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SERIES L: ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Use of ICT sites to support environmental sensing

Recommendation ITU-T L.1507

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ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

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Recommendation ITU-T L.1507

Use of ICT sites to support environmental sensing

Summary

Mitigating and adapting to climate change are global issues, and developing solutions to enable effective adaptation and early warning becomes important. One of the key aspects for developing the innovative solutions is the availability of highly stable environmental monitoring data. The meteorological organizations work on realizing the stable and fine grained collection of the global environmental conditions. To achieve this goal, it is necessary to deploy a large number of environmental sensing stations, which requires large amount of efforts. Information and communication technology (ICT) sites are good candidates to resolve such an issue due to their global distribution, reliable power, network communications, and maintenance as well as the availability of poles and towers to host various environmental sensors.

Recommendation ITU-T L.1507 presents a set of rules for installing the environmental sensing system on ICT sites to utilize the ICT sites as environmental sensing stations.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T L.1507	2019-07-14	5	11.1002/1000/13965

Keywords

Climate change, environmental sensing, ICT sites, weather monitoring.

* 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

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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.

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

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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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Use of ICT sites to support environmental sensing

1 Scope

This Recommendation focuses on collecting the environmental data utilizing ICT sites and infrastructure. It investigates the present challenges of the meteorological sector to improve the stable and fine grain sensing of environmental conditions. These challenges require an increased number of stable environmental sensing stations. This Recommendation presents a set of rules for installing the environmental sensing system on ICT sites in order to utilize the ICT sites as environmental sensing stations. This Recommendation covers the following:

– General architecture of environmental sensing system;

– Requirements for installing environmental sensing system on ICT sites;

– Deployment use cases.

2 Reference

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 standalone document, the status of a Recommendation.

[ITU-T L.1325] Recommendation ITU-T L.1325 (2016), *Green ICT solutions for telecom network facilities*.

[ETSI EN 300-132-1] ETSI EN 300-132-1 (2019), *Environmental Engineering (EE); Power supply interface at the input to Information and Communication Technology (ICT) equipment; Part 1: Alternating Current (AC)*.

[ETSI EN 300-132-2] ETSI EN 300-132-2 (2016), *Environmental Engineering (EE); Power supply interface at the input to telecommunications and datacom (ICT) equipment; Part 2: Operated by -48 V direct current (dc)*.

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

[IEC 60950-1] IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*.

[ISO 16818] ISO 16818:2008, *Building environment design – Energy efficiency – Terminology*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 infrastructure [ITU-T L.1325]: Equipment that supports the ICT equipment, e.g., power delivery components and cooling system components.

3.1.2 power [ISO 16818]: Rate at which energy is transmitted.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 environmental sensing: An action to sense environmental condition(s).

3.2.2 environmental condition: Metric used to monitor atmospheric conditions (e.g., wind speed, wind direction, air temperature, relative humidity, atmospheric pressure, precipitation).

3.2.3 environmental sensing station: A facility that has instruments and equipment for the monitoring of environmental conditions to provide information for weather forecasts.

3.2.4 environmental sensing system: A system that is installed in an ICT site and used to monitor environmental conditions (e.g., temperature, humidity, wind speed, precipitation, etc.).

3.2.5 ICT site: A radio base station that supports the installation of environmental sensing systems.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AC Alternating Current

DC Direct Current

EMC Electromagnetic Compatibility

ICT Information and Communication Technology

IP Ingress Protection

RBS Radio Base Stations

RBSN Regional Basic Synoptic Networks

5 Conventions

None.

6 Overview of challenges in meteorological sector

Climate change requires innovative solutions to enable effective adaptation and early warning. One of the main aspects contributing to the innovative solutions is the availability of highly stable weather monitoring data, as it constitutes the basis for reliable weather forecasting and proper alarm generation. The meteorological organizations, particularly the World Meteorological Organization (WMO) are struggling to collect such highly stable global weather monitoring data.

There are two main challenges in the metrological sector.

The first challenge is to steadily collect the data for global environment conditions as global environmental sensing is based on about 10,000 manned and automatic environmental sensing stations spread all over the world [b-WMO Observation]. It is fundamental that data are collected from all stations with no gap, otherwise the dependability of the weather forecasts for that area may be seriously flawed. Figure 1 gives the status of the SYNOP (surface SYNOPtic observations) reports collected from the regional basic synoptic networks (RBSN) of environmental sensing stations. It seems evident that some regions such as Africa, Latin America, and part of Oceania and Asia have a large portion of environmental sensing stations with low response rate or which are silent. Such lack of success in transmission is mainly due to the lack of local power, communication or maintenance of the environmental sensing stations.

