

International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

M.1401

(05/2005)

SERIES M: TELECOMMUNICATION MANAGEMENT,
INCLUDING TMN AND NETWORK MAINTENANCE

Designations and information exchange

**Formalization of interconnection designations
among operators' telecommunication networks**

ITU-T Recommendation M.1401



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.

ITU-T Recommendation M.1401

Formalization of interconnection designations among operators' telecommunication networks

Summary

This Recommendation defines designations and additional information intended primarily for human-to-human communication between various Operators, i.e., network operators or service providers.

This Recommendation contains data definitions for designations of interconnections and other information about network resources that are required to be communicated between operators.

This Recommendation will eventually replace ITU-T Rec. M.1400, Designations for interconnections among operators' networks. However, in an indefinite period, both Recommendations apply.

This Recommendation is developed in order to facilitate computerized interoperation between telecommunication operators. For this use a more formal approach than M.1400 is required. See Appendix III.

Note that since ITU-T Rec. M.1400 does not formally specify data structures, backward compatibility with existing implementations may not be ensured, but this Recommendation is based on ITU-T Rec. M.1400. For further details, see Appendix II.

This revised ITU-T Rec. M.1401 is updated with Equipment Identity, Unique Item Identifiers and Local identifiers in order to provide compliance with ETSI and ATIS recommended standards.

Source

ITU-T Recommendation M.1401 was approved on 14 May 2005 by ITU-T Study Group 4 (2005-2008) under the ITU-T Recommendation A.8 procedure.

Keywords

Data definitions, designations, domestic, interconnection, international, operator, terminology, X interface.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. 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, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

© ITU 2005

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

CONTENTS

	Page
1 Scope	1
2 Normative references	1
3 Definitions	1
4 Abbreviations	1
5 Conventions	2
6 Application schema	3
7 Appendices	17
Appendix I – Registration of ICCs	18
I.1 Introduction	18
I.2 ITU ICC procedure	18
I.3 Distributed ICC web	18
Appendix II – Remarks	19
Appendix III – Data-oriented human-machine interface specification technique – Formalism	21
III.1 Introduction	21
III.2 Scope	21
III.3 References	21
III.4 General	22
III.5 Objects	22
III.6 References	22
III.7 Attributes	22
III.8 Values	23
III.9 Functions	23
III.10 Schema-Population references	23
III.11 Denotations	24
III.12 Documentation	24
III.13 Graphical notation	24
III.14 Textual notation	25
Appendix IV – Example transit network registration	25
IV.1 Example	25
IV.2 Representation	25
BIBLIOGRAPHY	31

Introduction

This Recommendation defines designations and additional information intended primarily for human-to-human communication between various Operators, i.e., network operators or service providers.

The area of interest is the communication between operators about network interconnections and network services. The objects of communication are network interconnection points, places, stations, nodes, interconnection links, and terminating and originating connections and transit connections, etc. Correct terms for these are provided by the application schema defined in this Recommendation.

This Recommendation focuses on human needs for stable and recognizable data formats independently of what media they are communicated over. Therefore, in order to support the human-to-human communication, the formats defined in this Recommendation are required to be provided at the corresponding human-to-computer interfaces, as well. Hence, this Recommendation defines the presentation formats of data at human-to-computer interfaces, but does not define the data communication formats for interfaces between computer systems, such as at the TMN X interface or non-TMN computer interfaces. However, it should be possible in the future to automatically map the human-to-computer formats to the computer-to-computer formats and vice versa. The details of this mapping are for further study.

Use of this Recommendation within national jurisdictions may be imposed by the national regulator or may be the result of bilateral negotiation between the operators and/or national regulatory authorities, in accordance with national laws and regulations.

The Recommendation defines both designations and additional information to be exchanged between two Operators. However, this Recommendation focuses on information on Operators, network resources and their addresses, and does not define order or transaction identification or additional information on the status or processing of these orders or transactions.

The definition of information is common for the functions it supports. However, the selection of information defined in this Recommendation basically supports provisioning and network maintenance. In addition, this Recommendation may cover some information required for other TMN or non-TMN functions, such as ordering and billing.

This Recommendation aims at supporting communication between network operators, but may also support communication between network operators and service providers, brokers, retailers, customers and installation providers.

This Recommendation aims at defining designations and additional information for technicians and file support personnel at their terminals supporting the network, and serves as design information for developers of operational support systems.

ITU-T Recommendation M.1401

Formalization of interconnection designations among operators' telecommunication networks

1 Scope

The area of interest is the communication between operators about network interconnections. The objects of communication are network interconnection points, places, stations, nodes, interconnection links, and terminating and originating connections and transit connections, etc. This Recommendation contains definitions of those terms in the application schema.

2 Normative 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.

- [1] ITU-T Recommendation M.1400 (2004), *Designations for interconnections among operators' networks*.
- [2] ITU-T Recommendation T.50 (1992), *International Reference Alphabet (IRA) (Formerly International Alphabet No. 5 or IA5) – Information technology – 7-bit coded character set for information interchange*.
- [3] ITU-T Recommendation T.51 (1992), *Latin based coded character sets for telematic services*.
- [4] ITU-T Recommendation T.52 (1993), *Non-latin coded character sets for telematic services*.
- [5] ISO 3166-1 (1997), *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes*.

3 Definitions

This Recommendation is comprised of structured definitions in the context of an application schema graph.

4 Abbreviations

This Recommendation uses the following abbreviations:

- ICC ITU Carrier Code
- SDH Synchronous Digital Hierarchy
- TMN Telecommunicating Management Network

5 Conventions

Figure 1 shows boxes containing object class labels to indicate object classes. Lines supported with a reversed arrowhead indicate subordinate object classes. Lines with two-way arrows indicate references between object classes. A dashed one-way arrow with an S at the arrowhead indicates a schema reference and is here used for stating recursion.

The text that follows Figure 1 includes a label and explanation for each class in the schema. A class can be an object class, an attribute class, or a reference class. The level of each class is depicted in the text by indentations (5 mm) of the class label, supported with dashes, where the number of indentations and dashes indicates the level of a given class within the schema. Therefore, each class label has a given indentation based on the Figure 1 schema graph.

Labels of data items that are subordinate to or referenced from a given object class are presented in the following sequence:

- 1) alphabetized object class attributes;
- 2) alphabetized object class references; and
- 3) alphabetized object classes that are contained within the given object class at the next lower level.

Textual definitions and explanations of object classes, attributes and references are provided in paragraphs that are adjusted 5 mm further to the right of their respective labels.

Object class labels are underlined; attribute group and attribute labels are not underlined. Object class references are written in blue, italics and underlined.

The formalism used in this Recommendation is introduced in Appendix III.

Data attributes other than Local identifiers consist of sequences of characters taken from Table 1/T.50, each character being either alphabetic (A-Z) or numeric (0-9). Local identifiers consist of sequences of characters which may include characters from other character sets (for example, the non-Latin characters in ITU-T Rec. T.52), on the basis of appropriate bilateral and/or multilateral agreements. Additional requirements for symbols are explicitly stated in format requirements for specific attributes. It is recommended that alphabetic characters be represented with upper-case letters unless stated otherwise.

6 Application schema

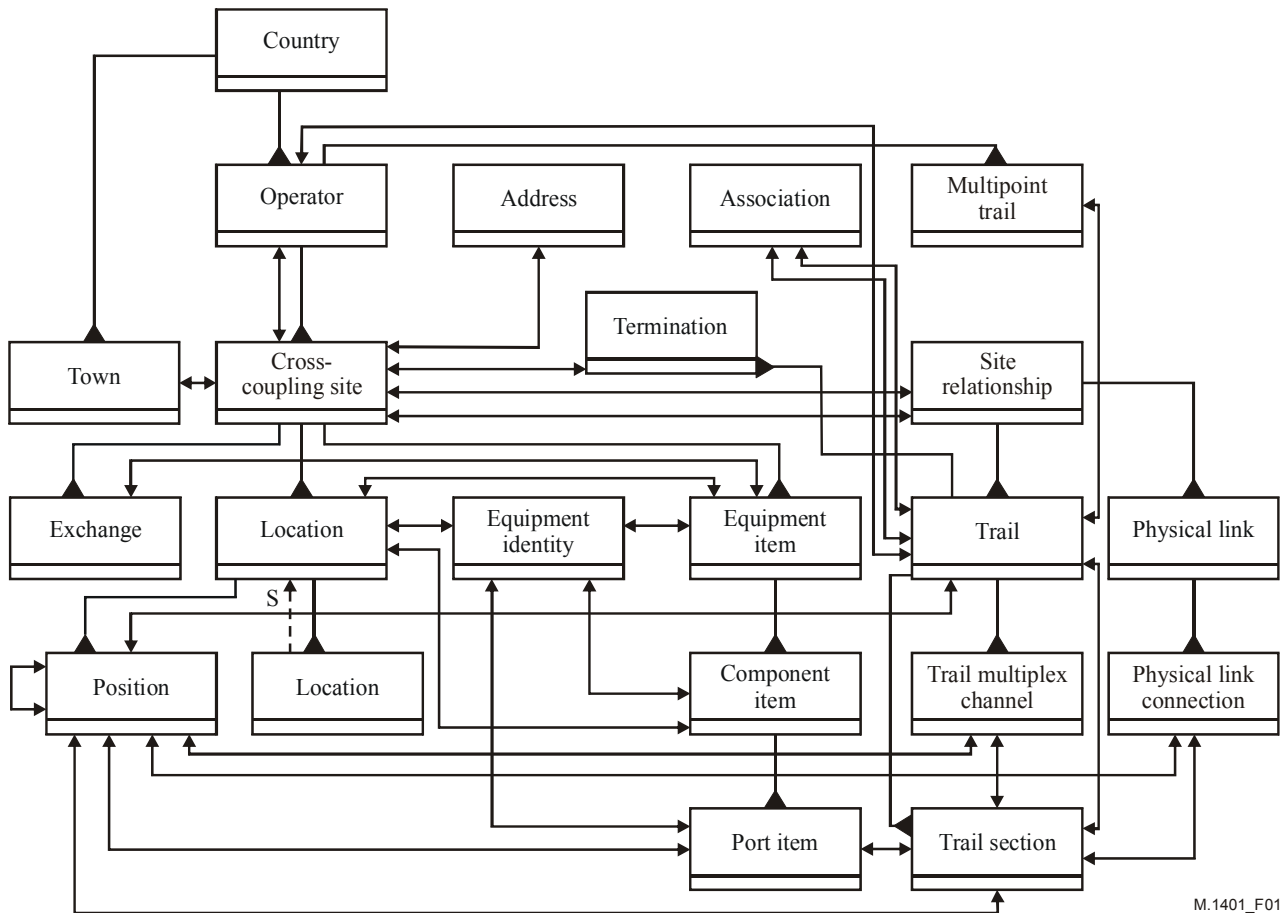


Figure 1/M.1401 – Application schema graph, depicting object classes (boxes), containment (reversed arrowheads) and references (two-way arrows)

Address

An Address identifies a geographic location, which may contain a Cross-coupling site.

