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

Personal digital assistant requirements and relevant data structure for infrastructure and network elements management

ITU-T Recommendation L.69

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Summary

Telecommunication networks require a minimum of planned periodical maintenance to minimize out-of-service risk and to guarantee Service Level Agreement satisfaction. Especially with respect to optical fibre-based infrastructures, with the corresponding huge amount of information transmitted, the issue is even more critical. There could be many network elements that are subject to maintenance, differing in position, dimension, field work and scheduled times for periodic maintenance.

FOREWORD

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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.

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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

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Personal digital assistant requirements and relevant data structure for infrastructure and network elements management

1   Scope

This Recommendation deals with telecommunication networks maintenance support system. In particular, it points out requirements for personal digital assistant (PDA) equipment used in field activities and data structure for information storage. PDA supports operators for paperless data collection and automatic database upgrade.

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 L.64]   ITU-T Recommendation L.64 (2007), *ID tag requirements for infrastructure and network elements management.*

[IEC 60529]   IEC 60529 (2001), *Degrees of protection provided by enclosures (IP code).*

3   Definitions

None.

4   Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

GPRS   General Packet Radio Service

GPS   Global Positioning System

GSM   Global System for Mobile communications

ID   IDentification

IP   Ingress Protection

ISM   Industrial, Scientific, Medical

MMC   MultiMedia Card

OSS   Operations Support System

PDA   Personal Digital Assistant

QR   Quick Response

RFID   Radio Frequency Identification

5 Personal Digital Assistant (PDA)

A PDA is a handheld device used by an operator as support for in-field maintenance activities.

Along with typical equipment available in electronic devices with man-machine interface (e.g., keyboard, display, etc.), it is recommended that PDAs be equipped with a tag reader to read/write tags (RFID, barcode, QR, etc.). It is suggested that PDAs also be equipped with a positioning system receiver to acquire geographical position, and with a network interface to communicate with the OSS.

5.1 Logon

It is recommended that PDAs support logon based on username and password. All the procedures executed on a PDA are then associated with its operator in order to certify in-field activities and to have a person responsible for data structure content.

5.2 Tag reader

A tag reader is used to acquire the unique ID code associated to the tag.

Tag readers should easily read tags according to their position on the network element and to the minimum distance that can be achieved between tag and reader.

When tags are situated close together, the tag reader should be able to read data of multi tags one at a time (anti-collision function).

It is recommended that between reader and tag there be no materials that could negatively affect radio transmission at the frequency used for tag reading.

If the tag cannot be read or it has been removed from the network element, the PDA should support the communication of this problem by the operator to the OSS.

It is recommended that the tag reader be able to read and write to the tag memory, where available and allowed, in the same conditions as described above.

Each time the tag memory writing procedure is executed, it is recommended that this operation be automatically followed by a read operation in order to verify that the data was correctly written into the tag.

It is recommended that PDAs support a diagnostic test procedure to enable the operator to check that the tag reader is functioning properly.

It is recommended that tag readers be based on a standard technology for wireless communication.

5.3 Positioning system receiver

It is not mandatory but it is suggested that PDAs be equipped with a positioning system receiver.

Positioning system receivers are used to acquire geographical coordinates (latitude, longitude, altitude) of network elements in outside plants where such a service is available. It is recommended that this interface be able to determine the geographical coordinates with a precision (spatial resolution) satisfying the application requirements, even in difficult environmental conditions.

When small distances between items in the same site cannot be discriminated by the positioning system, it is suggested to use the same set of geographical coordinates for all these network elements (site coordinates).

In case of indoor applications, it is suggested to determine an outdoor position to be used as geographical coordinates for all the indoor network elements, or to define the entire site as an outside network element with geographical coordinates, where all the network elements are inside.

In case of failure in determining a geographical position, it is recommended that operators be warned so they can decide on how to proceed.

It is recommended that PDAs support a diagnostic test procedure to enable the operator to check that the positioning system receiver is functioning properly.

It is recommended that the positioning system receiver be based on a standard technology for wireless communication.

5.4 Network interface

It is not mandatory but it is suggested that PDAs be equipped with a network interface.

Network interfaces are used to exchange information with the OSS through a telecommunication network. It is recommended that PDAs communicate with the OSS in a client/server architecture where the PDA is the client.

The PDA can be used to send information to the OSS (e.g., to be stored in the database after maintenance activity) and to collect information from the OSS (e.g., to support before maintenance activity). If both downlink and uplink bandwidths are fundamental, it is suggested that the network interface support symmetrical connection.

Since network connectivity requirements can be different, depending on site position and network availability, it is recommended that PDAs support at least the communication interface that guarantees on average the best performances in terms of connection availability and bandwidth.

Connection availability and bandwidth define the delay between in-field maintenance activity and central database update.

PDAs can support multiple network interfaces to offer best solution according to site characteristic.

In case of communication failure, it is recommended that operators be immediately warned, so that they can decide on how to proceed.

It is recommended that PDAs support a diagnostic test procedure to enable the operator to check that the network interface is functioning properly.

It is recommended that network interfaces be based on a standard technology to communicate with the OSS.

5.5 Memory

It is recommended that PDAs be equipped with a rewritable non-volatile memory. Memory is used to store both the data that must be transferred to the OSS (upload) and the data that can be received from the OSS (download).

Memory should be able to store enough information so PDAs can work continuously from two consecutive download or upload procedures, according to scheduled in-field activities.

