

PROJECT

## LOCAL4GLOBAL

# SYSTEM-OF-SYSTEMS THAT ACT LOCALLY FOR OPTIMIZING GLOBALLY

**Funding:** European (7th RTD Framework Programme)

**Duration:** Oct 2013 - Dec 2016

**Status:** Complete

**Total project cost:** €3,197,058

**EU contribution:** €2,515,864



[CORDIS RCN : 110048](#)

### Background & policy context:

Despite the fact that the problem of real-time signal control at the junctions of urban traffic networks has been studied for many decades, and many different urban traffic control strategies have been developed, tested and are operational in a number of cities around the world, it is today a well-accepted fact that urban traffic control systems are not able to cope effectively with the constantly increasing problem of congestion. According to the American FHWA (Federal Highway Administration) *"No current generally available tool is adequate for optimizing [signal] timing in congested conditions"* (2008). Moreover, the problem of designing effective urban traffic control strategies will become significantly more complicated with the introduction of *cooperative traffic/transport systems*, whereby vehicles will be enabled to communicate directly with each other and with the infrastructure. **Thus, apart from controlling the traffic signals in the junctions, the control system is also called to optimize the routes and speeds of the cooperative vehicles.**

An urban traffic network may seem, at first view, to have a steady and constant structure with respect to its subsystems (i.e. the junctions). However, the functional interdependencies between these subsystems are, in reality, subject to change. When traffic conditions are non-saturated (i.e. when vehicle queues forming during the red phase are cleared during the next green phase), then upstream flows (released from upstream traffic signals) influence the downstream junctions and their traffic signals. On the other hand, when the links start building increasing vehicle queues (e.g. during the daily peak period congestion), then the outflow from upstream junctions is hindered due to existing long queues in the downstream links, hence an existing queue may extend towards upstream links; in other words, congested traffic conditions mark a radical change of the subsystem interactions, which are now directed from downstream to upstream and are strengthened substantially. Thus, the tail of a queue forming at a critical link, propagates upstream, may form multiple congested branches of upstream links, and may even lead to gridlocks and accordingly strongly degraded traffic flow operation.

### Objectives:

#### The Main Objectives

To develop and extensively test and evaluate in real-life Transport Management and Control System (TMCS), a generic, integrated and fully-functional methodology/system for TMCS with the following attributes:

1. **The TMCS elements (traffic lights, cooperative vehicles, etc.) are operating as fully autonomous units that react and interact depending only on their local environment in order to optimize the TMCS emerging performance at the global level.**
2. There **will be no need for an elaborate and tedious effort to deploy the Local4Global system or to re-design/re-configure** it in cases of changes in the topology, environment or hierarchy of the TMCS. In essence, the Local4Global methodology will provide a **"plug-and-play control mechanism"** for the system elements/components with the ability to fully exploit each element's abilities **by embedding within it learning, evolving and self-organizing capabilities.**

- Moreover, there will be **no need for an elaborate, “expensive” infrastructure** that provides each and every element with information coming from all over the TMCS.

The Local4Global methodology/system will be applicable to generic TMCS that comprise **highly heterogeneous** TMCS. Moreover, it will, by its very nature, be totally **scalable and computationally efficient**.

### Methodology:

Apparently, an ideal traffic control system would be one that could control the traffic signals (as well as the cooperative vehicles routes/speeds) on a second-by-second basis by using real-time information stemming from throughout the whole traffic network. However, such an ideal control system is practically impossible to be developed, as the problem becomes extremely complex (NP-complete). Additionally, as the traffic network characteristics and dynamics as well as the number and locations of cooperative vehicles are constantly changing, such an ideal control system would have to deal with a problem where the dynamics and structure of the controlled system constantly change.

*Within Local4Global we take the view that by treating the overall system of junction controllers/cooperative vehicles as a system comprised by element constituent sub-systems which are **based only on local information**, learn, evolve and self-organize so as to optimize the global performance, we will be able to provide with a control strategy that approaches the performance of the above-mentioned ideal system and outperforms the existing centralized or utterly decentralised local traffic control strategies.*

### Parent Programmes:

[FP7-ICT - Information and Communication Technologies](#)

**Institute type:** Public institution

**Institute name:** European Commission

**Funding type:** Public (EU)

**Other programmes:** FP7-ICT-2013.3.4: ADVANCED COMPUTING, EMBEDDED AND CONTROL SYSTEMS D) FROM ANALYZING TO CONTROLLING BEHAVIOUR OF SYSTEM OF SYSTEMS (SOS)

### Partners:

- CERTH - Centre for Research and Technology Hellas (coordinator)
- ETHZ - Eidgenössische Technische Hochschule Zürich (partner)
- RWTH - RWTH Aachen University (partner)
- IK4 - IK4 TEKNIKER (partner)
- TRV - TRANSVER GmbH (partner)
- TUC - Technical University of Crete (partner)
- TUM - Technische Universität Muenchen (partner)

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### Technologies:

Road and traffic management systems  
Transport Management and Control System (TMCS)

**Development phase:** Research/Invention

**STRIA Roadmaps:** Network and traffic management systems

**Transport mode:** Multimodal transport

**Transport sectors:** Passenger transport, Freight transport

**Transport policies:** Digitalisation

**Geo-spatial type:** Other