Communication-based ITS
ERTICO – ITS Europe was founded at the initiative of leading members of the European Commission, Ministries of Transport and the European Industry.

ERTICO is the network of Intelligent Transport Systems and Services stakeholders in Europe. It connects public authorities, industry players, infrastructure operators, users, national ITS associations and other organisations together.
The initiative was driven by the European Commission, with the support of ERTICO and the ACEA (Association of European Car Manufacturers).

eSafety is working for a quicker development and increased use of smart road safety and eco-driving technologies.
EU 통신기반 ITS: 추진체계 [4]

The **eSafety Forum** is a joint platform involving all road safety stakeholders. Its general objective is to promote and monitor the implementation of the recommendations identified by the **eSafety Working Group** and to support the development, deployment and use of eSafety systems.

[Diagram of eSafety Forum Working Groups]

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EU 통신기반 ITS: 추진체계 [4]

**C2C Communication Consortium**

http://www.car-to-car.org

**Industrial Consortium:** The CAR 2 CAR Communication Consortium (C2C-CC) is a non-profit organisation consisting of nearly all European vehicle manufacturers, several suppliers, research organisations and other partners.

**CEN**

http://www.cen.eu

**Standardisation:** The European Committee for Standardization (CEN) is a business facilitator in Europe, removing trade barriers for European industry and consumers.
EU 통신기반 ITS: 추진체계 [4]

ETSI

http://www.etsi.org

Standardisation: The European Telecommunications Standards Institute (ETSI)

IETF

http://www.ietf.org

Standardisation: The Internet Engineering Task Force (IETF)
EU 통신기반 ITS: COM eSafety [4]

Political, Social and Economic Interests

European Projects

- COOPERS
- CVIS
- SAFESPOT
- Etc.

Harmonization

- Convening
- Stimulation
- Moderation
- Editing
- Dissemination

Standardisation

- ETSI
- CEN
- IEEE
- ITU
- ISO
- IETF

Group of Experts

Specifications

Combination
Clarification

For detail, refer to “1.2 Standardization and other Consortia” of [4], pp. 23–33.

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Visualization of the Requirements Collection Process
EU 통신기반 ITS: 주요 프로젝트 [4]

Co–operative Systems for Intelligent Road Safety
http://www.coopers-ip.org

Cooperative Vehicle–Infrastructure Systems
http://www.cvisproject.org

Preparation for driving implementation and evaluation of C2X communication technology
http://www.pre-drive-c2x.eu

Communication for eSafety
http://www.comesafety.org

Cooperative vehicles and road infrastructure for road safety
http://www.safespot-eu.org

Secure Vehicular Communication
http://www.sevecom.org

European ITS Framework Architecture
http://www.frame-online.net

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While the CAR 2 CAR Communication Consortium has invested significant effort into the *specification* of a car-to-car communications mechanism suitable for safety applications, its mandate does not extend beyond defining a specification.

At the same time, ongoing projects like SafeSpot would need an actual implementation to rely on whereas other such as CVIS are developing a communication architecture relying on the maintenance of a *constant access to the Internet over IPv6*.

**GeoNet** shall bring the basic results from the work of the CAR 2 CAR Communication Consortium to the next step, by further improving these specifications and creating a baseline software implementation interfacing with IPv6.

The goal of GeoNet is thus to implement and formally test a networking mechanism as a **standalone software module** which can be incorporated into Cooperative Systems.
EU 통신기반 ITS: 주요 프로젝트 [4]

SAFESPOT, CVIS, COOPERS European projects are:

- part of the COMeSafety Task Force to design the common architecture
- demonstrating the technological feasibility of:
  - applications for road safety and traffic efficiency
  - interoperability of cooperative systems

COMeSafety, E-FRAME European projects are:

- moving steps towards the common European architecture

EU 통신기반 ITS: 프로젝트 별 주안점

EU 통신기반 ITS: 프로젝트 별 주안점

**CVIS**
- Coordinator: ERTICO
- Total budget: € 41 Million
- Consortium: 61 partners - 12 countries
- Focus: Efficiency - V2R services

**SAFESPOT**
- Coordinator: Fiat Research Centre
- Total budget: € 38 Million
- Consortium: 51 partners - 12 countries
- Focus: Safety - V2V low latency

**coopers**
- Coordinator: Austria tech
- Total budget: € 16.8 Million
- Consortium: 37 partners - 14 countries
- Focus: Roadside / Infrastructure

Co-operating projects also includes: GeoNet, SeVeCOM, COMeSafety, Car-2-Car Communications Consortium (C2C-CC), Network on Wheels (NoW), INVENT, ACTIV (Germany), CVIS (UK), IVSS (Sweden)

