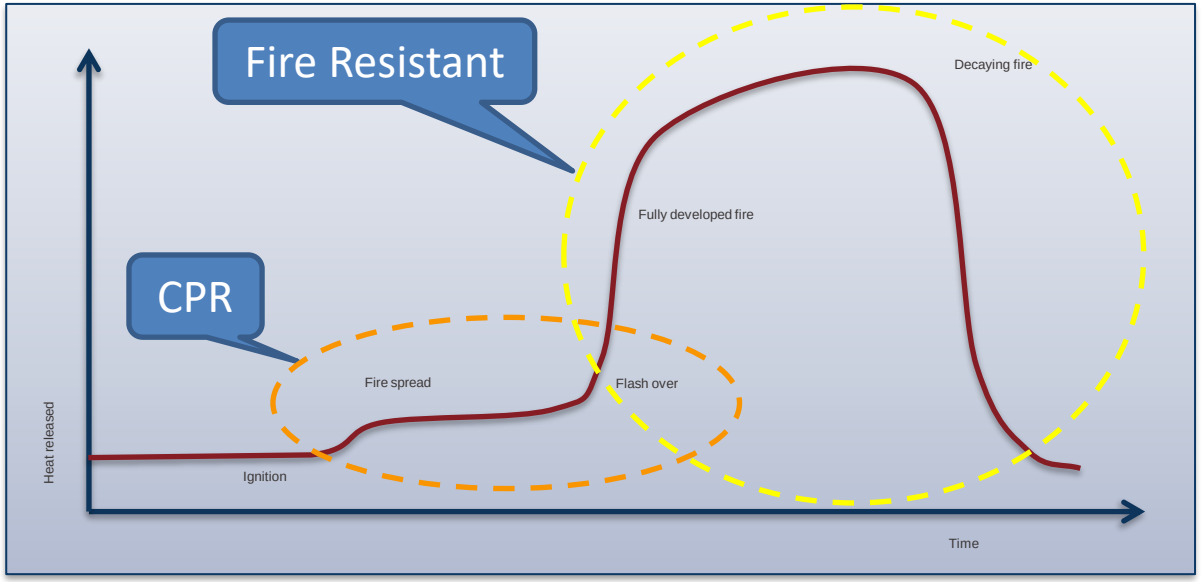
How does the cable protect us?



CPR rated cables:

- Reaction to fire, EN 50399
- (*Resistance to fire, EN 60332-1-2*)
- Release of dangerous substances, EN 61034-2 and EN 50267-2-3

Fire Resistant cables:

- IEC 60331-25
- EN 50200, IEC 60331-1
- BS 8434-2
- Others

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Fiber

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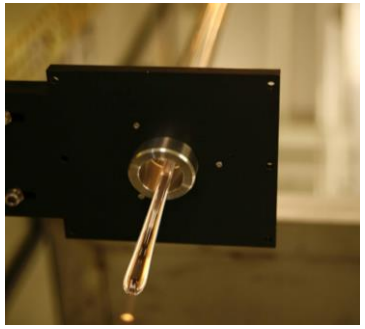
Single Mode Fibres

ITU-T G.652



- These are the widely used over all others.
- Used everywhere and special focus on:
  - The long-haul
  - Metro networks.
- The most modern type, the G.652.D:
  - Low water peak which allows its availability in the whole range between 1310nm and 1550nm.
  - Supports the CWDM* transmission system.

