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

Use of global navigation satellite systems to create a referenced network map

Recommendation ITU-T L.94

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Use of global navigation satellite systems to create a referenced network map

Summary

Recommendation ITU-T L.94 provides general implementation guidelines regarding the creation, operation and maintenance of the telecommunication network map by using the global navigation satellite system (GNSS) and geo-referenced systems. This Recommendation deals with potential information on outdoor infrastructures to be collected, the procedure for creating a geo-referenced map and the operation and maintenance of geo-referenced systems when the network infrastructure is updated.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T L.94	2015-01-13	15	11.1002/1000/12414

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

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

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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

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

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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, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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1 Scope

The purpose of this Recommendation is to provide general implementation guidelines regarding the creation, operation, and maintenance of the telecommunication network map by using global navigation satellite system (GNSS) and geo-referenced systems. This Recommendation deals with potential information on outdoor infrastructures to be collected, the procedure for creating a geo-referenced map, and the operation and maintenance of geo-referenced systems when the network infrastructure is updated.

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] Recommendation ITU-T L.64 (2012), *ID tag requirements for infrastructure and network elements management*.

[ITU-T L.69] Recommendation ITU-T L.69 (2007), *Personal digital assistant requirements and relevant data structure for infrastructure and network elements management*.

[ITU-T L.90] Recommendation ITU-T L.90 (2012), *Optical access network topologies for broadband services*.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 differential global navigation satellite system (DGNSS): Navigation system that derives differential location information by comparing traditional global navigation satellite system (GNSS)-based data to localized reference positions. It is a technology that provides better location accuracy than traditional GNSS, from 5-10 metres down to a few metres depending on the availability of line of sight satellite communications, to about 10 cm in case of the best implementations.

3.2.2 geo-referencing: The process of applying a coordinate system to a layer of data, in order to define its existence in physical space.

3.2.3 global navigation satellite system (GNSS): A system of satellites that provide autonomous geo-spatial positioning with global coverage. The global navigation satellite system (GNSS) receiver calculates its own position on earth. This positional information can be used in many applications such as mapping, surveying, navigation and mobile geographical information system (GIS).

3.2.4 WGS-84: The World Geodetic System – 1984 (WGS-84) coordinate system is a conventional terrestrial system (CTS), realized by modifying the Navy navigation satellite system (NNSS), Doppler Reference Frame (NSWC 9Z-2) in origin and scale, and rotating it to bring its reference meridian into coincidence with the International Time Bureau – defined zero meridian.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CAD Computer Aided Design

DGNSS Differential Global Navigation Satellite System

GIS Geographical Information System

GNSS Global Navigation Satellite System

ID Identification

PDA Personal Digital Assistant

WGS-84 World Geodetic System – 1984

5 Conventions

None.

6 Telecommunication outdoor infrastructure in a geo-referenced map

A geo-referenced map should be in digital format.

6.1 Information

The information of telecommunication outdoor infrastructure in a geo-referenced map depends on user requirements. Typical examples of information in telecommunication network geo-referenced maps are as follows:

- the cable routing and the type of infrastructure;
- the length of each section;
- the owner of each section;
- the status of infrastructure use, for example empty or occupied duct;
- the year of installation;
- the number of ducts;
- the dimensions of the duct, cable, optical closure and optical cabinet, etc.;
- the number and the type of cable inside the duct;
- distribution points (as described in [ITU-T L.90]).

6.2 Elements of the network

On the geo-referenced map, the following minimum network element should be visualized: central offices, poles, manholes, optical closures, optical cabinets, ducts and tunnels.

7 Software

Network maps should be visualized both in geographical information system (GIS) format for geographical view, and in a computer aided design (CAD) system, for schematic view.

8 Mobile device used in the field

The device used for collecting in-field data should be a mobile handheld device, compliant with [ITU-T L.69]. It is suggested that the mobile device has a screen with sufficient dimensions to see the map.

9 Global positioning system

In order to geo-reference the network elements, assign geographical coordinates, elevation, longitude and latitude, it is recommended to use a global navigation satellite system (GNSS) receiver.

However, a GNSS has a positioning accuracy of 5 to 10 metres, because there must be a relative line of sight between the GNSS antenna and at least four satellites. Objects, such as buildings, overpasses, and other obstructions, that shield the antenna from a satellite can potentially weaken a satellite's signal such that it becomes too difficult to ensure reliable positioning. These difficulties are particularly prevalent in urban areas. In order to have reliable positioning both in urban and in non-urban areas, with an error from 1 to 10 cm, it is recommended to use differential GNSS.

10 Maintenance of digital existing data

A geo-referenced map should show the users the position, the name and the status of the network element (such as new, old or to be changed) and additional information. Furthermore, a geo-referenced map should show the process of maintenance of the infrastructure components, scheduling times for periodic maintenance and the status of the maintenance action through a work flow system.

The status of the network elements should be upgraded when finishing a construction or repairing work and the mean time of update should depend on the network element type.

11 Procedure

The procedures for creating digital and geo-referenced cartography are different depending on whether or not the paper network maps exist.

If network maps exist in paper format, digital map should be created through CAD editing and it should be possible to import it in GIS.

