**3GPP TSG RAN Meeting #68 RP-151109**

**Malmö, Sweden, June 15 - 18, 2015**

**Source: LG Electronics, CATT, Vodafone, Huawei**

**Title: New SI proposal: Feasibility Study on LTE-based V2X Services**

**Document for: Approval**

**Agenda Item: 13.1.1**

3GPP™ Work Item Description

For guidance, see [3GPP Working Procedures](http://www.3gpp.org/About/WP.htm), article 39; and [3GPP TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm).  
Comprehensive instructions can be found at <http://www.3gpp.org/Work-Items>

# Title: Feasibility Study on LTE-based V2X Services

## Acronym: FS\_LTE\_V2X

## Unique identifier:

NOTE: If this is a RAN WID including Core and Perf. part, then Title, Acronym and Unique identifier refer to the feature WI. Please tick (X) the applicable box(es) in the table below:

|  |  |
| --- | --- |
| **This WID includes a Core part** |  |
| **This WID includes a Performance part** |  |

## 1 3GPP Work Area

|  |  |
| --- | --- |
| X | **Radio Access** |
|  | **Core Network** |
|  | **Services** |

## 2 Classification of WI and linked work items

### 2.0 Primary classification

This work item is a …

|  |  |
| --- | --- |
| X | Study Item (go to 2.1) |
|  | Feature (go to 2.2) |
|  | Building Block (go to 2.3) |
|  | Work Task (go to 2.4) |

NOTE: Core, Performance and Testing parts of RAN WIs are usually Building Blocks.  
If you are in doubt, please contact MCC.

### 2.1 Study Item

|  |  |  |
| --- | --- | --- |
| Related Work Item(s) (if any] | | |
| Unique ID | Title | Nature of relationship |
|  | Study on LTE support for V2X services | Corresponding SA1 study item |

Go to §3.

### 2.2 Feature

|  |  |  |
| --- | --- | --- |
| Related Study Item or Feature (if any) | | |
| Unique ID | Title | Nature of relationship |
|  |  |  |

Go to §3.

### 2.3 Building Block

|  |  |  |
| --- | --- | --- |
| Parent Feature (or Study Item) | | |
| Unique ID | Title | TS |
|  |  |  |

This work item is …

|  |  |
| --- | --- |
|  | Stage 1 (go to 2.3.1) |
|  | Stage 2 (go to 2.3.2) |
|  | Stage 3 (go to 2.3.3) |
|  | Test spec (go to 2.3.4) |
|  | Other (go to 2.3.5) |

#### 2.3.1 Stage 1

|  |  |  |
| --- | --- | --- |
| Source of external requirements (if any) | | |
| Organization | Document | Remarks |
|  |  |  |

Go to §3.

#### 2.3.2 Stage 2

|  |  |  |
| --- | --- | --- |
| Corresponding stage 1 work item | | |
| Unique ID | Title | TS |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| Other source of stage 1 information | | |
| TS or CR(s) | Clause | Remarks |
|  |  |  |

**If no identified source of stage 1 information, justify:**

Go to §3.

#### 2.3.3 Stage 3

|  |  |  |
| --- | --- | --- |
| Corresponding stage 2 work item (if any) | | |
| Unique ID | Title | TS |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| Else, corresponding stage 1 work item | | |
| Unique ID | Title | TS |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| Other justification | | |
| TS or CR(s) or external document | Clause | Remarks |
|  |  |  |

**If no identified source of stage 2 information, justify:**

Go to §3.

#### 2.3.4 Test spec

|  |  |  |
| --- | --- | --- |
| Related Work Item(s) | | |
| Unique ID | Title | TS |
|  |  |  |

Go to §3.

#### 2.3.5 Other

|  |  |  |  |
| --- | --- | --- | --- |
| Related Work Item(s) | | | |
| Unique ID | Title | Nature of relationship | TS / TR |
|  |  |  |  |

Go to §3.