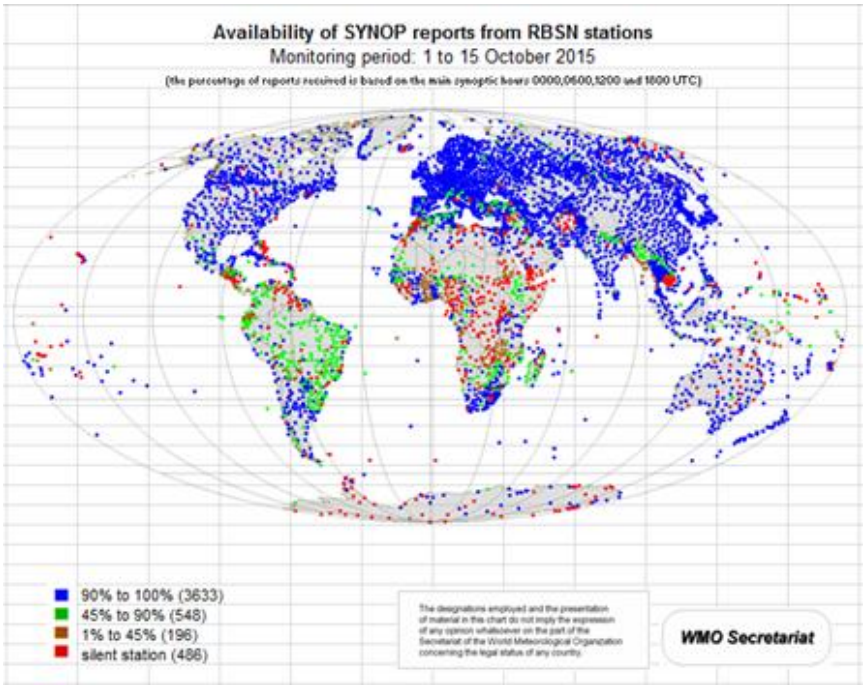

Figure 1 – Status of the SYNOP reports collection from the RBSN stations

ICT sites have reliable power and communication capability. The number of radio base stations (RBSs) that comprise ICT sites greatly exceeds the number of environmental sensing stations. As a matter of fact, the entire continent of Africa hosts hundreds of thousands of radio base stations, compared to approximately 5000 environmental sensing stations in 2015. The very large quantity of ICT (telecom) sites that are spread evenly throughout Africa could serve as stable environmental sensing stations. As an example, Figure 2 shows the mobile network coverage of Tanzania. It should be noted that such map just reports the status of one of the four mobile operators in that country, so the total number of sites will be even greater.

Therefore, it is important to benefit from RBS's reliable power equipment and communications infrastructure by installing environmental sensing system in the perimeter of an ICT site to support stable collection of environmental conditions.