Cooperative Vehicle-Infrastructure Systems

http://www.cvisproject.org

• To create a unified technical solution allowing all vehicles and infrastructure elements to communicate with each other in a continuous and transparent way using a variety of media and with enhanced localisation

• To enable a wide range of potential cooperative services to run on an open application framework in the vehicle and roadside equipment
In-vehicle Map Update: To receive map updates and live traffic or road infrastructure reports, along with other relevant local information views in cars.
In-vehicle Internet/Mobile Office: To provide Internet services on board that can be used by the driver when the car is stopped or by the passengers with the car on the move.
**Obstacle Warning:** To increase driver’s awareness of obstacles by receiving live information (e.g. video) from other vehicles or roadside units.
Road Status Report: To alert other drivers (and infrastructure) about road conditions/incidents (e.g. by image sharing and possibly by store and forward).
Flexible Lane Allocation: To increase the capacity on certain road sections in and around towns by allowing the use of bus lanes, without causing any disturbance to the public transport.
Area Routing and Control: To offer alternative routes in towns in the event of an accident or incident.
Cooperative Traveller Assistance: To give support to drivers by planning a personalised route to follow, and to help the roadside manager to predict traffic congestion and delays as well.
Personalized Route Planning Based on Expected Travel Times: To provide drivers with a personalised route to follow and to help the roadside manager to predict traffic congestion and delays.
Urban Parking Zones: To allow advanced booking of urban parking lots (to professional and particular drivers).
CVIS: ITS Subsystems


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SAFESPOT is working to design cooperative systems for road safety based on vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) communication.

SAFESPOT will prevent road accidents by developing a: "SAFETY MARGIN ASSISTANT" to detect in advance potentially dangerous situations and extend, in space and time, drivers’ awareness of the surrounding environment.
**Accident at intersection**: A crash happens at an intersection resulting in a dangerous situation; the drivers approaching an intersection are warned about such event.
**SAFESPOT: Applications [2]**

**Safe Overtaking:** Host vehicle (1) starts to overtake vehicle (3) while a Powered Two Wheelers (2) is already in overtaking manoeuvre PTW (2) informs the host vehicle (1) about its manoeuvre.

**Lane Change Maneuver:** This scenario aims to inform and/or warn truck driver (V1) about the presence of other vehicle (V2) around him during manoeuvre, especially during lane change manoeuvre.
**SAFESPOT: Applications [2]**

Head On Collision Warning: As in the pictogram below, host vehicle (1) attempts an overtaking manoeuvre to vehicle (3) which obstructs the driver's (1) field of view, while vehicle (2) is approaching from the opposite lane.

Rear End Collision Warning: A vehicle (2) is climbing up a sharp hairpin curve, while a heavy vehicle (1), short ahead, is driving at a low speed due to the steep road.
SAFESPOT: Applications [2]

Speed Limitation and Safety Distance: This scenario aims to provide to the vehicle driver (2) some recommendations in term of speed and safety distance regarding the behaviour or status of the vehicle in front. Special focus can be done on trucks carrying dangerous goods.

Static Obstacle Warning: This scenario aims to inform and/or warn truck drivers about the presence of a static obstacle in front.

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**SAFESPORT: Applications [2]**

**V2I-based Road Condition Status:** This scenario aims to inform and/or the driver in V2 about the road condition status detected by V1. The data is transferred via a road control centre.
V2I-based Road Condition Status: Host vehicle (1) transmits to an infrastructure transponder (3) its speed and (possibly) other vehicle dynamics information. Later, a vehicle approaching to the rural black spot (2) receives this information, adapting its speed depending on multiple parameters, including map and navigational information, if available, and the behaviour of other vehicles.
Vulnerable Road User Detection: This scenario aims to inform/warn/recommend vehicle driver about the presence of a vulnerable road user who is crossing a road.

The vehicle V1 is equipped with an on-board VRU detection system. A VRU is not detected by the driver V2 due to the bad visibility: hidden by a vehicle (V1 or V3) or due to bad weather condition.
The development of innovative telematics applications on the road infrastructure with the long term goal of a “Co-operative Traffic Management” between vehicle and infrastructure.

The enhancement of road safety by direct and up to date traffic information communication between infrastructure and motorized vehicles on a motorway section.
Co-operative Traffic Management

COOPERS Service List

- Accident/Incident Warning
- Road/Weather Condition Warning
- Roadwork Information
- Lane Utilization Information
- In-Vehicle Variable Speed Limit Information
- Traffic Congestion Warning
- ISA with Infrastructure Link
- Road Charging to Influence Demand
- International Service Handover
- Route Navigation – Estimated Journey Time
- Route Navigation – Recommended Next Link
- Route Navigation – Map Information Check of Current Update for Digital Maps
For drivers:
• traffic jam warning and guidance
• in–car display and alert of area–specific speed limits
• lane specific, selective ban of lorries
• estimated time of arrival, based on current traffic situation on the network
• car breakdown/emergency services