- Site

An Address' subordinate Site is a role of a Cross-coupling site that is placed at the Address. An Address may have several Sites.

Association

An Association defines an ordered or unordered relationship between a Trail and some other Trails. The ordering is indicated by the Superior trail reference.

- Kind

Kind is indicating the usage of the Association. Kind is a 2-character field, adjusted to the left. S indicates reserve. In this case, Superior trail indicates the main trail, and Trail indicates the reserve trail.

- Superior trail

An Association's subordinate Superior trail is a role of a Trail that controls the Association. In case of an ordered relationship, the Association will have one and only one Superior trail. In case of an unordered relationship, the Association will have no Superior trail.

- Trail

An Association's subordinate Trail is a role of a Trail being controlled by the Association. An Association must have one or more Trails. In case of an unordered relationship, the Association will have two or more Trails.

Country

A Country with its Name and Country Code is defined in ISO 3166.

Operators within a Country are recognized and identified by the national regulatory authorities within that Country.

- Name

The Country Name identifies a Country, dependency, or other area of particular geopolitical interest. Countries are assigned a globally unique Name in ISO 3166-1.

- Code

The Country Code is a 3-character globally unique code that identifies each Country according to ISO 3166-1.

- Operator

For this Recommendation, an Operator is an organization responsible for identification and management of telecommunication resources. The Operator must be legally recognized by the telecommunication Administration of the Country, or delegation thereof. An Operator may or may not correspond to a trading partner.

For this Recommendation, an Operator can be a network operator or service provider.

Both the national authority and the Operators should note that each Operator would be registered as a separate entity in each Country in which it operates, and is required to report country-specific information to each national authority. This may or may not imply a need for a multinational Operator to use different ICCs in each Country. Multinational Operators are encouraged to ensure that they are registered in each Country in which they operate.

- ICC

The ITU Carrier Code provides a unique identifier of an Operator within a Country. The assignment of ICCs may be delegated to a lower-level regional administration (for example, a province).

The ICC is used as an indispensable part in the assignment of identifiers for interworking between Operators. It is permissible that an operator uses one ICC for assignment of identifiers, while other operator codes are used for ordering, billing, etc.

ICC is a 1- to 6-character alphanumeric field.

See Appendix I on registration of ICCs.

- Controlled site

An Operator's subordinate Controlled site is a role of a Cross-coupling site that is currently owned by the Operator, but not identified locally to this Operator. If the Operator owns Cross-coupling sites that are not identified locally to this Operator, this reference has to be explicitly provided.

- Controlled trail

An Operator's subordinate Controlled trail is a role of a Trail being controlled by the Operator. An Operator may have many Controlled trails. Note that Controlled trail indicates responsibility for maintenance and not ownership.

- ▪ Cross-coupling site

The Cross-coupling site allows termination of a Trail, e.g., in an exchange, at a subscriber's premises or other. In case of termination of the Trail, e.g., at the subscriber's premises or in an international transmission centre, the Operator's network is considered to exist at one side of the Cross-coupling site only, i.e., the Operator's network may not include the connection between the Cross-coupling site and the customer's equipment.

The Cross-coupling site allows cross-couplings to route a Trail through that node, and the Cross-coupling site allows cross-couplings between Trails within that Cross-coupling site. The cross-coupling may use internal equipment, termination points and internal Trails which are associated to the routed Trail.

The cross-couplings may be provided by automated management, e.g., in digital cross-connect or SDH network matrixes, or the cross-connect can be made manually as in a fibre matrix. However, a Cross-coupling site typically may contain more than a single piece of such Equipment items, and the individual Equipment item should not be registered as a Cross-coupling site.

A Cross-coupling site can be a transmission station, a radio station, a base station, an earth station, a distribution frame, or a junction box, which as a special case can be an end junction box.

A control station or sub-control station can be registered as a Cross-coupling site even if it may not provide for cross-couplings within that site.

A Cross-coupling site cannot be geographically distributed over more than one building. However, it is also permissible to define several Cross-coupling sites at the same Address. In this case, separate Trails and other resources shall be defined to route Trails between these Cross-coupling sites at the same Address.

A cross-coupling within a Cross-coupling site is typically made on the basis of a cross-coupling or routing order. Hence, the cross-couplings are considered to be semi-permanent. Junctions which contain permanent cross-couplings or permanently installed equipment, are not Cross-coupling sites. Note that this permanently installed equipment outside Cross-coupling sites may still be subject to automatic surveillance by management functions.

A Cross-coupling site may contain one or more Exchanges, concentrators, routers and other equipment.

- ▪ ▪ Identifier

The Identifier uniquely identifies the Cross-coupling site within the scope of an Operator. Cross-coupling sites of different Operators, e.g., in the same room, shall be defined as separate Cross-coupling sites. However, if the place is managed by one Operator only, the place should be defined as one Cross-coupling site locally to that Operator. The other Operator's Equipment items, Exchanges and Locations shall then be identified locally to this Operator's Cross-coupling site. Hence, registration of ownership of Equipment items is distinguished from naming of the Equipment items within the Cross-coupling site.

Aliases of Cross-coupling site Identifiers are not permitted for communication between Operators of different Countries. However, Operators may exchange Local identifiers that are local to a specific Operator, country or region.

Note that some Operators may use the town name, or an abbreviation for this, as a part of the Cross-coupling site Identifier or for some of their Cross-coupling site Identifiers, while other Operators may not. Use of town names may be useful for international Trails terminating in towns, but may not be appropriate for Trails terminating in rural

areas or even for local terminations in a town. The name of the town, if any, will additionally be provided in the Cross-coupling site's subordinate Address.

- ▪ ▪ ▪ **Town**

The Name of the Town being referenced in the Cross-coupling site's subordinate Town. See field length and use of characters in this Name.
- ▪ ▪ ▪ **Site detail**

An identifier of the Cross-coupling site that is at least unique within a Town and an Operator. This requirement does not prohibit that someone choose to make the identifier independent of Town or Operator. The identifier has up to six characters. Symbols that may be included are hyphen (-), underscore (_) and space ().
- ▪ ▪ **Local identifier**

An identifier of the Cross-coupling site that is unique within an Operator, having up to 18 alphabetic and/or numeric characters. A Local identifier is specific to an Operator, country or region. Such use of Local identifiers would be subject to national regulation and/or bilateral agreement between Operators, as stated in ITU-T Rec. M.1400.
- ▪ ▪ **Address**

A Cross-coupling site's subordinate Address is a role of an Address denoting a geographical location. A Cross-coupling site has one Address only, which is the physical location address of the Cross-coupling site.

Note that the Cross-coupling site's subordinate Exchanges, Locations and Equipment items do not have separate references to Addresses, but their detailed addresses may be provided in address notes.
- ▪ ▪ **A-end site relationship**

A Cross-coupling site's A-end site relationship is a role of a Site relationship, of which the Cross-coupling site is referenced as an A-end site. A Cross-coupling site may have multiple A-end site relationships.
- ▪ ▪ **B-end site relationship**

A Cross-coupling site's B-end site relationship is a role of a Site relationship, of which the Cross-coupling site is referenced as a B-end site. A Cross-coupling site may have multiple B-end site relationships.
- ▪ ▪ **Current operator**

A Cross-coupling site's subordinate Current operator is a role of an Operator who is currently responsible for the Cross-coupling site. A Cross-coupling site may have one Current operator only. If the Current operator deviates from the superior Operator of the Cross-coupling site, it has to be explicitly provided.
- ▪ ▪ **Termination**

A Cross-coupling site's subordinate Termination is a role of a Trail's subordinate Termination. A Trail may have two Terminations, and a Cross-coupling site may have one or two Terminations for each Trail.
- ▪ ▪ **Town**

A Cross-coupling site's subordinate Town is a role of a Town subordinate to Country. The Name of this Town is used as a part of the Cross-coupling site Identifier.
- ▪ ▪ **Equipment item**

An Equipment item provides a collection of functions and is considered as a unit from a placement point of view in a Location.

An Equipment item may be an Exchange, taking up a whole room, and it may be an individual circuit card.

- ▪ ▪ ▪ Identifier

An Equipment item is assigned a unique Identifier within the scope of its superior Cross-coupling site. Room identification may or may not be a part of the Equipment item Identifier. The Operator of the Cross-coupling site assigns the Equipment item Identifier, and different pieces of Equipment items within a Cross-coupling site may be owned or used by different entities.

