



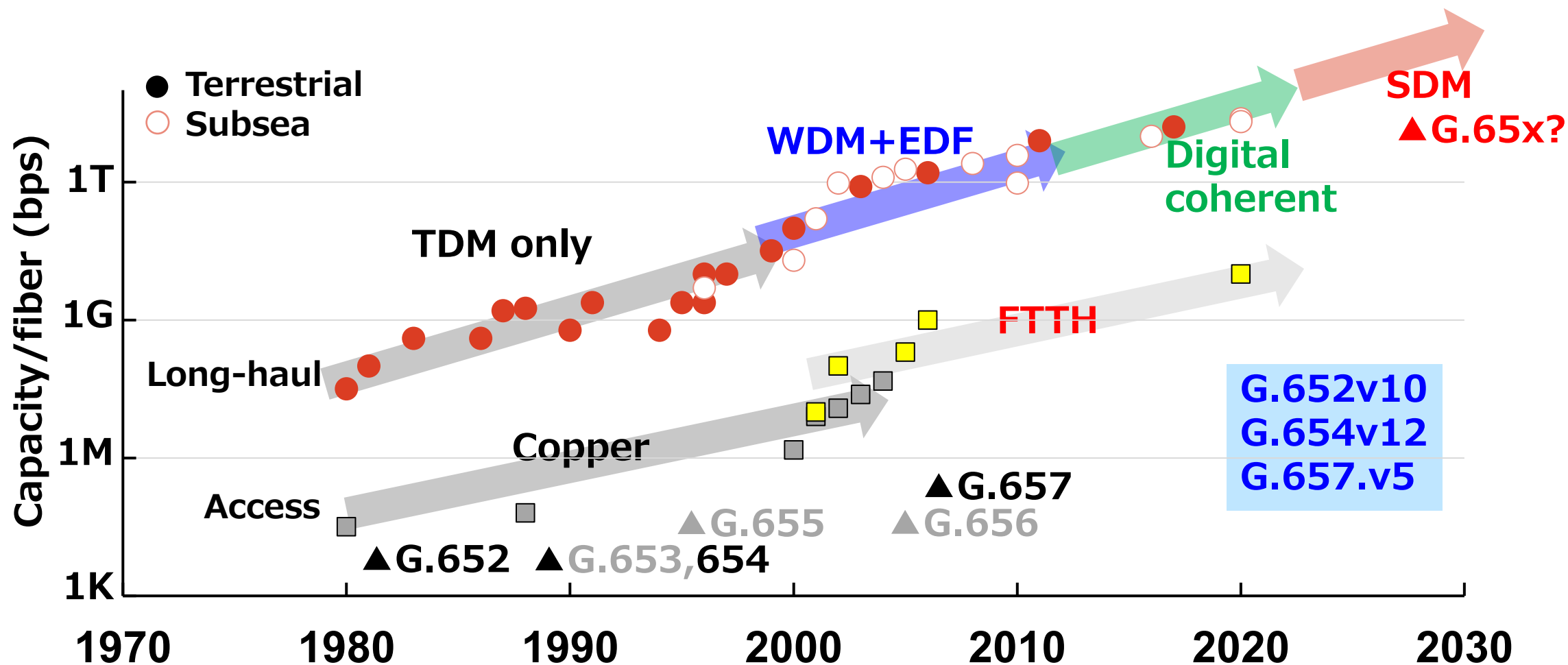
Standardization activities in ITU-T SG15 on Multi-Core Fiber Technologies

Takashi Matsui

Access Network Service Systems Laboratories,
NTT, Inc.