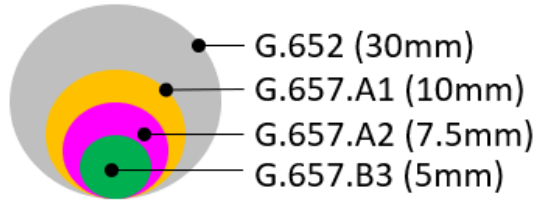
ITU-T G.657

- Increasing demand due to:
  - Macrobending and microbending losses.
- Main applications on:
  - FTTx
  - Central offices
  - High fibre density solutions
  - Drop applications
  - Data centres
- Smaller loop guides:
  - Easy installation
  - Reduces passive network elements

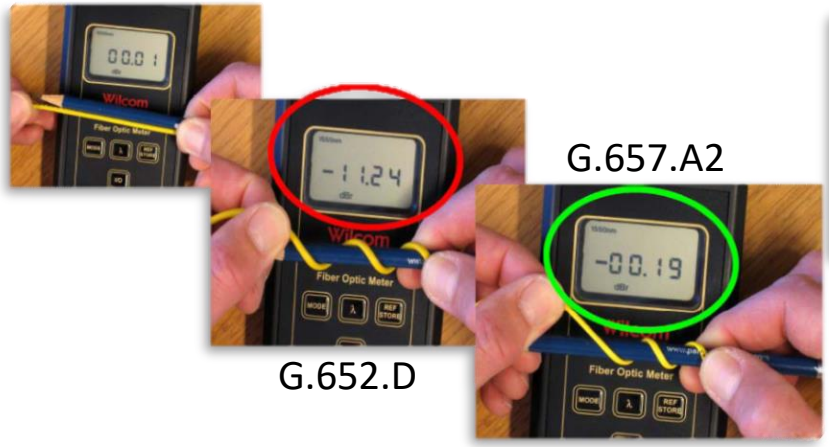
Bending insensitive fibres

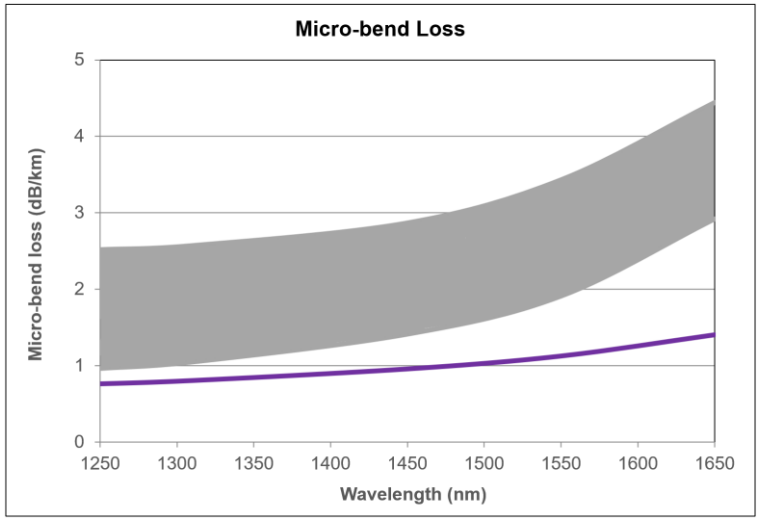
Fibre Attributes		ITU-T G.657.A1	ITU-T G.652.D
Uncabled fibre macrobending loss	Radius	15	ITU-T G.652 fibres deployed at a radius of 15 mm generally can have macrobending losses of several dB per 10 turns at 1625 nm.
	Number of turns	10	
	Max. at 1550 nm	0.25	
	Max. at 1625 nm	1.0	

Bend radius limit



Fibre Attributes		ITU-T G.657.A2	ITU-T G.657.B3
Uncabled fibre macrobending loss	Radius	7.5	5
	Number of turns	1	1
	Max. at 1550 nm	0.5	0.15
	Max. at 1625 nm	1.0	0.45





