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# ITU-T

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SERIES L: CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

## Databases for optical access network infrastructure

ITU-T Recommendation L.72

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**Summary**

ITU-T Recommendation L.72 deals with the configuration and functions of databases for the optical access network infrastructure to be used in the design, maintenance, operation and administration of optical access networks.



**Source**

ITU-T Recommendation L.72 was approved on 8 January 2008 by ITU-T Study Group 6 (2005-2008) under the ITU-T Recommendation A.8 procedure.

## FOREWORD

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## Introduction

Progress on communication technologies has led to the active development of many kinds of broadband service such as voice, data and video communication using access networks. It is important to realize high-speed broadband networks to provide such services economically. In order to provide these services in a timely way, we must construct optical access networks. In addition, there will be a huge expansion of the optical access network infrastructure, including optical fibre and optical fibre cable, as the number of customers increases. Therefore, databases for the optical access network infrastructure for network design, maintenance, operation and administration is important and should be considered.

# ITU-T Recommendation L.72

## Databases for optical access network infrastructure

### 1 Scope

This Recommendation describes the configuration and functions of databases for the optical access network infrastructure to be used in the design, maintenance, operation and administration of optical access networks.

### 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 G.694.1] ITU-T Recommendation G.694.1 (2002), *Spectral grids for WDM applications: DWDM frequency grid*.

[ITU-T G.694.2] ITU-T Recommendation G.694.2 (2002), *Spectral grids for WDM applications: CWDM wavelength grid*.

[ITU-T G.983.1] ITU-T Recommendation G.983.1 (2005), *Broadband optical access systems based on Passive Optical Networks (PON).*

[ITU-T G.983.2] ITU-T Recommendation G.983.2 (2005), *ONT management and control interface specification for B-PON*.

[ITU-T G.983.3] ITU-T Recommendation G.983.3 (2001), *A broadband optical access system with increased service capability by wavelength allocation*.

[ITU-T G.983.4] ITU-T Recommendation G.983.4 (2001), *A broadband optical access system with increased service capability using dynamic bandwidth assignment*.

[ITU-T G.983.5] ITU-T Recommendation G.983.5 (2002), *A broadband optical access system with enhanced survivability*.

[ITU-T G.984.1] ITU-T Recommendation G.984.1 (2003), *Gigabit-capable Passive Optical Networks (G-PON): General characteristics*.

### 3 Terms and definitions

This Recommendation defines the following terms:

**3.1 cluster**: A system consisting of several servers that can take over a job or application from the other servers when trouble occurs.

**3.2 load balancer**: Equipment for the management and load distribution of an access request from outside that enables forwarding to another server.

## 4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

FTTB Fibre to the Building

FTTC Fibre to the Curb

FTTH Fibre to the Home

FTTx Fibre to the x (C: Curb, O: Office, B: Building, N: Node, P: Premises, H: Home)

ID Identification

LAN Local Area Network

OLT Optical Line Terminal

ONU Optical Network Unit

QR Quick Response

RFID Radio Frequency Identification

## 5 Database configuration

There will be a huge expansion of the optical access network infrastructure as the number of customers increases. Therefore, it is very important that the database for the optical access network infrastructure for FTTx, including outside plants (e.g., optical fibres, optical fibre cables, closures, manholes, poles) be used easily for the design, maintenance, operation and administration of access networks. Moreover, the database may include data for the physical and logical optical fibre line between OLTs and ONUs. The data for the database described in this Recommendation includes the above.

The database for access networks contains several kinds of data including those for maps and symbols indicating places and outside plant, respectively. There is some relation between these kinds of data and they should not be contradictory. Efficient operation cannot be achieved if each kind of data is managed individually. For example, if one kind of data is updated, all the linked data must be updated individually. Therefore, an integrated database should be constructed and all linked data should be updated simultaneously to reduce the maintenance and management of database operation.