17th Oct. 2025, ITU-IEC Joint workshop

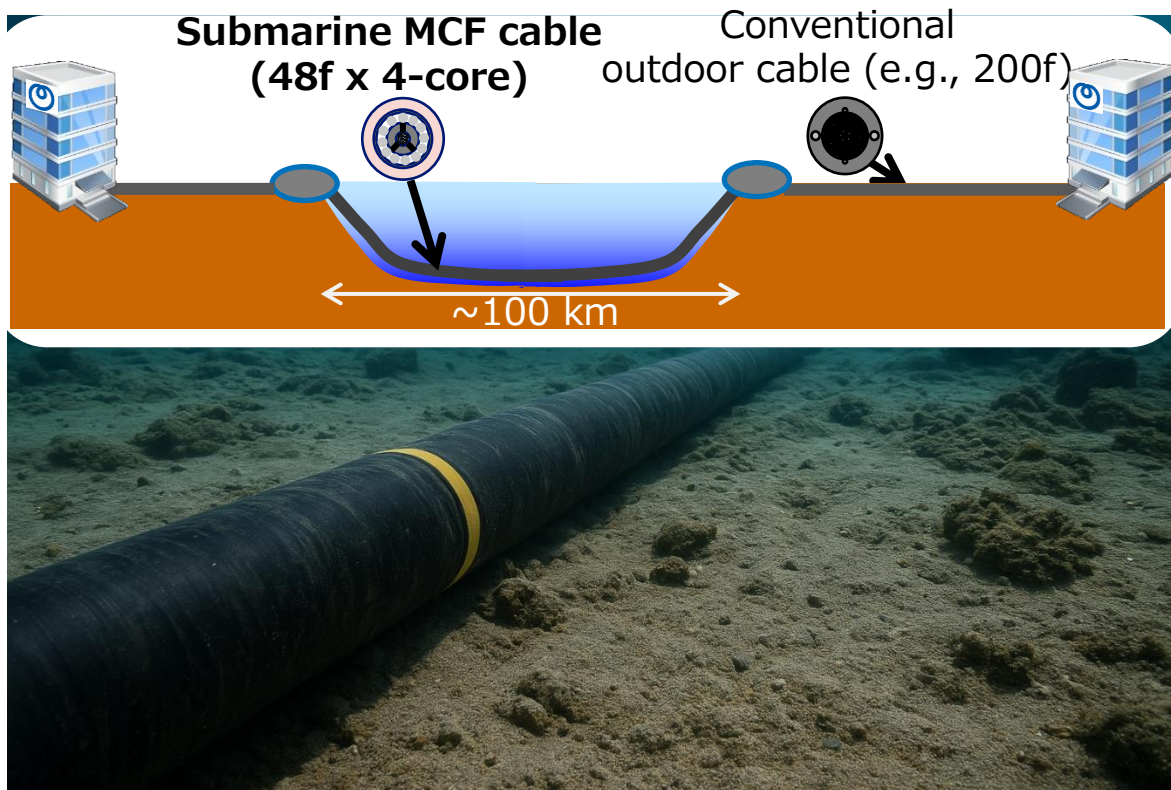
Evolution of Optical Fiber Standards



Optical fiber standards align with system evolution and functionality

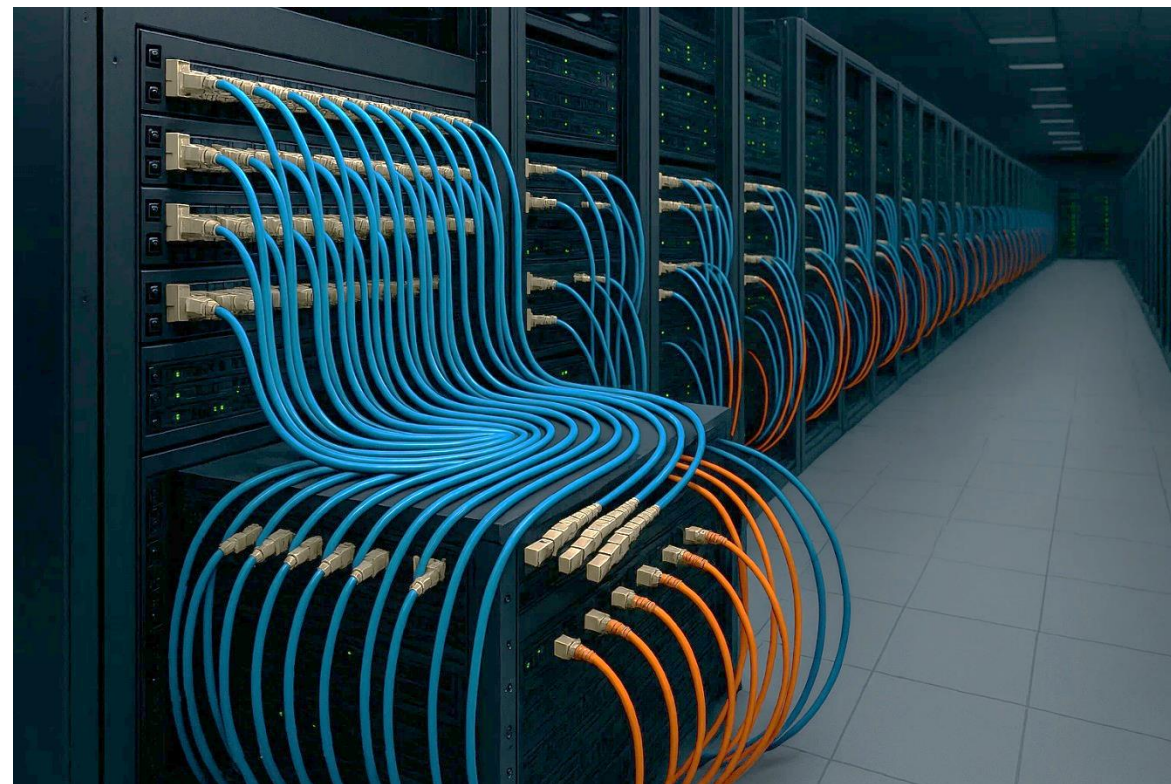
Application area of multi-core fibers

Submarine cables



- ✓ Long-haul submarine system with **>1Pbps/cable** by using existing cable structure
- ✓ Applicability to submarine cables within terrestrial cable link

