iTETRIS Newsletter

June 2010

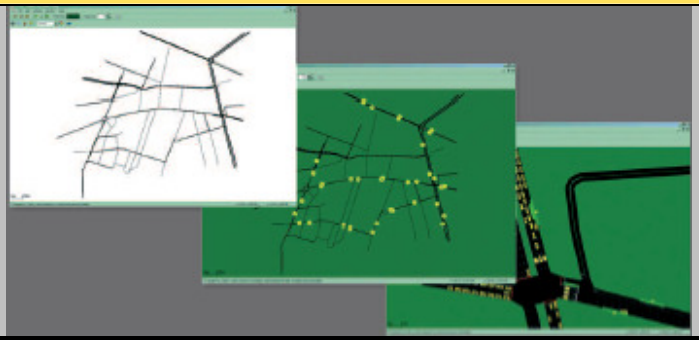
Welcome to the third issue of the iTETRIS (www.ict-itetris.eu) newsletter. This project supported by FP7 Cooperation Work Programme ICT is engineering an integrated wireless and traffic simulation platform for real-time road traffic management solutions. This third issue of the iTETRIS newsletter focuses on the activities carried out inside the project for the successful delivery of the iTETRIS simulation framework. This third newsletter is elaborated from the use cases presented in the previous issue to introduce the features that have been implemented and that have been instrumental in leveraging the first observations on the large scale effectiveness of cooperative ITS traffic management strategies. The following sections present the main features behind traffic management, communications and networking that profile iTETRIS capabilities. The Newsletter also covers integration aspects of the three main components of the iTETRIS platform: SUMO, ns-3 and the iCS (iTETRIS Control System). Finally, the next steps to be followed in the establishment of an iTETRIS Open Community are presented.

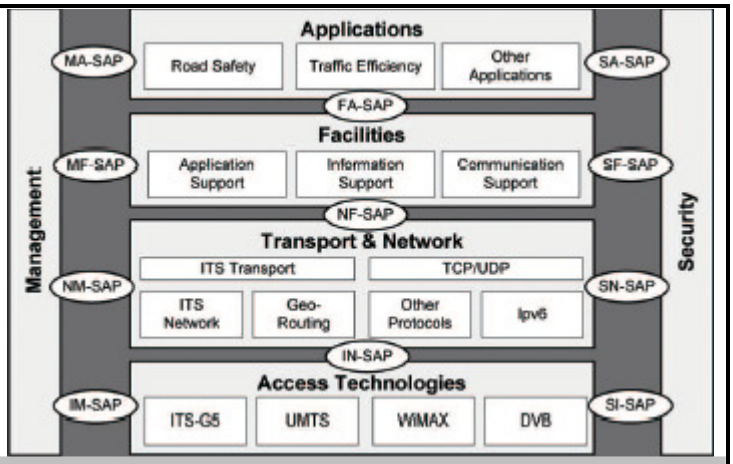
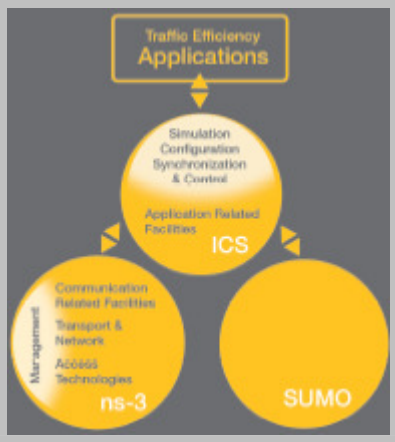
iTETRIS – Cooperative ITS at Large Scale

The most important question raised today by road authorities is: how can road traffic engineering applications be estimated in terms of the actual worthiness of investment and effectiveness in large-cities? V2V/V2I communication technologies promise to improve traffic management through Real-Time exchange of Traffic Information (RTTI). However, before cooperative ITS systems are widely deployed and evaluated in Field Operational Tests (FOTs), road authorities need clear evidence at city level on the benefits and impact of these solutions for their own particular scenarios.

