

Recommendation

ITU-T M.3110.1 (03/2025)

SERIES M: Telecommunication management, including
TMN and network maintenance

Telecommunications management network

X-interface for the management of shared network resources – Protocol neutral requirements

ITU-T M-SERIES RECOMMENDATIONS

Telecommunication management, including TMN and network maintenance

Introduction and general principles of maintenance and maintenance organization	M.10-M.299
International transmission systems	M.300-M.559
International telephone circuits	M.560-M.759
Common channel signalling systems	M.760-M.799
International telegraph systems and phototelegraph transmission	M.800-M.899
International leased group and supergroup links	M.900-M.999
International leased circuits	M.1000-M.1099
Mobile telecommunication systems and services	M.1100-M.1199
International public telephone network	M.1200-M.1299
International data transmission systems	M.1300-M.1399
Designations and information exchange	M.1400-M.1999
International transport network	M.2000-M.2999
Telecommunications management network	M.3000-M.3599
Integrated services digital networks	M.3600-M.3999
Common channel signalling systems	M.4000-M.4999

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

Recommendation ITU-T M.3110.1

X-interface for the management of shared network resources – Protocol neutral requirements

Summary

Recommendation ITU-T M.3110.1 specifies a set of requirements to enable the cooperative management of the shared network resources across the X-interface between the master operator (MOP) and the participating operator(s) (POP(s)), and provides high-level use cases as well as function sets for exchanging shared management information across the X-interface for the management of shared network resources. The function sets across this interface include: business activation, operation management, fault handling, resource allocation management and security management, and the interface is developed following the interface specification methodology from Recommendation ITU-T M.3020, in a protocol neutral manner.

History*

Edition	Recommendation	Approval	Study Group	Unique ID
1.0	ITU-T M.3110.1	2025-03-29	2	11.1002/1000/16278

Keywords

Management of shared network resources, master operator, network element sharing, participating operator, X-interface.

* To access the Recommendation, type the URL <https://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, and information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

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.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents/software copyrights, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the appropriate ITU-T databases available via the ITU-T website at <https://www.itu.int/ITU-T/ipr/>.

© ITU 2025

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

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.....	2
4 Abbreviations and acronyms	2
5 Conventions	3
6 Concepts and background.....	3
6.1 Overview of shared network resources management.....	3
6.2 Roles for the use and management of shared network resources.....	4
7 Business level requirements	5
7.1 Requirements.....	5
7.2 Actor roles	9
7.3 Telecommunication resources	9
8 Specification level requirements.....	12
8.1 Business activation related function set	12
8.2 Operation management related function set.....	15
8.3 Fault handling related function set	19
8.4 Resource allocation management related function set	22
8.5 Security management related function set.....	27
Bibliography.....	29

Recommendation ITU-T M.3110.1

X-interface for the management of shared network resources – Protocol neutral requirements

1 Scope

This Recommendation specifies the requirements to enable cooperative management of the shared network resources across the X-interface between the master operator and the participating operators. It specifies business level requirements, specification level requirements and use cases for exchanging shared management information across the X-interface for the management of shared network resources.

The management requirements of the X-interface provided in this Recommendation follows the [ITU-T M.3020] interface specification methodology in the requirements phase, and is developed in a protocol neutral manner.

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.

- [[ITU-T M.3010](#)] Recommendation ITU-T M.3010 (2000), *Principles for a telecommunications management network*.
- [[ITU-T M.3016.3](#)] Recommendation ITU-T M.3016.3 (2005), *Security for the management plane: Security mechanism*.
- [[ITU-T M.3020](#)] Recommendation ITU-T M.3020 (2023), *Management interface specification methodology*.
- [[ITU-T M.3320](#)] Recommendation ITU-T M.3320 (1997), *Management requirements framework for the TMN X-Interface*.
- [[ITU-T M.3701](#)] Recommendation ITU-T M.3701 (2010), *Common management services – State management – Protocol neutral requirements and analysis*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 master operator [b-3GPP TS 32.130]: In radio access network (RAN) and/or core network (CN) sharing scenarios, deployment and daily operation of shared network elements are entrusted to a single actor, called the master operator. The master operator provides network and OAM&P services to other operators, called participating operators (POPs). The master operator is the only one to have a direct OAM&P connection from its domain manager (DM) to the shared network elements.