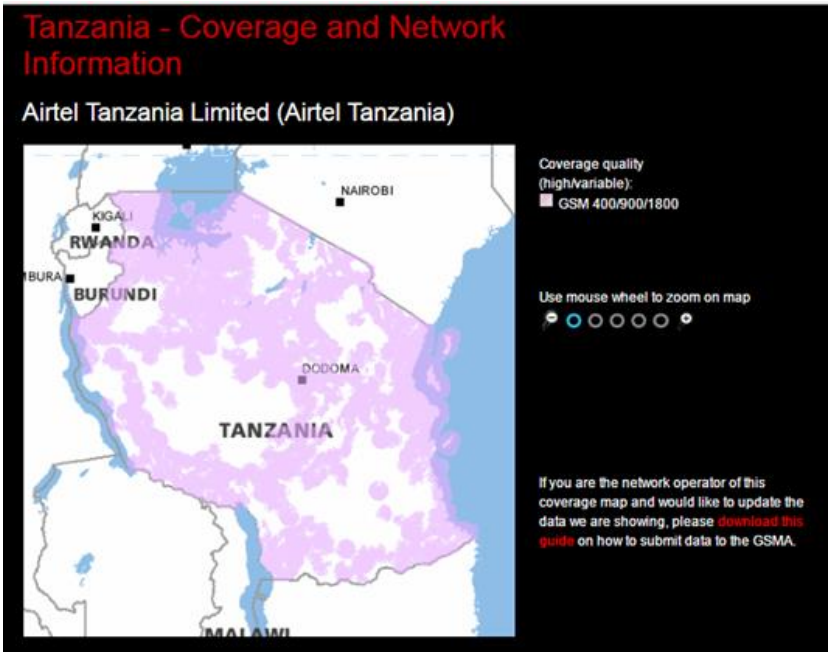

Figure 2 – Example of coverage map of a mobile operator in Tanzania

The other challenge in the meteorological sector is to enable fine grained environmental monitoring. Much more fine grain sensing is needed as the meteorological sector aims at km-scale sensing to enable more localized forecasts and to provide prompt alarm to population when it is needed. Km-scale sensing requires contributions from much more environmental sensing stations. In order to realize fine grain sensing, it is necessary to deploy a large number of environmental sensing stations, which requires large amount of efforts. Since the number of ICT sites are larger than the number of environmental sensing stations, ICT sites are good candidates to resolve such an issue due to their global distribution, reliable power, network communications, and maintenance, as well as the availability of poles and towers to host various environmental sensors.

Therefore, it is necessary to develop best practices and use cases for utilizing ICT sites to support environmental sensing [b-ITU-T L.1500], [b-ITU-T L.1501], [b-ITU-T L.1502] and [b-ITU-T L.1503].

7 Environmental sensing using ICT sites

7.1 Overview

Radio base stations that comprise ICT sites have several advantages for the installation and operation of environmental sensing systems.

The advantages are:

– Always-on power supply: Since ICT equipment need electricity for operating, ICT sites have always-on power supply systems. It is easy to supply environmental sensing system with electricity.

– Robust network connectivity: ICT sites have strong radio signal and robust network connectivity, so environmental sensing results can be stably transferred using the network.

– Tower structure: ICT sites such as radio base stations have tower structure in order to install antenna equipment. Environmental sensing system can be installed in the tower structures.

– Maintenance work: ICT sites require visits to maintain the equipment. During the visits, environmental sensing system may also be maintained.

Therefore, ICT sites can be adequate facilities for installing and operating environmental sensing system with low additional cost. Figure 3 shows examples of radio base stations.

Figure 3 – Examples of radio base stations

7.2 Architecture of environmental sensing system for ICT sites

This clause describes the architecture of environmental sensing system for ICT sites as shown in Figure 4. The environmental sensing system for ICT sites consists of three components including environmental sensor component, power/communication box, and distribution panel, which are attached to a pole. Environmental sensor component monitors weather conditions using the individual sensors such as precipitation, temperature, wind speed, and so on, or integrated sensors. The sensing results are delivered to power/communication box through interface board. The interface board also supply power to the environmental sensors. The distribution panel is connected to the power supply system in the ICT site and distributes power to the power/communication box. Either AC power according to [ETSI EN 300-132-1] or DC power according to [ETSI EN 300-132-2] may be delivered to the power/communication box depending on the configuration of the ICT site. Lightning arrester is installed on the distribution panel in order to protect the equipment from lightning. The power/communication box consists of several sub-components, connection terminal, AC/DC converter, surge protector, and communication model, etc. The connection terminal connects environmental sensor and distribution panel to power/communication box. AC/DC converter sub-component coverts AC power to DC power. Surge protector is installed to mitigate the effects of electrical noise or surge to the sub-components in the power/communication box. Communication modem transfers the weather sensing results to a remote monitoring server. The remote monitoring server may be operated by weather forecast service providers, telecom operators, research organizations, etc. Since the ICT sites are owned and administrated by telecom operators, additional service agreements between the telecom operators and third-party weather forecast service providers may be required.