The iTETRIS FP7 project has developed an **open, ETSI standard compliant, and flexible simulation framework** to satisfy this need within a close collaboration between engineering companies, road authorities, and communications experts.

iTETRIS integrates **high-fidelity wireless communications and road traffic simulation platforms** in an environment that is easily tailored to specific situations allowing performance analysis of cooperative ITS at city level. The accuracy and scale of the simulations leveraged by iTETRIS will clearly reveal the impact of cooperative ITS assisted-traffic engineering on city road traffic efficiency, operational strategy, and communications interoperability. The main technical capabilities provided by iTETRIS simulation framework include:

Feature	*Description*	*Figure*
Cooperative ITS city level evaluation	Large scale evaluation of Cooperative ITS strategies (**25.000+ vehicles** and city level) pose unprecedented challenges in terms of simulation complexity and **wireless communication modeling accuracy**. iTETRIS through its unique architecture meets such challenges..	

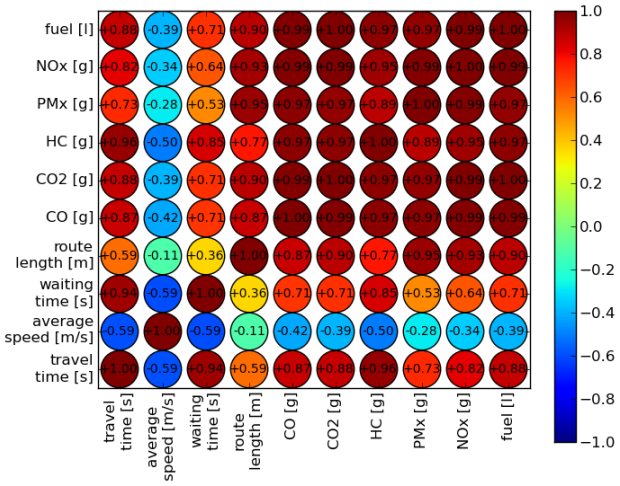
ETSI ITS Architecture Compliance	iTETRIS is aligned with the **communication architecture** defined by **ETSI for Intelligent Transport Systems (ITS)**. The standard specifications concern a communication system designed for various types of traffic applications which can use several coexistent communication technologies. The architecture assumes three different actors communicating in an ITS scenario, each representing a given subsystem: vehicle, roadside and central subsystems.	
Easy integration of traffic and network simulators	iTETRIS architecture is highly modular and flexible and permits the integration of a wide variety of network and traffic simulators through **open APIs.** To overcome the coupling barrier the iTETRIS architecture defines a new block to be responsible of the tasks that are not specific of the simulators, wireless communications or traffic, neither the traffic management applications. This new block is named as iCS (iTETRIS Control System), which governs the operation of the simulators.	

Traffic Management

Apart from using the fastest route through the network that depends on the travel times, other measures for optimising a route assignment are also possible. Some of those are quite conventional – differing between the duration and the road length of a trip is known by most people planning routes. Sometimes, the assumed fuel consumption is also important. Besides these conventional measures, in the recent past further route measures have been found. It is known for example that drivers try to avoid moving over intersections to the left – due to the higher risks during such manoeuvres and the cognitional effort. Also, other drivers try to avoid heavy traffic or extreme weather conditions. Systems which try to propose a “nice sightseeing” route are also available.

For evaluating the reasons of similar results, the Pearson correlation between the measures was computed. As input, the measures – emitted pollutants, travel time, etc. – collected from all vehicles of a single simulation run were used. The resulting correlations for different measures are shown in figure below.

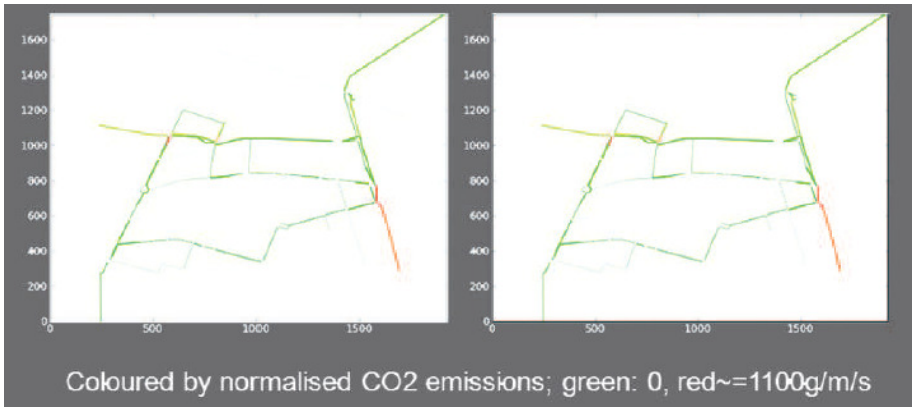
While important for a theoretical evaluation, **pre-simulation traffic assignment is of a lesser usability for an on-line evaluation of rerouting approaches.** It uses a complete knowledge about the state of the regarded road network, not available in reality. All new routes are computed for all vehicles, whereas only vehicles equipped with an appropriate navigation system are meant to be rerouted in reality. Additionally, traffic assignment techniques are often too slow for an on-line computation of new vehicle routes.