3.1.2 participating operator [b-3GPP TS 32.130]: Participating operators are service providers who share, alongside other participating operators, the network (RAN and/or CN) facilities provided by the master operator. According to TS 36.300 ... up to 6 operators can share a RAN.



3.1.3 X-interface [ITU-T M.3010]: An interface applied at x reference points.

3.1.4 x reference point [ITU-T M.3010]: A reference point located between OSF function blocks in different TMNs.

NOTE – Entities located beyond the x reference point may be part of an actual TMN (OSF) or part of a non-TMN environment (OSF-like). This classification is not visible at x reference points.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 dedicated network element: A network element that is only used and managed by the owner operator.

3.2.2 shared network element: A network element whose usage and access are shared by multiple operators, and the management of which requires the collaboration of multiple operators.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

BA	Business Activation
CAPEX	Capital Expenditure
FH	Fault Handling
ID	Identification
IMT-2020	International Mobile Telecommunications-2020
MOP	Master Operator
NE	Network Element
OAM	Operations, Administration and Maintenance
OAM&P	Operation Administration Maintenance and Provisioning
OM	Operation Management
OPEX	Operational Expenditure
OS	Operations System
OSF	Operations Systems Function
POP	Participating Operator
RA	Resource Allocation
REQ	Requirement
SC	Service Customer
SLA	Service Level Agreement
SM	Security Management
SP	Service Provider
SU	Service User
TMN	Telecommunication Management Network

5 Conventions

In this Recommendation:

The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.

6 Concepts and background

With the deployment and development of telecommunication networks (e.g., IMT-2020 and beyond), network operators are confronted with increased capital and operating expenditure (CAPEX and OPEX) for network construction and maintenance. To address this issue, network resource sharing is a possible method to help telecommunication operators save costs and enhance efficiency. Operators can choose to share the telecommunications infrastructure and equipment such as switches, telecom towers, fibre-optic cables, routers with other operators or with service users (SUs) or Service customers (SC), which can help avoid overlapping investment and improve network and capital operation efficiency, as well as reducing costs and increasing benefits.

Network resource sharing allows two or more operators to use, maintain and manage the shared network resources. Therefore, the operation administration and maintenance (OAM) of shared network resources requires the participation of multiple operators to cooperative management through X-interfaces. In addition, exchanging shared management information among operators can significantly improve the efficiency of shared network operation.

The purpose of cooperative management is to realize that the participating operators (POPs) can manage the shared network resources of the master operator (MOP) through the X-interface, and to exchange shared management information of the shared network resources across the X-interface.

6.1 Overview of shared network resources management

Figure 1 shows the X-interface interconnecting the MOP and the POP addressed in this Recommendation. The X-interface is also referred to as the "cooperative management model" interface and is used to convey information related to management between two sharing partners, as defined in [ITU-T M.3320].

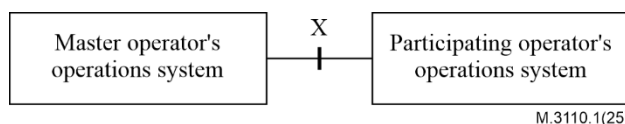


Figure 1 – Reference interface X between the MOP's OS and the POP's OS

In a shared network, the network element (NE) can be shared between two or more operators. Figure 2 shows a reference model for shared network resource management. The interface between operator A and operator B is an X-interface, through which operators exchange management information of shared resources with each other. A contract agreement that includes the type, location, supported functions and performance requirements of the shared NE is signed by operator A and operator B before using the shared network elements. The contract agreement can be signed offline in a physical form or online by smart contract. The contract agreement requests are initiated by the POP that uses the shared network resources, and sent to the MOP through the X-interface between the two operators, enabling the POP to promptly operate and manage resources in the shared NEs through the X-interface.

Operator A and operator B shown in Figure 2 can be both MOP and POP interchangeably. In Figure 2 two kinds of Nes are shown: dedicated NE and shared NE. The MOP is the only one that have a direct OAM&P connection to the shared NE. The management of the dedicated NE can use the conventional Q interface between the operating system (OS) and dedicated NEs. The shared NE is also managed

by the MOP through the Q interface, while the POP can also manage the shared resources in the shared NE through the X-interface. The management of shared NEs requires the cooperative participation and information exchanging between the POP and the MOP.

