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SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
DIGITAL SYSTEMS AND NETWORKS

Digital sections and digital line system – Optical fibre
submarine cable systems

**Transverse compatible dense wavelength
division multiplexing applications for repeatered
optical fibre submarine cable systems**

Recommendation ITU-T G.977.1

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Recommendation ITU-T G.977.1

Transverse compatible dense wavelength division multiplexing applications for repeatered optical fibre submarine cable systems

Summary

Recommendation ITU-T G.977.1 provides physical layer specifications for dense wavelength division multiplexing (DWDM) applications on dispersion-unmanaged repeatered optical fibre submarine cable systems. Transverse compatible applications for DWDM applications for repeatered optical fibre submarine cable systems are described for point-to-point, multichannel line systems with optically pumped amplifiers. The primary purpose is to enable multiple vendors to design DWDM transmission equipment for submarine fibre links that are compliant with this Recommendation.

History

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DWDM, repeatered optical fibre submarine cable system, transverse compatibility.

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FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Recommendation ITU-T G.977.1

Transverse compatible dense wavelength division multiplexing applications for repeatered optical fibre submarine cable systems

1 Scope

This Recommendation specifies a physical layer for dense wavelength division multiplexing (DWDM) applications in point-to-point repeatered optical fibre submarine cable systems. The goal is to enable transversally compatible applications.

The primary purpose is to enable multiple vendors to provide terminal equipment for submarine fibre links that are compliant with this Recommendation.

This Recommendation includes a generic reference model for physical layer applications. The specifications take into account parameters such as maximum attenuation, fibre types, wavelength ranges, maximum chromatic dispersion (CD), minimum local CD coefficient, maximum differential group delay (DGD) and effective area.

This Recommendation focuses on repeatered optical fibre submarine cable systems without CD management.

This Recommendation presumes that the optical tributary signals transported within optical channels are digital.

This Recommendation covers a multiple-link partial transverse compatible repeatered optical fibre submarine cable system, where all the submerged plant is provided by a single vendor for all fibre pairs, while the terminal equipment at either end of the link may be provided by a different vendor. A full transverse compatible system, where different types of submerged equipment are provided by different vendors from its terminating equipment, lies outside the scope of this Recommendation.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

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|-----------------|---|
| [ITU-T G.650.2] | Recommendation ITU-T G.650.2 (2015), <i>Definitions and test methods for statistical and non-linear related attributes of single-mode fibre and cable</i> . |
| [ITU-T G.652] | Recommendation ITU-T G.652 (2016), <i>Characteristics of a single-mode optical fibre and cable</i> . |
| [ITU-T G.653] | Recommendation ITU-T G.653 (2010), <i>Characteristics of a dispersion-shifted, single-mode optical fibre and cable</i> . |
| [ITU-T G.654] | Recommendation ITU-T G.654 (2020), <i>Characteristics of a cut-off shifted single-mode optical fibre and cable</i> . |
| [ITU-T G.655] | Recommendation ITU-T G.655 (2009), <i>Characteristics of a non-zero dispersion-shifted single-mode optical fibre and cable</i> . |
| [ITU-T G.656] | Recommendation ITU-T G.656 (2010), <i>Characteristics of a fibre and cable with non-zero dispersion for wideband optical transport</i> . |



