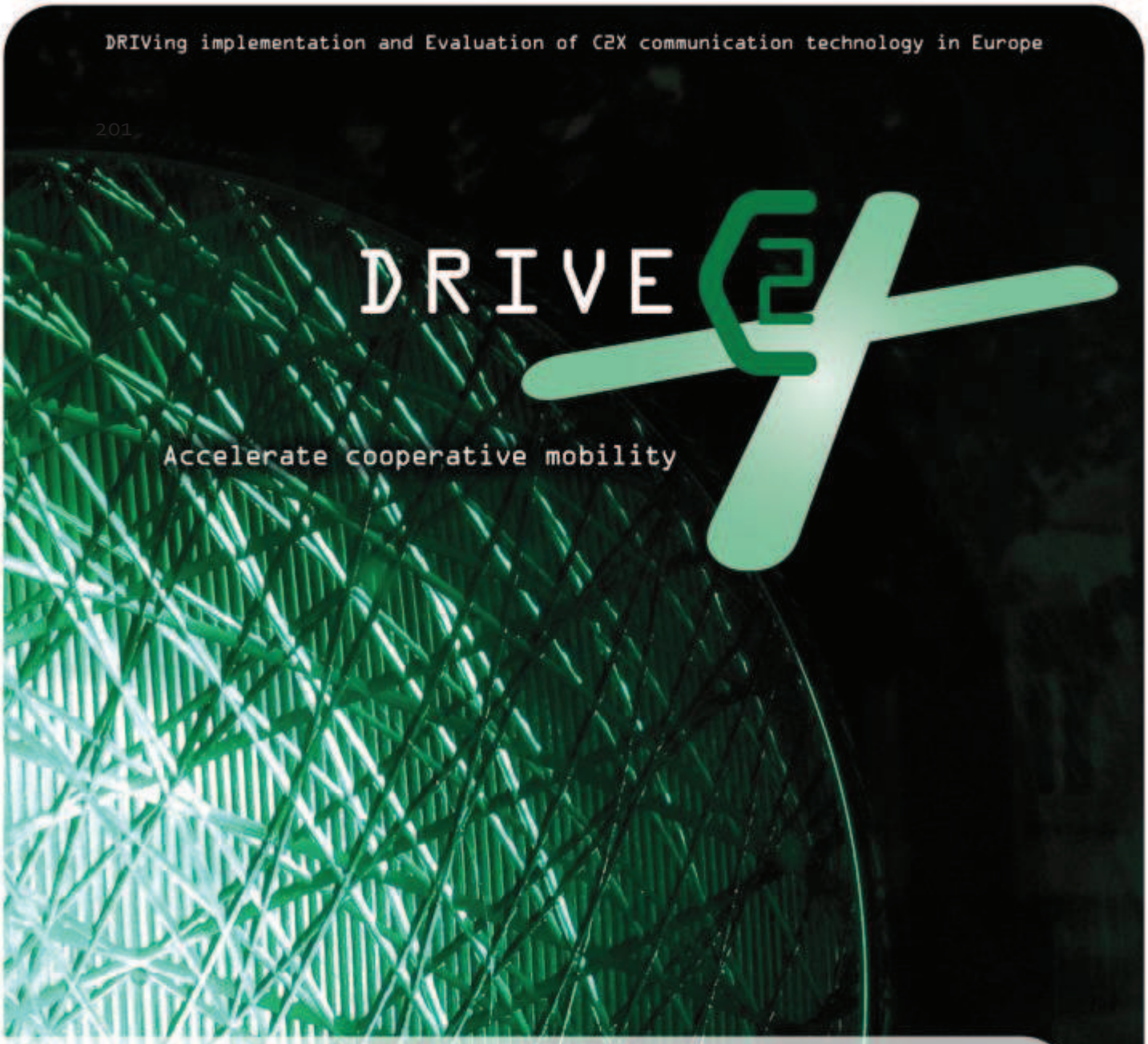
DRIVing implementation and Evaluation of C2X communication technology in Europe