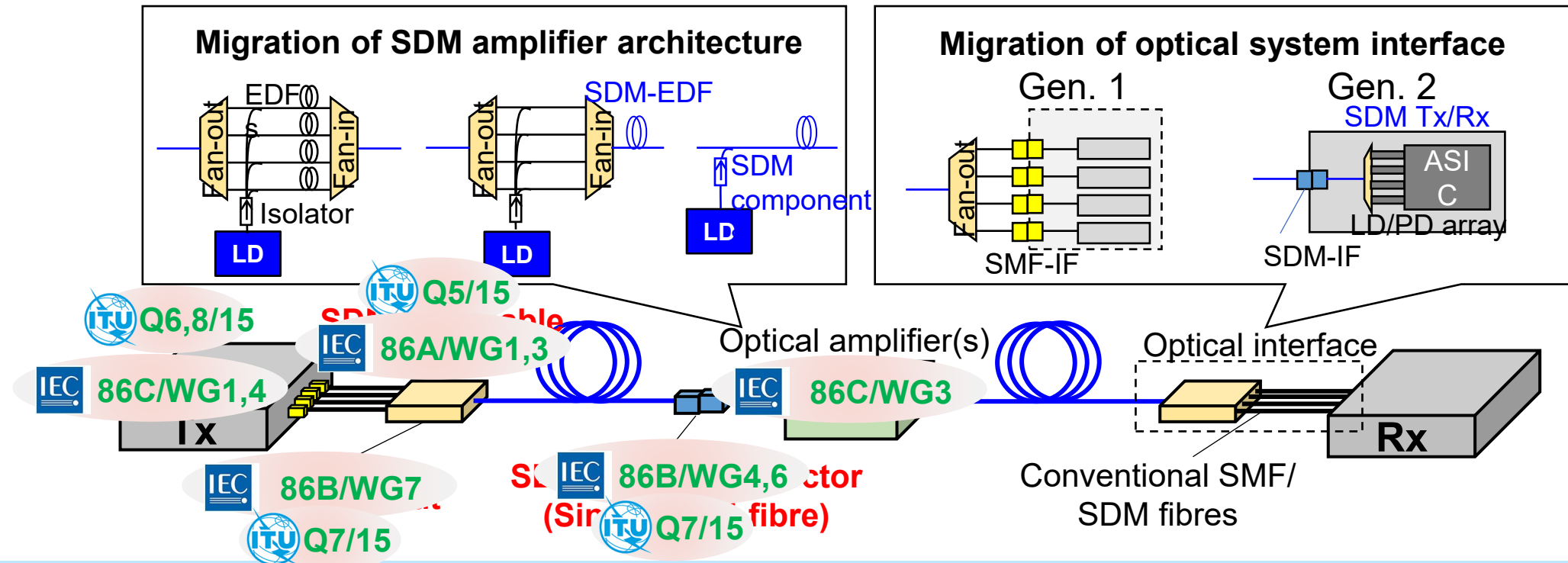
Datacenter interconnect



- ✓ Emerging demand in AI/ML datacenter with **massive & parallel** optical interconnection
- ✓ Possibility to reduce splicing works and points because of thinner and lighter cable

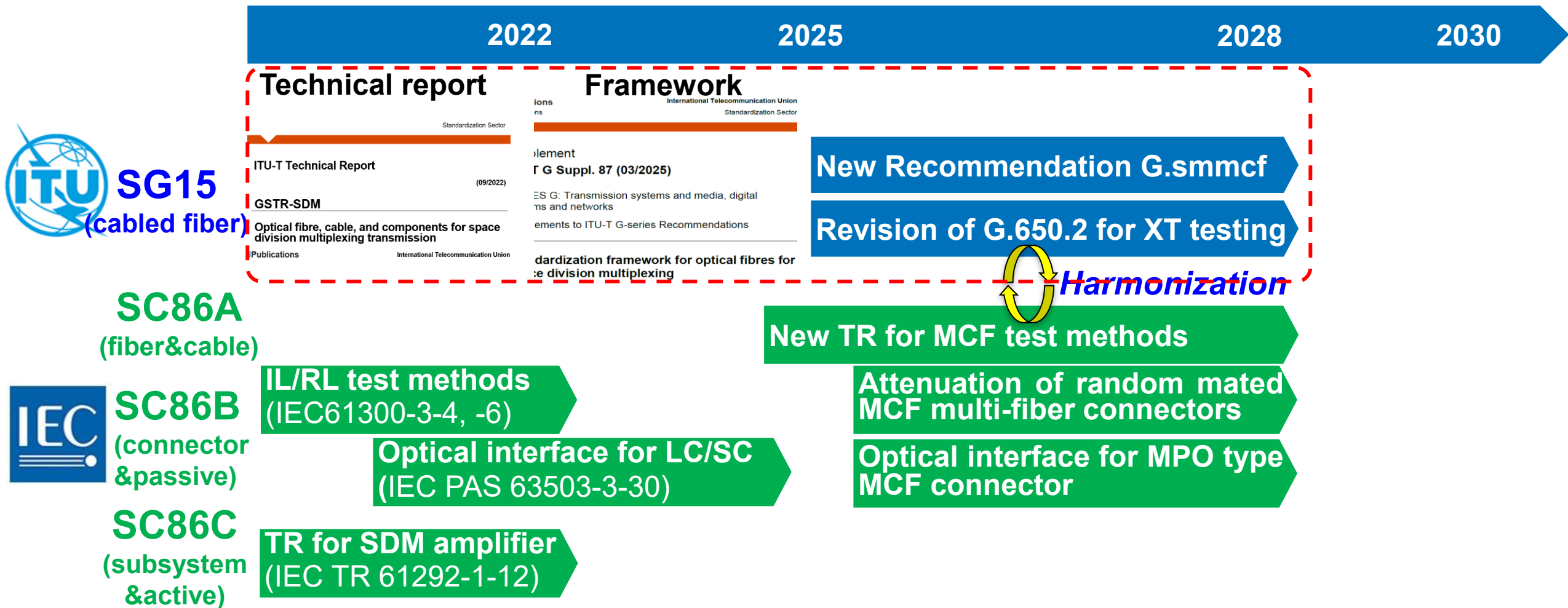
Essential components for MCF link

[ITU MyWorkspace: ITU-T G Suppl. 87 \(03/2025\) - Standardization framework for optical fibres for space division multiplexing](#)



- ✓ At early stage of MCF system, **existing optical components, transceivers and systems can be utilized** by using fan-in/fan-out (FIFO) devices.
- ✓ As aligning with development of MCF techno-ecosystem, MCF components and transceivers having MCF interfaces will be developed and standardized.

