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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

**Characteristics of monitoring systems for
optical submarine cable systems**

Recommendation ITU-T G.979



ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TRANSMISSION MEDIA AND OPTICAL SYSTEMS CHARACTERISTICS	G.600–G.699
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999
General	G.900–G.909
Parameters for optical fibre cable systems	G.910–G.919
Digital sections at hierarchical bit rates based on a bit rate of 2048 kbit/s	G.920–G.929
Digital line transmission systems on cable at non-hierarchical bit rates	G.930–G.939
Digital line systems provided by FDM transmission bearers	G.940–G.949
Digital line systems	G.950–G.959
Digital section and digital transmission systems for customer access to ISDN	G.960–G.969
Optical fibre submarine cable systems	G.970–G.979
Optical line systems for local and access networks	G.980–G.989
Access networks	G.990–G.999
MULTIMEDIA QUALITY OF SERVICE AND PERFORMANCE – GENERIC AND USER-RELATED ASPECTS	G.1000–G.1999
TRANSMISSION MEDIA CHARACTERISTICS	G.6000–G.6999
DATA OVER TRANSPORT – GENERIC ASPECTS	G.7000–G.7999
PACKET OVER TRANSPORT ASPECTS	G.8000–G.8999
ACCESS NETWORKS	G.9000–G.9999

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T G.979

Characteristics of monitoring systems for optical submarine cable systems

Summary

Recommendation ITU-T G.979 is concerned with the characteristics of monitoring systems for optical fibre submarine cable systems with repeaters. It covers the aspects relating to functional architecture, the characteristics of monitoring equipment and the parameters for monitoring.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T G.979	2012-10-29	15

FOREWORD

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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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Table of Contents

	Page
1 Scope	1
2 References.....	1
3 Definitions	1
3.1 Terms defined elsewhere	1
3.2 Terms defined in this Recommendation.....	1
4 Abbreviations and acronyms	2
5 General architecture.....	2
5.1 Reference points	4
6 Characteristics of monitoring equipment.....	4
6.1 Passive monitoring	4
6.2 Active monitoring.....	4
6.3 Monitoring impact	4
7 Recommended parameters for monitoring	5
7.1 Parameters for passive monitoring	5
7.2 Parameters for active monitoring	5
Appendix I – Examples of parameters of monitoring systems for optical submarine cable systems.....	6

Recommendation ITU-T G.979

Characteristics of monitoring systems for optical submarine cable systems

1 Scope

This Recommendation is concerned with the characteristics of monitoring systems for optical fibre submarine cable systems with repeaters. It covers the aspects relating to functional architecture, the characteristics of monitoring equipment and the parameters for monitoring.

The purpose of this Recommendation is to help users (e.g., submarine network operators) in their operation and maintenance, diagnostics and deployment of optical fibre submarine cable systems.

Detailed information is given for:

- 1) monitoring system architecture
- 2) reference points
- 3) parameters for monitoring.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provision 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.

- [ITU-T G.972] Recommendation ITU-T G.972 (2011), *Definition of terms relevant to optical fibre submarine cable systems*.
- [ITU-T G.976] Recommendation ITU-T G.976 (2010), *Tests methods applicable to optical fibre submarine cable systems*.
- [ITU-T G.977] Recommendation ITU-T G.977 (2011), *Characteristics of optically amplified optical fibre submarine cable systems*.
- [IEC 61746-1] IEC 61746-1 (2009), *Calibration of optical time-domain reflectometers (OTDR) –Part 1: OTDR for single mode fibres*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

- 3.1.1 maintenance controller:** See [ITU-T G.972].
- 3.1.2 optical fibre submarine cable system:** See [ITU-T G.972].
- 3.1.3 supervisory system:** See [ITU-T G.972].
- 3.1.4 terminal station:** See [ITU-T G.972].

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 active monitoring equipment (AME): This is one of the two categories of MEs (the other is PME) which monitors the status of submerged equipment by communicating with the monitored equipment to obtain a performance status.

3.2.2 monitoring equipment (ME): Equipment used to monitor the status of the submerged plant of a submarine cable system, which is classified into two categories according to the monitoring mechanism: passive monitoring equipment with no communication between the submerged plant and the monitoring equipment, or active monitoring equipment which has communication between the two.