When the access network database is designed and constructed, it should be systematized to operate stably as the managed data increase. When systematizing the database, the following main items should be considered:

1) Common data that are managed universally, such as the coordinate data on maps, should be separated from other data and managed efficiently to prevent overlapping data management.

2) Universal data, such as physical plant data, should not depend on changeable data that are provided for a plant's convenience such as plant name and plant number. Therefore, it is desirable for the universal data and changeable data to be separated and stored in different tables.

3) It is desirable for complementary data, which explain the main data, to be separated and stored in different tables.

## 6 Database functions

The following should be considered when a database for the optical access network infrastructure is constructed.

## 6.1 Basic functions

### 6.1.1 Database contents and structure

The database contents (e.g., data items, data format, data fields) and software should first be determined when a database for the optical access network infrastructure is designed based on the database requirements which are made taking into account the optical fibre network configuration (point-to-point network, ring network and/or point-to-multipoint network), optical system (e.g., CWDM, DWDM), maintenance method, etc.

In addition, it is necessary to link efficiently between many kinds of data without any contradictions in the database. Therefore, the database structure should be determined so that it links efficiently between many kinds of data without contradiction. For example, it should be possible to link efficiently without contradiction by using a database structure in which the outside plant for access networks are separated and managed in several layers.

### 6.1.2 Data input, deletion and updating

In general, the database should have data input, deletion, update, reference and retrieval functions. In addition, easy methods for input, deletion and update using, for example, QR cords and RFID tags should be considered.

The data should always be up-to-date. Therefore, a data maintenance procedure should be determined. Moreover, a data checking procedure or system will also be needed on the assumption that there will be data input errors.

In addition, the effective use of the existing database should be taken into consideration. For example, it should display a cable route visibly and easily on a map by using the existing digital map database such as the database for a car navigation system.

### 6.1.3 Network construction for database access

In order to access the database from different departments and input, delete, update and/or refer to data when the access network is designed, maintained and operated, it is necessary to construct a network for database access that connects between the database server and client terminal.

## 6.2 Reliability

It is important to improve the database reliability to reduce the time needed to link the access network to a customer and to ensure efficient network maintenance when the demand for optical access networks increases. The following items should be considered.

### 6.2.1 Reliability of the database system

The database system consists of servers, data storage and networks, client terminals, etc. The server load should be dispersed using a load balancer controlled by middleware, clusters, and/or multi-task systems. Moreover, two or more data storage systems should be used and each system should store the same data as a backup in case of damage. A network configuration such as a ring network should be selected for database access to improve reliability.

In addition, a system recovery procedure and system recovery target time should be determined for use when the database system experiences trouble.

### 6.2.2 Backup

To improve database reliability and to avoid interferring with the design, maintenance and operation when data are accidentally deleted and/or the hardware is broken, a data backup and recovery system should be provided.

### 6.3 Extension

There should be a function or data field that allows data to be added as required for the growing access network infrastructure and/or the upgrading of an optical access network when the required transmission capacity, transmission length and/or number of customers increase (e.g., change point-to-point network to PON) in the future.

### 6.4 Security

Those responsible for design, maintenance, operation and administration should be able to access the database easily, but unauthorized access should be prevented to avoid data draining or destruction. In particular, it is necessary to achieve sufficient database security when several people have access to the database using, for example, a LAN and/or the Internet, to prevent data draining or destruction as the result of illegal access and/or cyber terror.

In addition, it is important to provide virus protection for a database that is connected, for example, to a LAN or the Internet.

#### 6.4.1 Virus protection

It is necessary to protect against viruses using anti-virus software or a special closed network for a database that is not connected to a public network such as the Internet.

#### 6.4.2 Account management

It is necessary to access the database using an account. Moreover, the database should have addition, deletion and correction functions to keep the account updated.

#### 6.4.3 Log recording

The access and system log should be recorded to make it possible to investigate the cause and provide a countermeasure when serious trouble or an accident occurs.