[ITU-T G.661]	Recommendation ITU-T G.661 (2007), <i>Definition and test methods for the relevant generic parameters of optical amplifier devices and subsystems.</i>
[ITU-T G.671]	Recommendation ITU-T G.671 (2019), <i>Transmission characteristics of optical components and subsystems.</i>
[ITU-T G.692]	Recommendation ITU-T G.692 (1998), <i>Optical interfaces for multichannel systems with optical amplifiers.</i>
[ITU-T G.694.1]	Recommendation ITU-T G.694.1 (2020), <i>Spectral grids for WDM applications: DWDM frequency grid.</i>
[ITU-T G.696.1]	Recommendation ITU-T G.696.1 (2010), <i>Longitudinally compatible intra-domain DWDM applications.</i>
[ITU-T G.697]	Recommendation ITU-T G.697 (2016), <i>Optical monitoring for dense wavelength division multiplexing systems.</i>
[ITU-T G.780]	Recommendation ITU-T G.780/Y.1351 (2010), <i>Terms and definitions for synchronous digital hierarchy (SDH) networks.</i>
[ITU-T G.959.1]	Recommendation ITU-T G.959.1 (2018), <i>Optical transport network physical layer interfaces.</i>
[ITU-T G.971]	Recommendation ITU-T G.971 (2020), <i>General features of optical fibre submarine cable systems.</i>
[ITU-T G.972]	Recommendation ITU-T G.972 (2020), <i>Definition of terms relevant to optical fibre submarine cable systems.</i>
[ITU-T G.976]	Recommendation ITU-T G.976 (2014), <i>Test methods applicable to optical fibre submarine cable systems.</i>
[ITU-T G.977]	Recommendation ITU-T G.977 (2015), <i>Characteristics of optically amplified optical fibre submarine cable systems.</i>
[ITU-T G.978]	Recommendation ITU-T G.978 (2010), <i>Characteristics of optical fibre submarine cables.</i>
[ITU-T G.979]	Recommendation ITU-T G.979 (2016), <i>Characteristics of monitoring systems for optical submarine cable systems.</i>

3 Terms and definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

- 3.1.1 **branching unit (BU)** [ITU-T G.977].
- 3.1.2 **cable terminating equipment (CTE)** [ITU-T G.972].
- 3.1.3 **client class** [b-ITU-T G.696.1].
- 3.1.4 **dense wavelength division multiplexing (DWDM)** [ITU-T G.972].
- 3.1.5 **dense wavelength division multiplexing system (DWDMS)** [ITU-T G.972].
- 3.1.6 **digital line section (DLS)** [ITU-T G.977].
- 3.1.7 **dispersion compensating single-mode fibre (DCF)** [ITU-T G.972].
- 3.1.8 **electrical command response (ECR)** [ITU-T G.972].
- 3.1.9 **forward amplified spontaneous emission (ASE) power level** [ITU-T G.661].

- 3.1.10 **gain equalizer** [ITU-T G.977].
- 3.1.11 **interoperable cable portion** [ITU-T G.972].
- 3.1.12 **land repeater** [ITU-T G.972].
- 3.1.13 **line optical channel (LOC)** [ITU-T G.977].
- 3.1.14 **maintenance controller** [ITU-T G.972].
- 3.1.15 **monitoring equipment (ME)** [ITU-T G.972].
- 3.1.16 **noise figure (NF)** [ITU-T G.661].
- 3.1.17 **optical coupling junction (OCJ)** [ITU-T G.972].
- 3.1.18 **optical signal-to-noise ratio (OSNR)** [ITU-T G.661].
- 3.1.19 **optical submarine repeater (OSR)** [ITU-T G.972].
- 3.1.20 **optical transport hierarchy (OTH)** [ITU-T G.972].
- 3.1.21 **polarization dependent loss (PDL)** [ITU-T G.671].
- 3.1.22 **polarization mode dispersion (PMD)** [ITU-T G.650.2].
- 3.1.23 **power feeding equipment (PFE)** [ITU-T G.972].
- 3.1.24 **submarine electro-optic interface (SEOI)** [ITU-T G.977].
- 3.1.25 **synchronous digital hierarchy (SDH)** [ITU-T G.780].
- 3.1.26 **terminal portion** [ITU-T G.972].
- 3.1.27 **tilt equalizer** [ITU-T G.977].
- 3.1.28 **maximum total output power** [ITU-T G.661].
- 3.1.29 **wavelength division multiplexing (WDM)** [ITU-T G.972].

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 generalized optical signal to noise ratio (GOSNR): A measurement of the total noise contributions due to linear noise and fibre nonlinearity.

3.2.2 multichannel receive main path interface reference point (MPI-R_M): A (multichannel) reference point on the optical fibre just before the optical network element transport interface input optical connector.

NOTE – Paraphrased from [ITU-T G.959.1].

3.2.3 multichannel source main path interface reference point (MPI-S_M): A (multichannel) reference point on the optical fibre just after the optical network element transport interface output optical connector.

NOTE – Paraphrased from [ITU-T G.959.1].

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ASE	Amplified Spontaneous Emission
AWGN	Additive White Gaussian Noise
BOL	Beginning Of Life
BU	Branching Unit