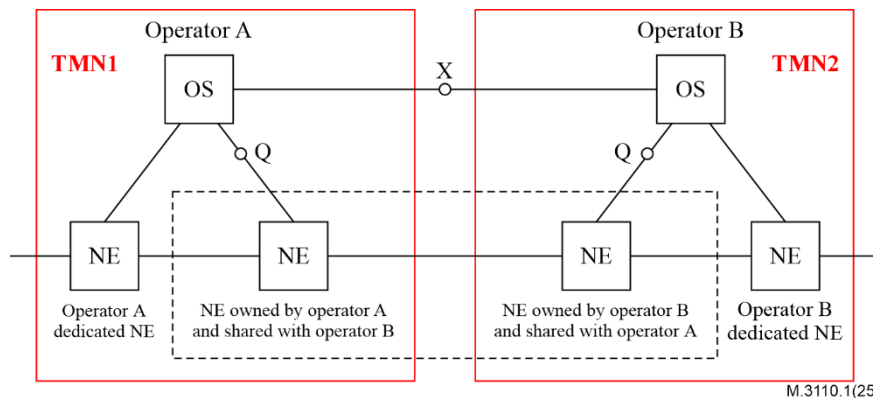


Figure 2 – Shared network resources management across the X-interface

Within this Recommendation, the MOP's OS collects data of shared NE from its own network and element managers, which are components of the operations system, and then makes available agreed upon network management data and information associated with the shared NE to the POP's OS.

6.2 Roles for the use and management of shared network resources

Due to the fact that it is not only operators who directly use shared NE, but also their customers or users, according to different NEs, there are two cases to consider. The first case is that the POP uses the NE of the MOP directly, especially when the NE is power supply, monitoring equipment, etc. in a telecommunications room. In this case, there is no service provider (SP), SU or SC of the POP to use the shared NE. The second case is that the SP contracts with the POP in order to use the shared NEs belonging to the MOP. For both cases, only the MOP and the POP can manage the shared NE, and the management should be completed through the Q interface or X-interface, while the SP/SC/SU has no rights to manage the shared NE.

Figure 3 illustrates the SP/SC/SU relationships for the use of shared network resources, when the SP contracts with operator A to use the shared NE of operator B. The SC/SU is the party authorized to use the service of the shared NE according to the established service level agreement (SLA), contract or service subscription established between the SC/SU and SP. The SC/SU then becomes the actual service user of the shared NE. By contracting with network operator A, the SP of operator A can send the information of its SC/SU to operator A, who can transmit the information to operator B through the X-interface, and finally it will be transmitted to the shared NE through the Q interface within operator B. In this way, the SC/SU can use the services in the shared NE.