If network maps of a specific zone do not exist, digital maps should be created through various steps. It is recommended to execute the following process at least:

- The survey process: People should collect data about network information through a PDA or mobile device with GNSS on board. In this way, the network component, its description, and coordinates are recorded in field and loaded in real time to the database;
- The back office process: During this step, the operator should access the district database, validate collecting data and transfer data on the final project;
- In order to collect data about buried infrastructure, georadar with GNSS (or differential global navigation satellite system (DGNSS)) should be used. Then all collected data should be loaded to the database.

All data, both edited with CAD and collected with mobile device and georadar machine should be visualized both in CAD and GIS and they should be created with the same geographical coordinate system, such as the international standard world geodetic system – 1984 (WGS-84).

It is recommended to collect and geo-reference data about all outdoor infrastructure components and buildings, such as central offices and customer premises where indoor elements, equipment, or optical distribution frames are installed.

12 Local and remote database

The geo-referenced system should be an appropriate application, such as a web-based system, in order to have a user-friendly interface. In terms of the local database, it should be possible to associate in-field information directly to the network element, recorded with an ID tag applied to it, as described in [ITU-T L.64].

Using the remote database, it should be possible to choose the central office area in order to visualize only the infrastructure of a specific zone and its component. Furthermore, it should be possible to select a layer of the network that contains a certain kind of information. For example, you could see only the telecommunication copper network or only empty ducts.

Appendix I

Italian experience regarding geo-referencing system

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

A solution has been developed and designed for asset management and collection of telecommunication infrastructure. The solution provides comprehensive support for inventory, management and maintenance of company assets, as well as procurement activities.

It gives the end user the ability to collect, analyse, display assets, locations and work orders in a geospatial perspective.

With the use of a mobile terminal, field technicians are able to work remotely and interact with business processes and data on the platform.

In a cloud environment and with the use of digital maps, it is possible to represent any type of network object, identify directly from the field, and update the central database for sharing data within other companies.

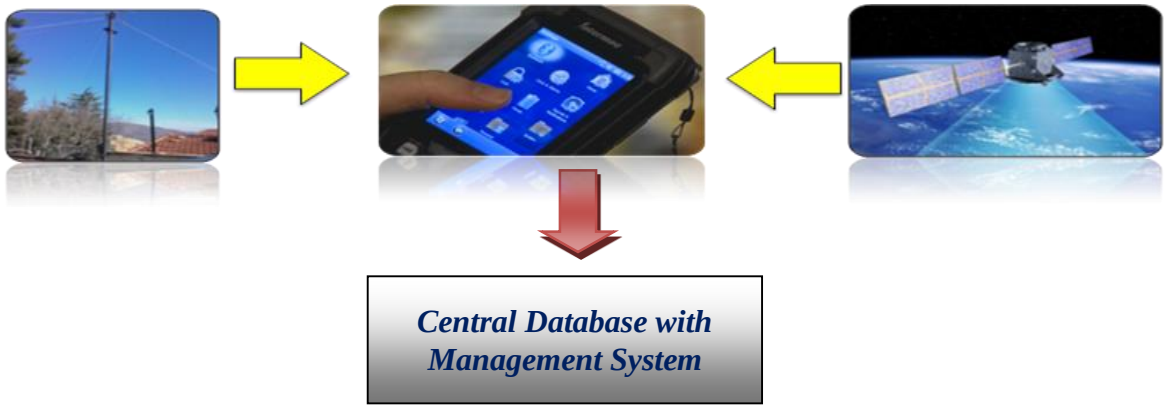

Figure I.1 – Collecting system

This proprietary platform is integrated with a workflow management and collaborative working platform for a better management of the life processes of infrastructure.

This platform is a software solution based on the SaaS paradigm (Software as a Service), reachable from any device with web access.

It also has a geospatial search engine that lets you view the results on a map. Advanced searches can be performed by filtering based on address, city, region, nation, or geospatial coordinates.

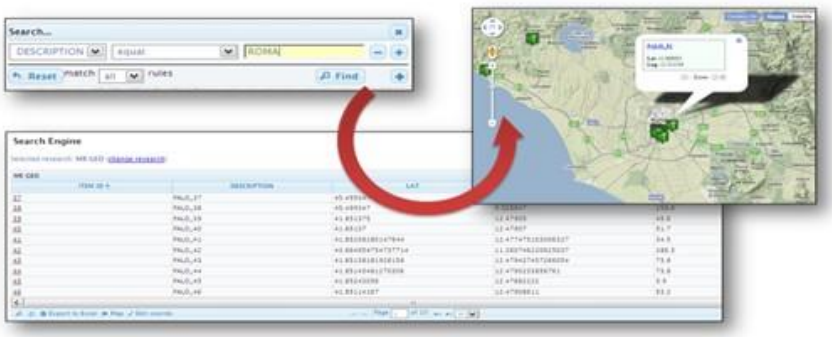

Figure I.2 – Browsing asset (Source: Google Maps)

Through this tool, the user can check online customer report parameters. The system allows configurable graphical representation of the data (pie, line, histogram, etc.) and it is possible to extract the results of the reports in different file formats.

Using the GNSS-enabled mobile terminal, it is possible to collect data of an asset and capture its GNSS position. Once the operation is completed, the device automatically sends the data to the cloud.

If it is necessary, the information digitalized from the field can be adjusted or integrated in a back office environment.

Figure I.3 – Editing asset on a map (Source: Google Maps)

In the Italian system, it is possible to import all types of geo-referenced data, such as the information about underground utilities, by georadar analysis, or existing cartography.

Figure I.4 – Data integration

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