Correlation between measures (@ iTETRIS Consortium)

For simulating the real-life modification of routes – both assisted by a navigation unit or not – other methods are needed. Some extensions for enabling the simulation to model such processes were done within iTETRIS project. The **iTETRIS simulation framework is equipped with** the following advanced features to assess sophisticated traffic management strategies:

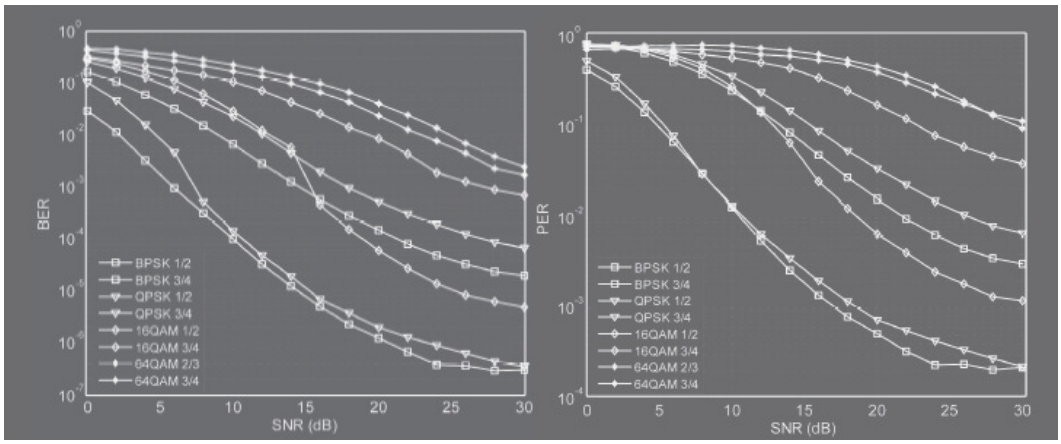
- Fine-grained sub-second traffic simulation support for evaluation of traffic management strategies under realistic context information disposability.
- Emission & noise modelling support for sustainable traffic management strategies evaluation.
- Intelligent re-routing simulation support for dynamic on-line route adaptation.
- Traffic Light System (TLS) algorithm support.
- ADAS modelling support.



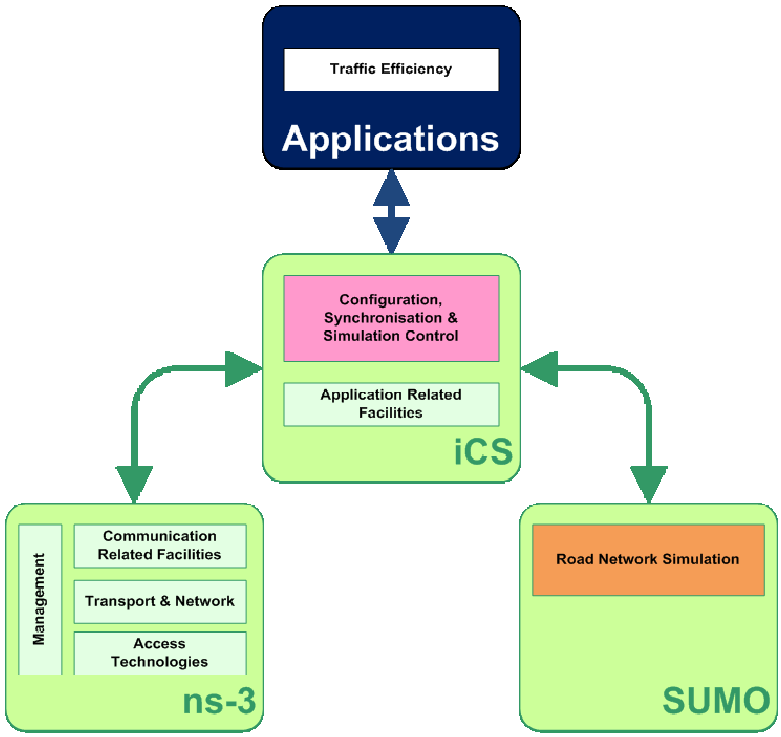
Communication Modelling & ITS Facilities