### 2.4 Work task

|  |  |  |
| --- | --- | --- |
| Parent Building Block | | |
| Unique ID | Title | TS |
|  |  |  |

## 3 Justification

The pace of LTE network deployment is accelerating all over the world, which enables more and more advanced services and Internet applications making use of the inherent benefits of LTE, such as higher data rate, lower latency and enhanced coverage. Widely deployed LTE-based network provides the opportunity for the vehicle industry to realize the concept of ‘connected cars’. By providing a vehicle with an access to the LTE network a vehicle can be connected to the Internet and other vehicles so that a broad range of existing or new services can be envisaged. Vehicle manufacturers and cellular network operators show strong interests in vehicle wireless communications for proximity safety services as well as commercial applications.

LTE-based V2X study is urgently desired from market requirement, and the market for V2V communication in particular is time sensitive. There are many research projects and field tests of connected vehicles in some countries or regions, such as US/Europe/Japan/korea. In China, CCSA has finished the feasible study for vehicle safety application based on TD-LTE in 2014 and began the series of industrial standard of communication based on LTE for vehicle application. Further, in March 2015, the frequency study of V2X also started in CCSA and some vehicular industrial alliances in china. Based on the study, National Regulatory Authority in China will allocate the frequency of connected vehicles.

In order to respond to this situation, SA1#69 recently agreed a new Rel-14 study on LTE support for V2X services to investigate the essential use cases and requirements for the following (S1-150284/SP-150051):

* V2V (vehicle-to-vehicle): covering LTE-based communication between vehicles.
* V2P (vehicle-to-pedestrian): covering LTE-based communication between a vehicle and a device carried by an individual (e.g. handheld terminal carried by a pedestrian, cyclist, driver or passenger).
* V2I/N (vehicle-to-infrastructure/network): covering LTE-based communication between a vehicle and a roadside unit/network. A roadside unit (RSU) is a transportation infrastructure entity (e.g. an entity transmitting speed notifications) implemented in an eNodeB or a stationary UE.

The SA1 study considers both safety services and non-safety services and the possibility of using existing LTE technologies for unicast/multicast/broadcast communication.

Furthermore, RAN#66 sent an LS to SA1 (RP-142312) on possibility of vehicular services by adapting Rel-12 D2D specifications. The intention of this LS from RAN was to ask SA1 for requirements to allow study and workon vehicular services possibly even in Rel-13. SA1 responded to this LS in RP-150557/S1-151629 which contains the interim outcome of the SA1 study. Meanwhile, it is necessary to establish the evaluation methodology for feasibility of LTE-based V2X. RAN1 study done in the past showed that defining an evaluation methodology could consume some meeting cycles. Considering that RAN1 has not performed evaluations focusing on vehicular communications so far, an early start of this feasibility study will be beneficial for timely completion of the related specification works.

## 4 Objective

### 4.1 Objective of SI or Core part WI or Testing part WI

The objectives of this study are to evaluate new functionalities needed to operate LTE-based V2X (V2V, V2I/N, and V2P), and to investigate potential enhancements for vehicular services defined in [SA1 TR: TR 22.885]. The study should cover LTE-based V2X both with and without LTE network coverage, and cover both the operating scenario where the carrier(s) is/are dedicated to LTE-based V2X services (subject to regional regulation and operator policy including the possibility of being shared by multiple operators) and the operating scenario where the carrier(s) is/are licensed spectrum and also used for normal LTE operation.

The study should utilise output from SA1 as a baseline, where available, and should aim to re-use information available from external fora such as ETSI ITS, SAE (DSRC TC J2945/1), and CCSA.

The detailed objectives are as follows:

1. To define the evaluation methodology for LTE-based V2V, V2I/N and V2P services to compare the performance of different technical options, including the following aspects: [RAN1]
   1. Deployment scenarios, considering the above operating scenarios
   2. Modeling of vehicle density and mobility
   3. Traffic models and performance metric

At least the aspects of the methodology relevant to PC5 for V2V shall target RAN#69, to enable completion of objective 2.