It is recommended that memory be able to store both the current running software and new software version in order to support secure software upgrades.

Before memory is completely full, it is recommended that operators be warned, so that they can decide on how to proceed. This may avoid information loss due to inability to save the data into the PDA.

Uploaded data can be deleted only when the OSS has confirmed that information has been received and stored in central database.

Memory can be embedded, detachable, or be a combination of both.

5.6 Software upgrade

Software upgrade on PDAs is necessary to guarantee an acceptable performance (e.g., bug fix and stability). It is suggested to use the supported network interface(s), where available, or a detachable memory device to download new software versions. It is recommended that the integrity of new software be checked before making the change definitive in the PDA, in particular if lossy links (e.g., a radio connection) is used to transfer the new software. It is recommended that downgrading software on PDA be blocked, or that the operator be warned.

In case of tag equipped with a non-volatile memory that has been previously written, it is recommended that new software version can still read and write tag memory.

In case of data structure extension, it is recommended that the new software version be able to manage previous data structures.

5.7 Power supply

PDAs support several electrical interfaces, and total power consumption depends on how much time these devices are switched on and remain active. It is recommended that power supplies be able to support PDAs working for all activities for at least one whole day.

It is recommended that PDAs support a function that enables the operator to monitor the battery residual charge.

Before the PDA's battery is completely exhausted, it is recommended that operators be warned, so that they can decide on how to proceed and thereby avoid information loss.

In heavy power-consuming conditions, it is suggested to have an alternative power supply solution (e.g., a spare battery pack or car charger).

Fast rechargeable battery packs with no memory effect are preferred to other types of batteries.

5.8 Case

It is recommended that PDA cases guarantee normal functioning during in-field activities in typical outside plants environmental conditions. The PDA case should have a degree of protection at least equal to IP54 [IEC 60529].

6 Data structure

A data structure is the set of information relevant for each network element. Typical data structures are divided into the following parts: site, native characteristics, installation characteristics, and maintenance report. Each part consists of data with specific meaning and use.

Values in data structure are entered in a PDA for the first time by its operator during the census phase. Census is the system start-up process where network elements are registered in the OSS database. Part of these values could be already written in the tag if the tag has an embedded non-volatile memory and has been supplied together with the network element.

Part of the data structure content for a network element changes every time maintenance activity takes place. Consequently, the central database content is also upgraded.

6.1 Site information

Site information of network elements defines their position in terms of location (e.g., geographical coordinates and addresses) and in terms of network hierarchal status (e.g., a site belonging to a certain network area).

It is recommended to enter, record and store site information in order to have a clear frame of the entire network hierarchy. Such information facilitates finding network elements on maps and in databases and can be used in the future to reach the site and then the network element.

6.2　Element characteristics

Element characteristics are typical of network elements as produced by the manufacturer (e.g., model, serial number, etc.). If the network element is supplied with a tag that embeds non-volatile memory, such information might already be stored in the tag.

It is recommended to enter, record and store network elements native information in order to make available in a database all data that can be mandatory or useful for future maintenance activities (such as substitution or repair).

6.3　Installation characteristics

Installation characteristics of network elements are defined when the installation takes place and takes into consideration external conditions (e.g., ground typology, such as where a telephonic pole is installed).

It is recommended to enter, record and store installation information of network elements in order to make available in a database all data that can be mandatory or useful for future maintenance activities (such as substitution or repair).

6.4　Maintenance report

The maintenance report is the set of information that describes the in-field maintenance executed, tests performed and their results.

It is recommended to enter, record and store maintenance report information in order to make available in a database all data that can be mandatory or useful for typical procedures in OSS (e.g., monitoring and analysis).

It is recommended to record and store information about the operator responsible for maintenance, and the times of the executed activities.

Appendix I

Italian experience regarding RFID tag solution for telephony poles

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

In Italy, RFID technology for maintenance support has been tested on poles used in the wireline access network throughout all the country, where the wooden poles represent the near totality of the poles used in this kind of network.

The first step was to trace the in-field maintenance actions and to collect more information on these items, in order to better understand the causes of poles turnover. On the one side, better knowledge of the pole network meant avoiding random and massive monitoring actions, better spare parts management and network planning. On the other side, information maintenance can be certified because the tag is on the pole and stores information about the latest actions (date, operator code, etc.).

Typical periodical maintenance requires checking all poles inside a network area. More than 40'000 poles have been checked in several networks areas spread across Italy.

PDAs used for this application (see Figure I.1) are equipped with a GPS receiver, a GPRS/GSM modem, a RFID tag reader and support an MMC memory card.

The RFID tag reader is compliant with ISO 14443 (proximity standard) and operates in the ISM band of 13.56 MHz. It is used to read and write ISO 14443 RFID tags fixed on poles.

The GPS receiver is a 12-channel receiver used to acquire geographical coordinates.

A GPRS/GSM modem is used to communicate with OSS.

The MMC memory card is a detachable support used to store data and software.

The data structure used for this application is shown in Table I.1

Figure I.1 – PDA

Table I.1 – Data structure for telephony poles

Site information	Geographical coordinates
	Network area
Element characteristics	Production year
	Material
	Length
	Capacity
Installation characteristics	Type
	Area
	Ground
	Presence of hanging strand
	Presence of any box
	Presence of grounding system
Maintenance report	State of conservation
	Result
	Maintenance actions
	Date
	Operator

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