An open platform for interactive ITS services on hybrid satellite/terrestrial networks

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In a mobile vehicle as a network node...

... an intelligent combination of several means of communication may offer new possibilities

Hybrid satellite/terrestrial networks are a cost-effective solution for a new generation of ITS
The car as a communication centre

Many new services around the vehicle

The expected number of users and applications demands for efficient communication

Applications for infotainment and ITS require increasing interactivity

No universal distribution channel is good for all applications and services
New services around the vehicle

1. MEDIA & ENTERTAINMENT
   • Satellite radio / TV
   • Entertainment services

2. NAVIGATION & INFORMATION
   • Map updates
   • Location-based services
   • Road safety alerts
   • Collaborative road alerts

3. CAR MANUFACTURERS
   • Software updates
   • Remote vehicle diagnostics

4. FLEET MANAGEMENT
   • Passenger ident. and tracking
   • Car / truck / trailer / goods tracking

5. INSURANCE
   • Pay-as-you-drive
   • Stolen vehicle tracking

6. TRANSPORTATION
   • Toll collection/ Road charging
   • Traffic management
   • Patrol with eyes

7. PUBLIC SECTOR
   • Emergency call (with video)
   • Intelligent Transport Systems (ITS)
   • Driver alertness service
I can do everything with my smartphone...

...true or false in a car?
A simple example

For a single SMS of 160 bytes sent to all Italian cars (about 36 million) around 6 GBytes of data are transmitted if using unicast channel.

To send one SMS per hour, a channel capacity of 12 Mbit/s is needed just for this simple service...

... and there are around 200 million of vehicles in Italy, France, Germany, Spain, UK and more than 300 million in EU27 countries.

Do we have enough spectrum?
Why digital broadcasting

Bandwidth availability
  ▶ With digital broadcasting around 1 Kbit/s is needed to send one SMS per second to an unlimited number of recipients

Area Coverage
  ▶ UMTS (and LTE) are mainly available in urban areas
  ▶ In-car connectivity is not always reliable
  ▶ Digital broadcasting offers the option for better availability
  ▶ Satellite broadcasting enables large area coverage without the need for terrestrial infrastructure

Real-time capabilities
  ▶ Alert messages to unlimited number of users with guaranteed delay for all recipients
Strengths of the satellite communication (SatCom)

Global coverage
- Independent of terrestrial network (in case of disaster)
- Supports pan-European services

Best support of broadcast applications
- Mobile TV, Satellite Digital Radio
- Increase the popularity of the system
- Increase the manufacturer’s interest

Quick and easy deployment
- Ensure full coverage as soon as the system is launched
- Avoid economical problem concerning low populated areas

Ecologic oriented
- Mix business oriented applications with institutional research
- More ecologic than terrestrial repeaters
S-band: a new opportunity from SatCom

Exclusive use for Mobile Satellite Services (MSS) according to the Decision 626/2008/EC

Eutelsat W2A satellite designed to include first European S-band payload, ramp-up for commercial services

Spectrum: 1980-2010 MHz uplink, 2170-2200 MHz downlink

Small omni-directional antennas for automotive

Broadcasting forward link with DVB-SH standard for multi-media broadcasting

Message-based return link with new standard protocol for short messages sent from vehicles via satellite
**S-band forward link with DVB-SH**

**DVB-SH** (SH is for *Satellite Handheld*) is the name of a transmission system standard designed to deliver video, audio and data services to vehicles and handheld devices.

DVB-SH is **hybrid satellite/terrestrial**. The use of satellite enables the coverage of large regions or even a whole country.

Where direct reception of the satellite signal is not possible, a terrestrial complementary network can provide seamless coverage.
Forward Link
Reference Scenario
DVB-SH Features

DVB-SH systems offer global coverage combining one *Satellite Component (SC)* and multiple *Complementary Ground Components (CGC)*:

- **SC** provides the wide geographical coverage
- **CGC** provides the urban and indoor cellular coverage

DVB-SH is designed to use frequencies below 3GHz

- 2 macro channels each 15 MHz wide, on the fwd and rtn link.
- Each macro channel is composed of 3 channels 5 MHz wide.
Why digital broadcasting for ITS?

Efficient Distribution
- Traffic information and alerts
- Local information like news, weather, park situation
- Update of maps

Availability
- Outside urban areas, no continuous reception of internet radio is possible
- Digital broadcasting offers additional availability
- Satellite broadcasting enables transnational area coverage

Convergence
- Using the best distribution channel depending on the situation
- Combination of various communication channels
What about interactivity?

Broadcast and interactive services (SS1) may intensively use broadcasting but also need the vehicle communicate with service centres.

Data acquisition services (SS2) will intensively use car-to-infrastructure communication and may sometimes use broadcasting features.

Real-time (emergency) services (SS3), requires full two-way communication with almost symmetric use of the forward and return link.
Example of Services

Broadcast Services: audio and video streaming, files delivery

Messaging services auxiliary to broadcast, with no need of GNSS: televoting, home shopping

Data acquisition services, with no need of GNSS: Vehicle Telemetry, User Short Messages

Data acquisition services, using also GNSS: Anti-theft, Traffic Monitoring, Automatic Toll Payment, Distress Beacon, Environmental Monitoring

Real-time emergency services: eCall, 2way IP connection, Alarm dispatch
Return link for the automotive

Terminals can start the communication at any moment

Terminals are not synchronized each other or with a service centre

Application messages can be normally sent via a “Store and Forward” mechanism

Short messages can cope with the needs of a wide number of interactive applications in the area of Broadcasting services, Messaging Services and Data acquisition services
True innovation in the return link

A new technology for the S-band return link allow a population of tens of millions of terminals to send few tens of short messages (150 Bytes) per day per user.

