

Supplement

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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

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Supplement 87 to ITU-T G-series Recommendations

Standardization framework for optical fibres for space division multiplexing

Summary

Supplement 87 to ITU-T G-series Recommendations provides a framework to guide standardization activities for space division multiplexing (SDM) optical fibres and cabled optical fibres. The first version of this Supplement considers a weakly-coupled multicore fibre (WC-MCF) having both a standard 125 μm cladding diameter and optical backward compatibility with G.65x fibres as the first prioritized SDM optical fibres.

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Background

Space division multiplexing (SDM) optical fibres can be used to overcome the spatial restrictions of optical network facilities and equipment to increase transmission capacity and optical paths utilizing standard fibre-optic technologies and existing network facilities.

The eco-system of the optical network and techno-economic viability of the new technology should be considered when introducing new optical fibre technologies. Recommendations and standards for SDM optical fibres and cables will be an essential part of the SDM eco-system and thus should be organized and prioritized with the challenges well understood in collaboration with other related technical standards developing organizations (SDOs).

Historically, optical fibre and cable standards have been developed through harmonization and collaboration between ITU-T Q5/SG15 and IEC SC86A. For SDM optical fibres, collaboration with other related technical standardization bodies will also be required. IEC SC86B and IEC SC86C specify the product specifications and test methods for optical network elements. ITU-T Q6/SG15 and ITU-T Q2/SG15 develop optical interface standards to support multi-vendor operable optical transmission systems and optical access networks, respectively. ITU-T Q8/SG15 develops system standards for submarine networks. ITU-T Q7/SG15 develops standards to support the network elements, maintenance, and operation of optical networks. Therefore, harmonized standardization with IEC SC86B, IEC SC86C, ITU-T Q6/SG15, Q8/SG15, Q7/SG15, and ITU-T Q2/SG15 is vital when developing physical layer standards for SDM optical fibre links.

The SDM optical fibre classification is described in clause 6.1 of [GSTR-SDM]. SDM optical fibres can be classified into single-core and multicore design as well as single-mode operation and multi-mode operation. Reduced coating diameter fibre (RCDF), reduced cladding fibre (RCF) and weakly-coupled multicore fibre (WC-MCF) support single-mode operation, while few-mode fibre (FMF), few-mode MCF (FM-MCF) and randomly-coupled MCF (RC-MCF) support multi-mode operation.

At the early stage of SDM technology implementation, the spatial restriction in the existing equipment and cables will mainly motivate the practical use of the SDM optical fibres, which corresponds to the submarine cables in the subsea field and ultra-high fibre count high-density cables in the terrestrial field. The capacity limitation of existing single-mode fibres (SMFs) in the terrestrial long-haul system is also recognized as a motivation to deploy the SDM optical fibre cables. Considering techno-economic feasibility and seamless upgradability from existing networks, backward compatibility with the existing SMFs is essential. WC-MCF having optical backward compatibility with G.65x fibres can be expected as the first candidate. After that, the multi-mode type SDM optical fibres may be required for some application areas in the future when many more spatial channels than those of the WC-MCF will be needed.

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Standardization framework for optical fibres for space division multiplexing

1 Scope

The purpose of this Supplement is to establish a framework to guide the standardization activities for SDM optical fibres and cabled optical fibres. It aims to clarify the relationship between emerging SDM optical fibres and established G.65x fibres, defining specifiable parameters and potential test methods as well as harmonizing with other standards development organizations (SDOs), such as IEC SC86A.

Furthermore, this Supplement provides a prioritized framework together with Appendix I of [ITU-T G Suppl.40] for developing potential new Recommendations for SDM optical fibres, along with the development and revision of other relevant standards.

Three key issues are addressed in developing the framework for standardization of SDM optical fibres.

Prioritization:

- The standardization of each technology should be prioritized on the basis of techno-economic feasibility as well as on broad market acceptance and customer demand.
- Spatial restrictions, power consumption reduction, and backward compatibility of optical and mechanical characteristics with existing G.65x single-mode fibres may be vitally important for coexisting with current optical networks and utilizing existing optical components, and thus they also influence the prioritization.

Standardization organizations:

- As so many new potential SDM technologies are emerging, they will need to be organized within current standardization structures so that they are well understood and intuitive to avoid market confusion.
- Appropriately categorizing these technologies early in this process will ease potential problems when adding new technologies in later years.
- Organizing work between SDOs will also minimize the duplication of efforts and enable acceptance in the marketplace.

Test methods and interoperability:

- Measurement of some existing and new parameters will require updated or new test methods to be agreed upon and inter-laboratory repeatability to be confirmed.
- Confirming interoperability requirements will also influence which parameters are standardized.

The first version of this Supplement considers a weakly-coupled multicore fibre (WC-MCF) having both standard 125 μm cladding diameter and optical backward compatibility with G.65x single-mode fibres as the first prioritized SDM optical fibre. A prioritized framework is provided together with Appendix I of [ITU-T G Suppl.40] which describes criteria for the existing G.65x fibres. This Supplement also aims to provide initial guidelines for specifiable parameters and potential test methods for the WC-MCF.

2 References

[[ITU-T G.650.1](#)]

Recommendation ITU-T G.650.1 (2024), *Definitions and test methods for linear, deterministic attributes of single-mode fibre and cable*.