Progress of MCF standardization



ITU-T Technical Report

(09/2022)

GSTR-SDM

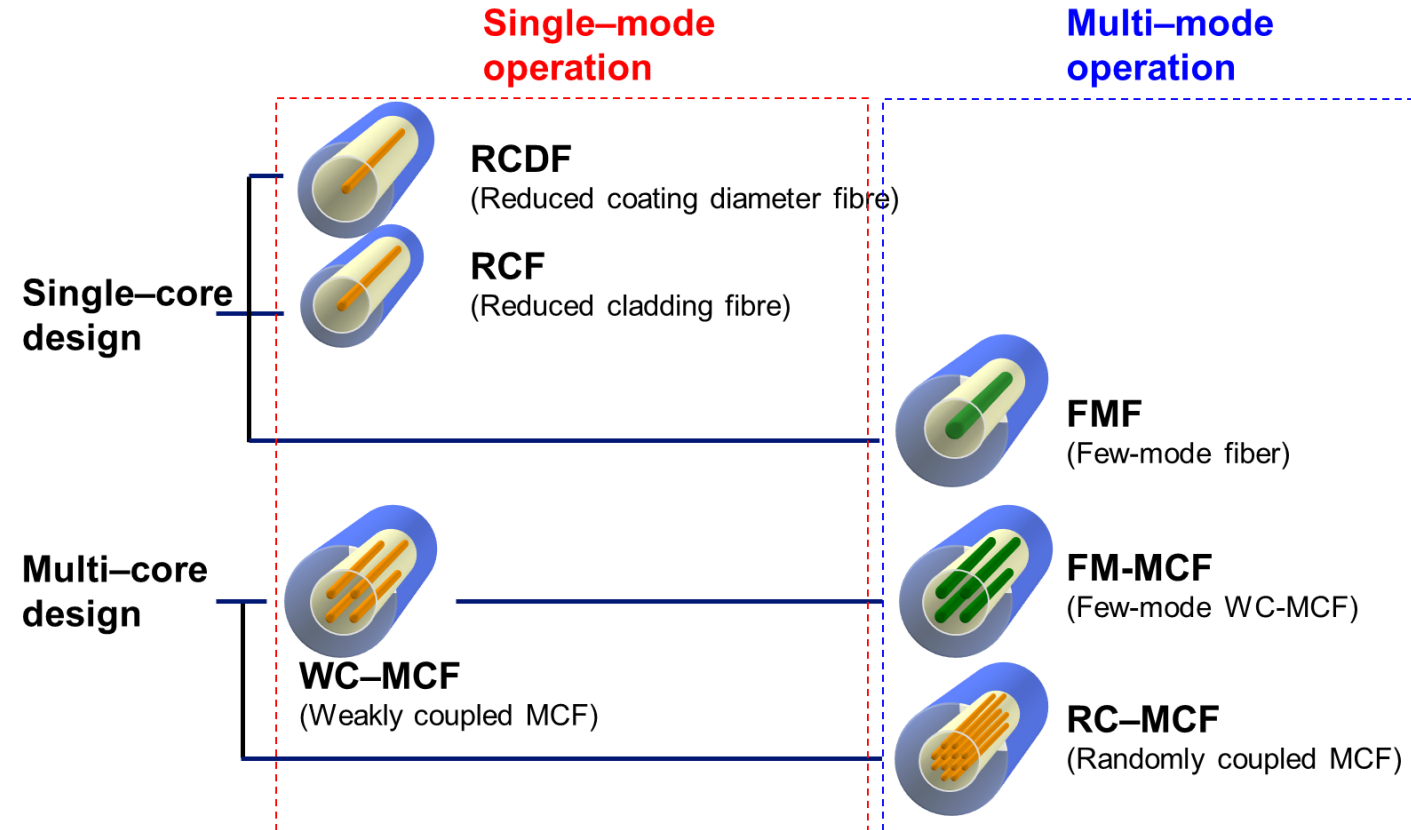
Optical fibre, cable, and components for space division multiplexing transmission

ITU Publications

International Telecommunication Union

- ✓ **First document** to describe technical aspects of SDM fiber technologies
- ✓ Pros. and Cons. of **several SDM options** and their challenges
- ✓ Primitive guideline for establishing techno-economic SDM system and for standardization discussion of SDM fiber technologies

<https://www.itu.int/en/publications/ITU-T/pages/publications.aspx?parent=T-TUT-HOME-2022-1&media=electronic>



G Suppl.87

Supplement
ITU-T G Suppl. 87 (03/2025)

