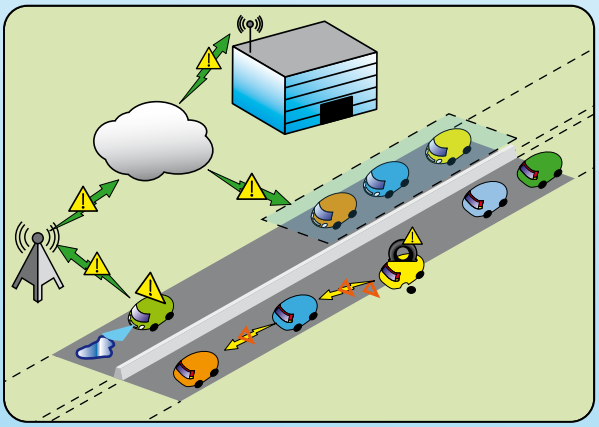
GeoNet

Geographic addressing and routing for vehicular communications

Vision

Next-generation vehicles are expected to be able to exchange information (beyond their immediate surroundings and line-of-sight) with other vehicles as well as with the road infrastructure and Internet peers. This will enable trajectories to be forecast, and the coordination of merging maneuvers between sideways neighbors. It would allow vehicles to be notified instantly of the braking action of vehicles in front of them and to warn oncoming traffic of icy patches. Road traffic conditions could be reported and parking lots located. It could also simply provide entertainment for passengers. In this context, the transmission of information shall target vehicles in a particular **geographic area**.



The exchange of information with vehicles in a particular geographic area - potentially far away from the information source - requires reliable and scalable communication capabilities. We refer to these capabilities as **geographic addressing and routing (geonetworking)**.

Geonetworking and IPv6 integration

The TCP/IP protocol suite provides a unifying layer between various physical communication technologies and various types of applications used in different contexts and environments. A wide deployment of in-vehicle onboard Internet access and services to millions of vehicles certainly will only be possible with IPv6, the latest version of the Internet Protocol. However, geonetworking is still lacking in IPv6.

GeoNet is thus committed to address this gap by **combining geonetworking and IPv6** into a single communication architecture, that we refer to as **IPv6 geonetworking**. The combination of geonetworking and IPv6 will allow for both IPv6 and non-IPv6 communications. This will, effectively, open the door for the development of new applications that require data to be transmitted to explicit geographical areas.

Standardization

Standardization is a necessary step for wide dissemination of any technology, particularly at the network layer and in IPv6. Consequently, GeoNet aims to develop **a reference specification** of IPv6 geonetworking. This will be achieved through active participation in standardization bodies such as ETSI TC ITS, ISO TC204 WG16 (CALM) and IETF.

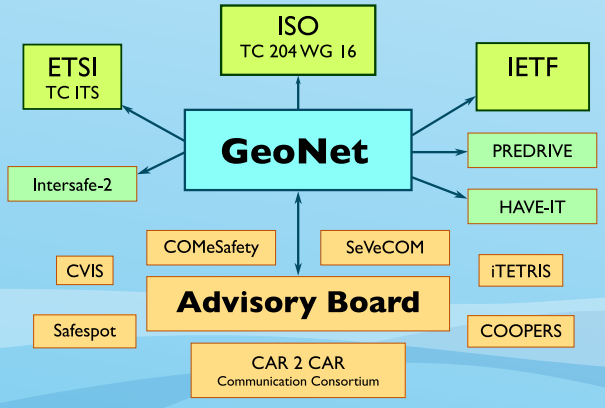
Development

Two independent Linux-based **prototype implementations** will be developed to ensure the completeness and unambiguity of the GeoNet reference specification. This will ensure greatly-enhanced software quality and stability. Implementations will be platform-independent and will be easily incorporated into different cooperative architectures. It will enable subsequent large-scale field operational trials (FOT) and facilitate the future development of more complex functionalities

The compliance of implementations with GeoNet specifications and their expected performance, scalability and efficiency will be assessed against well-known ETSI and ISO/IEC standards. This will be done during conformance tests and field trial experiments conducted using actual vehicles. An emulation environment including emulated and real radio modules will be developed to validate implementations in scenarios traditionally too complex to be performed in field tests.

Links with other projects

GeoNet is coherent with the i2010 Intelligent Car Initiative7. Its impact on the 2007 Work Programme will be the "Improved safety, efficiency and competitiveness of transport systems across Europe". GeoNet will, therefore, be an enabler for the rapid introduction of vehicular communications in Europe. Its reference specification will become the baseline for vehicular networking for several years to come. The resulting prototype implementations shall enable subsequent field trials to assess reliability and scalability of vehicular communications under realistic scenarios as opposed to just demonstrating the feasibility of some data exchange between vehicles.