Deliverable D55.1

Report on compliance of DRIVE C2X system and applications with international ITS standards

Version number	Version 2.1
Dissemination level	RE
Lead contractor	Daimler
Due date	30/06/2014
Last update	27/06/2014

SEVENTH FRAMEWORK PROGRAMME

www.drive-c2x.eu

Authors v1.0

Dr. Andreas Festag (NEC Laboratories Europe)

Florian Friederici (Fraunhofer FOKUS)

Dr. Tim Leinmüller (Denso International Europe)

Lan Lin (Hitachi Europe Ltd.)

Dieter Seeberger (Daimler AG)

Dr. Andrea Tomatis (Hitachi Europe Ltd.)

Authors v2.1

Dr. Mate Boban (NEC Laboratories Europe)

Pedro d'Orey (NEC Laboratories Europe)

Project funding

7th Framework programme

INFORMATION AND COMMUNICATION TECHNOLOGIES

Objective ICT-2009.6.2: ICT for Mobility of the Future

Large-scale integrating project

Grant agreement no.: 270410

Project co-ordinator

Matthias Schulze

Daimler AG

HPC 050 – G003

71059 Sindelfingen

Germany

Phone	+49 7031 4389 603
Mobile	+49 160 86 33 30 8
Fax	+49 7031 4389 218
E-mail	matthias.m.schulze@daimler.com

Legal disclaimer

The information in this document is provided 'as is', and no guarantee or warranty is given that the information is fit for any particular purpose. The above referenced consortium members shall have no liability for damages of any kind including without limitation direct, special, indirect, or consequential damages that may result from the use of these materials subject to any liability which is mandatory due to applicable law.

© 2014 by DRIVE C2X Consortium

Executive summary

The present document analyses the compliance of the DRIVE C2X reference system with current standards for cooperative ITS. This analysis first gives an overview of standards that are relevant for the DRIVE C2X reference system and then assesses the compliance of the DRIVE C2X implementation with these standards. The assessment is focused on Vehicle and Roadside ITS Stations and covers standards related to the protocol layers and entities of these stations, including ITS access technologies, networking and transport, facilities, the application layer and the management and security entity.

The analysis takes into account standards that are developed in the context of the mandate M/453 by the European Commission, in particular standards from ETSI TC ITS and CEN TC 278, as these are most relevant for the DRIVE C2X system. Standards from other standard development organizations are considered if they represent base standards from which profile standards have been derived, such as from SAE and IEEE. Relevant standards from these organizations are also listed and detailed in this document.

The report mainly considers standards for communication among Vehicle and Roadside ITS Stations using ITS-G5 and ad hoc communication; for other aspects, such as for GPS and cellular systems, standards are only listed but not detailed as they do not represent specific technologies for cooperative ITS.

The deliverable starts with general overview in Chapter 1 that briefly presents the purpose and objectives of standards, introduces the relevant standardization development organizations and explains the structure of the document.

Chapter 2 gives an extensive overview of standards from different categories, including the formal information about each standard and, more importantly, its relation to the DRIVE C2X reference system. Categories include ITS access technologies, networking and transport, facilities, application, management and security. The overview is presented in a tabular form in order to provide a structured overview of the available standards.

Chapter 3 lists the core standards that are required for interoperability, i.e. exactly 11. These core standards are derived from the standard overview of the previous chapter. The chapter then provides details about specific aspects that were considered in the analysis and covers potential extensions of the DRIVE C2X implementation that go beyond the core standards. Then, for every category of standards the following aspects are addressed: (i) Compliance of the DRIVE C2X reference system and technology component with the related core standard(s), (ii) Method how the compliance is verified (e.g. considered in design, conformance tests, plug tests), and (iii) deviation of the DRIVE C2X system or technology component from the standard.