Aliases of Equipment item Identifiers are not permitted for communication between Operators. However, Operators may exchange additional Equipment item identifiers that are local to a specific Operator.

- ▪ ▪ ▪ Unique item identification

The manufacturer may assign a Unique item identification (UID) to an Equipment item.

- ▪ ▪ ▪ [Equipment identity](#)

An Equipment item's subordinate Equipment identity is a role of an Equipment identity to which the Equipment item belongs.

- ▪ ▪ ▪ [Exchange](#)

An Equipment item's subordinate Exchange is a role of an Exchange that is implemented by the Equipment item.

- ▪ ▪ ▪ [Location](#)

An Equipment item's subordinate Location is a role of a Location subordinate to the superior Cross-coupling site or a recursively subordinate Location. Each Equipment item shall be assigned exactly one Location placement where the Equipment item can be found.

- ▪ ▪ ▪ [Component item](#)

A Component item is a separate unit, e.g., a circuit card, within an Equipment item. A Component item has a specified Location, and a Component item has one or more Port items, which may provide inputs, outputs or both.

- ▪ ▪ ▪ Identifier

A Component item is assigned a unique Identifier within the scope of the superior Equipment item.

- ▪ ▪ ▪ Unique item identification

The manufacturer may assign a Unique item identification (UID) to a Component item.

- ▪ ▪ ▪ [Equipment identity](#)

A Component item's subordinate Equipment identity is a role of an Equipment identity to which the Component item belongs.

- ▪ ▪ ▪ [Location](#)

A Component item's subordinate Location is a role of a Location subordinate to the Location of the Equipment item containing the Component item. Each Component item shall be assigned exactly one Location placement where the Component item can be found.

- ▪ ▪ ▪ ▪ Port item
 - A Port item defines a functional unit of a Component item of an Equipment item. The Port item can be sender, receiver, or bidirectional. It may also be possible to modify the function of a Port item.
- ▪ ▪ ▪ ▪ Identifier
 - A Port item is assigned a unique Identifier within the scope of its superior Component item.
- ▪ ▪ ▪ ▪ ▪ *Equipment identity*
 - A Port item's subordinate Equipment identity is a role of an Equipment identity to which the Port item belongs.
- ▪ ▪ ▪ ▪ ▪ *Position*
 - A Port item's subordinate Position is a role of a Position that terminates the Port item.
- ▪ ▪ ▪ ▪ ▪ *Trail section*
 - A Port item's subordinate Trail section is a role of a Trail section in a Trail.
- ▪ ▪ Exchange
 - An Exchange is an entity that directs individual calls, packages or cells.
 - Exchanges can be switches, concentrators or routers. Exchanges can be customer exchanges or transit exchanges. Intelligent Network servers and Operation Support System servers are not Exchanges and are not Cross-coupling sites. A Cross-coupling site may contain several Exchanges of various types.
- ▪ ▪ ▪ No
 - The number No uniquely identifies an Exchange within the scope of a Cross-coupling site. The managing Operator of the superior Cross-coupling site decides the numbering.
 - Note that it is permissible to define a Cross-coupling site for each Exchange or a set of Exchanges at the same Address. In this case, separate Trails and other resources are required to route Trails between these Cross-coupling sites at the same Address. See also under Cross-coupling site.
- ▪ ▪ ▪ *Equipment item*
 - An Exchange's subordinate Equipment item is a role of an Equipment item subordinate to a Cross-coupling site. The Exchange object class role is provided due to the specific identification of Exchanges different from identification of Equipment item in general. The reference via Equipment item provides a reference to the placement of the Exchange in a specific Location, e.g., in a room.
- ▪ ▪ Location
 - A Location is a subdivision of a Cross-coupling site. It is an object in which resources, such as Exchanges, Equipment items and termination points, are placed. It should be noted that the term "Location" is here given a particular meaning local to Cross-coupling site, and that this definition may not apply for the generic term location.
 - A Location can be a room, a frame, a rack, a block, a shelf or a slot in a shelf, and these may contain subordinate Locations recursively.
- ▪ ▪ ▪ Identifier
 - The Identifier of a Location uniquely identifies a Location within a superior Location or Cross-coupling site. The Identifier may consist of both digits and letters. The Location Identifier is assigned by the Operator of the Cross-coupling site.

- ▪ ▪ ▪ Unique item identification
The manufacturer may assign a Unique item identification (UID) to a Location
- ▪ ▪ ▪ Component item
A Location's subordinate Component item is a role of a Component item of an Equipment item in this Location.
- ▪ ▪ ▪ Equipment identity
A Location's subordinate Equipment identity is a role of an Equipment identity to which the Location belongs.
- ▪ ▪ ▪ Equipment item
A Location's subordinate Equipment item is a role of an Equipment item being placed in this Location.
- ▪ ▪ ▪ Location
A Location may contain Locations recursively.
- ▪ ▪ ▪ ▪ S<> 'Location' Location
The recursion is indicated by the subordinate Location class inheriting properties by the S(schema) reference to its superior Location class.
- ▪ ▪ ▪ Position
A Position is a unit that is used to enter terminations and cross-couplings. The Position can be an individual pin, a pair of pins or a group of pins, depending on the design, planned or actual use of the Position.
- ▪ ▪ ▪ ▪ Identifier
A Position is assigned a unique Identifier within the scope of its superior Location. The Identifier may, e.g., indicate a group of pins (3), or an individual pin (3a).
- ▪ ▪ ▪ ▪ Physical link connection
A Position's subordinate Physical link connection is a role of a Physical link connection being terminated on this Position.
- ▪ ▪ ▪ ▪ Port item
A Position's subordinate Port item is a role of a Port item being terminated on this Position.
Note that the Position can be on the slot of the shelf. This allows cables to be terminated on the slot of the shelf and not on the card, and thus allows the card to be easily replaceable.
- ▪ ▪ ▪ ▪ Position
A Position's subordinate Position is a role of another Position that is connected by cross-coupling or termination to this Position.
Note that the cross-coupling or termination is assigned no direction. This means, e.g., that if the termination is from a position (i.e., a connector) on a slot in a shelf to a pin group on a block, only the names of the two Positions indicate the direction.
- ▪ ▪ ▪ ▪ Trail
A Position's subordinate Trail is a role of a Trail being terminated on this Position.

- ▪ ▪ ▪ ▪ [Trail multiplex channel](#)
A Position's subordinate Trail multiplex channel is a role of a Trail multiplex channel being terminated on this Position.
- ▪ ▪ ▪ ▪ [Trail section](#)
A Position's subordinate Trail section is a role of a Trail section in a Trail.
- ▪ [Multipoint trail](#)
A Multipoint trail is a connected set of Trails that are connecting three or more endpoints. A Multipoint trail can reside within one Cross-coupling site, or it may connect two or more Cross-coupling sites.
- ▪ ▪ Identifier
The Identifier uniquely identifies the Multipoint trail within the scope of an Operator. This means that if the resources of a Multipoint trail are shared between Operators, each Operator may assign its local Identifier to the Multipoint trail. This scheme is different from Identifiers of Trails within the Multipoint trail, as they are identified locally to Site relations.
- ▪ ▪ Local identifier
An identifier of a Multipoint trail that is unique within an Operator, having up to 26 alphabetic and/or numeric characters. A Local identifier is specific to an Operator, country or region. Such use of Local identifiers would be subject to national regulation and/or bilateral agreement between Operators, as stated in ITU-T Rec. M.1400.
- ▪ ▪ [Trail](#)
A Multipoint trail's subordinate Trail is a role of a Trail that is contained in the Multipoint trail.
- [Town](#)
Town defines a geographical or administrative area defined by the authorities of that Country.
- ▪ Name
Name of the Town as spelled by the authorities in that Country, i.e., in a national language of that Country. Note that different spellings dependent on the user are not permissible. Town Name has up to 12 characters. Upper- and lower-case letters are permitted. Symbols that may be included in Town Name are hyphen (-), underscore (_) and space (.). In case the spelling given by the authorities exceeds 12 characters is not unique with 12 characters only, the Administration in that Country is responsible for assigning a unique identifier.
- ▪ [Site](#)
A Town's subordinate Site is a role of a Cross-coupling site subordinate to Operator.
This referenced Cross-coupling site's Identifier contains the Town Name.

Equipment identity

A category of equipment instances that may be characterized by a combination of:

- manufacturer name;
- manufacturer part number;
- manufacturer equipment version number;
- equipment category number;
- substitutability (upward/downward compatible replacement).

An Equipment identity may categorize a set of Equipment items, Component items, Port items, or Locations, but an Equipment identity cannot categorize items belonging to more than one of these classes simultaneously.

- Identifier

A code that uniquely identifies a type of manufactured telecommunications network equipment or an assignable entity within a type of equipment. This code is assigned on behalf of the manufacturer.

- Component item

An Equipment identity's subordinate Component item is a role of a Component item belonging to the Equipment identity. An Equipment identity may relate to several Component items, and one Component item may relate to only one Equipment identity.

- Equipment item

An Equipment identity's subordinate Equipment item is a role of an Equipment item belonging to the Equipment identity. An Equipment identity may relate to several equipment items, and one Equipment item may relate to only one Equipment identity.

- Location

An Equipment identity's subordinate Location is a role of a Location belonging to the Equipment identity. An Equipment identity may relate to several Locations, and one Location may relate to only one Equipment identity.

- Port item

An Equipment identity's subordinate Port item is a role of a Port item belonging to the Equipment identity. An Equipment identity may relate to several Port items, and one Port item may relate to only one Equipment identity.

