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Ensuring short-term e-bus compatibility and interoperability within Europe - ASSURED 1.0 interoperability reference

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Abstract

The electric bus market is booming, and a shift from single pilots to real large scale fleet deployments has started. A key factor in ensuring the success of e-fleet upscaling is the interoperability of the vehicles and the charging units, as this simplifies the design and tendering of the system infrastructure. This will be partly driven by the standardisation of the charging infrastructure, however, effective interoperability can only be achieved by means of thorough and good quality conformance testing, based on solid standardisation.

At present, the standardisation efforts are still ongoing on the e-bus fast charging. To support these efforts, project ASSURED has developed a first baseline specification called “ASSURED 1.0 interoperability reference” to enable conformance and interoperability testing. This first issue has been developed in close cooperation with the project partners and it is based on the latest draft standards. The ASSURED 1.0 solution includes three different fast charging methods utilizing Automated Connection Devices. The ASSURED 1.0 specification is filling the currently existing gaps in and between the standards. This baseline specification can be utilized as the first guidebook or reference in the implementation of e-bus systems also outside the project, until the standardisation is finalized.

Keywords: E-bus; electric; bus; fast charging; charging infrastructure; standardisation;

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1.1.1. Abbreviations

ACD	Automated Connection Device
AFI	Alternative Fuels Infrastructure
CCS	Combined Charging System
DC	Direct Current
HD	Heavy Duty

2. Introduction

The electric bus market is booming, and a shift from single pilots to real large scale fleet deployments has started. A key factor in ensuring the success of e-fleet upscaling is the interoperability of the vehicles and the charging units, as this simplifies the design and tendering of the system infrastructure. This will be partly driven by the standardisation of the charging infrastructure, however, effective interoperability can only be achieved by means of thorough and good quality conformance testing, based on solid standardisation.

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3. Development of European Electric Bus Standardisation

This chapter is giving an overview of the standardization efforts related to electric buses within Europe.

3.1. Alternative Fuels Infrastructure Directive (2014/94/EU)

In October 2014, a directive on deployment of the alternative fuels infrastructure (later AFI Directive) was adopted by the European Parliament and the Council of the European Union. The directive was, among other vehicle classes, calling after infrastructure for e-bus charging, but did not include technical specifications for the charging infrastructure, as the standardization was still lacking on the bus sector. The directive was calling for standardization and legislation for the supply of electricity.

3.2. European Commission Mandate 533

To address the need for standardization related to the AFI directive, the European Commission issued a mandate 533, requesting the European Committee for Standardisation and European Committee for Electrotechnical Standardisation (CEN-CENELEC) to establish European standards for the different alternative fuels infrastructures. For electric buses, the mandate 533 is requesting standardization for both conductive and wireless charging solutions. The conductive charging solution should be preferably based on the existing standards developed for the passenger and light duty vehicles. The mandate is requesting a single solution for the supply connectors and socket outlets.

3.3. Project ZeEUS

Project ZeEUS (Zero Emission Urban Bus System) was started in 2013, with the aim in facilitating the electric bus uptake in Europe via live demonstrations, information sharing and supporting standardization efforts. Within the ZeEUS project, UITP initiated an industry-led standardization committee, which established the initial guidelines for standardization, in collaboration with the CEN-CENELEC. This document was later developed to become the CEN-CENELEC recommendation for standardization during spring 2018.
The industrial partners of the project reached an agreement to include three different solutions for the e-bus

charging in the recommendation. The solutions have a lot in common, the main differences being related to the communication between the vehicle and charger, and to the mechanical connectors.

3.4. CEN-CENELEC recommendation for standardization

CEN-CENELEC presented the European Commission its recommendation for standardization in June 2018. The recommendation includes three different fast charging methods with different connection devices, thus deviating from the original EC goal of having a single solution for the electrical supply connection.

3.5. Ongoing standardization efforts

For the manual plug charging of the electric buses, the standardization is already existing, based on the passenger vehicle standardization. The same Combined Charging System (CCS) plug can be used also for electric bus charging. However, the higher battery voltages in the electric buses have called for slight changes to the standardization also related to the manual plug.

In fast charging, the solutions are different, mainly due to the higher power levels used in heavy duty (HD) vehicles, and the need to have fast and automated solutions for the vehicle connection to the charger. In electric buses, ACDs are used in opportunity charging for a fast and high power connection between the charger and the vehicle.

There are four main standards related to the fast charging electric bus implementation. The standards and their drafting bodies are presented in Table 1.

Table 1. Standardisation related to electric buses

Technical area	Standard	Drafting body	Schedule
Electric vehicle conductive charging systems - DC charging with an Automated Connection Device (ACD)	IEC 61851-23-1	IEC TC69 / PT 61851-23-1	Q3 / 2020
Contact interface for Automated Connection Device	prEN 50696	CENELEC CLC/TC 23H WG5	Q1 / 2020
Vehicle to grid communication interface	ISO 15118-20	ISO TC 22/SC 31	Q1 / 2020
Electrical safety, vehicles	ISO/DIS 17409	ISO TC 22/SC 37	Q4 / 2019

3.6. Project ASSURED

Project ASSURED was started in October 2017, continuing partly the work started in ZeEUS. The main focus of ASSURED is in testing and demonstrating interoperability of the fast charging solutions for the HD vehicle segment.

The ASSURED project is planning to perform conformance and interoperability testing for the participating partners' vehicles and chargers, starting in November 2019. As the standards for the electric bus fast charging are still in progress, the project identified a need to create a baseline specification, based on the intermediate versions of the standards, to be able to perform the testing.

4. ASSURED 1.0 specification

The ASSURED project identified the need for its own baseline specification during planning of the conformance and interoperability test protocol, which will also be a deliverable from the project. As a result, the project decided to initiate a workshop for planning the work to create the document. In the first workshop, it was decided that the specification will include the same three fast charging methods included in the CEN-CENELEC recommendation for standardisation, and three working groups shall be formed to work on the definition of the baseline. The working groups included the industry partners involved in the ASSURED project.

The working groups identified the standards and their versions related to be used for the ASSURED work; as well as the gaps still left by the standardisation, such as common Wi-Fi credentials for the Type A and C ACDs.

Based on the inputs from these three working groups, the final synthesis and reviews of the document were performed and organized by VTT Technical Research Centre of Finland. The specification "ASSURED 1.0 interoperability reference" was released as a public document at the UITP Summit in May 2019, and it is downloadable from the ASSURED website.

As the ASSURED 1.0 specification is released as a public document, it allows the current e-bus implementations to utilize a common framework, to ensure short-term compatibility and interoperability of the HD vehicle fast charging.

5. Conclusions

The standardization of e-bus fast charging solutions is still on-going. The specification "ASSURED 1.0 interoperability reference", developed in the ASSURED project, is enabling PTAs and OEMs alike to utilize the specification as a guidebook or reference in their implementations, ensuring interoperability and reliability of the electric vehicle fleets already today, especially in multi-brand environments.

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