Future Internet Applications for Traffic Surveillance and Management

- overall abstract -

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1 Context

The proposal will address the traffic issues in large EU urban cities. The prosperity of these cities, such as Amsterdam, Bucharest, Budapest, Copenhagen, Lisbon, Liverpool, Munich, Sofia, and Thessaloniki, is crucial for the European development since they, in addition to the bigger EU cities, deliver most of the Union's commercial output. The bigger capital cities, such as Athens, Berlin, Brussels, London, and Paris are unique and typically have created individual traffic management solutions. Nevertheless, the smaller medium-sized cities have much more in common allowing for (partial) solution re-use. This motivates us to address problems in cities like Sofia, Bulgaria, with the perspective of applying developed solutions for solving problems in other EU cities. Furthermore, we address the transport domain since easing and greening traffic in such cities is considered as a major issue for the prosperity of the EU as a whole. We particularly focus on road traffic as directly related to sustainability and resource optimization. Hence, we will propose innovative solutions concerning the road traffic in Sofia and other EU cities with similar needs.

The use of information and communication technology (ICT) is increasingly proliferating in transport vehicles. It is applied to support the main functions like car management and supporting the driver to navigate the vehicle from A to B. We begin to see intelligent systems using sensors and actuators to prevent accidents, for example when the car is approaching other cars too closely. Other applications include information systems like navigators to guide the driver to their destination taking traffic information into account. Other ICT systems are there to entertain the travelers with music and/or video movies. The above mentioned functionalities have been developed independently of each other: car sensors, engine management, traffic information systems, entertainment, and telecommunications. A number of these developments are currently specific to the car manufacturer and therefore the brand of the car. In near future, cars (of different brands) will be able to exchange information.

2 Problem

More and more cars are appearing in urban streets due to commuting and increasing transportation needs. This leads to severe traffic jams, especially during peak hours resulting to:

- increasing CO_2 emissions from more cars being stuck on the road for prolonged periods;
- people are spending more time in traffic jams, compromising private and work time;
- wasting fuel with engines on while cars are in traffic jams;
- stress levels on drivers and transport users are increasing, leading to increased potential for accidents.

Even though many cities, like Sofia, are less technologically equipped than some of the cities above-mentioned, in none of the EU cities (and also cities worldwide) an exhaustive solution to these problems has been successfully realized by now. There are examples of technological achievements, such as highly dense electromagnetic induction loop sensor networks, car sensing systems, automated and remotely operated traffic lights, and advanced surveillance facilities. Nonetheless, these have never been adequately integrated in an IT system that essentially monitors and supports the road traffic or at least such a system has not been successfully deployed. Moreover, the personalized needs and emotions of drivers have not been factored into the design of these systems.

3 Challenges

Research on ad hoc mobile networks is actively pursued, and the information infrastructures are available to create them. However, information management systems are not keeping pace with the potential offered up by this network technology. For example, besides on-car sensors simply sensing that the host car is slowing down, cars may also inform each other that they are slowing down. Information about a traffic situation can be backwards propagated to let others anticipate dangerous situations. Traffic information can be exchanged, i.e., at the micro level, where a vehicle can inform others in the vicinity about their intentions/actions, to help prevent accidents. Information exchange can also happen at a macro level, e.g. cars, through their navigation systems, may exchange their destination information. Traffic management systems may use this information to optimize traffic management by, for example, adapting flows through changing the timing of traffic lights.

As traffic densities become greater, modeling of traffic patterns becomes increasingly more important to help manage the strategies for traffic flow. However, the modeling also becomes increasingly complex due to the volumes of data and sensor information. The need for real-time decisions in traffic network operator centers pushes the demands of modeling systems even further.

There needs to be more strategic business model engineering applied to the transport sector and the design of traffic information systems. There is considerable scope for developing and testing business model engineering approaches (design, validation, implementation cycle) created for other domains (such as mobile services, e-health, information services), for the engineering and optimization of traffic management platforms and related services.

Similarly, there is benefit to be gained in the specification of transport systems using model driven engineering, such that the design and implementation issues can be presented in abstract, non-technology dependent terms, such that engagement with a wider range of stakeholder interests can be included at the design stage.

Further, getting access to sensor traffic data is not always easy. Network management centers cannot always make the data available on a demand driven basis (essential for real time monitoring) or if they do, it is of too low a resolution (e.g. sampled at 15minute time intervals) to be useful in traffic management systems.

As for building intelligent systems (on top of legacy network control centers), this may be very difficult as well, especially if there is not a high level of IT support for the host network center.

4 Goal

Our strategic goal is to design and develop a powerful and deployable service-oriented and context-aware road traffic surveillance and management system able to support individual mobility and network wide operations. By ‘service-oriented’ we mean operating through services whose underlying technological complexity remains ‘hidden’ from users. By ‘context-aware’ we mean adapting their behavior depending on the surrounding context.

5 Approach

Work in progress, more information will appear soon.