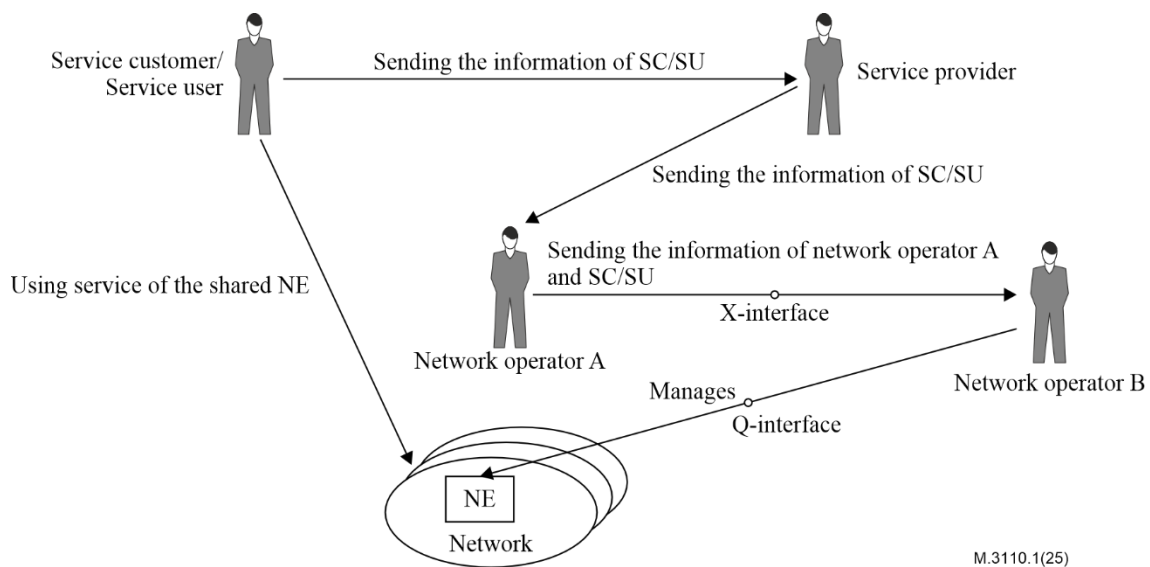


Figure 3 – The SP/SC/SU relationships for the use of shared network resources

7 Business level requirements

7.1 Requirements

Within this Recommendation, the X-interface is for network management as defined in [ITU-T M.3010]. According to the differences in management requirements, the business level requirements of the X-interface for the management of shared network resources can be grouped into the following categories:

- Business activation related function set: register the POP to be authorized, authenticate successfully and authorize the access of a shared NE, and authenticate failed and reject the access of a shared NE.
- Operation management related function set: request attributes configuration of the shared NE, query the configuration attributes of the shared NE, query the performance indicators of the shared NE and query the log information of the shared NE.
- Fault handling related function set: submit fault reports of the shared NE, submit status reports for corrective actions and notify the state of the shared NE.
- Resource allocation management related function set: request dynamic adjustment of resources in the shared NE, alert performance degradation of the shared NE, request the configuration of QoS level in the shared NE and notify the recovery of the QoS level in the shared NE.
- Security management related functions set: control access of shared NE management, transmit the enciphering keys (MOP to POP), transmit the encrypted information (POP to MOP), transmit the enciphering keys (POP to MOP) and transmit the encrypted information (MOP to POP).

7.1.1 Business activation related function set

The MOP is required to provide the function for the POP to transmit the registration information through the X-interface. Afterwards, the MOP is required to authenticate and authorize the POP to use the shared NE through the X-interface. (See also Table 1.)

The MOP is required to provide a function for the POP to:

REQ-BA-FUN-01: Register the POP to be authorized.

The MOP is required to:

REQ-BA-FUN-02: Authenticate successfully and authorize the access of a shared NE;

REQ-BA-FUN-03: Authenticate failed and reject the access of a shared NE.

Table 1 – Business activation related function set

Identifier	Definition	Related use case(s) / motivation
REQ-BA-FUN-01	The MOP's OS is required to provide the function for the POP to transmit the registration information (e.g., the information of the POP and its SCs/SUs) to the MOP's OS through the X-interface.	—
REQ-BA-FUN-02	The MOP'S OS is required to authenticate and authorize the POP or the POP's SCs/SUs to access the shared NE through the X-interface, when the authentication succeeds.	—
REQ-BA-FUN-03	The MOP'S OS is required to reject the POP or the POP's SCs/SUs to access the shared NE through the X-interface, when the authentication fails.	—

7.1.2 Operation management related function set

The POP is required to be involved in the operation management of shared NEs through the X-interface including: requesting configuration management and querying the configuration attributes, physical performance indicators and log information of the shared NE. The MOP is required to respond to the POP's requests and queries. (See also Table 2.)

The MOP is required to provide a function for the POP to:

REQ-OM-FUN-01: Request attributes configuration of the shared NE;

REQ-OM-FUN-02: Query the configuration attributes of the shared NE;

REQ-OM-FUN-03: Query the performance indicators of the shared NE;

REQ-OM-FUN-04: Query the log information of the shared NE.

Table 2 – Operation management related function set

Identifier	Definition	Related use case(s) / motivation
REQ-OM-FUN-01	The MOP's OS is required to provide the function for the POP's OS to request to configure its own proprietary attributes for the shared NE through the X-interface.	—
REQ-OM-FUN-02	The MOP's OS is required to provide the function for the POP's OS to query the configuration attributes of the shared NE through the X-interface.	—
REQ-OM-FUN-03	The MOP's OS is required to provide the function for the POP's OS to query the performance indicators of the shared NE through the X-interface.	—
REQ-OM-FUN-04	The MOP's OS is required to provide the function for the POP's OS to query the log information of the shared NE through the X-interface.	—