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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

E-waste and circular economy

Methodology to identify key equipment for environmental impact and e-waste generation assessment of network architectures

Recommendation ITU-T L.1050

ITU-T L-SERIES RECOMMENDATIONS

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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Methodology to identify key equipment for environmental impact and e-waste generation assessment of network architectures

Summary

While a framework for assessing the environmental impacts of the ICT sector exists (developed by the ITU in, for example, Recommendation ITU-T L.1410 on environmental life cycle assessments of information and communication technology goods, networks and services), best practices for equipment identification, developed specifically to assess the environmental impacts of network architecture, are lacking. In this Recommendation, key equipment in networks are identified for smoother life cycle assessment (LCA) calculations.

Different types of network architecture employ different goods which entail differences in terms of energy usage, e-waste generation and environmental footprints. This Recommendation will examine three types of network architectures and will suggest an appropriate set of equipment to be considered for each. This Recommendation will begin to support network designers in determining the environmental and circular performance of different network architectures.

Recommendation ITU-T L.1050 utilizes information compiled from stakeholders which can provide good insights into the specified potential challenges.

History

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Circular economy, energy efficiency, environmental footprint, LCA, networks, waste.

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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.

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.

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

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Introduction

In practice, modern networks are highly heterogeneous. An important challenge for energy and the environmental performance optimization of hybrid parallel applications on such platforms is how to accurately estimate the energy consumption (and environmental impact) of application components running on different compute devices of the platform [b-Lastovetsky].

For environmental impact investigations, life cycle assessment (LCA) covers raw material extraction, manufacturing, any transport, use phase, and end-of-life treatment [ITU-T L.1410]. The effects of any specific use modes of the equipment in a given network configuration and concept are usually not considered. Consequently, any effects in other network layers, e.g., layer 2 or layer 3, are often not considered. The main problem here is that network-wide optimization depends on cross-layer optimization, e.g., considering additional Layer-2 and/or Layer-3 equipment and their joint interworking. This goes beyond the usual LCA scope for networks. In theory, network LCA should consider all relevant equipment and its interdependencies. However, since the LCA of almost all ICT network infrastructure equipment is dominated by use-phase energy consumption, it would be simpler to restrict such a network LCA (including cross-layer analysis) to the use stage energy consumption [b-Grobe]. However, the upstream and after-use must also be considered in LCA [ITU-T L.1410].

Nevertheless, it may be immensely difficult to model a complete network infrastructure in detail every time information on the environmental performance is sought. Indeed, if for equipment installed recently, data collection regarding the number of pieces of equipment, their configuration location and their energy consumption during the use phase can be carried out, it is much more difficult for network equipment installed decades ago. A limited list of chosen equipment, ideally comprising >80% of the environmental impact, can potentially be identified for common network types.

The resolution of the equipment scope herein is similar to [b-Griffa] for FTTx, [b-Andrae-1] for off-grid RAN sites and [b-BATS] for satellite networks.

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Methodology to identify key equipment for environmental impact and e-waste generation assessment of network architectures

1 Scope

The objective of this Recommendation is to provide best practices for equipment identification for ICT service architecture designers to be able to evaluate the environmental performance of different network architectures.

The Recommendation will specify the necessary requirements for identifying equipment types used in network life cycle assessments (LCAs). The proposed set of equipment can be used to evaluate the following dimensions of network architecture:

- Energy efficiency
- E-waste amounts
- LCA impacts
- Circularity indicators [ITU-T L.1023]

NOTE – Applying [ITU-T L.1023] to a network (in order to achieve a single 0% to 100% score for the network) requires allocation (e.g., based on share of cost, share of environmental impact, share of mass, share of functional performance) of the individual [ITU-T L.1023] scores of the equipment composing the network.

This not an exhaustive list. While it does not give network architect designers environmental impact values for each equipment, for the environmental performance calculation of network architecture, it does provide a solid baseline for the scope and overview of network architectures for later calculation of environmental footprint indicators.

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.1023] Recommendation ITU-T L.1023 (2020), *Assessment method for circular scoring*.

[ITU-T L.1410] Recommendation ITU-T L.1410 (2014), *Methodology for environmental life cycle assessments of information and communication technology goods, networks and services*.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

BAS	Broadband Access Server
BBU	Baseband Unit
BSC	Base Station Controller
BTS	Base Transceiver Station
CDN	Content Delivery Network
CMTS	Cable Modem Termination Systems
DHCP	Dynamic Host Configuration Protocol
DSLAM	Digital Subscriber Line Access Multiplexer
FTTH	Fibre To The Home
FTTx	Fibre To The x
GPON	Gigabit Passive Optical Network
HDD	Hard Disk Drive
HLR	Home Location Register
HSS	Home Subscriber Server
ICT	Information Communication Technology
LCA	Life Cycle Assessment
MGW	Media Gateway
MSC	Mobile Switching Centre
NFC	Near Field Communication
OLT	Optical Line Termination
ONT	Optical Network Terminal
PDU	Power Distribution Unit
PGW	Packet data network Gateway
QoE	Quality of Experience
RAN	Radio Access Networks
RFID	Radio-Frequency Identifier Device
RNC	Radio Network Controller
RRH	Radio Remote Head
RRU	Radio Remote Unit
SBN	Satellite Broadband Network
SDD	Software Disk Driver
TGBT	General Low Voltage Switchboard