### 6.5 Compatibility

The databases of different countries or telecommunication companies may not be compatible. This is because each database is used for the design, maintenance, operation and administration of optical access networks in individual telecommunication company or country. If necessary, the database contents should be determined so that they can negotiate with each other.

# Appendix I

## Japanese experience

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

### I.1 Database structure

It is necessary to link between many kinds of data in the database. Therefore, a database structure with several layers is employed in Japan to make it possible to link efficiently between many kinds of data without any contradictions. Figure I.1 and Table I.1 show an example of the database structure used in Japan. The features of the database structure are as follows:

– The database has five layers: figure, civil plant, cable, fibre and link.

– The information about the plant and of its joint or link are in the same layer.

– Plant accommodation information is on a different layer. This is because the information for plant in a lower layer accommodates that in a higher layer.

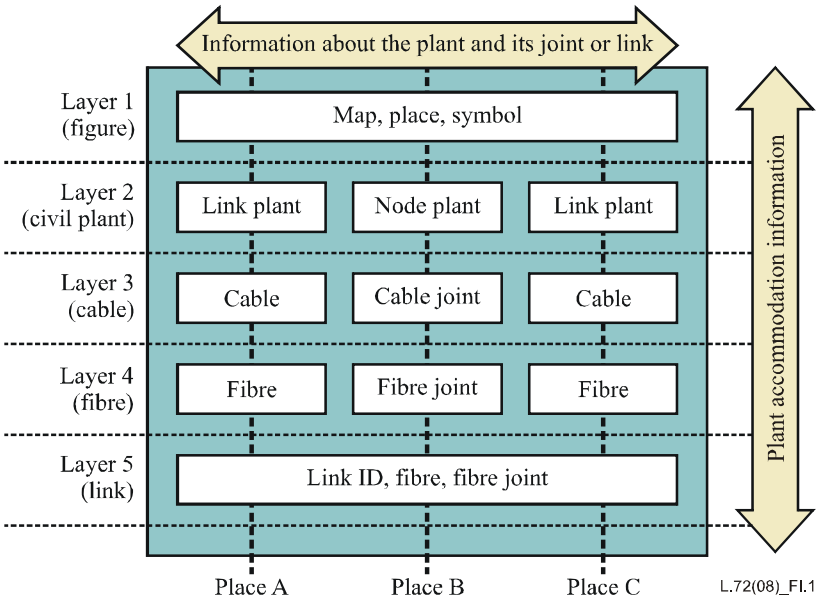



**Figure I.1 – Illustration of database structure with several layers**

**Table I.1 – Example of database structure with several layers**

| Layer | Data | Example of table | Notes |
|---|---|---|---|
| Figure | Symbol | | Symbol for the indicated outside plant |
| | Map | | Information about place, etc. |
| Civil plant | Node plant | Pole, manhole | Information (place, dimension, etc.) about node plant |
| | Link plant | Duct, conduit | Information about plant that connects node plants |
| Cable | Cable joint | Closure | Information about cable joint accommodation component |
| | Cable | Cable | Physical information about cable |
| Fibre | Fibre joint | Fibre joint | Physical information about fibre joint |
| | Fibre | Fibre | Physical information about fibre in cable |
| Link | Link ID | Link ID, fibre, fibre joint | Total fibre link information between OLT and ONU |

## I.2 When using a passive optical network (PON) system

In Japan, fibre to the home (FTTH) has grown rapidly in recent years. The number of FTTH subscribers exceeded 9.66 million by the end of June 2007. The PON system is mainly used for FTTH in Japan. This clause describes the database that is needed when using a PON system.

