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Okoljski inženiring (EE) - Postopna migracija informacijske in komunikacijske tehnologije (IKT) na virih in distribuciji 400 VDC

Environmental Engineering (EE) - Progressive migration of Information and Communication Technology (ICT) site to 400 VDC sources and distribution

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Foreword

This ETSI Standard (ES) has been produced by ETSI Technical Committee Environmental Engineering (EE).

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Executive summary

The present document gives explanation, requirements and guidance for increasing the use of up to 400 V Direct Current (400 VDC) power systems and the distribution to Information and Communication Technology (ICT) equipment. It includes 400 VDC remote powering up to 400 VDC of distributed ICT equipment, the option of interconnection of local renewable energy sources and their connection to DC power nanogrids and other users, extending the resilience capability of the telecommunication network and ICT sites to grid failures and climate change.

Introduction

Telecommunication network energy consumption and cost are increasing at a rate of several percentage points per year as reported in Trends in worldwide ICT electricity consumption from 2007 to 2012 [i.11]. The use of up to 400 V Direct Current (400 VDC) architecture (as presented in Table 1, Annex B and Annex C) can result in significant savings.

The use of up to 400 VDC solutions result in energy savings with higher efficiency and reduced distribution losses, reduction in maintenance cost due to higher reliability and lower unavailability, savings in space for power equipment in Information and Communication Technology (ICT) rooms (each square metre being of high cost) and, finally, more simplicity in site installation and development.

Different levels of saving and improvement result from a comparison of up to 400 VDC solutions to -48 V solutions (copper savings) or to Uninterrupted Power Supply (UPS) solutions (reliability, efficiency, easier installation). 400 VDC remote power can be beneficial.

As for the power system, energy savings in addition to those resulting from efficiency improvements depend on the load in the telecommunication or data centre. Energy efficiency should be evaluated at the system level, including the general distribution cabling and voltage conversion stages, as well as the internal power circuits inside the load downstream of the power interface, i.e. conversion architecture in the system (e.g. dual inputs, local back-up, AC/DC rectifier losses).

Indirect savings of up to 400 VDC solutions relate to lifecycle in the production and recycling phase as there should be less passage through copper and electronics as well as less battery usage for given output power and system dependability. Battery capacity and dependability savings are achieved by removing inverter losses if replacing AC UPS or by reducing -48 V distribution losses.

The present document specifies requirements for a safe migration of an existing site to a unified up to 400 VDC powering feeding system, power distribution and the power interface of telecommunication/ICT equipment. It includes requirements relating to the stability, cabling, earthing, as well as bonding and measurement, for the existing site.

The main significant components of up to 400 VDC equipment and additional progressive migration equipment are presented in Figures 2 and 3. These are schematic diagrams that do not show all the electrical arrangement details. The architecture under consideration complies with Recommendation ITU-T L.1204 [14] on electrical architecture, including energy storage defined in ETSI TS 103 553-1 [i.1] or Recommendation ITU-T L.1220 [i.2], technically equivalent, and with ETSI ES 203 474 [9] or Recommendation ITU-T L.1205 [15], technically equivalent, for DC coupling of a local RENewable Energy (REN) system on site or with DC nano/micro grid interconnecting sites with REN sources and storage or ICT equipment requiring remote powering. Smart DC nanogrids are under study as reported in Intelligent DC Microgrid Living Lab [i.12].

The migration simplifies the use of up to 400 VDC combined with REN and DC nanogrids and should extend resilience capability of telecommunication networks sites to grid failures and climate change.

The present document was developed jointly by ETSI TC EE and ITU-T Study Group 5. It is published respectively by ITU and ETSI as Recommendation ITU-T L.1207 [i.3] and ETSI ES 203 726 (the present document), which are technically-equivalent.

1 Scope

The present document defines solutions for progressive migration of Information and Communication Technology (ICT) sites (telecommunication and data centres) to up to 400 V Direct Current (400 VDC) distribution and direct use of up to 400 VDC powering ICT equipment from 400 VDC sources. The present document also defines different major use case options and migration scenarios, such as:

- migration to an up to 400 VDC of telecommunication site power solution;
- migration to an up to 400 VDC of data centre power solution;
- migration with up to 400 VDC power transfer between existing -48 V centralized sources to high power density -48 V equipment, such as routers;
- integration of up to 400 VDC remote powering;
- combined architecture with up to 400 VDC and AC sources and distributions possibly using hybrid power interfaces on ICT equipment.

For each of these, the present document describes many possible options and characteristics, such as:

- migration architecture with up to 400 VDC/-48 V conversion to power existing -48 V equipment using existing -48 V room distribution;
- conditions for tripping overcurrent protection devices without -48 V batteries;
- migration architecture with up to 400 VDC/AC inverter as an alternative to the AC UPS to power existing AC equipment;
- use of local up to 400 VDC for remote powering of ICT equipment;
- coupling up to 400 VDC systems to a local REN source or to a DC microgrid;
- possibility of conversion between battery and up to 400 VDC distribution, e.g. for long power distribution or short-circuit current or battery technology (e.g. lithium-ion).