Site relationship

A Site relationship is a combination of exactly two Cross-coupling sites. The two Cross-coupling sites may be different or the same. The last case is used in case of identification of internal Trails within a Cross-coupling site.

- Identifier

An Identifier of a Site relationship is an attribute group that uniquely identifies the Site relationship. The scope of the identification may be global in case of international Trails, which means that all fields are required to be filled in. The scope may be a Country in case of inter-operator Trails within that Country, which means that the two Country Codes may be left out. The scope may be the Operator in case of intra-operator Trails, which means that the two ICCs may be left out, and only the two Cross-coupling site Identifiers are filled in. This last case is outside the scope of this Recommendation.

- ▪ A-end

The A-end of the Identifier is an attribute group uniquely identifying the Site relationship's subordinate A-end site.

- ▪ ▪ Country Code

Country Code identifies (recursively superior) Country of the Site relationship's A-end site.

- ▪ ▪ ICC

ICC identifies the (superior) Operator of the Site relationship's A-end site.

- ▪ ▪ Site

Site contains the Identifier of the Cross-coupling site referenced by the Site relationship's A-end site.

- ▪ B-end
 - The B-end of the Identifier is uniquely identifying the Site relationship's subordinate B-end site.
- ▪ ▪ Country Code
 - Country Code identifies (recursively superior) Country of the Site relationship's B-end site.
- ▪ ▪ ICC
 - ICC identifies the (superior) Operator of the Site relationship's B-end site.
- ▪ ▪ Site
 - Site contains the Identifier of the Cross-coupling site referenced by the Site relationship's B-end site.
- A-end site
 - The A-end site is a role of the Cross-coupling site having the distinguished name that comes first in the alphabet. The distinguished name consists of Country Code, ICC and Cross-coupling site Identifier, in that sequence.
- B-end site
 - The B-end site is a role of the Cross-coupling site having the distinguished name that comes last in the alphabet. The distinguished name consists of Country Code, ICC and Cross-coupling site Identifier, in that sequence.
- Local identifier
 - The Local identifier of a Site relationship is an attribute group that uniquely identifies the Site relationship.
 - A Local identifier is specific to an Operator, country or region. Such use of Local identifiers would be subject to national regulation and/or bilateral agreement between Operators, as stated in ITU-T Rec. M.1400.
 - Aliases of Cross-coupling site Identifiers are not permitted for communication between Operators of different Countries. However, Operators may exchange Local identifiers that are local to a specific Operator, country or region.
- ▪ A-end
 - The A-end of the Local identifier uniquely identifies the Site relationship's subordinate A-end site, using its Local identifier.
- ▪ B-end
 - The B-end of the Local identifier uniquely identifies the Site relationship's subordinate B-end site, using its Local identifier.
- Physical link
 - A Physical link represents a set of parallel physical transport resources between two Cross-coupling sites. The physical transport resources are called Physical link connections. All Physical link connections in a Physical link shall be routed in the same cable branches. A cable branch connects either two Cross-coupling sites or two junctions where the pairs of the cable branch are split into pairs of cable branches leading to two or more different Cross-coupling sites. Cable branches represent one layer of the physical network, and Physical links represent the layer at which resources are allocated to route Trails of multiplex groups or other usages.
 - A Physical link is terminated in exactly two Cross-coupling sites, which allow for termination of or cross-couplings between Physical link connections. A Physical link cannot terminate in a junction that requires construction work to provide the couplings.

Note that attributes of physical resources are different from attributes of logical resources and trail notions.

- ▪ Identifier

The Identifier of a Physical link uniquely identifies the Physical link within the Site relationship. Note that Physical links are identified independently from Trail Identifiers within the same Site relationship. This allows cable and radio resources to be identified independently from Trails and the concerns of customers in the use of Trail Identifiers.

- ▪ Physical link connection

A Physical link connection represents a physical resource between two Cross-coupling sites and can be allocated to a single Trail. The resource may represent a single fibre, a pair, a set of two pairs or other, which is planned to be used as a section of a Trail.

- ▪ ▪ Identifier

The Identifier of a Physical link connection uniquely identifies the Physical link connection within the Physical link. The syntax of the Identifier may indicate that it represents a single branch (e.g., 3a), a pair (3), a set of two pairs (3-) or other.

- ▪ ▪ Position

A Physical link connection's subordinate Position is a role of a Position on which the Physical link connection is terminated.

- ▪ ▪ Trail section

A Physical link connection's subordinate Trail section is a role of a Trail section in a Trail.

- Trail

A Trail provides a transport of signals between two Cross-coupling sites. The Cross-coupling site Positions may be located in Cross-coupling sites within different Countries, by different Operators, the same Operator, or within one and the same Cross-coupling site – in case of internal Trails. Also, the Trail may be terminated at the customer premises, i.e., outside the Cross-coupling site. Trails being terminated by the same Operator are outside the scope of this Recommendation.

The Trail may be routed via several connected Cross-coupling sites. The routing and involved cross-couplings of the Trail are established on a semi-permanent basis based on a coupling order. However, switching to alternate Trails may be provided dynamically.

A Trail may be routed on other Trails, e.g., each Operator may define a separate Trail Identifier for the routing within its domain, while a common inter-operator Trail is defined for the total routing. Also, the detailed routing within a Cross-coupling site may be defined in a separate internal Trail.

A Trail may be involved as a part of a multipoint Trail, e.g., a ring. In this case, no Trail should be defined to pass the branching points. However, Trails routed on subordinate Trail multiplex channels may be routed through the branching points.

The Trail may be established as a means to configure the Operator's network or be established to provide a service or product to a customer.

The Trail may provide:

- a transmission system functionality, e.g., a coax system between two pieces of line termination equipments;
- a multiplex group capacity, e.g., an SDH link;
- a reserve functionality, e.g., an alternate routing for a multiplex group;
- a traffic capacity, e.g., for routing of traffic between two (neighbouring) Exchanges;

- a user functionality, e.g., a leased line between two customers.

Note that Trails are semi-permanent, which means that Trails do not comprise temporary dialled circuits, which directs traffic over a series of Trails. Also, Trails are not permanent cable resources between two (neighbouring) junction boxes. Dialled circuits are switched dynamically, and cable resources are installed permanently. Dialled circuits are established on the basis of a call attempt per call, per file transfer or per packet and are not established based on a coupling order. Cable resources are established based on construction plans and not on coupling orders.

- Identifier

The Identifier of a Trail uniquely identifies the Trail within the Site relationship.

Note that the Identifier of the Trail's superior Site relationship is independent of the identifiers of the Exchanges, Locations or Equipments in which the Trail is terminated.

Note also that the Identifier of the superior Site relationship is independent of traffic or transmission direction of the Trail.

- Local identifier

An identifier of a Trail that is unique within an Operator, having up to 26 alphabetic and/or numeric characters. A Local identifier is specific to an Operator, country or region. Such use of Local identifiers would be subject to national regulation and/or bilateral agreement between Operators, as stated in ITU-T Rec. M.1400.

- Bandwidth

This attribute group defines the capacity of the medium.

- Maximum

This attribute group defines the maximum available capacity of the medium.

- Size

This attribute defines the Size of the Bandwidth as a multiple of the unit being given in the Unit attribute. This is a 5-character field of decimal digits adjusted to the right without leading zeros.

- Unit

This attribute defines the unit being used to give the Size of the Bandwidth. The Unit is given in an alphanumeric 4-character field and is adjusted to the left.

NOTE – This field must be provided if Size is provided, or Size may be a multiple of a default unit.

- Actual

This attribute group defines the actual capacity being allocated to the Trail.

- Size

This attribute defines the Size of the Actual bandwidth as a multiple of the unit being given in the Unit attribute. This is a 5-character field of decimal digits adjusted to the right without leading zeros.

- Unit

This attribute defines the unit being used to give the Size of the Actual bandwidth. The Unit is given in an alphanumeric 4-character field and is adjusted to the left.

NOTE – This field must be provided if Size is provided, or Size may be a multiple of a default unit.

- Signalling

This attribute indicates the signalling system or signalling type being used on the Trail.

The attribute is a 20-character alphanumeric field adjusted to the left. The permissible values are for further study.

- ▪ Urgency
Urgency defines priority of restoration and may define a deadline for the restoration.
- ▪ ▪ Priority
Priority defines priority classes for restoration. The field length is 1 character, and the permissible values are 1, 2 and 3, or the field may be left blank.
- ▪ ▪ Limit
Limit defines number of hours for the restoration to be completed. The hours are counted from the moment when the Limit is given. The field length is 2 decimal digits, with leading zeros, or the field may be left blank.
- ▪ ▪ Deadline
Deadline defines date and hour for completion of the restoration.
When transferred between time zones, the Deadline shall be given in standard GMT.
When communicating within a time zone, two operators may agree to use local time.
Each of the four fields is given by 2 decimal numbers with leading zeros. Either all fields are filled in or all are left blank.
The fields may be calculated automatically from Limit and entering time when entered, be transformed to GMT when transferred and recalculated to local time at the receiving end if the communicating users are made aware of this conversion.
The attribute has the substructure given below, and the fields may be separated by punctuation marks (.).
 - ▪ ▪ ▪ Date
 - ▪ ▪ ▪ ▪ Day
 - ▪ ▪ ▪ ▪ Month
 - ▪ ▪ ▪ ▪ Year
 - ▪ ▪ ▪ Time
 - ▪ ▪ ▪ ▪ Hour
- ▪ [Association](#)
A Trail's subordinate Association is a role of an Association. A Trail may be involved in several Associations.
- ▪ [Controller](#)
A Trail's subordinate Controller is a role of an Operator. A Trail may have several Controllers listed in falling priority. Note that Controller indicates responsibility for maintenance and not ownership.
- ▪ [Multipoint trail](#)
A Trail's subordinate Multipoint trail is a role of a Multipoint trail that is supported by the Trail.
- ▪ [Position](#)
A Trail's subordinate Position is a role of a Position that terminates the Trail.
- ▪ [Routing trail section](#)
A Trail's subordinate Routing trail section is a role of a Trail section in the routing of another Trail, which is routed on the current Trail.