1. For support of PC5 transport for V2V services (to be completed by RAN#70 – December 2015), at least including:
   1. Identify necessary enhancements (e.g. of potential enhancements: mitigate impact of half duplex constraint, reduce resource collision, enhance pool structure, enhance resource patterns, SA information transmitted in same subframe as the associated data) to the resource allocation mechanism to meet identified requirements for robustness, latency, overhead and capacity [RAN1]
   2. Identify any necessary PC5 enhancements for high Doppler case (e.g. up to 280 km/h up to 6 GHz) such as enhanced DMRS, and also synchronization based on GNSS at least for out of coverage operation.[RAN1]

Support for PC5 transport for V2V services shall be given the highest priority until RAN#70.

1. For support of Uu transport for V2V, and PC5/Uu transport for V2I/N and V2P services (to be completed by RAN#72 – June 2016), at least including:
   1. Evaluate the feasibility of Uu transport for V2V and V2P in terms of meeting latency requirements, network coordination required, resource efficiency, and energy efficiency of UE,. [RAN1, RAN2, RAN3]
   2. Identify and evaluate enhancements required to support each of eNB type and UE type RSU [RAN1, RAN2, RAN3]. According to the current SA status, RAN2 will not study solutions for UE-to-UE relaying based on a new architecture for UE-type RSU.
   3. Identify and evaluate the necessity of enhancements to multi-cell multicast/broadcast for reduced latency and improved efficiency [RAN1, RAN2, RAN3].

Note: It is up to SA WG(s) how to name the interface for direct vehicle-to-vehicle communication.

The identified options/enhancements should reuse the existing features of LTE as much as possible.

### 4.2 Objective of Performance part WI

### 4.3 RAN time budget proposal

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **RAN #68** | |  | | **Q3/2015** | | |  | | | | **RAN #69** | |
| R1L | R1U | R2L | R2U | | R2J | R3 | | R4RF  Core | R4RD Core | R4RF  Perf | | R4RD Perf |
| 82 | 82 | 91 | 91 | | 91 | 89 | | 76 | 76 | 76 | | 76 |
| **0.5** |  |  |  | |  |  | |  |  |  | |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **RAN #69 Q4/2015 RAN #70** | | | | | | | | | | | | | | | | | | | |
| R1L | R1U | R2L | R2U | R2J | R3 | R4RF  Core | R4RD Core | R4RF  Perf | R4RD Perf | R1L | R1U | R2L | R2U | R2J | R3 | R4RF  Core | R4RD Core | R4RF Perf | R4RD Perf |
| 82bis | 82bis | 91bis | 91bis | 91bis | 89bis | 76bis | 76bis | 76bis | 76bis | 83 | 83 | 92 | 92 | 92 | 90 | 77 | 77 | 77 | 77 |
| **2** |  | **0.5** |  |  |  |  |  |  |  | **2** |  | **0.5** |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **RAN #70** | |  | | **Q1/2016** | | |  | | | | **RAN #71** | |
| R1L | R1U | R2L | R2U | | R2J | R3 | | R4RF  Core | R4RD Core | R4RF  Perf | | R4RD Perf |
| 84 | 84 | 93 | 93 | | 93 | 91 | | 78 | 78 | 78 | | 78 |
| **2** |  | **1** |  | |  | **0.5** | |  |  |  | |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **RAN #71 Q2/2016 RAN #72** | | | | | | | | | | | | | | | | | | | |
| R1L | R1U | R2L | R2U | R2J | R3 | R4RF  Core | R4RD Core | R4RF  Perf | R4RD Perf | R1L | R1U | R2L | R2U | R2J | R3 | R4RF  Core | R4RD Core | R4RF Perf | R4RD Perf |
| 84bis | 84bis | 93bis | 93bis | 93bis | 91bis | 78bis | 78bis | 78bis | 78bis | 85 | 85 | 94 | 94 | 94 | 92 | 79 | 79 | 79 | 79 |
| **2** |  | **2** |  |  | **0.5** |  |  |  |  | **2** |  | **2** |  |  | **0.5** |  |  |  |  |

L: LTE, U: UMTS, J: Joint, RD: RRM/demodulation

## 5 Service Aspects

## 6 MMI-Aspects

## 7 Charging Aspects

## 8 Security Aspects

## 9 Impacts

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Affects:** | UICC apps | ME | AN | CN | Others |
| **Yes** |  | X | X | X |  |
| **No** | X |  |  |  |  |
| **Don’t know** |  |  |  |  | X |