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Bending insensitive fibres

Bend insensitive fibres are crucial for network innovation

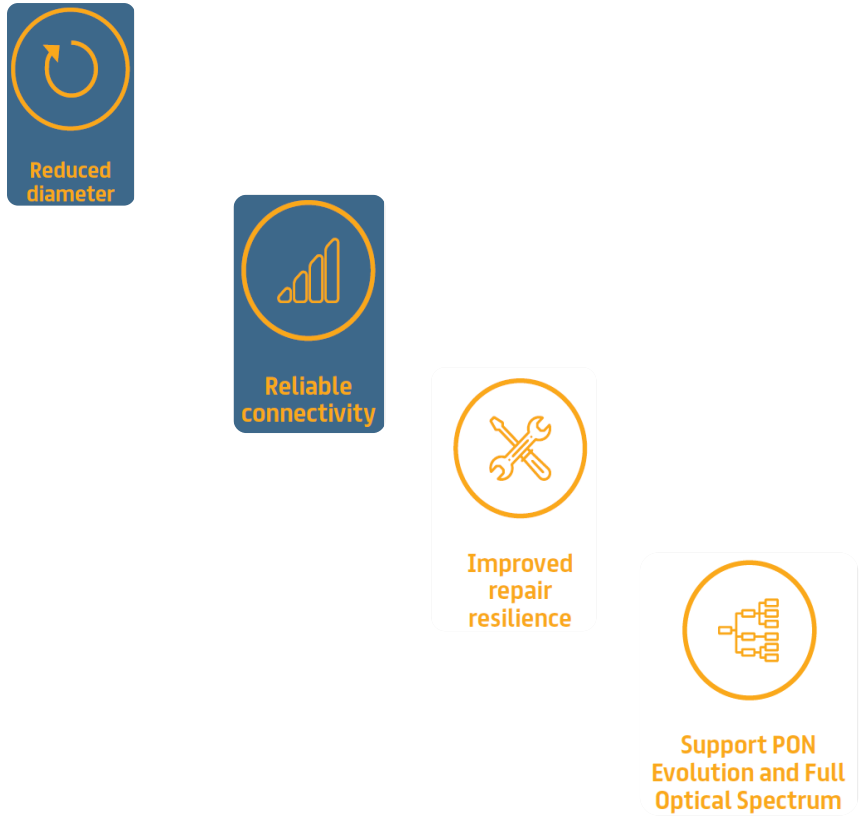
Densification
High fiber count cables, micro cables, space saving
Reduce TCO and sustainability

Reliability
Protection against bending events, repairs and network expansion
TCO reduction

Compatibility
Splicing and commission compatibility

Future-proof
Operation with next generation PON at longer wavelengths
Design freedom for high density cables and connectivity devices