With this new technology, terminals use a new protocol similar to 3GPP W-CDMA / S-UMTS and can be compact, low power and easy to build.

Receive/Transmit antennas are very compact: they fit the needs of the automotive market.

The new protocol, named Enhanced Spread Spectrum Aloha (E-SSA) has been patented by ESA and currently under standardization by ETSI (S-MIM).
S-band Return Link Reference Scenario
On a 5MHz channel, **36 Millions of terminals can send 10 SMS per day of 1.200 bits each**
The mission of the SafeTRIP project

Combine digital broadcasting with novel satellite return link technology and complementary communication channels to enable truly innovative bi-directional services for the automotive user with pan-European coverage.

Use S-band satellite communication with GNSS positioning (GPS / EGNOS / GALILEO), in order to create a powerful and flexible open platform allowing any organization to implement and deploy their own ITS and multimedia entertainment applications.
SafeTRIP at a glance

SafeTRIP: Satellite Applications For Emergency handling, Traffic alerts, Road safety and Incident Prevention

- 20 partners from 7 countries
- **Call:** FP7-SST-2008-RTD-1; **Project:** SCP8-GA-2009-233976
- **Duration:** 42 months; **Start:** 01/10/2009; **End:** 31/03/2013
- **Budget:** M€ 11,25; **Funding:** M€ 7,90
- **Web-Site:** [http://www.safetrip.eu](http://www.safetrip.eu)
- **Project Coordinator:** Guy Fremont – Sanef (Abertis Group)
- **Contact:** contact@safetrip.eu
SafeTRIP system concept

EGNOS/Galileo

S-band satellite

DVB SH

3G/4G

Greenbox

App1  App2  AppN

HUB/NOC: DVB-SH hub facilities, CDMA hub, A/V interfaces, Interface to service center
The way to the SafeTRIP logical architecture 1/2
The way to the SafeTRIP logical architecture 2/2

Make applications independent on the transport media

• Hardware abstraction layer
• Positioning and map data
• Vertical handover with smart routing
• User authentication, profiling and accounting
• Non real-time short messages protocol
• Reliable file datacasting
• Broadcasting with Electronic Service Guide
• …

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SafeTRIP Logical Architecture
The SafeTRIP middleware
What is the middleware?

- The middleware provides applications and services with an abstraction of the communications layer and core services.
- Application developers will not deal with implementation details, but will make use of simple and standard interfaces.
- It provides a number of enabling services that work as mediators and are used by the end user services.
- It runs on both the onboard unit and a central segment.
Middleware components

- Broadcast
- Non Realtime Messaging
- Core
- Realtime Bi-Directional
Current status of the SafeTRIP project

Development will end on December 2011

On-going integration and tests in Italy, Germany, Spain and France

Preliminary field trials scheduled in March 2012 in Germany

Field trials from June 2012 in Spain and France, mainly on autoroutes
SafeTRIP demonstrator Hub equipment

- Fully software implementation of the RTN link demodulator (MBI)
- Software radio technology in combination with GPU computing
- Runs on commercial hardware
SafeTRIP demonstrator onboard setup

Experimental on-board unit including S-band technology prototyped by FHG-IIS

Commercial OBU including most of the demo applications provided by Masternaut

Passenger interaction based on TabletPC
An example of vehicular antenna

Receive DVB-SH, Transmit E-SSA

Dual circular polarisations

Available now
New possibilities for attractive services

Satellite coverage allows truly pan-European traffic management services

New satcom technologies allow efficient and convenient distribution of content to large groups of users and to send messages directly from the car to the satellite

Standards-based middleware simplify deployment of advanced services hiding the complexity of the communication channel
An example: *SafeTRIP Info Explorer*

**Problem(s)**
- Information Overload for the driver
- Poor information search interfaces
- Demand for rich geo-localised information

**SafeTRIP Info Explorer**
- Exploit broadcast capability of SafeTRIP
- **Innovation** – New Information Exploration paradigm
Service Overview

SafeTRIP Info Explorer Service Centre
Aggregation, Adaptation, Transmission

Internet

3rd Party Service Providers
POI, hotels, restaurants, weather

In-vehicle Aggregator
Web Application

Broadcast to all vehicles
Map & geolocalised information

SafeTRIP.eu
Development roadmap

Apr
Mock-Up
Development roadmap

Apr
Mock-Up

July
Bus Study
Development roadmap

Apr
Mock-Up

July
Bus Study

Aug
In-car study

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Development roadmap

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- July: Bus Study
- Aug: In-car study
- Nov: Final Version

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User Interface

Zoom

Search

Channels

My Location

Target

Marker/Link
Trials in London
SafeTRIP cross-fertilization

- **NEARCTIS**
  - Network of Excellence for Advanced Road Cooperative traffic management in the Information Society

- **SCUTUM**
  - SeCuring the EU GNSS adopTion in the dangeroUs Material transport

- **OVERSEE**
  - Open Vehicular Secure Platform
SafeTRIP will be present at...

Automotive User Interfaces and Interactive Vehicular Applications 2011 (29/11-02/12/2011, Salzburg, Austria)

Transport Research Arena Europe 2012 (23-26/04/2012, Athens, Greece)

Computer Human Interface CHI2012 (USA)

75th IEEE Vehicular Technology Conference VTC2012 (6-9/05/2012, Yokohama, Japan)

SPACOMM 2012 - 4th International Conference on Advances in Satellite and Space Communications (29/04-04/05/2012, Chamonix, France)

European Forum on digital TV (June 2012, Lucca, Italy)

ASMS 2012 - 6th Advanced Satellite Multimedia Systems Conference (Fall 2012, Baiona, Spain)

ITS World Congress 2012 (22-26/10/2012, Vienna, Austria)
Credits

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Thank you for attention

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