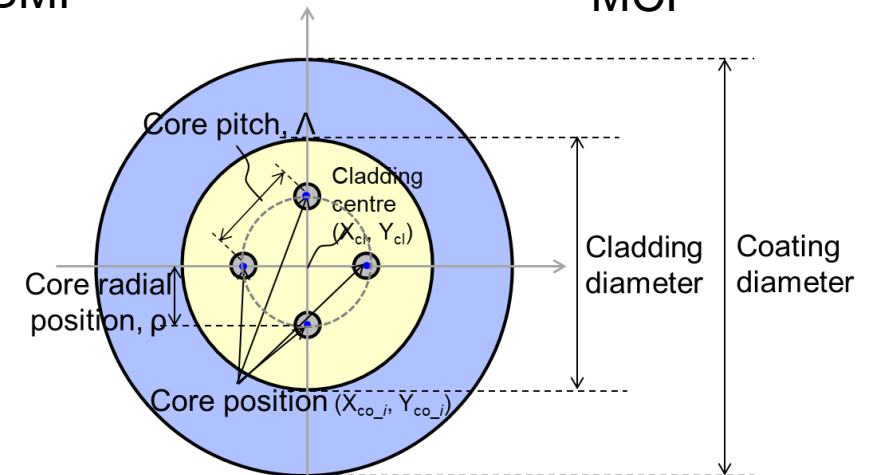
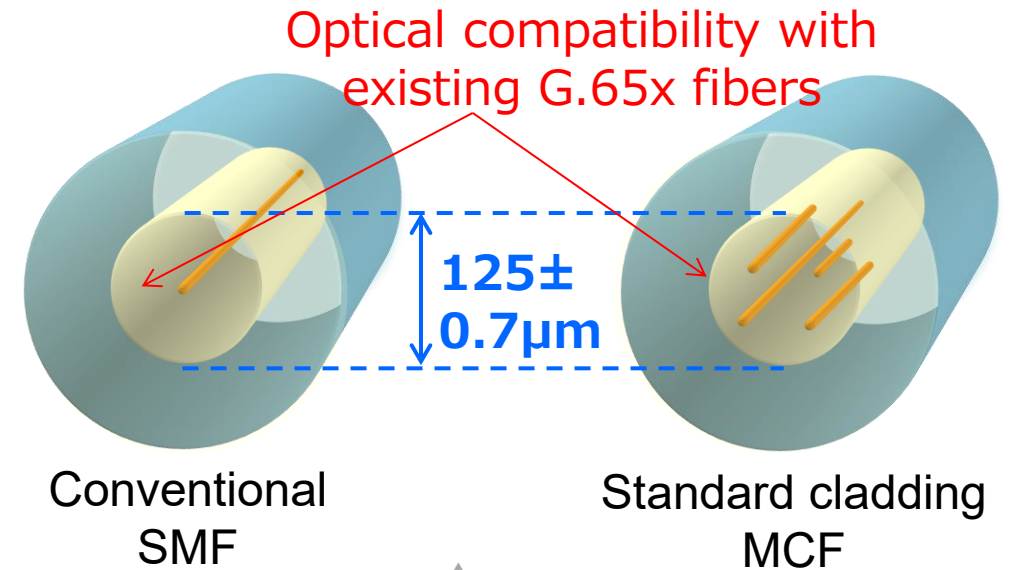
SERIES G: Transmission systems and media, digital systems and networks

Supplements to ITU-T G-series Recommendations

Standardization framework for optical fibres for space division multiplexing

- ✓ Focus on **MCF having standard 125μm cladding and optical compatibility with G.65x fibers**
- ✓ Initial guidelines for **specifiable parameters and potential test methods**
- ✓ **Framework of harmonization and collaboration** with relating standards development organizations

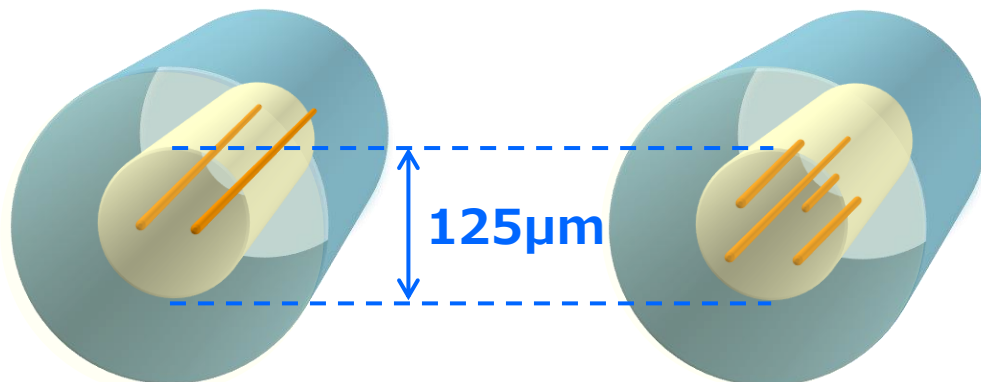
[ITU MyWorkspace: ITU-T G Suppl. 87 \(03/2025\) - Standardization framework for optical fibres for space division multiplexing](#)



Possible geometrical definition for MCF

New fiber Recommendations

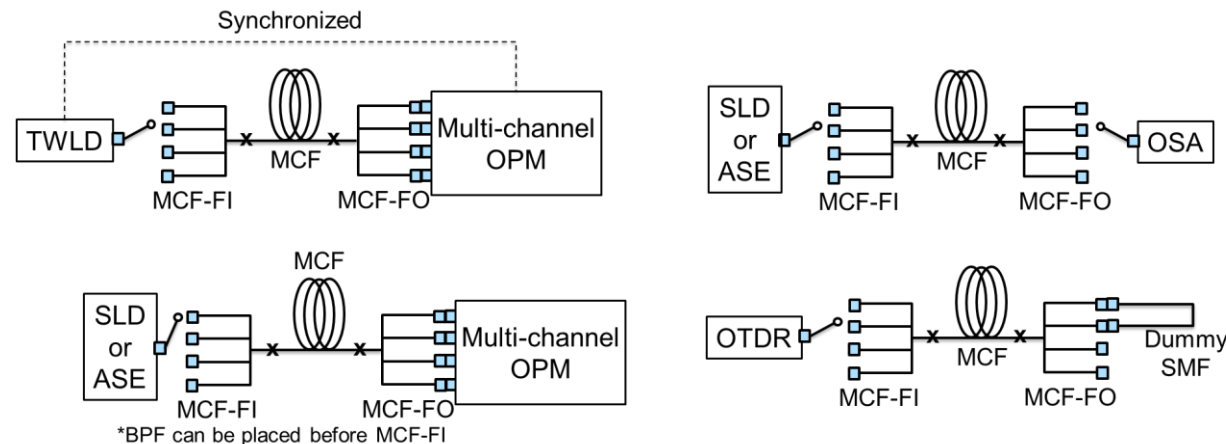
- ✓ MCF having standard 125μm cladding and optical compatibility w/ G.652/657 and G.654 fiber
- ✓ Application for **DC, terrestrial and submarine network supported by 2-core and 4-core WC-MCF**



