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Transmission and Multiplexing (TM); Requirements of passive Optical Access Networks (OANs) to provide services up to 2 Mbit/s bearer capacity

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# ETSI EN 300 463 V1.1.2 (2000-06)

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*European Standard (Telecommunications series)*

## **Transmission and Multiplexing (TM); Requirements of passive Optical Access Networks (OANs) to provide services up to 2 Mbit/s bearer capacity**

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## Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM).

The present document describes cost effective and flexible access networks using optical fibre technology and is designed to provide both services to meet the current demands and an infrastructure, which is able to satisfy the requirements of the future.

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# 1 Scope

The present document describes cost effective and flexible access networks using optical fibre technology. The present document is designed to provide both services to meet the current demands and an infrastructure, which is able to satisfy the requirements of the future.

The present document describes the characteristics of an Optical Access Network (OAN) with the capability of transporting interactive services, based on 64 kbit/s bearer capabilities, between the User Network Interface (UNI) and the local exchange. The present document considers an OAN capable of providing business and residential customers with a range of services (up to 2 Mbit/s) over a passive split optical network. Distributive services (e.g. cable television) are outside the scope of the present document.

The OAN described in the present document has considered the requirement for the access network to adapt to the changing requirements of individual customers in terms of capacity, flexibility and types of services offered without the need for network operators to provide service specific overlay networks.

The considered systems within the present document are based on Time Division Multiple Access (TDMA) and/or Subcarrier Multiple Access (SCMA) methods. One and two fibre systems are described.

The present document considers OANs where the Optical Distribution Network (ODN) is based on point-to-multipoint tree and branch options as described in ETS 300 681 [4].

The present document is not a complete system definition. It identifies aspects that can be defined without preventing transmission innovation.

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## 2 References

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The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

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- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

- [1] EC SYN 287 (1990): "Proposal for the council directive concerning the protection of individuals in relation to the processing of personal data".
- [2] EC SYN 288 (1990): "Proposal for the directive concerning the protection of personal data and privacy in the context of public digital telecommunication networks, in particular the integrated services digital network (ISDN) and public digital mobile networks".
- [3] EN 60950: "Safety of information technology equipment, including electrical business equipment".
- [4] ETSI ETS 300 681 (1996): "Transmission and Multiplexing (TM); Optical distribution network for Optical Access Networks (OANs)".
- [5] ETSI ETS 300 736: "Transmission and Multiplexing (TM); Operation and maintenance of Optical Access Networks (OANs)".
- [6] ETSI ETR 080: "Transmission and Multiplexing (TM); Integrated Services Digital Network (ISDN) basic rate access; Digital transmission system on metallic local lines".
- [7] ETSI ETS 300 011: "Integrated Services Digital Network (ISDN); Primary rate user-network interface; Layer 1 specification and test principles".



- [8] ETSI ETS 300 012: "Integrated Services Digital Network (ISDN); Basic user-network interface; Layer 1 specification and test principles".
- [9] ETSI ETS 300 019: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".
- [10] ETSI ETS 300 233: "Integrated Services Digital Network (ISDN); Access digital section for ISDN primary rate".
- [11] ETSI ETS 300 288: "Business TeleCommunications (BTC); 64 kbit/s digital unrestricted leased line with octet integrity (D64U); Network interface presentation".
- [12] ETSI ETS 300 324: "Signalling Protocols and Switching (SPS); V interfaces at the digital Local Exchange (LE); V5.1 interface for the support of Access Network (AN)".
- [13] ETSI ETS 300 347: "Signalling Protocols and Switching (SPS); V interfaces at the digital Local Exchange (LE); V5.2 interface for the support of Access Network (AN)".
- [14] ETSI EN 300 376-1: "Telecommunications Management Network (TMN); Q3 interface at the Access Network (AN) for configuration management of V5 interfaces and associated user ports; Part 1: Q3 interface specification".
- [15] ETSI EN 300 378-1: "Telecommunications Management Network (TMN); Q3 interface at the Access Network (AN) for fault and performance management of V5 interfaces and associated user ports; Part 1: Q3 interface specification".
- [16] ETSI ETS 300 462-2: "Transmission and Multiplexing (TM); Generic requirements for synchronization networks; Part 2: Synchronization network architecture".
- [17] ETSI ETS 300 462-5: "Transmission and Multiplexing (TM); Generic requirements for synchronization networks; Part 5: Timing characteristics of slave clocks suitable for operation in Synchronous Digital Hierarchy (SDH) equipment".
- [18] ETSI ETS 300 418: "Business TeleCommunications (BTC); 2 048 kbit/s digital unstructured and structured leased lines (D2048U and D2048S); Network interface presentation".
- [19] ITU-T Recommendation G.703: "Physical/electrical characteristics of hierarchical digital interfaces".
- [20] ITU-T Recommendation G.704: "Synchronous frame structures used at 1 544, 6 312, 2 048, 8 488 and 44 736 kbit/s hierarchical levels".
- [21] ITU-T Recommendation G.803: "Architectures of transport networks based on the synchronous digital hierarchy (SDH)".
- [22] ITU-T Recommendation G.823: "The control of jitter and wander within digital networks which are based on the 2 048 kbit/s hierarchy".
- [23] ITU-T Recommendation G.832: "Transport of SDH elements on PDH networks: Frame and multiplexing structures".
- [24] ITU-T Recommendation I.430: "Basic user-network interface - Layer 1 specification".
- [25] ITU-T Recommendation M.3010: "Principles for a telecommunications management network".
- [26] EC ITSEC: "Information Technology Security Criteria (ITSEC)".
- [27] ETSI EG 201 212: "Electrical Safety; Classification of interfaces for equipment to be connected to telecommunication networks".

## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following definitions apply:

**access link:** whole of transmission means between a given network interface and a single user interface. The concept of access link is used in order to allow a functional and procedural description and a definition of the network requirements

NOTE 1: The user-side and the network-side of the access link are not identical and therefore the access link is not symmetrical.

**Adaptation Unit (AU):** provides adaptation functions between the Optical Network Unit (ONU) and the user-side

**duplex working:** bi-directional communication using a different wavelength for each direction of transmission over a single fibre

**duplex working:** bi-directional communication using the same wavelength for both directions of transmission over a single fibre

**Field Replaceable Unit (FRU):** lowest level of maintenance spare and will typically be a plug-in card. The modules of an Optical Line Termination (OLT) and ONU should be FRUs

**full access:** given no other connections, any slot on one side of the concentrator may be connected to any slot on the other side of the concentrator

**multiplexing static:** system of multiplexing where the relationship between the position of the tributaries to the multiplexed format (channels) is predetermined and fixed

**multiplexing dynamic:** system of multiplexing where the relationship between the position of the tributaries to the multiplexed format (channels) is flexible. It also allows for tributaries to be aggregated where there are more tributaries than available channels and the possibility to vary the bandwidth to  $n$  times the capacity of the channels

**non-blocking:** any allowable connection may be made at any time, regardless of the order in which connections are established or removed (An allowable connection assumes that the respective slots are free)

**Optical Access Network (OAN):** set of access links sharing the same network-side interfaces and supported by optical access transmission systems

NOTE 2: The OAN may include a number of ODNs connected to the same OLT.

**Optical Distribution Network (ODN):** provides the optical transmission means from the OLT towards the users, and vice versa

**Optical Line Termination (OLT):** provides the network-side interface of the OAN and is connected to one or more ODNs

**Optical Network Unit (ONU):** provides (directly or remotely) the user-side interface of the OAN and is connected to the ODN

**optical filter:** device for the selection of optical signals at optical specific wavelengths

**optical power splitter:** device that has  $n$  inputs with  $k$  outputs, where  $n = 1$  to  $k$  and  $k \geq 2$

**passive component:** component part of the ODN that does not require external power, i.e. fibre, splitter, filter

**point-to-multipoint:** transmission system, which can have one input or output at one end with multiple inputs or outputs at the other end

**Passive Optical Network (PON):** subset of an ODN and refers to a point-to-multipoint option

**Space Division Multiplexing (SDM):** bi-directional multiplexing using different fibres for up and downstream signals

**Sub Carrier Multiplexing (SCM):** multiplexing multiple electrical frequencies onto a single fibre at a single wavelength to provide an individual frequency to each multipoint to point path

**serial number:** reference number assigned to an object, component, etc.

**service channel:** each bearer service is allocated a service channel in the PON systems. e.g. a 64 kbit/s channel to support the Public Switched Telephone Network (PSTN)

**Service Unit (SU):** FRU that supports service interface (Service Unit (SU)) function(s)

**simplex working:** communication which uses a different fibre for each direction of transmission

**Time Compression Multiplexing (TCM):** bi-directional multiplexing using different time slots for up and downstream signals

**Time Division Multiplexing (TDM):** multiplexing information onto fixed time ranges

**Tributary Unit (TU):** FRU with one or more tributary interface functions

**Wavelength Division Multiplexing (WDM):** bi-directional multiplexing using different optical wavelength for up and downstream signals