iTETRIS has devoted a significant effort in the development of **accurate wireless ITS communication models** that could bring together high-fidelity in terms of information distribution accuracy and availability for cooperative ITS traffic management strategy implementation. For this purpose, iTETRIS considers the main technologies involved in V2V & V2I communications for cooperative ITS, namely, four radio technologies: ITS 5.9 GHz, UMTS, WiMAX and DVB-H. Access Technologies and Transport & Network layers are layers devoted entirely to support the radio communications and therefore they are completely implemented in the wireless communications simulators, thus ns-3. Since the Management layer of iTETRIS mostly implements

the dynamic selection of the suitable radio access technology, as a consequence its development is embedded in ns-3 as well.



A key aspect in the implementation of iTETRIS is the support of the ETSI ITS Facility Layer. The ITS Facilities layer collects a set of common functionalities which are shared by several applications for various tasks. The facilities provide data structures to store process and maintain data of different type and source. On top of the stack, the ETSI ITS Communications architecture addresses traffic safety and efficiency applications, and value-added services. Although iTETRIS is particularly focused on traffic efficiency applications, the platform could also allow testing and optimising other applications.



iTETRIS distributed ETSI ITS communications architecture (@ iTETRIS Consortium)

As illustrated in the figure above, the iTETRIS distributed architecture with a centralized control is suitable for a clear and convenient separation of Facilities functionalities, with a positive impact on simulation speed and

performance. As a result, a line is traced in the ETSI ITS Facilities layer, leaving the implementation of application related facilities to the iCS and the remaining communication related facilities to ns-3.

iTETRIS Block	Facility
Application-Related Facilities (iCS)	Mobile Station
	Location Referencing
	Relevance Check
	iFMT Manager
Communication-Related Facilities (ns-3)	Service Management
	Message Management
	Addressing Support
	Session Support

Summarising, iTETRIS meets the requirements of delivering an interoperable platform capable of supporting ITS cooperative standard-based solutions thanks to the adoption of the ETSI ITS architecture. The architecture strikes an optimum balance between platform modularity and performance of the overall platform for large scale traffic application evaluation. **iTETRIS is equipped** with the following features:

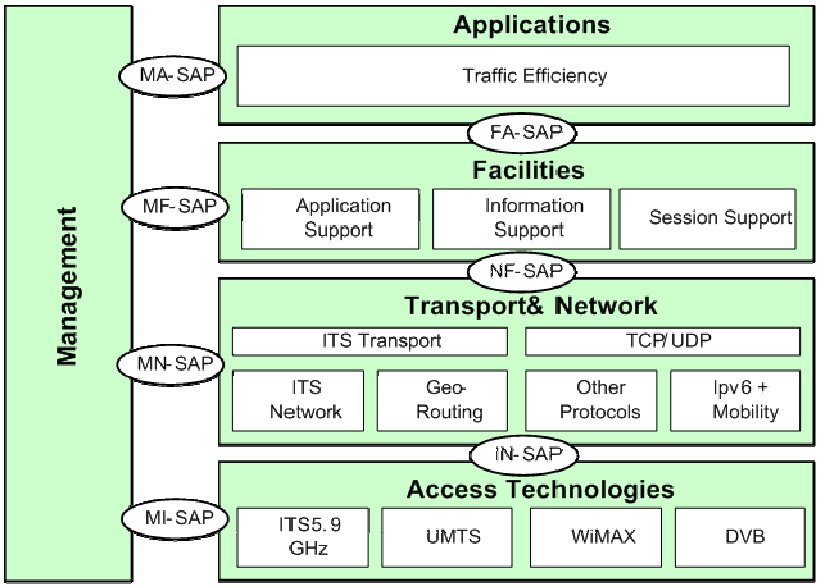
- Wireless communication protocol stack and high-fidelity channel models
  - WAVE (802.11p),
  - Wi-MAX,
  - DVB-H and
  - UMTS.
- Dynamic & adaptive communication technology and transmission mode selection
  - Multi-bearer support.
  - Multi-channel support.
- ETSI ITS Facilities
  - Local Dynamic Map (LDM) Facilities.
  - Messages facilities.
  - Mobile stations facilities.
  - Location referencing facilities.
  - Relevance check facilities.