- ▪ [Subordinate association](#)

A Trail's subordinate Subordinate association is a role of an Association. A Trail may have several Subordinate associations.
- ▪ Termination

A Trail's subordinate Termination indicates termination in a Cross-coupling site. A Trail will normally have two Terminations.
- ▪ ▪ Direction

A Termination's Direction indicates transmission direction of the Trail. The Direction can be S(ender), R(eceiver) or T(wo-way). If the Direction is S(ender), then the Direction of the other Termination is R(eceiver) and vice versa. If the D(irection) is T(wo-way), then the Direction of the other Termination is T(wo-way), as well.
- ▪ ▪ [Cross-coupling site](#)

A Termination's subordinate Cross-coupling site is a role of a Cross-coupling site. A Termination has just one Cross-coupling site, and a Cross-coupling site may have one or two Terminations for a Trail.
- ▪ Trail multiplex channel

A Trail may be split into several parallel Trail multiplex channels. The Trail multiplex channels in a Trail may have different capacities. All Trail multiplex channels in a Trail have the same routing, as the routing is assigned to Trails only, and not to Trail multiplex channels.

Each Trail multiplex channel is terminated in the same multiplex Equipment item as the superior Trail. The Trail may be terminated at the higher capacity side of the Equipment item, while the Trail multiplex channels are terminated at the lower capacity side. Also, Trail multiplex channels and Trails may be terminated at Connection termination points or Trail termination points inside the Equipment item, as may be the case in SDH network matrixes.

Trail multiplex channels may be implemented by different technologies, like frequency multiplexing, pulse code multiplexing, etc.
- ▪ ▪ Number

Trail multiplex channels are numbered within their superior Trail.

Note that this naming scheme is different from naming of linkConnections within links within layerNetworkDomains. However, the scheme does not prohibit definition of a Trail for each link, as long as all linkConnections have the same routing.
- ▪ ▪ [Position](#)

A Trail multiplex channel's subordinate Position is a role of a Position on which the Trail multiplex channel is terminated.
- ▪ ▪ [Trail section](#)

A Trail multiplex channel's subordinate Trail section is a role of a Trail section in the routing of the Trail.
- ▪ Trail section

A Trail section is any element that makes up the routing of a Trail.

Normally, Trail sections are connected in series to define the routing.

However, Trail section may also define parallel elements.

Example of a two-pair circuit: The Trail is defined as a series of Trail sections, each of these Trail sections is split in two parallel Trail sections, representing individual cable pair.

Example of diverse routing of a two-pair circuit: The Trail is split in two parallel Trail sections representing a circuit pair, each Trail section is defined as a series of Trail sections, representing individual cable pairs. A more comprehensive registration can be obtained by letting the two parallel Trail sections represent one individual Trail each, with separate Identifiers, each of these Trails is defined as a series of Trail sections, representing individual cable pairs.

There is no defined hierarchy between Trail sections by containment or references. However, the subordinate Trail sections are immediately following their superior Trail section, and information in each Trail section indicates if they represent an individual fibre, a pair, or a set of pairs.

Users may do both selection and projection of Trail sections within a Trail. Selection means that only Trail sections within a geographical area may be listed. Projection means that only Trail sections connecting different Cross-coupling sites may be listed, etc.

- ▪ ▪ Identifier
 - A Trail section may have an Identifier that uniquely identifies the Trail section within the Trail.
- ▪ ▪ [*Physical link connection*](#)
 - A Trail section's subordinate Physical link connection is a role of a Physical link connection that is included in the routing of the Trail.
- ▪ ▪ [*Port item*](#)
 - A Trail section's subordinate Port item is a role of a Port item that is included in the routing of the Trail.
- ▪ ▪ [*Position*](#)
 - A Trail section's subordinate Position is a role of a Position that is included in the routing of the Trail.
- ▪ ▪ [*Trail*](#)
 - A Trail section's subordinate Trail is a role of a Trail that is included in the routing of the Trail.
- ▪ ▪ [*Trail multiplex channel*](#)
 - A Trail section's subordinate Trail multiplex channel is a role of a Trail multiplex channel that is included in the routing of the Trail.

7 Appendices

This Recommendation contains four appendices containing additional information, and a bibliography. Appendix I contains procedures for registration of ICCs on the basis of information provided by national authorities. Appendix II contains some notes on work for further study. Appendix III presents notions of the formalism used in this Recommendation for the specification of end-user terminology. Appendix IV provides an example transit network registration.

Appendix I

Registration of ICCs

I.1 Introduction

There are two procedures for registering ICCs:

- ITU ICC procedure;
- Distributed ICC web.

I.2 ITU ICC procedure

ICCs are registered by ITU-TSB. Instead of individual Operators sending their ICCs to the TSB for registration, the national regulatory authorities are requested to provide the validated codes and related information of domestic Operators directly to the ITU-TSB.

NOTE – ITU-TSB is the International Telecommunication Union – Telecommunication Standardization Bureau.

The national authority in each Country is requested to:

- collect the filled-in form from each Operator in that Country;
- ensure that the ICCs are unique within that Country;
- ensure that all information on the ICC Notification Form is provided; and
- to submit the information to the TSB Director.

The national authority should inform operators in that Country on the need of using the ICCs for designations to be used in inter-operator communication.

The national authority should collect and submit the required information whenever new Operators appear in that Country. Incremental changes to the information on operators in each Country should be reviewed and submitted to the TSB at least once a year.

Only in case that the national authority cannot take the described responsibility may the Operator itself contact the TSB directly to obtain an ICC. The TSB will reject applications for ICCs which are already in use in that Country.

Information on the *ICCs* in use together with the contact information will be found on the ITU web at www.itu.int/ITU-T/inr/icc/index.html.

I.3 Distributed ICC web

Administrations may choose to maintain their own website and be referenced from the central ITU ICC website. The central ITU ICC website together with referenced websites from the central ITU ICC website is referred to as the ITU distributed ICC web. Note that only Administration's websites or websites established on behalf of Administrations can be incorporated into the ITU-distributed ICC web. One organization, e.g., NECA, may manage local ICC websites for several Administrations.

NOTE – NECA is the National Exchange Carrier Association, Inc. in North America.

The central ITU ICC website may include a page for ICC information, having one entry for each country. Each entry may have a reference to a local ICC website containing the appropriate information about ICCs in that country. Some Administrations may ask the TSB to maintain their list of ICCs at the central ITU ICC website, while others may choose to establish their own website, e.g., through NECA.

Administrations that choose to incorporate a website into the ITU-distributed ICC web shall fill in a form that remains to be created by the TSB and return it to the TSB.

The local ICC website to be referenced shall in a direct way provide:

- 1) the same kind of information as on the central ITU ICC website, as provided through TSB Circular 253;
- 2) name of country and country code for that country;
- 3) name of Administration and address of this Administration;
- 4) name of organization providing the local ICC website and contact address to a person responsible for the local ICC website;
- 5) reference to the central ITU ICC website.

It should be noted that ICCs can be assigned both to ITU-T and non-ITU-T members, and the referenced local ICC website may contain ICCs of operators of both kinds.

All local ICC websites should be accessible free of charge. It is up to each Administration to charge operators for being registered and for the ITU-T to charge Administrations for registration of references to their local website or operator information maintained on behalf of that Administration. One method of cost recovery is for assessing an annual fee to each operator for maintaining and updating the operator's data in the registry.

Each local ICC website page may contain references to information on other pages that is not publicly available or free of charge.

The local ICC website page must support the same data formats as on the central ITU ICC website page, but may provide more restricted variants of these formats, e.g., shorter field lengths, restrictions on character sets, etc.

The local ICC website page(s) should not contain additional information that makes it difficult to select the same kind of information as on the central ITU ICC website pages.

The local website pages(s) shall in particular not provide advertising information, but can provide simple logos and names that refer to other websites that have such information.

The local website page(s) may use other layouts than that of the central ITU ICC website, but organizations are encouraged to use the central ITU ICC website pages as a model for their design.

Registration procedures for each local ITU ICC website may be developed by each Administration.

Appendix II

Remarks

Decomposition of Address information is for further study.

Definition and identification of ring is for further study.

Mappings to TMN are for further study.

Definition and explanation of architecture, notations and methods are for further study.

The physical cable network may contain additional object classes that are not used for routing purposes, e.g.:

- Junction, which is a site that is used for cable splitting (splice junction), cable junctions, regenerators, repeaters, etc. Junctions require construction work and do not allow for cross-couplings. Cross-coupling is restricted to Cross-coupling sites;
- Cable section, connecting two adjacent junctions;

- Cable series providing a series of one or more Cable sections;
- Cable branch, between two junctions where the cable is split in two or more Cable branches leading to different Cross-coupling sites; thus, a Cable branch may contain Cable series both in sequence and in parallel;
- Multipoint physical link, containing all Cable branches which can be reached by passing junctions without crossing Cross-coupling sites;
- Cable section connection, a fibre or pair of parallel physical resources within the Cable section;
- Cable series connection, a series of Cable section connections;
- Cable branch connection, a fibre or pair of parallel physical resources within Cable branch; a series of Cable branch connections makes up a Physical link connection; a Cable branch connection is a series of Cable series connections;
- Multipoint physical link connection; a set of connected Cable branch connections having three or more endpoints.