Coating
Mass Colored
Tight diameter control of reduced diameter fibers



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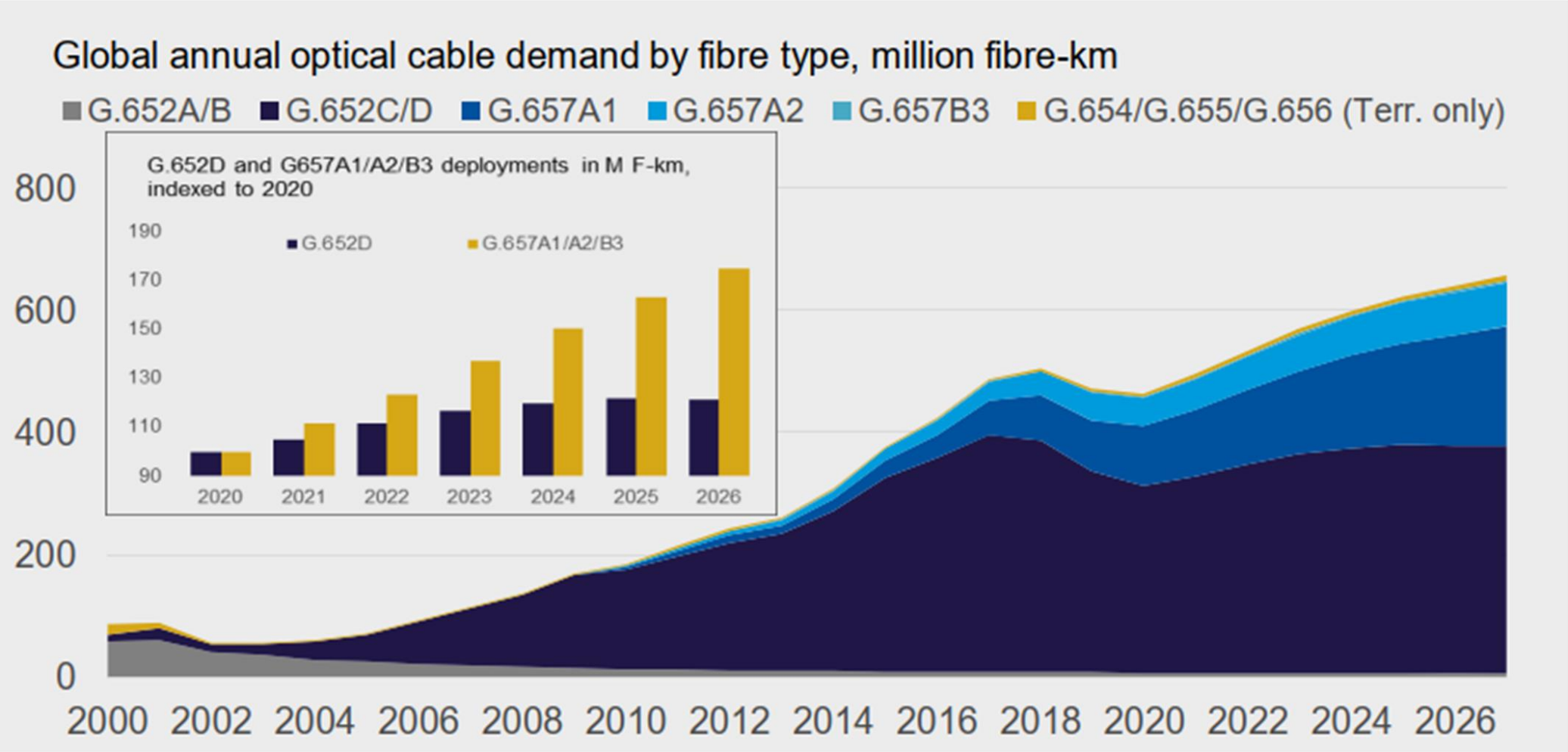
Optical Fibre Deployments



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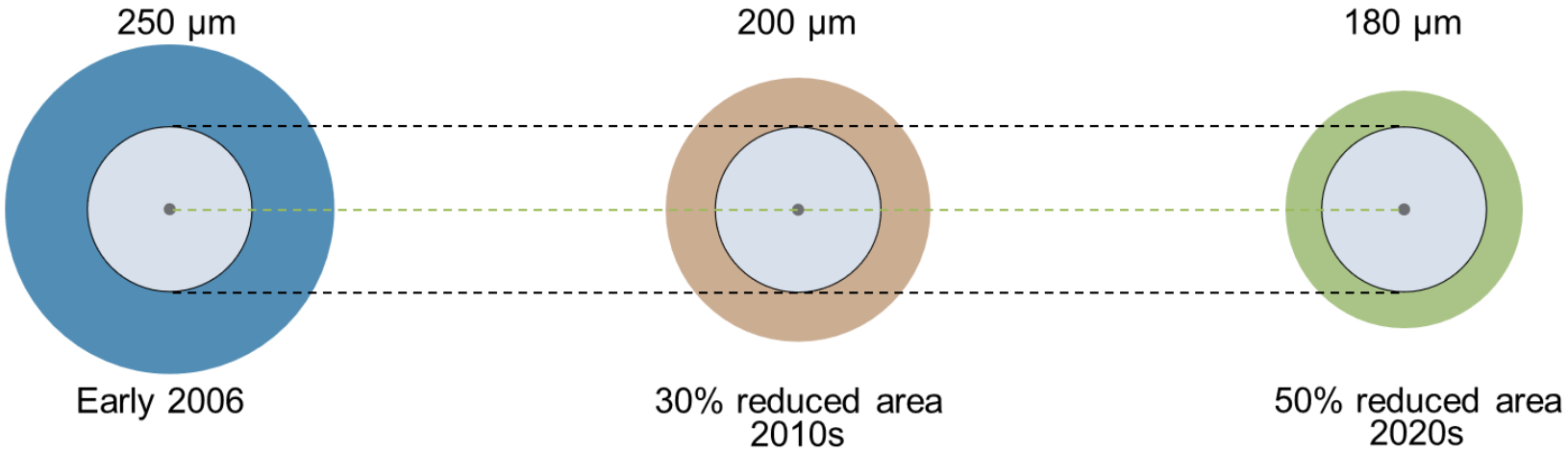
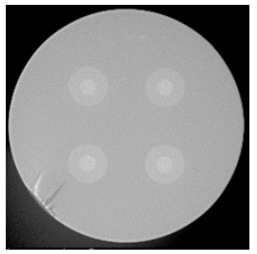
Innovative Single Mode Fibres Designs