Cooperative ITS Networking & Management

The management layer is a transversal layer handling cross-layer information exchange among the horizontal layers. The main functionalities implemented in this block include:

- Dynamic selection of the access technology for a given application,
- Monitoring of communication interfaces' parameters,
- Management of transmission permissions and priorities,
- Management of services, and
- Implementation of congestion control mechanisms.

iTETRIS does not specifically implement the security management functionality. As a result, the ETSI ITS Communication architecture the iTETRIS architecture design has implemented is illustrated in the picture below.



ETSI ITS communications architecture implemented by iTETRIS (@ iTETRIS Consortium)

The Networking & Transport layer contains the different networking and transport protocols needed for a fully functional communication in ITS scenario. Each networking protocol may be connected to a specific dedicated ITS transport protocol or to pre-existing transport layer protocols, e.g. UDP, TCP. Hence, iTETRIS supports both **C2C-CC & IP communication stacks**.

iTETRIS has been developed to support **unicast, multicast and broadcast communication mechanisms** for ITS applications and implements a number of networking protocols including standard compliant **geo-networking** addressing schemes.

These features permit that iTETRIS has implemented a number of networking protocols:

Name of Protocol	Main Functionalities / Type of Protocol	Other capabilities
BZB	FW + GB	
GPSR	GA + GU	
CBF	GA + GU	
SAR	GA + GU	
Abiding Geocast	GB + TB	Lifetime for geocast messages
LANE-RP	GA + GU	Road topology aware
REDNET	FW + GA + GU	Reliable forwarding
OPRAM	FW + GB + GA + TB + GU	Opportunistic congestion control
DiRCoD	FW + GB + GA + GU	Supporting mechanisms for georouting message dissemination
MobCast	FW	DTN

FW = Efficient Forwarding Mechanism
GB = GeoBroadcast
GA = GeoAnycast
TB = TopoBroadcast
GU = GeoUnicast

iTETRIS Open Source Community

Summer 2010 has been a major milestone in the development of the iTETRIS simulation platform. The first large scale evaluations of cooperative ITS traffic management strategies are taking place at the time of writing this newsletter.

The next step in developing the iTETRIS platform is the establishment of a large constituency of users and developers that will enjoy the use and improve the iTETRIS technical capabilities presented in this Newsletter. For this purpose, iTETRIS project will foster the creation of the iTETRIS Community through a new Section in our webpage in the last quarter of 2010 – 10th October 2010.

Please remember the date **10-10-10,** make a note in your diary and visit our website to learn more about our iTETRIS community, what is there for you and how you can become an active member.

www.ict-itetris.eu/10-10-10-community

iTETRIS – Where to find us

The latest developments regarding the iTETRIS project will be presented at the following events. If you are interested in our research please do not hesitate to contact our research team.

IEEE International Symposium on Wireless Vehicular Communications (WiVEC) 2010
iTETRIS: Adaptation of ITS Technologies for Large Scale Integrated Simulation
http://www.ieeevtc.org/wivec2010/
Date: 16-17 May 2010
Place: Taipei (Taiwan)

IEEE International Conference on Communications (ICC) 2010
Data Dissemination in Cooperative ITS from an Information-centric Perspective
http://www.ieee-icc.org/2010/
Date: 23-27 May 2010
Place: Cape Town (South Africa)

IEEE International Conference on Intelligent Transportation Systems (ITSC) 2010
Unambiguous Metrics for Evaluation of Traffic Networks
Information-Centric Opportunistic Data Dissemination in Vehicular Ad Hoc Networks
http://itsc2010.isr.uc.pt/
Date: 19-22 September 2010
Place: Madeira Island (Portugal)

2010 POLIS Conference
http://www.polis-online.org/
Date: 25-26 November 2010
Place: Dresden (Germany)

IEEE Infocom 2011

Relieving the Wireless Infrastructure: When Opportunistic Networks Meet Guaranteed Delays

http://www.ieee-infocom.org/

Date: 10-15th April 2011

Place: Shangai (China)

iTETRIS Information

Project Duration:

July 2008 – December 2010

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