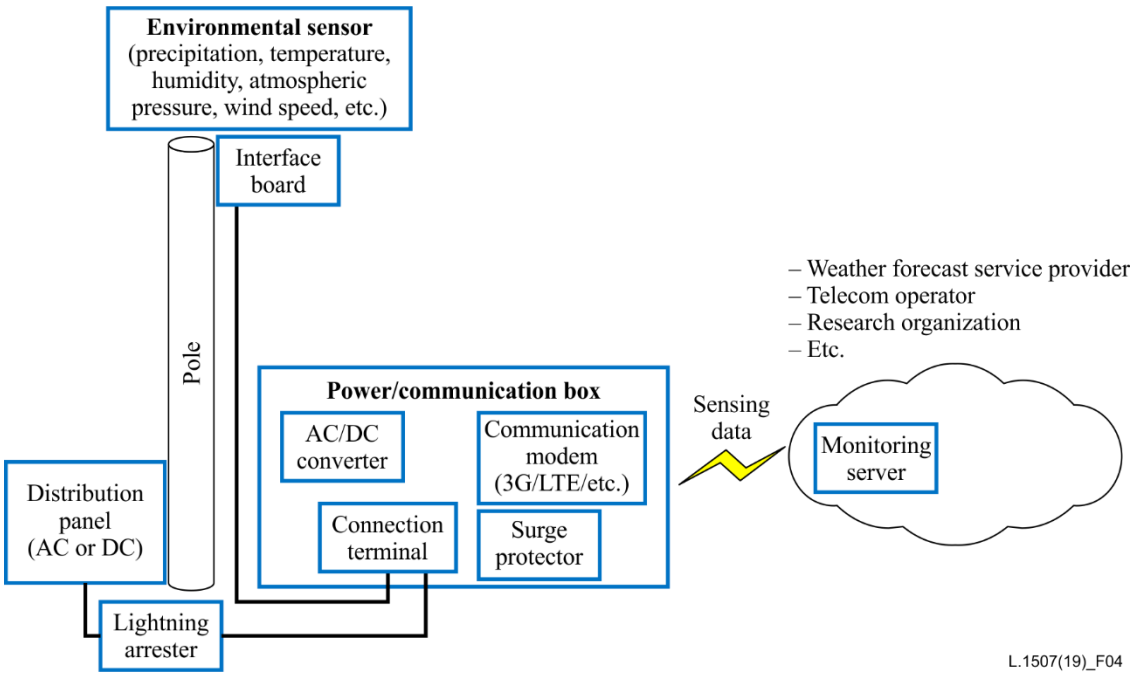

Figure 4 – Architecture of environmental sensing system for ICT sites

The environmental sensing system can be installed on the ground, on top of the building, or on the utility pole depending on the configurations. Figure 5 shows the installation examples of environmental sensing system to ICT sites.