3.2.3 passive monitoring equipment (PME): One of the two categories of MEs (the other is AME) which does not communicate with the submerged plant, but monitors the status of the submerged plant by detecting optical/electrical paths, e.g., monitoring equipment based on OTDR/COTDR. To get a performance status, return paths within submerged plant (described in clause 7.5 of [ITU-T G.977]) are necessary.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AME	Active Monitoring Equipment
BU	Branching Unit
COTDR	Coherent Optical Time Domain Reflectometry
CTE	Cable Terminating Equipment
MC	Maintenance Controller
ME	Monitoring Equipment
OTDR	Optical Time Domain Reflectometry
PFE	Power Feeding Equipment
PME	Passive Monitoring Equipment
TTE	Terminal Transmission Equipment

5 General architecture

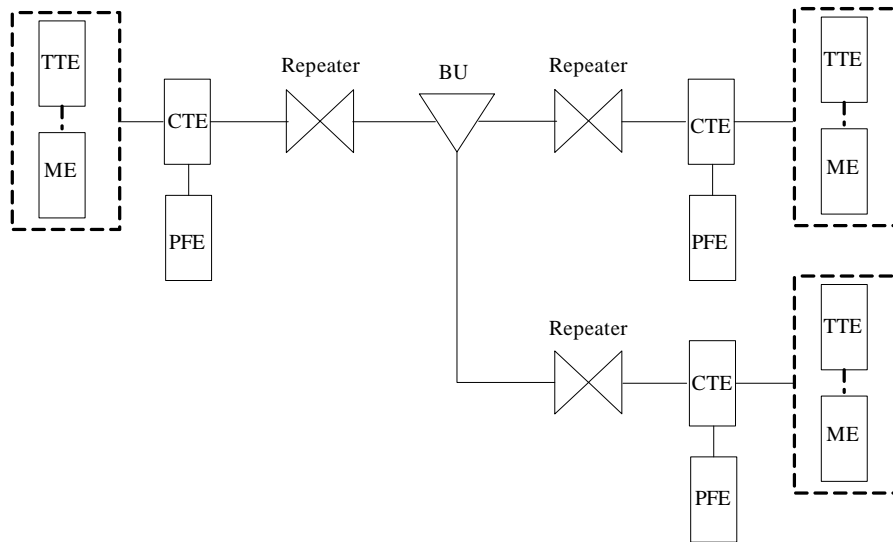
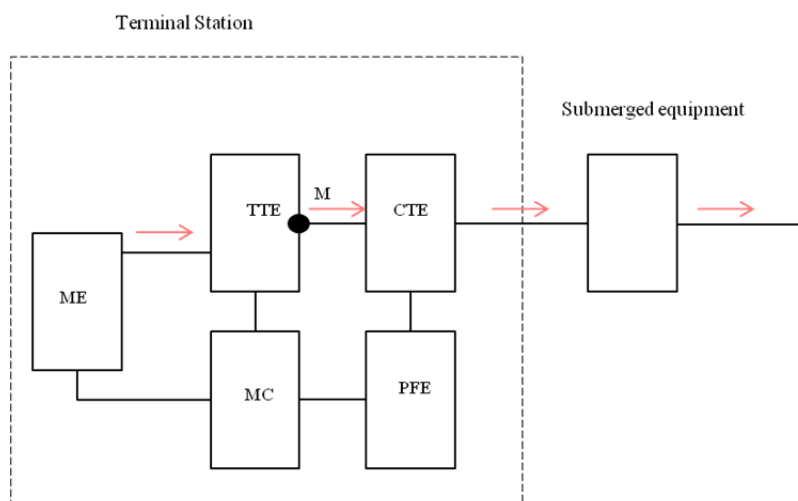


Figure 1 – General architecture

Figure 1 shows the general architecture of an optical fibre submarine cable system with monitoring equipment. Monitoring equipment should be deployed in each terminal station to provide routine monitoring for maintenance. The monitoring of system status could be obtained by periodically collecting performance data from a submerged plant. Also, for maintenance convenience, it should support or provide interfaces to assist fault location.

Two different ways may be chosen to configure an ME's connection in a submarine cable system:

- A TTE is connected between an ME and CTE (refer to Figure 2), and monitoring signals and service signals are coupled within the TTE and sent to the submarine cable system.
- An ME is connected between a TTE and CTE (refer to Figure 3), and service signals and monitoring signals are coupled within the ME and sent to the submarine cable system.

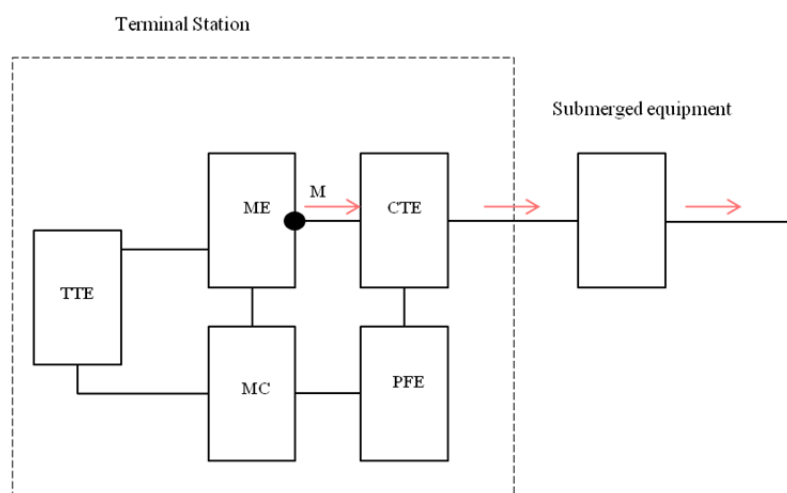


NOTE 1 – M denotes monitoring output interface to cables.