A PON system shares an optical fibre between several customers by using a (fibre-optic) branching component between an OLT and several ONUs as shown in Figure I.2. This makes information about the (fibre-optic) branching component important as regards the maintenance, operation and administration of a PON system. The database must contain the following information about the (fibre-optic) branching component:

– Information about the place where the (fibre-optic) branching component is set up
– Information about the accommodation component (e.g., closure) housing the (fibre-optic) branching component
– Information about the (fibre-optic) branching component
– Information about the service that can be provided using the (fibre-optic) branching component
– Information about the optical fibres, including the branched optical fibres, that are joined to the (fibre-optic) branching component
– Information about the (fibre-optic) branching component ports
– Information about the connection method used to join the fibres and the (fibre-optic) branching component

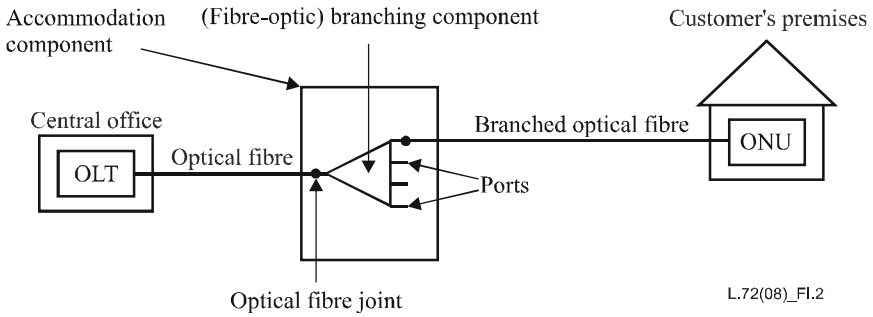



**Figure I.2 – PON configuration using (fibre-optic) branching components for outside plant**

With respect to the above requirements, there are two kinds of tables for (fibre-optic) branching components in the database: the (fibre-optic) branching component table and the (fibre-optic) branching component port table.

The (fibre-optic) branching component table found in layer 4 contains (fibre-optic) branching component data (e.g., accommodated outside plant data, joined fibre data) as shown in Table I.2. Moreover, the (fibre-optic) branching component port table found in layer 5 contains information about the (fibre-optic) branching component port (e.g., port number) as shown in Table I.3.

**Table I.2 – Example (fibre-optic) branching component table**

| No. | Column name | Notes |
|---|---|---|
| 1 | FACILITIES_NAME | Outside plant information about where the (fibre-optic) branching component is set up |
| 2 | FACILITIES_NUMBER | |
| 3 | SPLITTER_NUMBER | (Fibre-optic) branching component information |
| 4 | SPLITTER_TYPE | |
| 5 | SPLITTER_BRANCH_NUMBER | |
| 6 | SERVICE_TYPE | Service information<br>(e.g., service A, service B) |
| 7 | CABLE_NAME | Information about joined optical fibre |
| 8 | LOGICAL_FIBRE_NUMBER | |
| 9 | ACCOMMODATION_NUMBER | Accommodation component information |
| 10 | ACCOMMODATION_TYPE | |

**Table I.3 – Example (fibre-optic) branching component port table**

| No. | Column name | Notes |
|---|---|---|
| 1 | FACILITIES_NAME | Outside plant information about where the (fibre-optic) branching component is set up |
| 2 | FACILITIES_NUMBER | |
| 3 | FACILTY_TYPE | |
| 4 | SPLITTER_NUMBER | (Fibre-optic) branching component information |
| 5 | SPLITTER_PORT_NUMBER | |
| 6 | USE_CLASSIFICATION | Used, not used |
| 7 | SERVICE_DETAILS | Service information |

There is information about the method used to join fibre and a (fibre-optic) branching component in the optical fibre joint table. The branched optical fibre data are managed in the branched optical fibre table. In addition, information about the method for joining fibre, including joining branched optical fibre and a (fibre-optic) branching component port, is found in the branch optical link table. The relationship between the above tables is shown in Figure I.3.