In addition to the above, comes a set of object classes to define sites, manholes, ducts, cable beds, placements, geography, distances, etc.

Note that Logical links are not provided. Trail is used as a substitute, as this allows routing of the entire Trail and does not require routing of each of its individual channels.

Note that Links in TMN are identified locally to layer network domain, while Physical link is here identified locally to Site relationship. The same goes for Trails.

Note that hierarchical recursive decomposition of circuit packs is not provided; only hierarchical recursive decomposition of Locations is supported.

Note that this Recommendation addresses the physical equipment and not the contained network elements and their internal Connection termination points and Trail termination points, which are the focus of network element management in TMN.

Termination of Physical link, e.g., with assignment of direction within the access network, is for further study.

Termination of Trail in Exchanges and assignment of traffic direction is for further study.

This Recommendation covers routing on Equipment within Sites; customer equipment at the customer premises is not covered.

This Recommendation treats physical resources within the Operator's network; products as sold to the customer are not covered.

Attributes of Trail sections are for further study.

Treatment of cross-couplings as individual Trail sections is for further study.

Subclasses of Trail sections are for further study.

External transmission media, clouds or sub-networks that are used to represent incomplete routing, informal routing or routing outside the scope of the current listing are not provided.

Multipoint Physical links, multipoint physical link connections, multipoint trail multiplex channels and rings are not provided.

In a Multipoint trail, a distinction can be made between Trail branches, connecting two branching points and/or end-points, and Trails, between endpoints only. If this distinction is made, then some Trails will be routed on the same resources, i.e., there will be several Trail sections for a given resource. A discussion on the needs of this distinction should be undertaken before the scope of the Recommendation is expanded on this point.

Use is for further study.

Transmission medium information is for further study.

Also, other attributes are for further study.

Local identifier of Cross-coupling site is introduced to allow mappings to North American T1 standards¹ and other regional or national standards.

Appendix III

Data-oriented human-machine interface specification technique – Formalism

III.1 Introduction

This appendix presents notions for the specification of end-user terminology and grammar of an application area. This specification may be provided in a separate External Terminology Schema. This schema provides a sub-layer of the Application Schema of a computer application system. See ITU-T Recs M.3300, Z.351 and Z.352.

In the end-user terminology, both class and instance data labels may be local to other data labels. This provides data management and definitions within contexts.

Also, both classes and instances may use significant duplicates within ordered lists; hence, strict naming may not be required. See the description of Identifiers under the Attributes clause.

End-users may request access to both class and instance data; hence, a homomorphic mapping from instances to classes is required to allow easy navigation between these. See the Schema-Population References section.

Finally, this appendix introduces the syntax of the formalism and does not emphasize modelling/semantics; however, a means for stating Denotation mappings is provided. See the Denotations clause.

III.2 Scope

The area of interest is the communication between end users, human-computer designers, implementers and computers about the terminology and grammar of data at the human-computer interface. The objects of communication are the terminology and grammar of both class data, such as headings, and instance data, such as values, at the human-computer interface.

This appendix focuses on specification of data that appear in forms and graphics, and does not target natural language and stream interfaces. Hence, this appendix provides key notions for the specification of human-computer interfaces to Operation Support Systems (OSSs).

III.3 References

- [1] ITU-T Recommendation Z.351 (1993), *Data oriented human-machine interface specification technique – Introduction*.
- [2] ITU-T Recommendation Z.352 (1993), *Data oriented human-machine interface specification technique – Scope, approach and reference model*.

¹ T1 standards are maintained since November 2003 by ATIS.

III.4 General

Data are arranged in a data tree, with references between the nodes in the tree.

The data nodes may be categorized as Objects, References, Attribute groups, Attributes or Values. This categorization is permitted for the convenience of the designers and users of the specification. The categorization depends on the specification designer's understanding of the application area.

However, once a choice has been made, this can have implications for the further choices.

Schema nodes are introduced to prescribe the form and behaviour of data in its Population node(s). A Schema is considered to contain the rules of the instantiated data found in the corresponding Population. The data in the Schema are referred to as classes relative to their instances in the Population. The Schema data are also collectively called specifications relative to the Population data.

Functions are introduced to further express constraints on and derivations of data. Schema-Population references are introduced to enforce constraints and derivations on instance data.

III.5 Objects

An Object class can either be the root of the data tree in a Schema or be immediately subordinate to some other Object class in the Schema. All instantiated data of an Object class are Object instances. Every Object instance is of one Object class only.

Both Object classes and Object instances are called Objects. If something is an Object, then its superior node in the data tree is an Object, as well. This implies that every recursively superior node of an Object is an Object.

III.6 References

The existence of a subordinate Object *x* of some Object *y* may be made dependent on the existence of another Object *z*. This other Object *z* is called a Referenced object of the Object *y*. The Object *x* providing the reference can be considered a Role of the Referenced object *z*. The Object *x* can be considered a Reference object, or just a reference, of its superior Object *y*.

Often references are made two-way, such that Object *z* has a subordinate Object *u*, which refers back to Object *y*.

III.7 Attributes

Subordinate data nodes to Object classes and which are not themselves Object classes are Attribute group classes or Attribute classes.

An Attribute group class is subordinate to an Object class or another Attribute group class. An Attribute class is subordinate to an Object class or an Attribute group class.

All instantiated data of an Attribute group class are themselves Attribute groups. All instantiated data of an Attribute class are themselves Attributes. If their prescriptive role is not considered, Attribute group classes may be considered being Attribute groups, and Attribute classes may be considered being Attributes.

Attribute groups are used to collect Attributes that appear together.

Some of the Attribute groups and/or Attributes of an Object can be defined to be Identifier attributes. An Identifier uniquely identifies the Object within the scope of its superior Object.

Each of the alternative Identifiers of the Object together with the Identifiers of the recursively superior Objects uniquely identifies the Object uniquely within the Population. An Object may or may not have an Identifier.

III.8 Values

The data nodes which are subordinate to an Attribute class are Value classes. All instantiated data of Value classes are Values. If their prescriptive role is not considered, Value classes may be considered being Values. The notion of Value types is not considered in this text, but the Schema-Population references indicate how this can be provided. A Value may have recursively subordinate nodes, which provide the syntax of the Value.

Some Attributes may be Single valued, others may be Multi-valued.

III.9 Functions

Function classes may be subordinate to any node of the data tree. All instantiated nodes of a Function class are Functions. If their prescriptive role is not considered, Function classes may be considered being Functions.

Functions express constraints and derivations. Each Function takes one or several Inputs and provides one Output. The Function provides references to its Inputs and Output.

A Function cannot remember states from one invocation to the next. Functions may provide recursion.

Cardinality is a special case of a Function. Cardinality can be stated for each node in the data tree. The Cardinality for a class node states the minimum and maximum number of instances of the class relative to the superior instance node in the data tree. If no Cardinality is stated, then any number of instances is permitted.

III.10 Schema-Population references

A Schema is a data node containing subordinate nodes that prescribe the form and behaviour of data subordinate to the Population node. S is a Role of the Schema, and P is a Role of the Population. S and P are used to express schema-population references between two nodes, as no node is a Schema or Population in an absolute sense. Hence, S and P are reserved words, but Schema, Population and Class are not.

Any node y in the data tree may contain one or more particular nodes S, which each refers to another data node z. The recursively subordinate nodes of the other node z are considered to contain the classes of the Population node y.

The node z may contain one or more subordinate particular nodes P, each of which refers back to the node y. The recursively subordinate nodes of the node y are considered to contain the instances of the Population node y relative to the Schema node z.

Each instance in a Population is an instance of exactly one class in a Schema of that Population, and each class may have several instances in each of the Populations of its Schema.

The mapping from instances to classes is homomorphic, meaning that the mapping is many-to-one to classes in one particular Schema. For every instance there is exactly one corresponding class in a particular Schema. If two instances are connected in a particular way – by subordination or references – the corresponding classes are connected in the same way.

Schema references may be recursive. This means that a Schema may contain nodes that have S references to other nodes within or outside the scope of the Schema. Also, an S reference can be made to a superior node, implying that the instances may make up a tree of many levels.

Note that some classes may have no instances in some Populations of their Schemata.

Note that since a Population may have several Schemata, the class of a particular instance may be found in any of its recursively referenced Schemata.

III.11 Denotations

A data node is a term that may denote a phenomenon. The phenomena are considered to be inside some observer and hence be data themselves. An observer may be an individual or a collective of individuals.

Mappings between terms and their phenomena are stated by using source mappings, O. Synonymity mappings, Y, provide the reverse mappings from phenomena to terms.

The source mapping is stated by an O reference from a node y to a node z. The reference back from z to y is made by a Y reference.

The denotation mapping is isomorphic, meaning that it is one-to-one, and if two phenomena are connected in a particular way – by subordination or references – the corresponding terms are connected in the same way.

However, we accept that some data may not denote any phenomenon, and some phenomena may not have any notation. Therefore, this mapping is partial. For example, while a Value may denote a phenomenon, the "syntactical sugar" of the Value may denote no phenomenon.

Most often, denotation references are not stated; therefore, most data denote/model nothing in a formal way. Also, many data nodes are introduced to provide overview of other data nodes, and it may not be convenient to consider each node to denote something. The object class Site relationship (between Cross-coupling sites) may provide such an example; it provides both overview of other data and an identification scheme of other data, and it may denote no concrete phenomenon in the observed universe. This lack of denotation does not preclude that study of the observed universe is essential to the design of data for managing phenomena within this universe. But study of the management itself is also needed to provide an efficient design of data.