NOTE 2 – → denotes the monitoring signal flow in the sending direction; the receiving signal is obtained from the other fibre.

NOTE 3 – This figure defines only one terminal station in the system, the others are the same as this one.

Figure 2 – Monitoring output from ME



NOTE 1 – M denotes monitoring output interface to cables.

NOTE 2 – → denotes the monitoring signal flow in the sending direction; the receiving signal is obtained from the other fibre.

NOTE 3 – This figure defines only one terminal station in the system, the others are the same as this one.

Figure 3 – Monitoring output from TTE

As part of a supervisory system, MEs are commonly connected to MCs through management interfaces.

5.1 Reference points

With reference to Figures 2 and 3, reference points should comply with the parameters specified for monitoring.

At point M, a monitoring output interface needs to comply with the following parameters:

- probe light output power, wavelength, and pulse width (for passive monitoring)
- modulation parameters (for active monitoring).

6 Characteristics of monitoring equipment

6.1 Passive monitoring

In passive monitoring, performance is obtained by detecting optical or electrical signals. Probe signals are sent to a submerged plant, and the returned signals will be analysed to reflect the system's performance status. For example, the backscattered light of the OTDR/COTDR described in [IEC 61746-1] is detected and processed, usually as curves of signal intensity versus distance to analyse and diagnose system status. One PME monitors one direction performance of the submarine cable system. To get bidirectional performance, a PME should be deployed in each terminal station.

It is recommended that status changes in the probed optical paths, such as fibre breaks, variations of repeater gain, and fibre attenuation or reflections, are monitored in passive monitoring.

As passive monitoring obtains the system status indirectly, comparison with baselines is used in status monitoring. Status monitoring should use the same parameters as the baselines to ensure the validity of the comparison and find changes in the performance caused by damage or faults that alter system status.

Baselines should be collected after the system has been properly deployed and should be updated after each repair or reconfiguration of the system.

6.1.1 Fault location

Fault location is often performed manually in the out-of-service state. It could be performed by a PME based on the OTDR/COTDR mechanism, or by commercial OTDR/COTDR equipment.

Highly accurate resolution in fault location is always useful for maintenance. Convenient functions are recommended, for example, automatic fault location, fast fault location with less accuracy but a shorter time.

The submerged equipment should have return paths as described in clause 7.5 of [ITU-T G.977] to support OTDR/COTDR for fault location.

6.2 Active monitoring

In active monitoring, the ME requests and collects directly the performance status of the submerged equipment. Related performance parameters are input power, output power, pump current, etc.

6.3 Monitoring impact

Monitoring signals may impact on the transmission performance of the monitored submarine systems.

7 Recommended parameters for monitoring

Parameters for monitoring are highly implementation-dependent, and may vary among different systems. The following is a minimum set of parameters for a user's maintenance convenience.

7.1 Parameters for passive monitoring

- repeater's gain
- fibre attenuation
- fibre break location.

7.2 Parameters for active monitoring

- repeater input optical power
- repeater output optical power
- pump working current
- pump output power.

Appendix I

Examples of parameters of monitoring systems for optical submarine cable systems

(This appendix does not form an integral part of this Recommendation.)

This appendix contains examples of a PME and an AME to demonstrate the applicable parameters. Since these parameters are highly system-related, they are not specifications or requirements for MEs. It shows the cases of obtainable parameters from current technologies.

Table I.1 gives information on the parameters of a PME.

Table I.1 – Example parameters of a PME

Parameter	Accuracy	Note
Variation of repeater gain	± 1.0 dB	
Fibre break location	± 1.0 km	
a) These parameters are applied in an OTDR/COTDR based PME. b) Values include contributions from measurement uncertainty and the threshold of variation should reflect the submerged equipment's failures, e.g., pump faults.		

Table I.2 gives information on the parameters of an AME.

Table I.2 – Example parameters of an AME

Parameter	Accuracy	Note
Repeater input optical power	± 0.5 dB	
Repeater output optical power	± 0.5 dB	
Pump working current	± 0.1 A	
Pump output power	± 0.5 dB	

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