Further discussion for detailed requirements which need much more communication with industry and other SDOs

Test methods; XT test in G.650.2

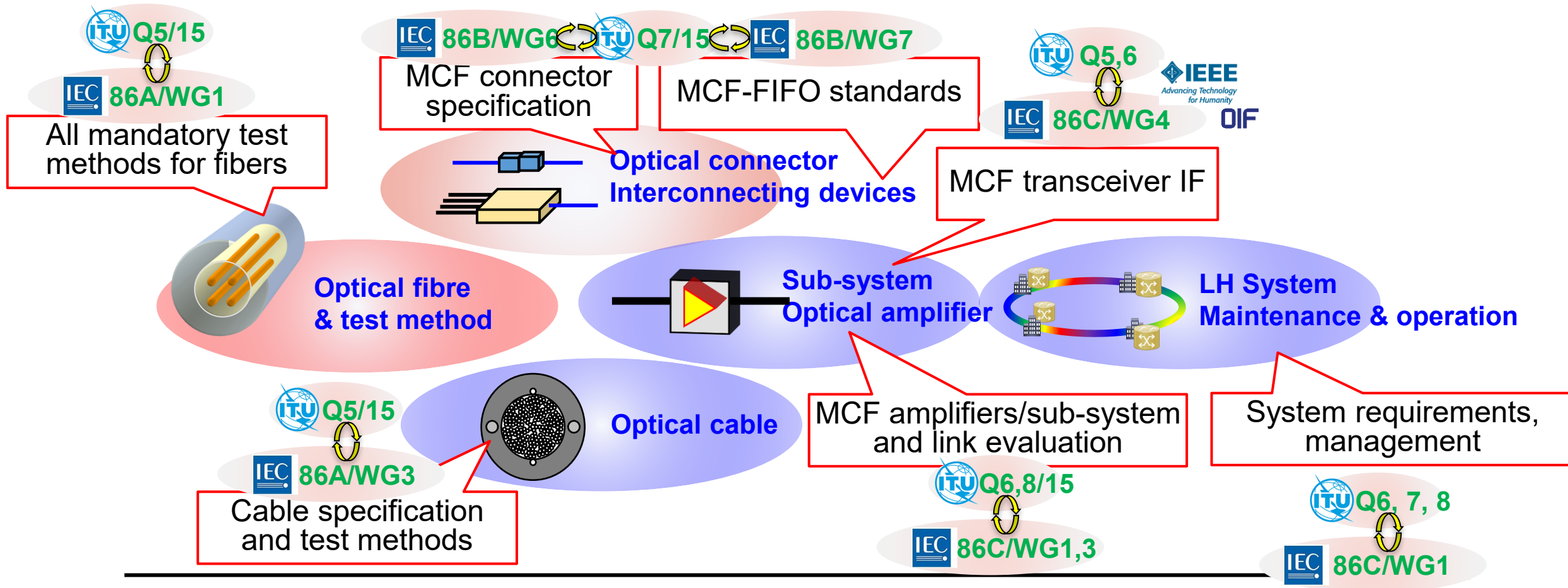
- ✓ **Definition and appropriate test methods** to measure inter-core XT, as well as PMD
- ✓ Collection of XT measurement experiences and specifying RTM and ATM



Harmonization with test methods discussion in IEC SC86A, and collaborative round-robin between ITU-T and IEC may be efficient

Perspective of MCF standardization

MCF standards align with development of MCF eco-system!