The present document also gives a saving assessment frame reference to define the best migration scenario and its steps by considering energy, resource, environmental impact and cost savings based on functional aspects such as modularity, flexibility, reliability, efficiency and distribution losses, as well as maintenance evolution when migrating from -48 V or Alternating Current (AC) to up to 400 VDC solutions. This also includes consideration of load architecture evolution dependent on use cases (e.g. telecommunication site, data centres).

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI EN 300 132-1 (V2.1.1) (2019): "Environmental Engineering (EE); Power supply interface at the input to Information and Communication Technology (ICT) equipment; Part 1: Alternating Current (AC)".

[2] ETSI EN 300 132-2 (V2.6.1) (2019): "Environmental Engineering (EE); Power supply interface at the input of Information and Communication Technology (ICT) equipment; Part 2: -48 V Direct Current (DC)".

[3] ETSI EN 300 132-3 (V1.2.1) (2003): "Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 3: Operated by rectified current source, alternating current source or direct current source up to 400 V".

[4] ETSI EN 300 253 (V2.2.1) (2015): "Environmental Engineering (EE); Earthing and bonding of ICT equipment powered by -48 VDC in telecom and data centres".

[5] ETSI EN 301 605 (V1.1.1) (2013): "Environmental Engineering (EE); Earthing and bonding of 400 VDC data and telecom (ICT) equipment".

[6] ETSI ES 202 336-2 (V1.1.1) (2009): "Environmental Engineering (EE); Monitoring and control interface for infrastructure equipment (Power, Cooling and environment systems used in telecommunication networks); Part 2: DC power system control and monitoring information model".

[7] ETSI ES 203 199 (V1.3.1) (2015): "Environmental Engineering (EE); Methodology for environmental Life Cycle Assessment (LCA) of Information and Communication Technology (ICT) goods, networks and services".

[8] ETSI ES 203 408 (V1.1.1): "Environmental Engineering (EE); Colour and marking of DC cable and connecting devices".

[9] ETSI ES 203 474 (V1.1.1): "Environmental Engineering (EE); Interfacing of renewable energy or distributed power sources to 400 VDC distribution systems powering Information and Communication Technology (ICT) equipment".

[10] ETSI TS 103 531 (V1.1.1): "Environmental Engineering (EE); Impact on ICT equipment architecture of multiple AC, -48 VDC or up to 400 VDC power inputs".

[11] Recommendation ITU-T L.1200 (2012): "Direct current power feeding interface up to 400 V at the input to telecommunication and ICT equipment".

[12] Recommendation ITU-T L.1202 (2015): "Methodologies for evaluating the performance of an up to 400 VDC power feeding system and its environmental impact".

[13] Recommendation ITU-T L.1203 (2016): "Colour and marking identification of up to 400 VDC power distribution for information and communication technology systems".

[14] Recommendation ITU-T L.1204 (2016): "Extended architecture of power feeding systems of up to 400 VDC".

[15] Recommendation ITU-T L.1205 (2016): "Interfacing of renewable energy or distributed power sources to up to 400 VDC power feeding systems".

[16] Recommendation ITU-T L.1206 (2017): "Impact on ICT equipment architecture of multiple AC, -48 VDC or up to 400 VDC power inputs".

[17] Recommendation ITU-T L.1320 (2014): "Energy efficiency metrics and measurement for power and cooling equipment for telecommunications and data centres".

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

[19] IEC 60364 (all parts): "Low-voltage electrical installations".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TS 103 553-1 (V1.1.1): "Environmental Engineering (EE); Innovative energy storage technology for stationary use; Part 1: Overview".

[i.2] Recommendation ITU-T L.1220 (2017): "Innovative energy storage technology for stationary use - Part 1: Overview of energy storage".

[i.3] Recommendation ITU-T L.1207 (2018-05): "Progressive migration of a telecommunication/information and communication technology site to 400 VDC sources and distribution".

[i.4] ETSI EN 302 099 (V2.1.1) (2014): "Environmental Engineering (EE); Powering of equipment in access network".

[i.5] Recommendation ITU-T K.48 (2017): "EMC requirements for telecommunication equipment - Product family Recommendation".

[i.6] IEC 60950-1: "Information technology equipment - Safety - Part 1: General requirements".

[i.7] IEC 62368-1: "Audio/video, information and communication technology equipment - Part 1: Safety requirements".

[i.8] ETSI EN 300 132-3-1 (V2.1.1) (2012): "Environmental Engineering (EE); Power supply interface at the input to telecommunications and datacom (ICT) equipment; Part 3: Operated by rectified current source, alternating current source or direct current source up to 400 V; Sub-part 1: Direct current source up to 400 V".

[i.9] ETSI EN 300 386 (V2.1.1) (2016): "Telecommunication network equipment; ElectroMagnetic Compatibility (EMC) requirements; Harmonised Standard covering the essential requirements of the Directive 2014/30/EU".

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[i.22] Fraunhofer Droop Intelec 2017 Wunder B et al.: "Droop controlled cognitive power electronics for DC microgrids". In Intelec 2017 - IEEE International Telecommunications Energy Conference, pp. 335-342, Queensland.

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