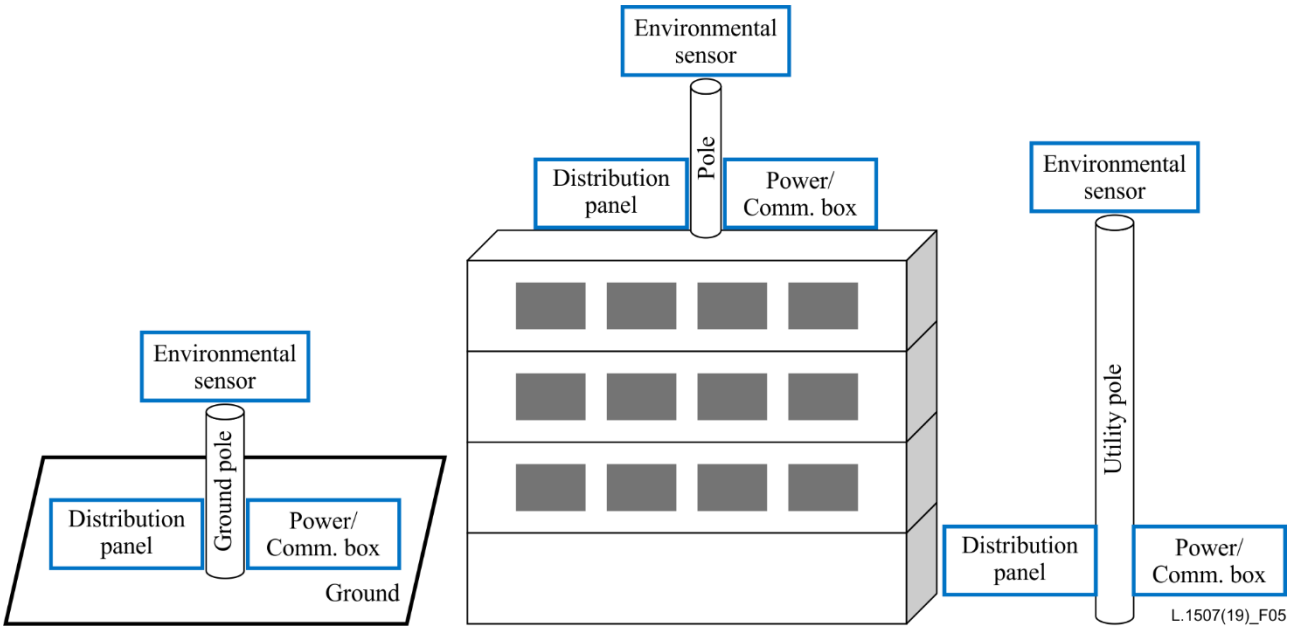

Figure 5 – Installation examples (ground, on top of building, utility pole)

Figure 6 shows the architecture of the environmental sensor component. The environmental sensor component has two separate sensor modules, which are precipitation meter and integrated sensor. The integrated sensor module measures temperature, relative humidity, atmospheric pressure, wind direction, and wind speed. Depending on the configurations, individual environmental sensors for each environmental metric may be installed separately. The measurement results of two sensor modules are transferred through the interface board. In addition, power line is connected to the interface board in order to provide power to the sensor modules.

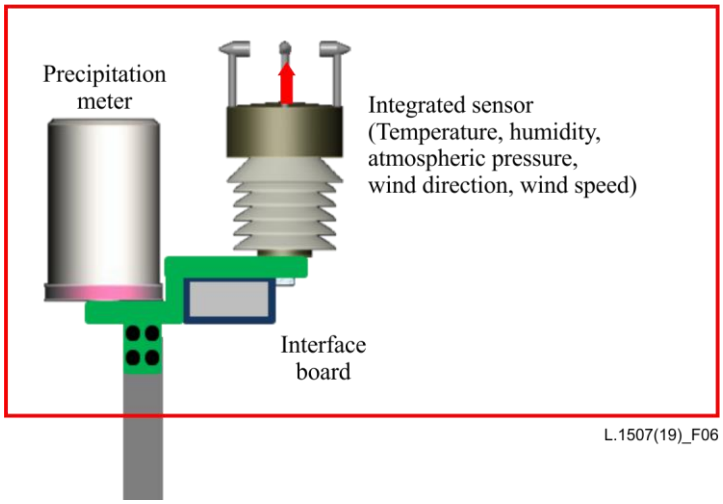

Figure 6 – Architecture of the environmental sensor component

8 Requirements for installing environmental sensing system to ICT sites

8.1 Requirements for environmental sensor

The following are the requirements for the environmental sector:

– The number of environmental sensors and the specifications of sensors should comply with the local regulations or standards, where the sensors will be installed.

– Bird spikes may be necessary to prevent birds from damaging the environmental sensors.

– The status of environmental sensors should be periodically checked and maintained if necessary either by on-line or off-line method.

– Surge protection devices should be appropriately installed in order to protect the environmental sensors.

Table 1 lists the specification for environmental sensors, which are recommended meteorological requirements by WMO [b-WMO]. It is noted that the specification of environmental sensors may be varied on the deployment sites due to the local regulations or standards.

Table 1 – Specification for six environmental sensors

Items		Contents
Wind speed	Measurement range	0 ~ 75 m/s
	Accuracy	<= 5 m/s: ±0.5 m/s
		> 5 m/s: ±10%
	Resolution	0.5 m/s
Wind direction	Measurement range	0 ~ 360°
	Accuracy	±5°
	Resolution	1°
Air temperature	Measurement range	−80°C ~ +60°C

Table 1 – Specification for six environmental sensors

Items		Contents
	Accuracy	<= −40°C: ±0.3°C > −40°C and <= +40°C: ±0.1°C > +40°C: ±0.3°C
	Resolution	0.1°C
Relative humidity	Measurement range	0 ~ 100%
	Accuracy	±1%
	Resolution	1%
Atmospheric pressure	Measurement range	500 ~ 1080 hPa
	Accuracy	±0.1 hPa
	Resolution	0.1 hPa
Precipitation	Measurement range	0 ~ 500 mm (daily)
	Accuracy	<= 5 mm: ±0.1 mm > 5 mm: ±2%
	Resolution	0.1 mm

8.2 Requirements for power/communication box and distribution panel

The requirements for the power/communication box and distribution panel are as follows:

– The power/communication box and distribution panel should pass electromagnetic compatibility (EMC) testing according to [IEC 60950-1].