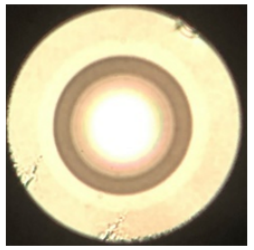
The most standard fibres are the 250µm fibres, used for all kind of applications and installations. Recently, different fibre designs have been developed to help on improving the installation, process, fibre density or the data transmission density:



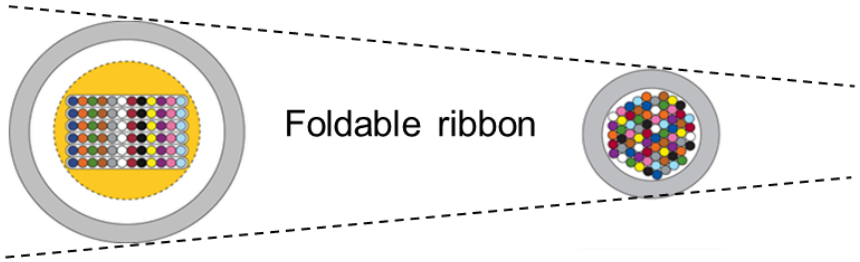
MCF

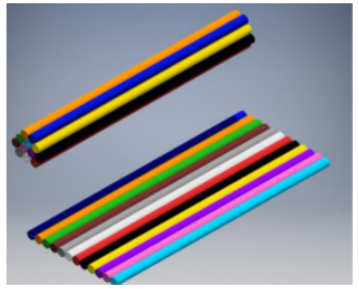


FMF



Space Division
Multiplexing fibers





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Multi Mode Fibers

The ITU-T G.651.1 describes the 50/125 µm graded-index multimode optical fibre cable. The bend insensitivity of that fibres have been increase during the last years.

The multimode optical fibres available today are:

- **OM1** – legacy fiber 62.5um used in some **industrial and military** systems
- **OM2** – legacy fiber being **replaced by OM3**
- **OM3** – **10Gbps** optimized fiber
- **OM4** – rapid adoption since 2010 used in **datacenter and LAN networks**
- **OM5** – **WDMS** optimized fiber for BiDi and SWDM systems

The main difference between the Multimode Fibres and Single Mode Fibres is **the large core of the OMx** which allow more **easier connections** and allow the use of **more cost effective light sources**.

MMF optics continue to offer multiple advantages **over SMF optics**:

- **Lower cost**
- **Less power consumption**
- **Scalable**

Specialty Fibers

- **Radiation Hardened Fibres**
  - ➢ Singlemode and Multimode fibres for doses up to 10 kGy
  - ➢ Singlemode and Multimode fibres for doses up to 2 MGy
  - ❖ Used for High Energy Physics, Nuclear, Space applications

- **High Temperature Acrylate Coated Fibre (HTA)**
  - ➢ Up to 150 °C
  - ❖ Used for Aerospace, Automobile, Sensing, Nuclear applications

- **Silicon Coated Fibre**
  - ➢ Up to 200 °C
  - ❖ Used for Aerospace, Oil & Gas applications