Chapter 4 summarizes the feedback of the DRIVE C2X project to the standardization process, i.e. identifies the standards to which the project has considerably contributed. In particular, this chapter elaborates on the contributions from DRIVE C2X project towards the finalization of the Release 1 of the standardization package as defined by the mandate M/453 of the European commission. This includes the development of CAM standard (EN 302 673-2) and DENM standard (EN 302 637-3), their message formats and validation, as

well as the GeoNetworking protocol suite (specifically, standards EN 302 636-4-1 and EN 302 636-4-1).

Chapter 5 presents the conclusions of the analysis and lists gaps between standards and the DRIVE C2X reference implementation, where standards do not exist (yet) or are at a preliminary stage, but would be needed and desirable. Such gaps were identified for infrastructure messages, decentralized congestion control, multi-channel operation, applications and management.

Finally, chapter 6 gives an extensive list of references; besides the general references, references for published and draft ETSI standards as well as other standards (from IEEE and CEN) are shown.

As a principal conclusion, the analysis shows a good compliance of the DRIVE C2X reference system with the published versions of the core standards. For standards for which test specifications have already been developed, the standard compliance was proven by passing the test procedures for conformance testing (for the implementations of the GeoNetworking protocols and selected facilities-layer messages) as well as by successful participation in ETSI Plugtests, where multiple implementations were proven to be interoperable). For other core standards, the compliance is attested by analysis and inspection of the standards. The implementation of the DRIVE C2X reference system provides therefore a solid basis for the impact assessment of cooperative ITS. Thanks to the efforts and contributions of DRIVE C2X project and its partners, standardization has progressed considerably. Many of the standards have been completed, for other standards updates were published. In particular, the mandate M453 has set clear deadlines for completion of the minimum set of standards for initial deployment. The DRIVE C2X project has considerably contributed to the standardization efforts. For several of the core standards, DRIVE C2X partners act as rapporteurs (i.e. editors) and main contributors. Also the corresponding test specifications were developed jointly with DRIVE C2X partners, who mainly provided test cases and their definitions. Feedback from the development and integration phase of the DRIVE C2X project was provided with the standardization progress during the whole time of the project. The valuable experiences of the project have therefore been successfully transferred to the standardization development process and improved the quality of the standard documents.

A particular challenge was caused by the fact that standards have evolved in the implementation and integration phase of the project. Partially, these changes were requested by DRIVE C2X partners as part of their feedback and were also implemented in the reference system. However, in principle the project tried to be compliant with the latest published version of the standard at the point in time when the reference system was specified and designed. This principle made it possible to provide a reliable and robust system for the field trials. The disadvantage is that the DRIVE C2X system is not always compliant with the latest draft version of the standard, but to the latest stable published version. A good example for the challenge is the CAM standard TS 102 673-2/EN 302 673-2: the message format was considerably enhanced during the period from 2012 to 2014, where the system implementation and integration of the DRIVE C2X project was already completed. The enhancement of the implementation to the latest version of the standard would have required additional resources and been at the expense of stability and

robustness of the implemented reference system. As a compromise, the project has implemented some selected features as "experimental" that can be enabled/disabled on demand. Moreover, it can also be stated that the influence of these changes on the impact assessment of applications/functions are rather small and negligible.

The report then gives a recommendation for consideration of drafts standards that are still under development while the development and integration of the DRIVE C2X system progresses. Also, a gap analysis is carried out that identifies missing standards for the DRIVE C2X system. Gaps between standards and the DRIVE C2X reference system were mainly identified in areas, where standards do not exist or are at a preliminary stage: (i) infrastructure-related messages for cooperative ITS, such as the Topology message (TOPO) and Signal-Phase and Timing message (SPAT) used in intersection scenarios, (ii) Decentralized congestion control , (iii) Multi-channel operation, (iv) incomplete application standards, (v) management standards for configuration management, management of decentralized congestion control and multi-channel operation.