For network operators:
• enhanced traffic management based on floating car data
• safety related information for drivers, speed and distance proposal
• data exchange between operators for international seamless service handover
• monitoring of transport flows and information exchange for changing demands of transport

COOPERS Project Abstract
COOPERS [3]

Road side data acquisition

RCU: Roadside Control Unit
Illustration of the infrastructure of COOPERS services
COOPERS [3]

Proposed interfaces between different devices in the COOPERS architecture
WAVE: IEEE 1609

WAVE (Wireless Access in Vehicular Environments)

The WAVE standards define an architecture and a complementary, standardized set of services and interfaces that collectively enable secure vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) wireless communications. Together these standards provide the foundation for a broad range of applications in the transportation environment, including vehicle safety, automated tolling, enhanced navigation, traffic management and many others.


**WAVE [5]**

IEEE 802.11p + IEEE 1609.x + SAE 2735

<table>
<thead>
<tr>
<th>Layer Type</th>
<th>Layer</th>
<th>ISO/OSI ref model</th>
<th>Data Plane</th>
<th>Management Plane</th>
</tr>
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<tbody>
<tr>
<td>Higher Layers</td>
<td>IEEE 1609.1</td>
<td>7 Application</td>
<td>e.g. HTTP, WAVE Application</td>
<td>WAVE Station Management</td>
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<td></td>
<td>SAE J2735</td>
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<tr>
<td>Network Services</td>
<td>IEEE 1609.2</td>
<td>4 Transport</td>
<td>TCP/UDP, WSMP</td>
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<td></td>
<td>IEEE 1609.3</td>
<td>3 Network</td>
<td>IPv6</td>
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<td>2b Data Link</td>
<td>802.2 LLC</td>
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<td></td>
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<td>WAVE MAC</td>
<td>MAC Management</td>
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<tr>
<td>Lower Layers</td>
<td>IEEE 1609.4</td>
<td>1b Physical</td>
<td>WAVE Physical Layer Convergence</td>
<td>PHY Management</td>
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<tr>
<td></td>
<td>IEEE 802.11p</td>
<td>1a Physical</td>
<td>WAVE Physical Medium Dependent</td>
<td></td>
</tr>
</tbody>
</table>

1609.1 Resource Manager  
1609.2 Security Services  
1609.3 Networking Services  
1609.4 Multi-channel operations

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WAVE: Requirements of IEEE 802.11p [5]

- Changes in baseline 802.11 standards are required to:
  - support longer ranges of operation (up to ~1000 meters),
  - the high speed of the vehicles (up ~500 km/h relative velocities),
  - the extreme multipath environment (many reflections with long delays (up to ~5 μs max excess)),
  - the need for multiple overlapping ad-hoc networks to operate with extremely high quality of service, and
  - the nature of the automotive applications (e.g. reliable broadcast) to be supported.

Based on: IEEE 802.11p & Tan (2008): Measurement and Analysis of Wireless Channel Impairments in DSRC Vehicular Communications
WiMAX vs. WiFi

Some people describe the difference between WiFi and WiMAX as analogous to the difference between a cordless phone and a mobile phone. WiFi, like a cordless phone, is primarily used to provide a connection within a limited area like a home or an office. WiMAX is used (or planned to be used) to provide broadband connectivity from some central location to most locations inside or outside within its service radius as well as to people passing through in cars. Just like mobile phone service, there are likely to be WiMAX dead spots within buildings.
A **Vehicular Ad-Hoc Network**. or VANET, is a form of Mobile ad-hoc network, to provide communications among nearby vehicles and between vehicles and nearby fixed equipment, usually described as roadside equipment.

This network tends to operate **without any infra-structure or legacy client and server communication**. Each vehicle equipped with VANET device will be a node in the Ad-Hoc network and can receive and relay others messages through the wireless network. Collision warning, road sign alarms and in-place traffic view will give the driver essential tools to decide the best path along the way. [http://en.wikipedia.org/wiki/VANET](http://en.wikipedia.org/wiki/VANET)
The **Communications Access for Land Mobiles** (CALM) architecture provides an abstraction layer for vehicle applications, managing communication for multiple concurrent sessions spanning all communications modes, and all methods of transmission.

CALM enables the following communication modes:
- **V2I**: communication initiated by either roadside or vehicle
- **V2V**: peer to peer ad-hoc networking amongst fast moving objects following the idea of MANET’s/VANET’s
- **I2I**: point-to-point connection where conventional cabling is undesirable

Methods of transmission may be based on one or more of the following communication media: Infrared, GSM, DSRC, IEEE802.11 including WAVE, WiMAX, MM-wave, Satellite, Bluetooth, RFID.

References