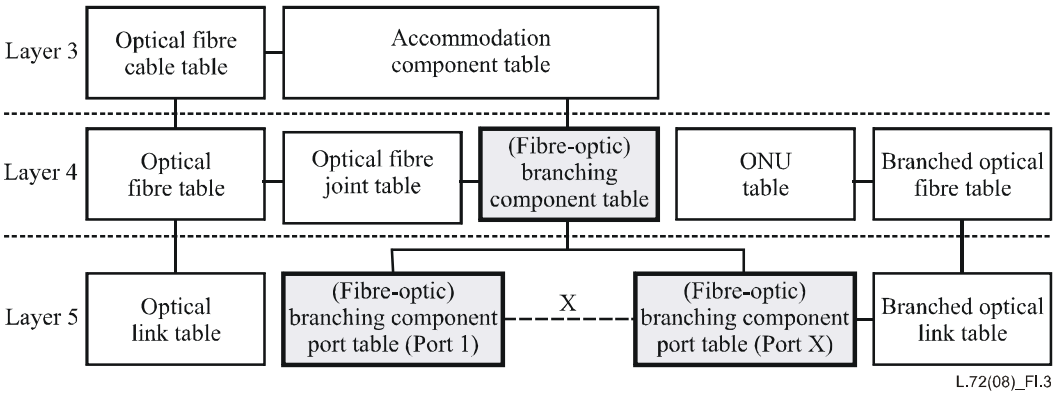
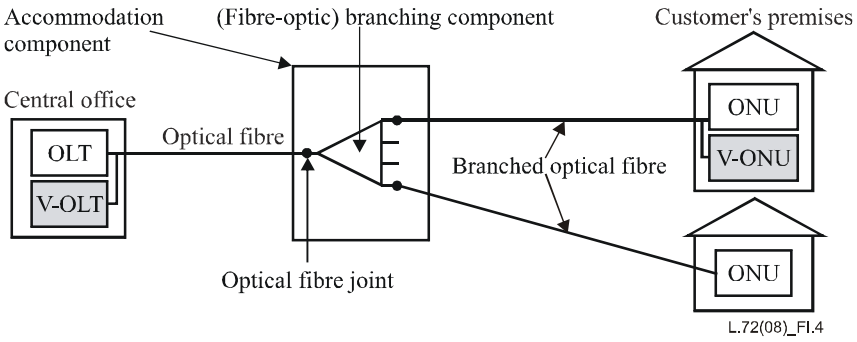



**Figure I.3 – Database structure for PON system**

In addition, wavelength division multiplexing (WDM) technology, which enables optical signals, such as voice, data and video optical signals at several different wavelengths to be transmitted through an optical fibre, is introduced into the optical access network system. Figure I.4 shows an example of an optical transmission system configuration using PON and WDM technologies. In this case, it is necessary to have the information about the (fibre-optic) branching component described below in addition to the above requirements.

- Information about whether or not the (fibre-optic) branching component that is connected to an OLT is using WDM technology.
- Information about whether or not the (fibre-optic) branching component port that is connected to an ONU is using WDM technology.
- Information about wavelength.




NOTE – Transmitted wavelength between OLT and ONU is 1.31 μm and transmitted wavelength between V-OLT and V-ONU is 1.552 μm and/or 1.558 μm.

**Figure I.4 – Optical transmission system configuration using PON and WDM technologies**

## I.3 When branching optical fibre cable

To respond flexibly to customer demand, the optical fibre cable is branched after initial cable installation as shown in Figures I.5 and I.6. This clause describes the addition of information to the database for optical fibre cable branching.

In this case, the required tables for each layer are produced to manage the branched optical fibre cable in the same way as the main optical fibre cable.

– The table for layer 3, which contains information about accommodation components (e.g., closures) is produced to manage the main and branched optical fibre cable joint data. Moreover, the optical fibre cable table that contains the optical fibre cable information is

also added to manage the branched optical fibre cable data. The optical fibre cable table contains columns that discriminate between the main and branched optical fibre cable as shown in Table I.4.

– The optical fibre joint table in Layer 4, which contains information about the optical fibre joint, is produced to manage the data regarding the optical fibre between the main and branched optical fibre cable as shown in Table I.5. Columns can be added to the optical fibre joint table according to the condition of the optical fibre joint.