## 3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternating Current
A/D	Analogue to Digital (conversion)
AN	Access Network
ATM	Asynchronous Transfer Mode
AU	Adaptation Unit
BA	Basic Access
B-ISDN	Broadband Integrated Services Digital Network
DC	Direct Current
D/A	Digital to Analogue (conversion)
D2048S	2 048 kbit/s digital structured ONP leased line
D2048U	2 048 kbit/s digital unstructured ONP leased line
FDM	Frequency Division Multiplexing
FITL	Fibre In The Loop
FRU	Field Replaceable Unit
ISDN	Integrated Services Digital Network
ISDN-BA	ISDN-Basic Access
ITSEC	Information Technology Security Criteria
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
NNI	Network to Network Interface
NT	Network Termination
NT1	Network Termination 1
OAM	Operations Administration and Maintenance
OAN	Optical Access Network
ODN	Optical Distribution Network
OLT	Optical Line Termination
ONP	Open Network Provision
ONU	Optical Network Unit
OS	Operations System
OSI	Open Systems Interconnection
OTDR	Optical Time Domain Reflectometer
PON	Passive Optical Network
POTS	Plain Old Telephony Services
ppm	parts per million
PRA	Primary Rate Access
PRC	Primary Reference Clock
PSTN	Public Switched Telephone Network

QAN	Q interface for the Access Network
SCM	Sub Carrier Multiplexing
SCMA	Sub Carrier Multiple Access
SDH	Synchronous Digital Hierarchy
SDM	Space Division Multiplexing
SNI	Service Node Interface
SPF	Signalling Processing Function
SSU	Synchronization Supply Unit
SU	Service Unit
TCM	Time Compression Multiplexing
TDM	Time Division Multiplexing
TDMA	Time Division Multiple Access
TU	Tributary Unit
UIpp	Unit Intervals peak to peak
UNI	User Network Interface
VC	Virtual Container
VF	Voice Frequency
WDM	Wavelength Division Multiplexing

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## 4 Configuration of an OAN

The configuration of an OAN is considered in this clause. It provides an introduction to the detailed requirements of an OAN.

NOTE: The functional architecture issues are under study in ETSI Sub Technical Committee (STC) TM3.

### 4.1 Topological and functional issues

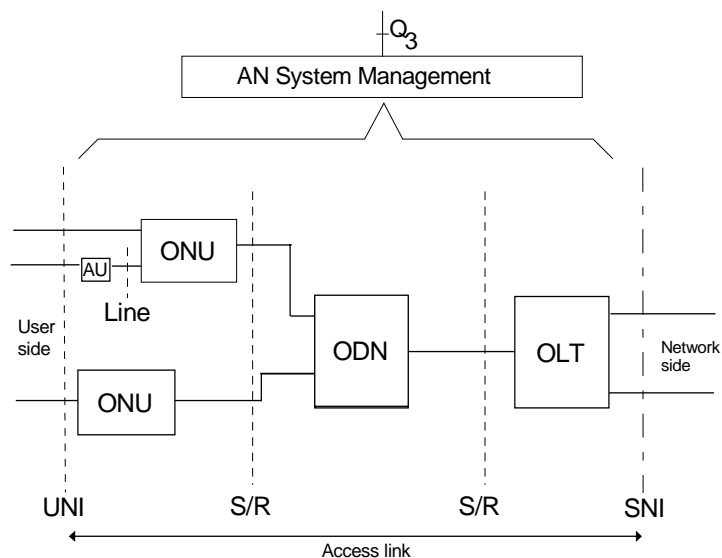
A configuration for an OAN is shown in figure 1. An OAN consists of:

- a) one OLT;
- b) at least one ODN;
- c) at least one ONU;
- d) AUs.

The ODN provides the optical transmission means from the OLT towards the users and vice versa. ONUs provide the user-side interface of the OAN and are connected to the ODN. The functions comprised by the AU include adaptation of the service interfacing between ONU and user (e.g. conversion of data communication protocols and rates) as well as transportation of the service over the last drop between the ONU and user when these interfaces do not coincide (e.g. Network Termination 1 (NT1) for Integrated Services Digital Network, Basic Access (ISDN-BA)).

The reference points User Network Interface (UNI) and Service Node Interface (SNI) as well as the Q3 interface shown in figure 1. The R and S reference points are described in ETS 300 681 [4].

NOTE: Standardization work related to such an AU is outside the scope of the present document.



**Figure 1: Example configuration for an OAN**

A functional architecture of the OAN in accordance with the principles of ITU-T Recommendation G.803 [21] is shown in figure 2. ISDN-BA is the adapted service shown in this architecture. The Service Node Interface (SNI) is according to V5.1; see ETS 300 324 [12]. The multiplexing of the user individual D-channels is performed on a higher layer and not shown in this structure. The structure of D and D\* are not identical. Although a number of other options exist (e.g. leased lines, V5.2, etc.) they are not shown on this diagram.

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