- **500 µm Coated Fibre**

- **High proof tested fibres for submarine applications**

Next

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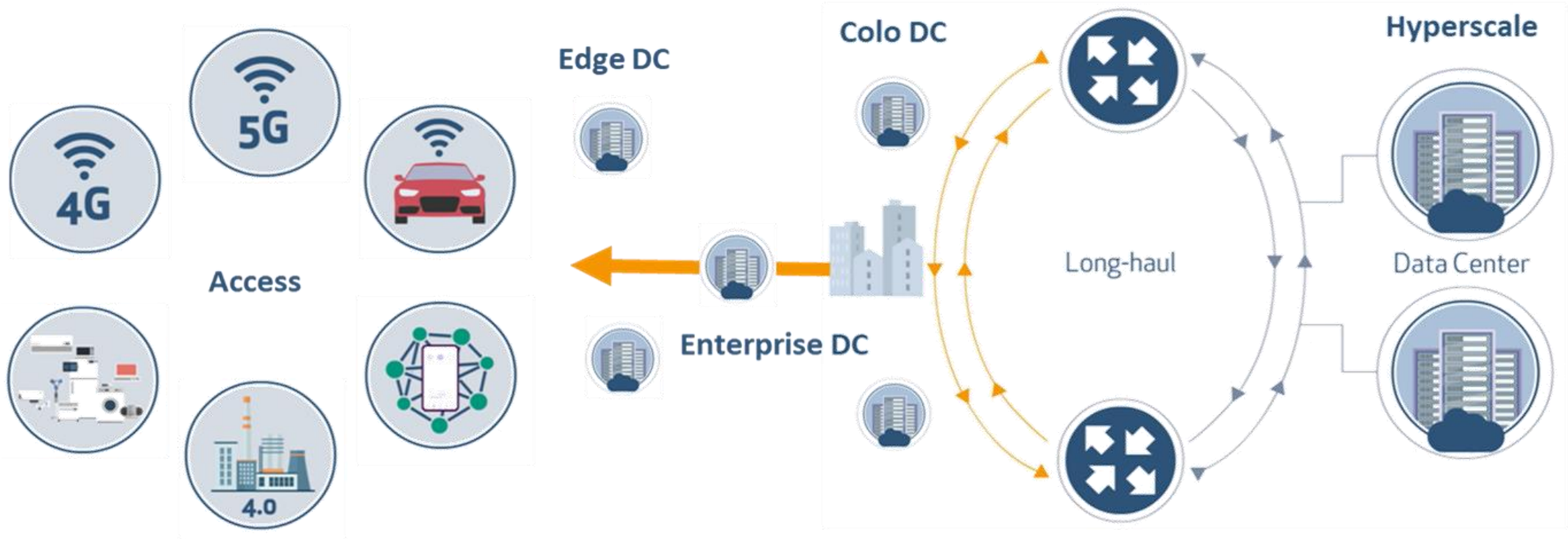
Densification of optical infrastructure

Innovation in optical fibre is needed to support high density, high bandwidth, low latency, reliable and sustainable optical connectivity.