III.12 Documentation

The documentation of an application area shall contain:

- Application area – textual definition and delimitation;
- Application Schema Graph – using the graphical notation;
- Textual Documentation – using the textual notation;
- Remarks – on needs for further study, etc.

III.13 Graphical notation

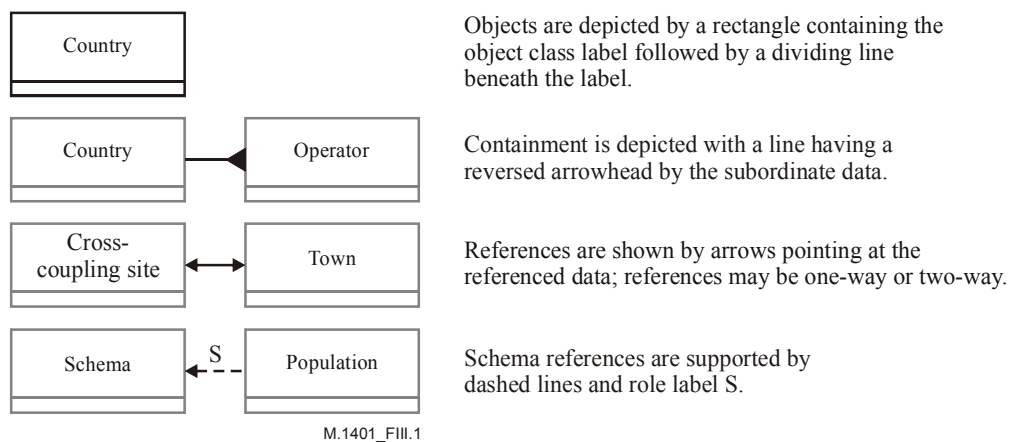


Figure III.1/M.1401 – Subset of graphical notation

III.14 Textual notation

Country

Natural language texts are indented.

- Name

Levels of the data tree are shown by indentations.

- Town

Object classes are underlined.

- ▪ Name

Attributes and other data have no underlining.

- ▪ *Site*

References are written with blue fonts and italics; the underlining indicates that the reference is an Object; the text tells how navigation is made to the referenced Object and indicates cardinalities.

- Operator

Figure III.2/M.1401 – Subset of textual notation

Appendix IV

Example transit network registration

IV.1 Example

The end-to-end trail in Figure IV.1 is routed via three Network Operators/Service Providers.

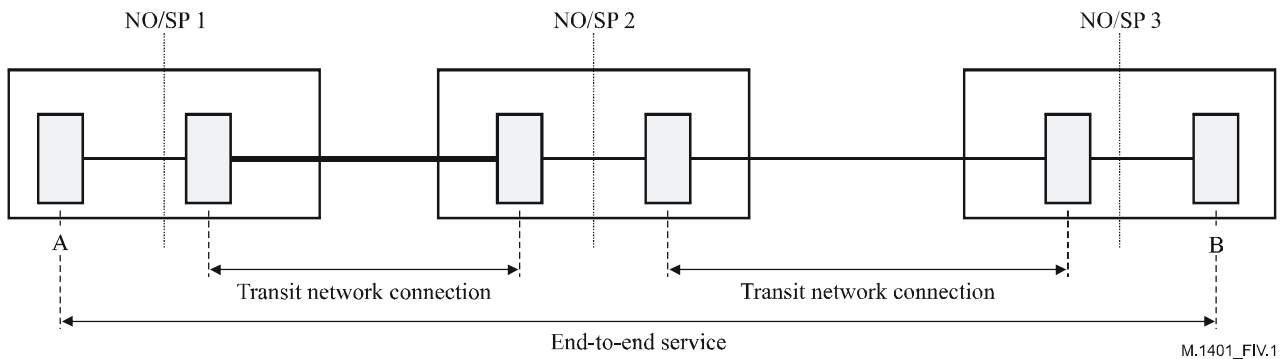


Figure IV.1/M.1401 – Transit network

IV.2 Representation

The network in Figure IV.1 may be represented as depicted in Figure IV.2.

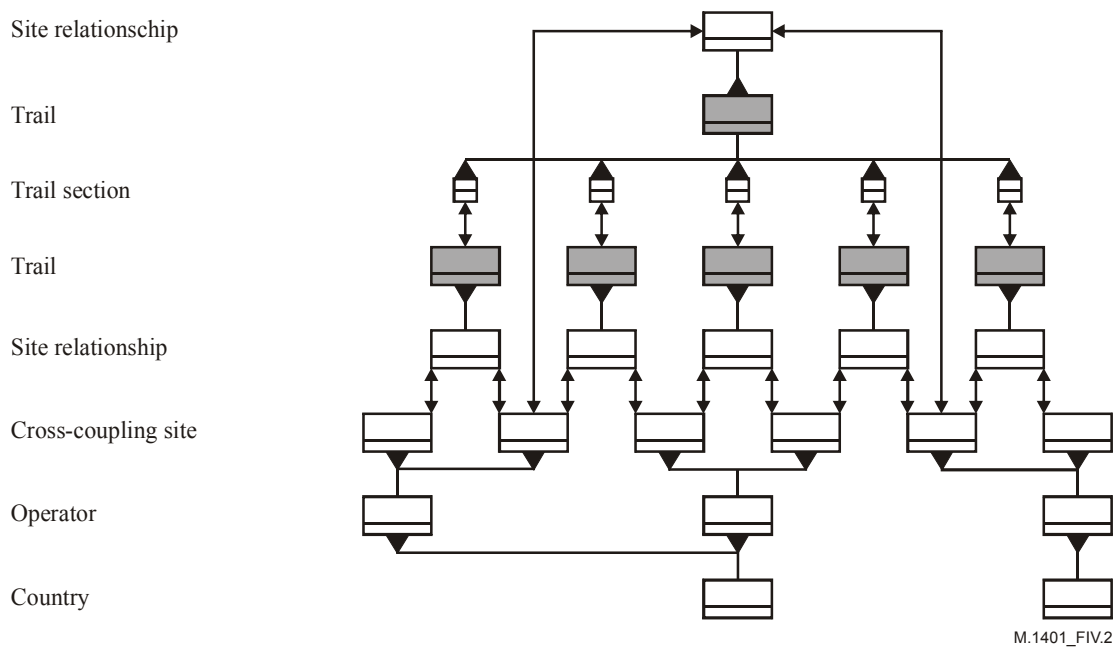


Figure IV.2/M.1401 – Population diagram

In this case, one Trail is routed on five other Trails. The Trails are indicated by shaded boxes.

Note that the end-to-end Trail has only a Site relationship to the main transmission centres (i.e., Cross-coupling node) of the terminating Operators, and not to the terminating junction boxes (i.e., Cross-coupling node) of these Operators.

Each Operator may only know parts of the routing. The routing known to the leftmost Operator is depicted in Figure IV.3.

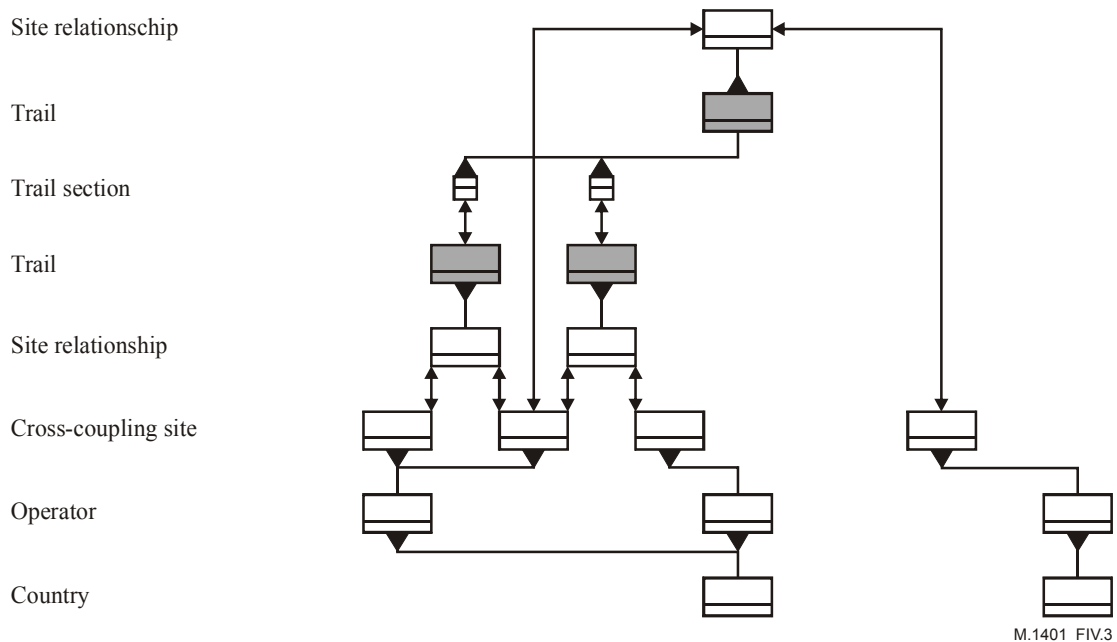


Figure IV.3/M.1401 – View of data

The identifiers of Figure IV.2 are shown in alphanumerical notation in Figure IV.4. Non-identifier attributes and references are not shown.

First, the Countries with their Operators and respective Cross-coupling sites are listed. Then come the Site relationships with their example Trails.

Note that the contents of the A-end and B-end Sites are only indicated informally in this Recommendation. In the example, their Identifiers with Town and Site detail are copied in.

The routing of the end-to-end Trail is indicated by Trail sections only, and not by references to their respective resources, which happen to be Trails, as well. However, these Trails are listed separately, in the appropriate sequence, under their Site relationships.