– The optical link table in Layer 5, which has all the fibre link information, is produced to manage the total link information corresponding to the branched optical fibre cable.

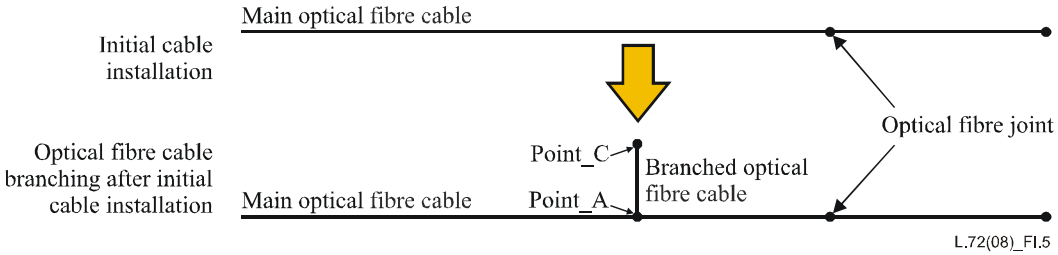



**Figure I.5 – Example of optical fibre cable branching after initial cable installation**

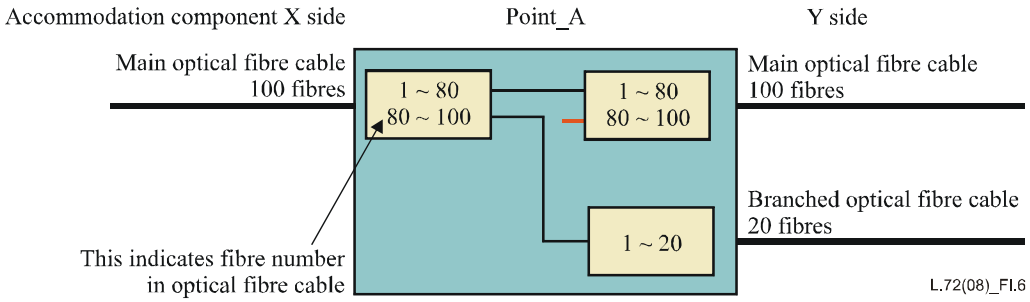



**Figure I.6 – Example of optical fibre joint (Point_A)**

**Table I.4 – Example of optical fibre cable table**

| No. | Column name | Notes |
|---|---|---|
| 1 | FACILITIES_NAME | Outside plant information about where an accommodation component is set up |
| 2 | FACILITIES_NUMBER | |
| 3 | CABLE_SERIAL_NUMBER | Cable number |
| 4 | WIRING_CONDITION | Main or branched |

**Table I.5 – Example optical fibre joint table**

| No. | Column name | Notes |
|---|---|---|
| 1 | FACILITIES_NAME | Outside plant information about where an accommodation component is set up |
| 2 | FACILITIES_NUMBER | |
| 3 | FACILITIES_NAME_X | Accommodation information about X side as shown in Figure I.6 |
| 4 | FACILITIES_ NUMBER_X | |
| 5 | SERIAL_NUMBER_X | Main optical fibre cable identification number |
| 6 | CORE_TERMINAL_X_START | Start and end joined fibre identification number in main optical fibre cable where terminals are joined to optical fibres in the branched optical fibre cable |
| 7 | CORE_TERMINAL_X_END | |
| 8 | FACILITIES_NAME_Y | Accommodation information about Y side as shown in Figure I.6 |
| 9 | FACILITIES_ NUMBER_Y | |
| 10 | SERIAL_NUMBER_Y | Branched optical fibre identification number |
| 11 | CORE_TERMINAL_Y_START | Start and end fibre identification number in branched optical fibre cable where terminals are joined to optical fibres in the main optical fibre cable |
| 12 | CORE_TERMINAL_Y_END | |
| 13 | METHOD_X | Fibre joint method of X and Y sides |
| 14 | METHOD_Y | |

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