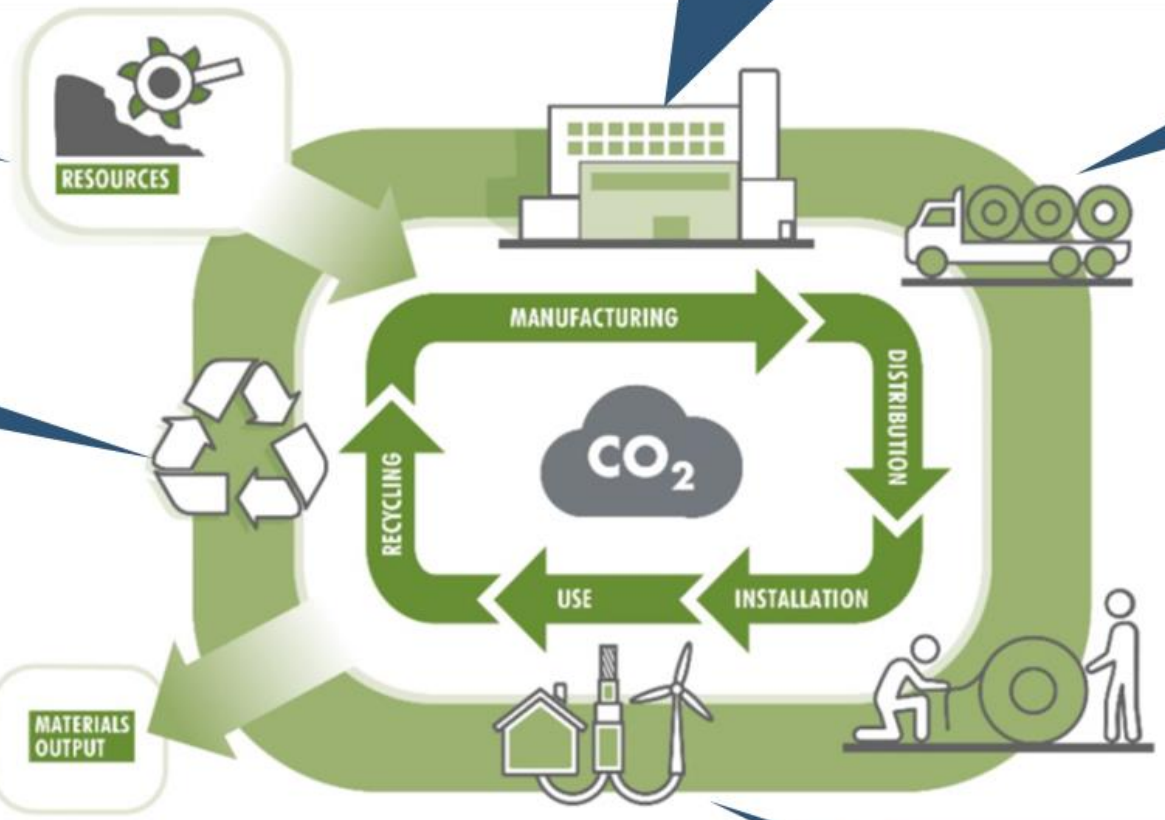


Sustainability

Reducing our carbon footprint

Building analytics and metrics

Sustainable supply chain



To increase the use of recycled material

Developing innovative cables to support our customers in their CO2 journey

Live Cycle Assessment (LCA)

- Quantification of the environmental impact of a product all along its lifecycle (from cradle to grave)

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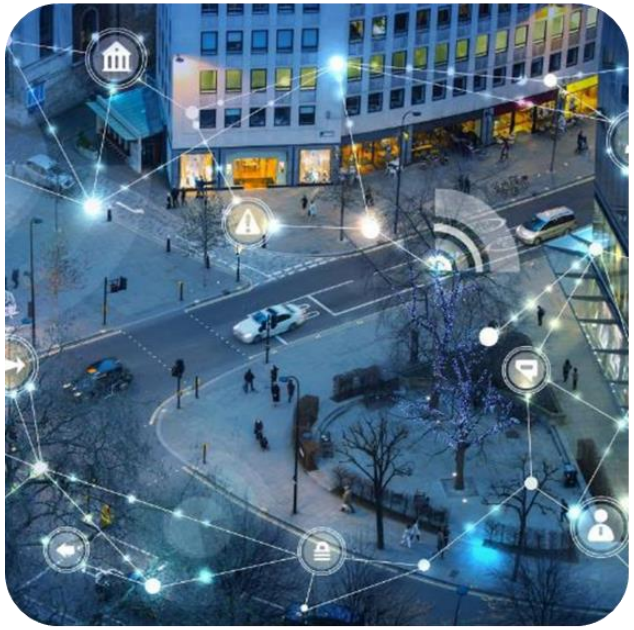
The only way is innovation

High Density



Lower TCO

Sustainability

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Thank You!

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