Figure IV.4/M.1401 – Data values in Example Population (*start*)

Country

- Name
 - ITALY
 - Code
 - ITA
 - Operator
 - ICC
 - WIND
 - Cross-coupling site
 - Identifier
 - Town
 - ROMA
 - Site detail
 - TAW-1
- Operator
 - ICC
 - TI
 - Cross-coupling site
 - Identifier
 - Town
 - MILANO
 - Site detail
 - MIL
 - Cross-coupling site
 - Identifier
 - Town
 - MILANO
 - Site detail
 - MIL-1

Country

- Name
 - FRANCE
- Code
 - FRA
- Operator
 - ICC
 - FRTE
 - Cross-coupling site
 - Identifier
 - Town
 - REIMS
 - Site detail
 - RE1
 - Cross-coupling site
 - Identifier
 - Town
 - REIMS
 - Site detail

REI-1

Site relationship

- Identifier
 - ▪ A-end
 - ▪ ▪ Country Code
 - FRA**
 - ▪ ▪ ICC
 - FRTE**
 - ▪ ▪ Site
 - ▪ ▪ ▪ Identifier
 - ▪ ▪ ▪ ▪ Town
 - REIMS**
 - ▪ ▪ ▪ ▪ Site detail
 - REI**
 - ▪ B-end
 - ▪ ▪ Country Code
 - ITA**
 - ▪ ▪ ICC
 - TI**
 - ▪ ▪ Site
 - ▪ ▪ ▪ Identifier
 - ▪ ▪ ▪ ▪ Town
 - ROMA**
 - ▪ ▪ ▪ ▪ Site detail
 - TAW**
 - Trail
 - ▪ Identifier
 - DC1**
 - ▪ Trail section
 - ▪ ▪ Identifier
 - 1
 - 2
 - 3
 - 4
 - 5

Site relationship

- Identifier
 - ▪ A-end
 - ▪ ▪ Country Code
 - ITA**
 - ▪ ▪ ICC
 - WIND**
 - ▪ ▪ Site
 - ▪ ▪ ▪ Identifier
 - ▪ ▪ ▪ ▪ Town
 - ROMA**
 - ▪ ▪ ▪ ▪ Site detail
 - TAW**
 - ▪ B-end
 - ▪ ▪ Country Code
 - ITA**
 - ▪ ▪ ICC
 - WIND**
 - ▪ ▪ Site
 - ▪ ▪ ▪ Identifier
 - ▪ ▪ ▪ ▪ Town
 - ROMA**
 - ▪ ▪ ▪ ▪ Site detail
 - TAW-1**
 - Trail
 - ▪ Identifier
 - DC1**

Site relationship

- Identifier
 - ▪ A-end
 - ▪ ▪ Country Code
 - ITA**
 - ▪ ▪ ICC
 - TI**
 - ▪ ▪ Site

- ▪ ▪ ▪ Identifier
- ▪ ▪ ▪ ▪ Town
- ▪ ▪ ▪ ▪ ▪ **MILANO**
- ▪ ▪ ▪ ▪ Site detail
- ▪ ▪ ▪ ▪ ▪ **MIL**
- ▪ B-end
- ▪ ▪ Country Code
- ▪ ▪ ▪ **ITA**
- ▪ ▪ ICC
- ▪ ▪ ▪ **WIND**
- ▪ ▪ Site
- ▪ ▪ ▪ Identifier
- ▪ ▪ ▪ ▪ Town
- ▪ ▪ ▪ ▪ ▪ **ROMA**
- ▪ ▪ ▪ ▪ Site detail
- ▪ ▪ ▪ ▪ ▪ **TAW**
- Trail
- ▪ Identifier
- ▪ ▪ **DC1**
- Site relationship
- Identifier
- ▪ A-end
- ▪ ▪ Country Code
- ▪ ▪ ▪ **ITA**
- ▪ ▪ ICC
- ▪ ▪ ▪ **TI**
- ▪ ▪ Site
- ▪ ▪ ▪ Identifier
- ▪ ▪ ▪ ▪ Town
- ▪ ▪ ▪ ▪ ▪ **MILANO**
- ▪ ▪ ▪ ▪ Site detail
- ▪ ▪ ▪ ▪ ▪ **MIL**
- ▪ B-end
- ▪ ▪ Country Code
- ▪ ▪ ▪ **ITA**
- ▪ ▪ ICC
- ▪ ▪ ▪ **TI**
- ▪ ▪ Site
- ▪ ▪ ▪ Identifier
- ▪ ▪ ▪ ▪ Town
- ▪ ▪ ▪ ▪ ▪ **MILANO**
- ▪ ▪ ▪ ▪ Site detail
- ▪ ▪ ▪ ▪ ▪ **MIL-1**
- Trail
- ▪ Identifier
- ▪ ▪ **DC1**
- Site relationship
- Identifier
- ▪ A-end
- ▪ ▪ Country Code
- ▪ ▪ ▪ **FRA**
- ▪ ▪ ICC
- ▪ ▪ ▪ **FRTE**
- ▪ ▪ Site
- ▪ ▪ ▪ Identifier
- ▪ ▪ ▪ ▪ Town
- ▪ ▪ ▪ ▪ ▪ **REIMS**
- ▪ ▪ ▪ ▪ Site detail
- ▪ ▪ ▪ ▪ ▪ **REI**
- ▪ B-end
- ▪ ▪ Country Code
- ▪ ▪ ▪ **ITA**
- ▪ ▪ ICC
- ▪ ▪ ▪ **TI**
- ▪ ▪ Site
- ▪ ▪ ▪ Identifier
- ▪ ▪ ▪ ▪ Town
- ▪ ▪ ▪ ▪ ▪ **MILANO**
- ▪ ▪ ▪ ▪ Site detail
- ▪ ▪ ▪ ▪ ▪ **MIL-1**

- Trail
- ▪ Identifier
 - **DC1**
- Site relationship
- Identifier
 - ▪ A-end
 - ▪ ▪ Country Code
 - **FRA**
 - ▪ ▪ ICC
 - **FRTE**
 - ▪ ▪ Site
 - ▪ ▪ ▪ Identifier
 - ▪ ▪ ▪ ▪ Town
 - **REIMS**
 - ▪ ▪ ▪ ▪ Site detail
 - **REI**
 - ▪ ▪ B-end
 - ▪ ▪ ▪ Country Code
 - **FRA**
 - ▪ ▪ ▪ ICC
 - **FRTE**
 - ▪ ▪ ▪ Site
 - ▪ ▪ ▪ ▪ Identifier
 - ▪ ▪ ▪ ▪ ▪ Town
 - **REIMS**
 - ▪ ▪ ▪ ▪ ▪ Site detail
 - **REI-1**
- Trail
- ▪ Identifier
 - **DC1**

Figure IV.4/M.1401 – Data values in Example Population (*end*)

If France Telecom were operating in Italy, this would require a separate ICC, which may or may not be identical to the identifier used within France, but different from other ICCs in Italy.

Note that the information within the Site relationship Identifiers are given in alphabetic sequence. In this example all Trails have the local Identifier DC1 within their respective Site relationship. The serial number 1 depends on what other Trails have been established within this Site relationship. The permissible Function codes, like DC, will be prescribed in the data type of the data class Trail Identifier; data types are not yet covered by this Recommendation.

BIBLIOGRAPHY

Attempts have been made to map M.1401 to other Recommendations and standards. Some compliance has been reached; however, no guarantee can be given as to full compliance between these standards.

Therefore, the following Recommendations and standards provide additional and not normative information to the provisions of this Recommendation.

- [1] ITU-T Recommendation G.853.1 (1999), *Common elements of the information viewpoint for the management of a transport network*.
- [2] ITU-T Recommendation M.3100 (2005), *Generic network information model*.
- [3] ANSI T1.251-2001 (Version 2), *Identification of Telecommunications Service Provider Codes for the North American Telecommunications System*.*
- [4] ANSI T1.253-1999, *Information Interchange – Code Description and Codes for the Identification of Location Entities for the North American Telecommunications System*.*
- [5] ATIS 0300007-2005, *Identification of Physical Network Resources*.
- [6] ETSI TS 102 209 V1.2.1 (2004-02), *Telecommunications and Internet converged Services and Protocols for Advancing Networks (TISPAN); Telecommunication Equipment Identification*.
- [7] ETSI TS 102 359 V1.1.1 (2004-10), *Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Equipment Information in the Management Information Base (MIB)*.

* T1 standards are maintained since November 2003 by ATIS.

SERIES OF ITU-T RECOMMENDATIONS

| | |
|-----------------|---|
| Series A | Organization of the work of ITU-T |
| Series D | General tariff principles |
| Series E | Overall network operation, telephone service, service operation and human factors |
| Series F | Non-telephone telecommunication services |
| Series G | Transmission systems and media, digital systems and networks |
| Series H | Audiovisual and multimedia systems |
| Series I | Integrated services digital network |
| Series J | Cable networks and transmission of television, sound programme and other multimedia signals |
| Series K | Protection against interference |
| Series L | Construction, installation and protection of cables and other elements of outside plant |
| Series M | Telecommunication management, including TMN and network maintenance |
| Series N | Maintenance: international sound programme and television transmission circuits |
| Series O | Specifications of measuring equipment |
| Series P | Telephone transmission quality, telephone installations, local line networks |
| Series Q | Switching and signalling |
| Series R | Telegraph transmission |
| Series S | Telegraph services terminal equipment |
| Series T | Terminals for telematic services |
| Series U | Telegraph switching |
| Series V | Data communication over the telephone network |
| Series X | Data networks, open system communications and security |
| Series Y | Global information infrastructure, Internet protocol aspects and next-generation networks |
| Series Z | Languages and general software aspects for telecommunication systems |