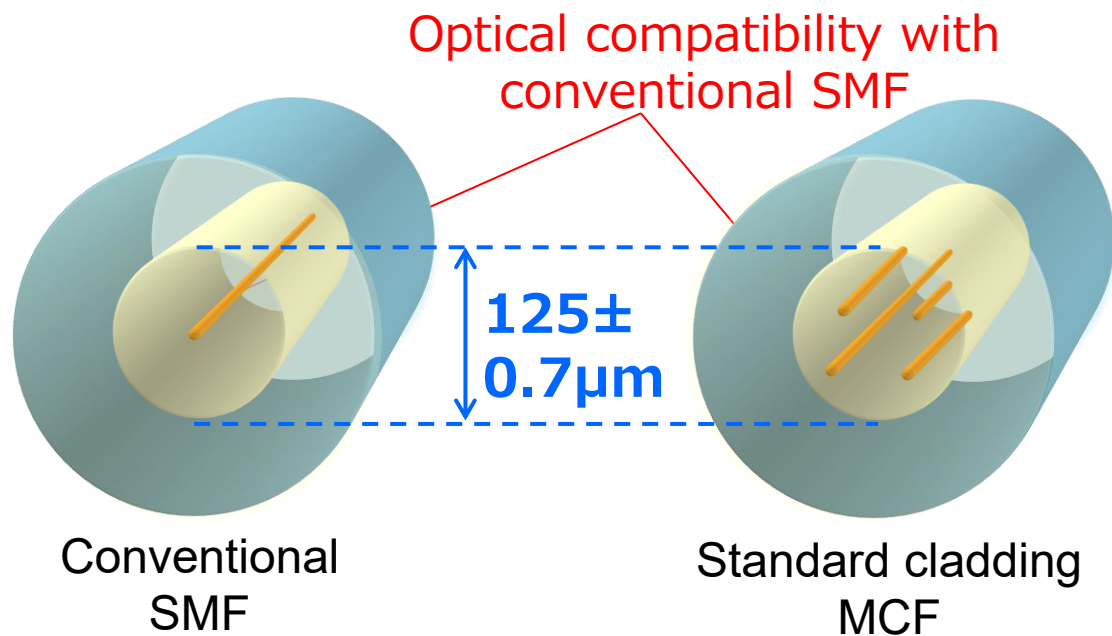


Innovating a Sustainable Future for People and Planet



How can we ensure MCF connectivity?

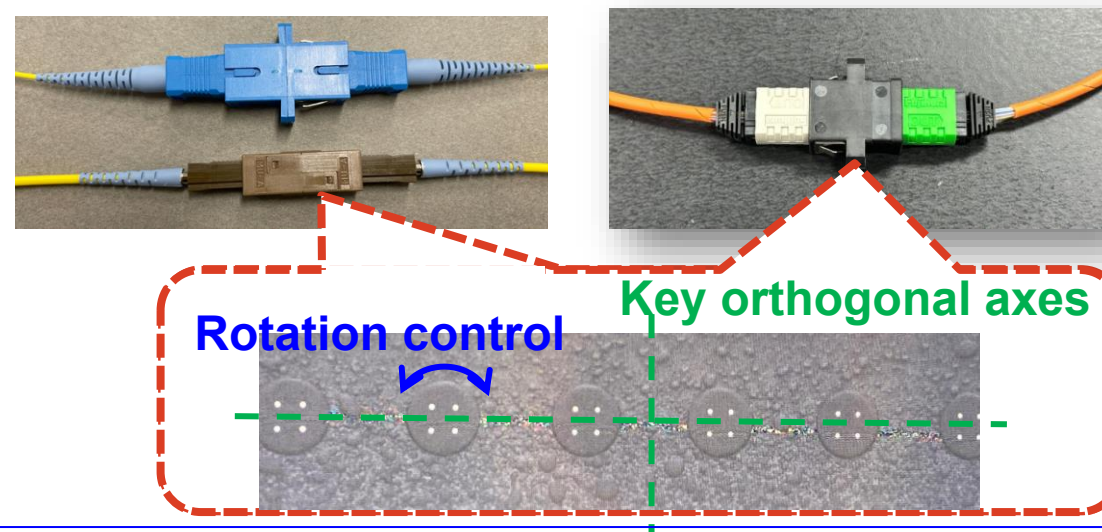
Interconnectivity as Fiber



- ✓ Optical interoperability can be ensured by index profile design of each core
- ✓ **Geometrical interconnectivity (core position, core pitch, # of cores) must be ensured**

Interconnectivity as Connector

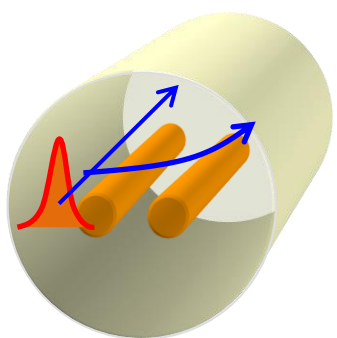
- 😊 Standard cladding MCF to enables us utilizing **existing connector ferrules and interfaces**



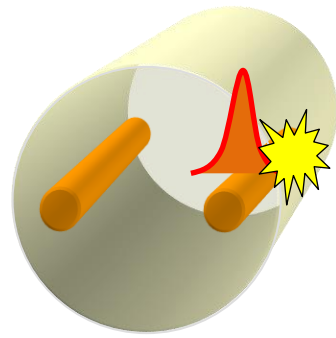
- ✓ **Rotation control for MCFs and definition of key orthogonal axes to align MCFs**
- ✓ Test method to specify rotation/core position is also needed (higher spatial resolution may be needed)