As such, GeoNet has been designed to ensure dissemination of its outputs and to provide for strong relationships with both existing and future projects. This is implemented through the **Advisory Board**, which brings together delegates from partner projects who provide feedback and advice such as CAR 2 CAR Communication Consortium, SafeSpot, COOPERS, CVIS, COMeSafety, SeVeCom, iTETRIS, HAVE-IT and PreDriveC2X.

Exploitation of results

As well as appearing in conference publications and journals, the reference specification of the implemented geonetworking stack will be made publicly available. Having contributed their efforts to design and implement the solution, GeoNet partners' rights will be safeguarded through IPR. This will also allow the public dissemination of the resulting specification and implementations to research and industrial third parties. To a certain extend, GeoNet is akin to Open Source within the GeoNet consortium. Agreements or licenses are necessary to use the binaries or access the source code.

Subject to agreement, training will be provided to interested parties, covering an explanation of the geonetworking architecture, a guide to application development over IPv6 geonetworking, and the integration of the prototype implementations into third party development platforms. A porting guide will be developed, identifying critical and system-dependent parts. The goal is to allow third parties to easily integrate the GeoNet stack into their own environment.

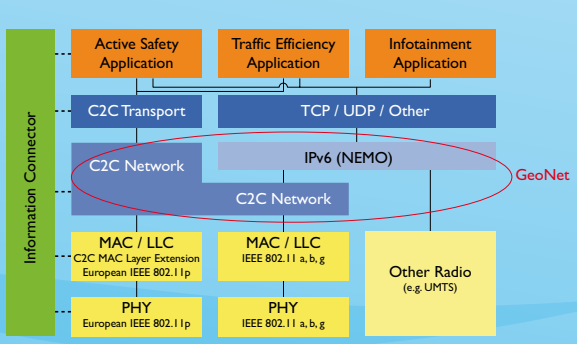
Technical approach

GeoNet is seeing vehicles as a network made of several communication nodes. A typical in-vehicle network comprises:

- An on-board unit (**OBU**) functioning as a **mobile router** in charge of communications with other vehicles, road-side units (RSUs) and computers located in the Internet;
- A number of application units (**AUs**) such as a dedicated device for safety applications like hazard-warning, a navigation system with communication needs, a nomadic device such as a PDA that runs Internet applications, or infotainment devices.

Several interfaces of various radio types will be available on the OBU. GeoNet will principally use IEEE 802.11p for its experiments but the communication architecture will not preclude any other communication media.

The OBU is in charge of maintaining Internet connectivity (using NEMO) and takes routing decisions, like maintaining routing paths with other vehicles (a georouting functionality efficient under fast changing topology without excessive amount of air interface signaling), deciding through which interface a particular flow should be transmitted (policy routing), etc.



GeoNet is structured in seven technical work packages, comprising all the usual design steps from architecture, specification, implementation, conformance testing, emulation environment, porting to a target platform, and experimental validation.

GeoNet starts its work from the Car 2 Car Communication Consortium (C2C-CC) protocol stack which includes IEEE standards, IETF TCP/IP standards, and ITS-specific IP and non-IP protocol blocks (see picture aside). The IPv6 protocol suite and past, unfruitful efforts on IPv6 geonetworking are then analyzed to identify the necessary protocol functionalities so that geonetworking is combined with IPv6. A thorough security threat analysis is conducted by investigating the impact of traditional attacks on vehicles operating IPv6 geonetworking.

The GeoNet reference specification includes:

- The geonetworking protocol with mandatory and compulsory functionalities.
- A transparent bridging adaptation layer between geonetworking and IPv6 networking protocols.

Project consortium

The GeoNet consortium is a well-balanced European consortium with 7 partners from 6 different countries including one of the new member states of the EC, It also reflects a well balanced typology comprising, as it does, of 2 Research Institutes, 1 SME and 4 industrial partners.

BroadBit Inc.
www.broadbit.com

Efkon AG
www.efkon.com

Hitachi Europe Ltd.
www.hitachi-eu.com

Fundación Instituto Madrileño de Estudios Avanzados
www.imdea.org

Institut National de Recherche en Informatique et en Automatique
www.inria.fr

lesswire AG
www.lesswire.com

NEC Laboratories Europe
www.neclab.eu

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www.geonet-project.eu