– The power/communication box and distribution panel should be adequately protected from environmental conditions such as temperature, dust, moisture, etc. Appropriate ingress protection (IP) code according to [IEC 60529] should be applicable to the power/communication box and distribution panel depending on the installation locations.

– The power/communication box and distribution panel should be securely locked in order to prevent unauthorized access.

– The communication box should comply with the regional radio requirements, particularly regulation for radio spectrum.

– The power/communication box should be considered in accordance with the relevant safety standards [b-IEC 6 0479-1] and [b-IEC 61557-8].

8.3 Requirements for impacts on ICT sites

The requirements for impacts on ICT sites are as follows:

– Installing environmental sensor should minimize the interference of the radio signal transmission of ICT sites.

– Installing communication modem should minimize the interference of the operation of ICT sites communication.

– Installing power/communication box and distribution panel should minimize the influence on the power quality of ICT sites.
– Installing environmental sensors and power/communication box should minimize the influence on the structural stability of antenna poles in ICT sites.
– Installing environmental sensors should minimize the influence on the onsite safety of ICT sites.
– Installing environmental sensors should not cause additional online security issues to ICT sites. For example, hacking, Distributed Denial of Service (DDoS) attack, viruses, etc. should be prevented.

Appendix I

Deployment examples

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

This appendix presents a deployment example of the environmental sensing system in ICT sites. Figure I.1 depicts the deployment example of an environmental sensing system on the radio base station antenna on top of a building. The environmental sensor component is installed on top of the antenna pole. The power/communication box is installed on the bottom of the pole due to easy maintenance and the environmental sensor component is connected to the power/communication box through outdoor wiring. The distribution panel is connected to the power supply equipment in the base station antenna in order to feed power to the environmental sensor and the power/communication box.

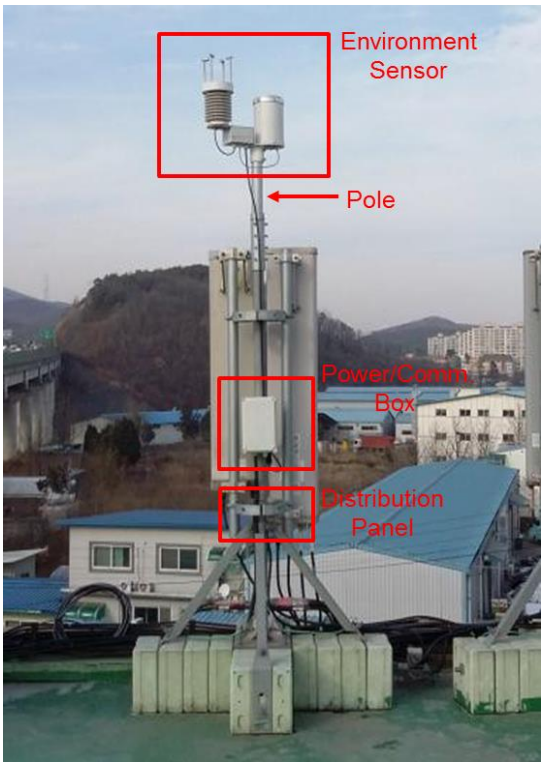

Figure I.1 – Deployment example of environmental sensing system in radio base station antenna

Figure I.2 shows the internal architecture of the power/communication box. The power/communication box has two layers, the upper layer and lower layer.