## 10 Expected Output and Time scale

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| New specifications [If Study Item, one TR is anticipated] | | | | | | |
| Spec No. | Title | 1st rsp. WG | 2nd rsp. WG(s) | Presented for information at plenary# | Approved at plenary # | Comments |
|  | Feasibility Study on LTE-based V2X Services – Radio Aspects | RAN1 | RAN2, RAN3 | RAN #71 | RAN #72 |  |

NOTE: If this is a RAN WID including Core and Perf. Part, then all new Core part specs have to be listed first and then all new Perf. Part specs. Indicate “Core part” or “Perf. Part” under Comments for each spec.  
By default a new specs can only be new for one of both parts.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Affected existing specifications [None in the case of Study Items] | | | | |
| Spec No. | CR | Subject of the CR | Approved at plenary# | Comments |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

NOTE: If this is a RAN WID including Core and Perf. Part, then all new Core part specs have to be listed first and then all new Perf. Part specs. Indicate “Core part” or “Perf. Part” under Comments for each spec.  
If an existing spec is affected by both (Core part and Perf. Part), then it has to be listed twice with appropriate approval dates.

## 11 Work item rapporteur(s)

Hanbyul Seo, LG Electronics (hanbyul.seo@lge.com)

Ying Peng, CATT (pengying@catt.cn)

Deping Liu, Huawei (Liudeping@huawei.com)

## 12 Work item leadership

Primary: RAN WG1

Secondary: RAN WG2, RAN WG3

## 13 Supporting Individual Members

|  |
| --- |
| Supporting IM name |
| LG Electronics |
| CATT |
| ETRI |
| General Motors |
| IAESI |
| III |
| ITL |
| ITRI |
| LG Uplus |
| Sharp |
| SK Telecom |
| NEC |
| Nokia Networks |
| WILUS Inc. |
| KT |
| OPPO |
| Potevio |
| Coolpad |
| Broadcom Corporation |
| Panasonic |
| US Celluar |
| Dish Network |
| Huawei |
| HiSilicon |
| InterDigital |
| Qualcomm |
| Vodafone |
| CATR |
| Ericsson |
| TD-Tech |
| Chengdu TD-Tech |
| Spreadtrum Communications |
| Fujitsu |
| Fiberhome |
| Beijing Starpoint Technology |
| SRTC |
| CMCC |
| BlackBerry |
| ZTE |
| Deutsche Telekom |
| Orange |
| MediaTek |
| Intel |
|  |

form change history:

2013-12-06 v1.14.1 modified §11 to read: <FamilyName>, <GivenName>, (If the person is new to 3GPP work, give full contact coordinates, in particular, email address.)

2013-10-03 v1.14.0 removal of embedded help text

v1.13.2: adds tdoc header

v1.13.1: minor changes resulting from discussions at CT#41 & SA#41

v1.13.0: mods to enforce linkage amongst stages 1, 2, 3

draft mods Scarrone-Meredith 2008-07 ff

v1.12.1: removes revision marks following approval at SP-29  
v1.12.0: includes provision for Study Items (SP-29)

v1.11.0: includes those changes from v1.8.0 agreed at SP-25.

v1.10.0: full circle

v1.9.0: a clean sheet

v1.8.0: includes comments from SA#24

v1.7.0: includes comments from RAN, CN and T #24; also includes “early implementation” data

v1.6.0: includes comments made during review period prior to TSGs#24

v1.5.0: includes comments made at TSGs#23 (Phoenix)

v1.4.0: offered to SA#23 for approval

v1.3.0: offered to CN#23, RAN#23 and T#23 for comments

DRAFT4 v1.3.0: 2004-03-09: Incorporation of comments from Leaders list

DRAFT3 v1.3.0: 2004-02-19: Incorporation of comments from MCC members

DRAFT2 v1.3.0: 2004-01-29: Complete redraft:

v1.2.0: 2002-07-04: "USIM" box changed to "UICC apps"

2003-05-28: spelling of “rapporteur” corrected

2002-07-04: "USIM" box changed to "UICC apps"