Geometrical & Optical interconnectivity

Narrow Core pitch Wide



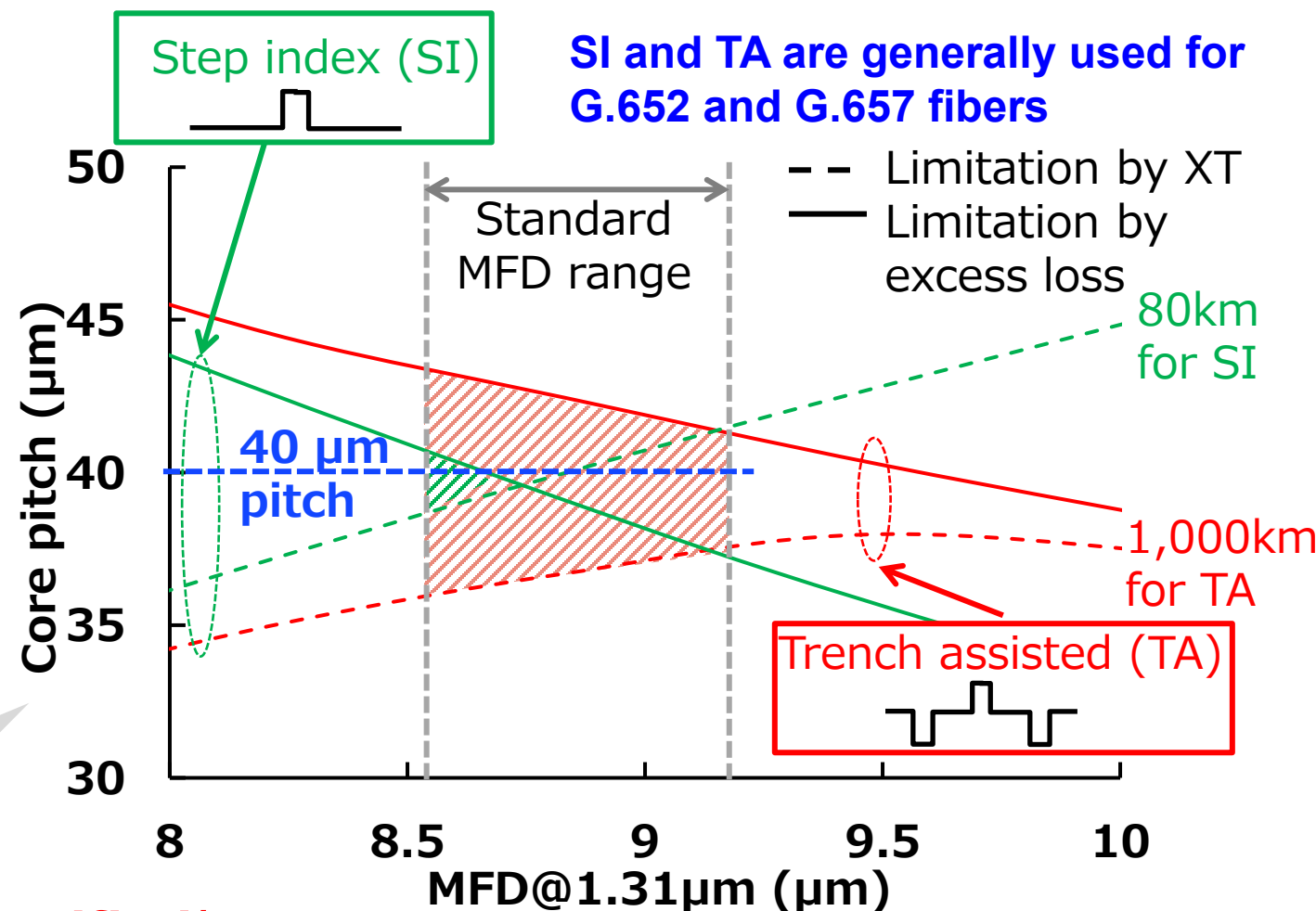
Higher XT



Higher excess loss

Trade-off in fixed cladding

- Cut-off wavelength $\leq 1.26 \mu\text{m}$ and bending loss compatible with G.657.A1
- Transmission distance assuming counter-propagation between neighboring cores



* T. Matsui, IEEE Proc., p. 1772, 2022

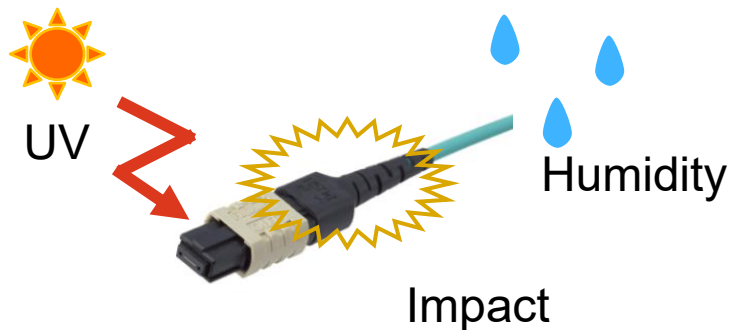
**Universal core pitch can be specified*
(e.g., 40 μm for 4-core MCF compatible with G.652/G.657.A1 fiber)**

Interconnectivity of MCF connectors

Performance standard (IEC61753-series)

- ✓ Ensuring mechanical and environmental characteristics, which will be common between SMF and MCF

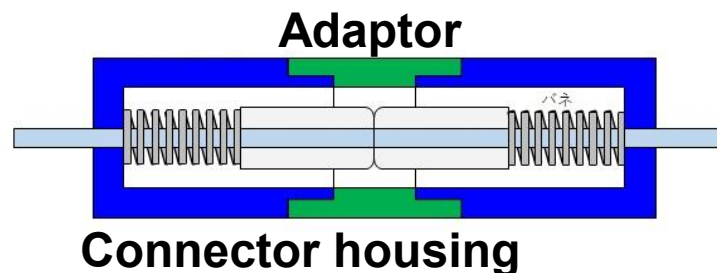
- ✓ Impact on XT may be needed



Interface standard (IEC61754-series)

- ✓ Ensuring mating condition including connector plug, adaptor and receptacle, which will be common

- ✓ **Uncentered core position and polarity** should be considered



Connector optical interfaces (IEC61755-series)

- ✓ Ensuring optical interconnectivity with fiber (core) position error and ferrule

- ✓ **Position of each core should be specified** to ensure the connection loss