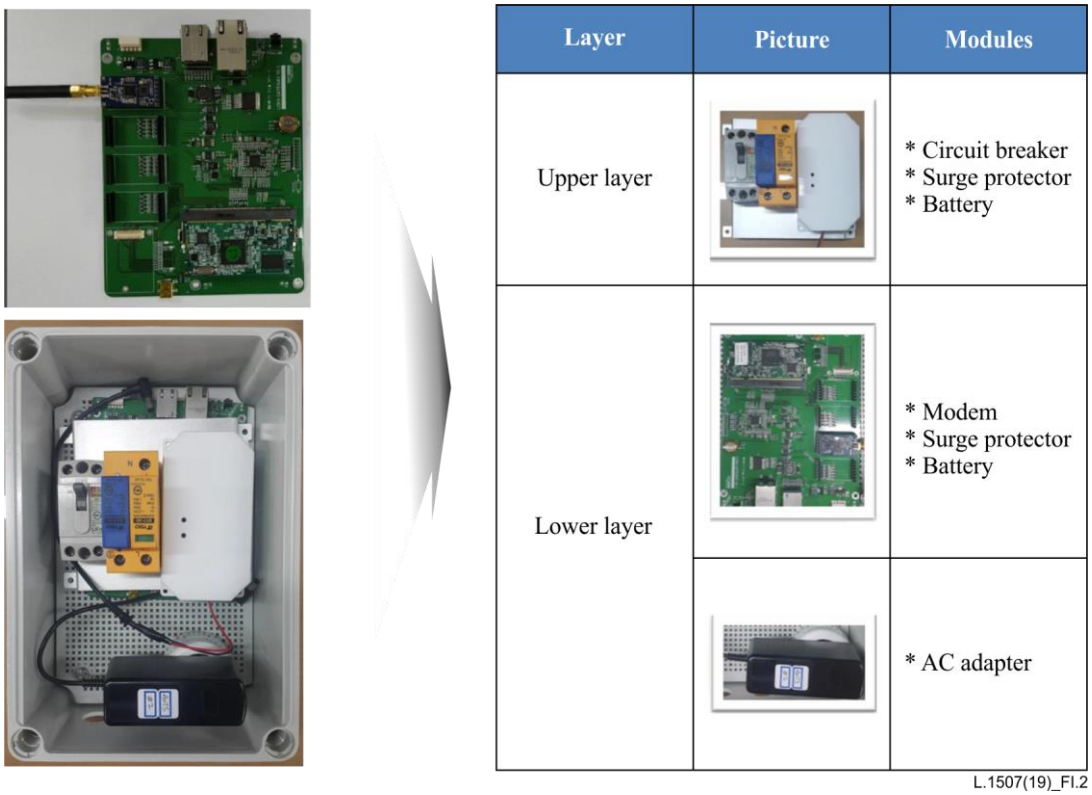

Figure I.2 – Internal architecture of power/communication box

Figure I.3 shows the physical specification of the environmental sensor component.

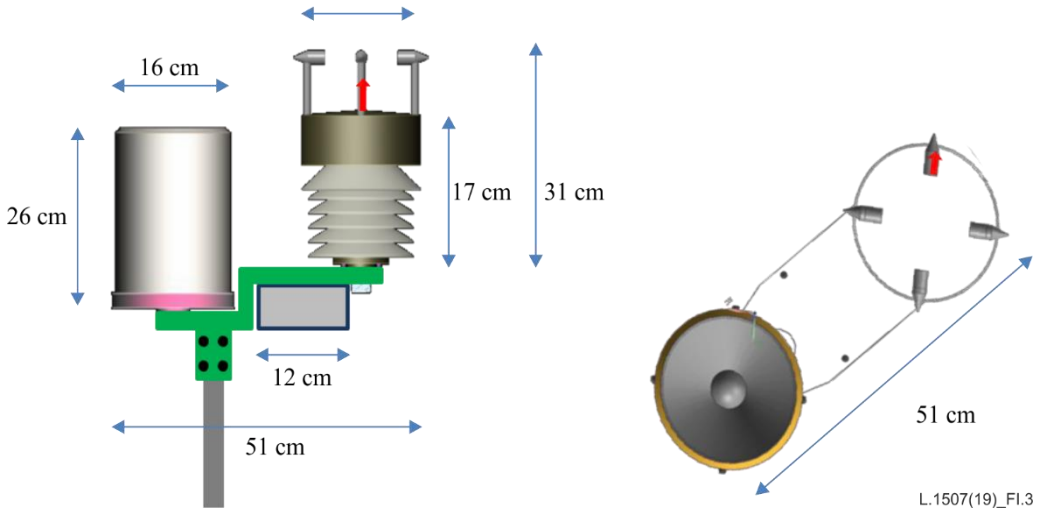

Figure I.3 – Physical specification of environmental sensing component (front view, view from above)

Figure I.4 shows deployment examples of environmental sensing systems for ICT sites. The environmental sensing systems are usually installed on the antenna pole of radio base station, but ground poles or utility poles are also used depending on the site configurations.

Figure I.4 – Deployment examples of installing environmental sensing system on various ICT sites

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