# Open Architecture for Road Tolling and Traffic Management Services

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## ABSTRACT

Efficient use of ITS resources, widely existing through the road network infrastructures, depends strongly on an ICT architecture that enables the efficient use of technology, information and increasingly, services available across the variety of ITS applications and systems.

Existing ITS architectures and concepts can be used to develop within a given framework [2] thereby facilitating such intersystem integration. However, these architectures typically include assumptions regarding the overall organization of systems functionality that prohibit integration of previously deployed systems without reengineering.

This paper discusses an open architecture to integrate both road tolling and traffic management operation services, based on the Intelligent Transport System Interoperability Bus (ITSIBus), a multi-technology service oriented infrastructure where specialized pluggable systems run services following a peer-to-peer architecture. Acting as a framework platform, ITS-IBus supports increasingly all middleware road side services for tolling, but also for traffic management, such variable message signs (VMS), closed-circuit television (CCTV), weather and environmental stations (WES), automatic incident detection (AID), tunnel management systems, among the others.

On top of the process chain for operation, Atlas Telematics provides application level context integration, based on a legal framework for identity, access, and logging. Atlas also provides an application interface for operation, maintenance and management, making use of services, processes or applications available anywhere in this collaborative world.

## INTRODUCTION

Brisa Auto-estradas de Portugal, shortly Brisa, was founded in 1972 with the aim of constructing, maintaining and operating motorways as their respective service areas under concessions scheme of motorways via toll system. With such experience, Brisa is the largest Portuguese operator, controlling 1,116 km of motorways, linking Portugal from the North to the South, from the West to East, through 11 motorways under operation.

In 2002, the company launched a technological initiative aiming at replacing most its decentralized operations' coordination by a centralized one based near its corporate headquarters. Such an apparently anachronistically centralization shift resulted from a strategic decision made possible given the unusual availability of bandwidth, previously installed in the motorway telecommunication ducts.

Accordingly, the intensive level of road operations could become coordinated centrally from a newly built Centre for Operations Coordination (CCO), provided that the infrastructure would be equipped with the necessary peripherals and that the necessary management systems would be developed.

This paper presents a framework for an ITS architecture that has been designed for integrating novel as well existing intelligent transportation systems and applications in Brisa.

## TOLL MANAGEMENT SYSTEM

Toll Plaza Management Systems (TPMS) are intended to provide capabilities to support either electronic or manual fee collection within a road toll plaza. TPMS is made up of collaborative processes to manage road side systems like DSRC car identification, car detection and classification (ADVC), license plate automatic recognition (ALPR), payment card reader (LIT) and a gate. These road side systems are coordinated by a lane management system (LMS) also responsible for the interactions with TPMS. Acting as System Broker, TPMS integrates with the Central Coordination System (CCS) supplying functional events for maintenance, operational events for

control, and electronic or manual transactions for clearing. The road side systems are interconnected through a service oriented middleware, an enterprise service bus (ESB) where the different systems are represented by services connected to the infrastructure on a "plug¬and-play" basis. This service based middleware layer follows the open intelligent transport systems interoperability bus (ITSIBus) architecture [3] and [4]. The ITSIBus provides open interfaces, contracts and event subscription and management for the ITS system's services (Fig. 1).

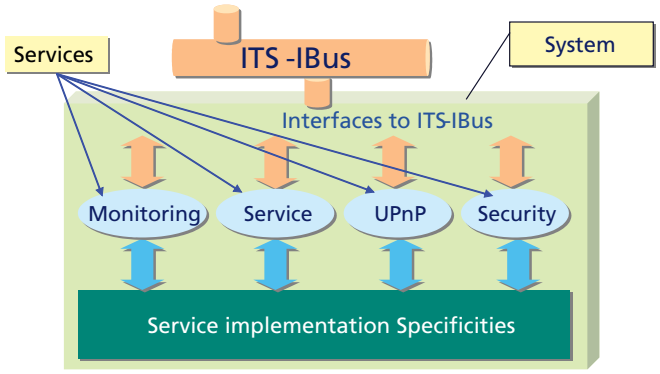


*Fig. 1 – Model of a service based road system in ITS-IBus*

The main objective of ITS-IBus is to contribute to an open ITS multi-vendor infrastructure where road systems follow open interfaces and contracts contributing this way to reduce technology lifecycle management costs. Furthermore, by making each road system represented by a service, with a minimal requirement of a TCP/IP connection, the ITS technological infrastructure becomes more flexible and able to support advanced structural patterns like low cost fault tolerance mechanisms based on automatic alternative service substitution. For coordination services (LMS, TPMS) there is a possibility to run them in an alternative computer. In the ITS-IBus infrastructure, services run in a distributed space, a network of computer systems, and for those that are not compromised with specific connected hardware devices there is the possibility to run them in any alternative compatible computer.

## TRAFFIC MANAGEMENT SYSTEM

Traffic Management Systems (TMS) are intended to operate within Traffic Management Centres (TMC) to improve traffic flows and road safety. Managed by human operators, TMS includes I) collecting information through human intervention, such

emergency call boxes (SOS), road patrols or police forces; ii) automated surveillance, such weather and environmental stations (WES), road side traffic data collectors, surveillance video cameras (CCTV); iii) field action, such surveillance patrolling, incident assistance, road side protection and breakdown services; iv) and information broadcast through message variable signs (VMS), 24 hours hotline for information, intern et web site and tollgate information.

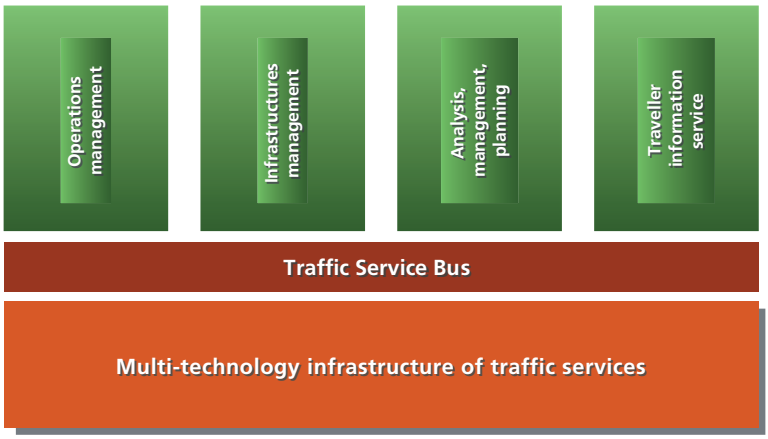


*Fig. 2 – Model of a service based architecture for traffic management*

## OPEN ARCHITECTURE FOR ROAD TOLL AND TRAFFIC MANAGEMENT SERVICES

Both TPMS and TMS technologies intended to achieve efficiency in the management of motorway operations. Nevertheless, even in the last generation of support systems, the large majority of internal operations are generally performed in a completely independent way.

Defined as a Unified Operations System, Atlas Telematics, shortly Atlas [1] is neither a product nor a system. It is an architecture and a collection of integrated operational as well decision-support application and databases that provide toll and traffic operators and managers easy access to core data and services.

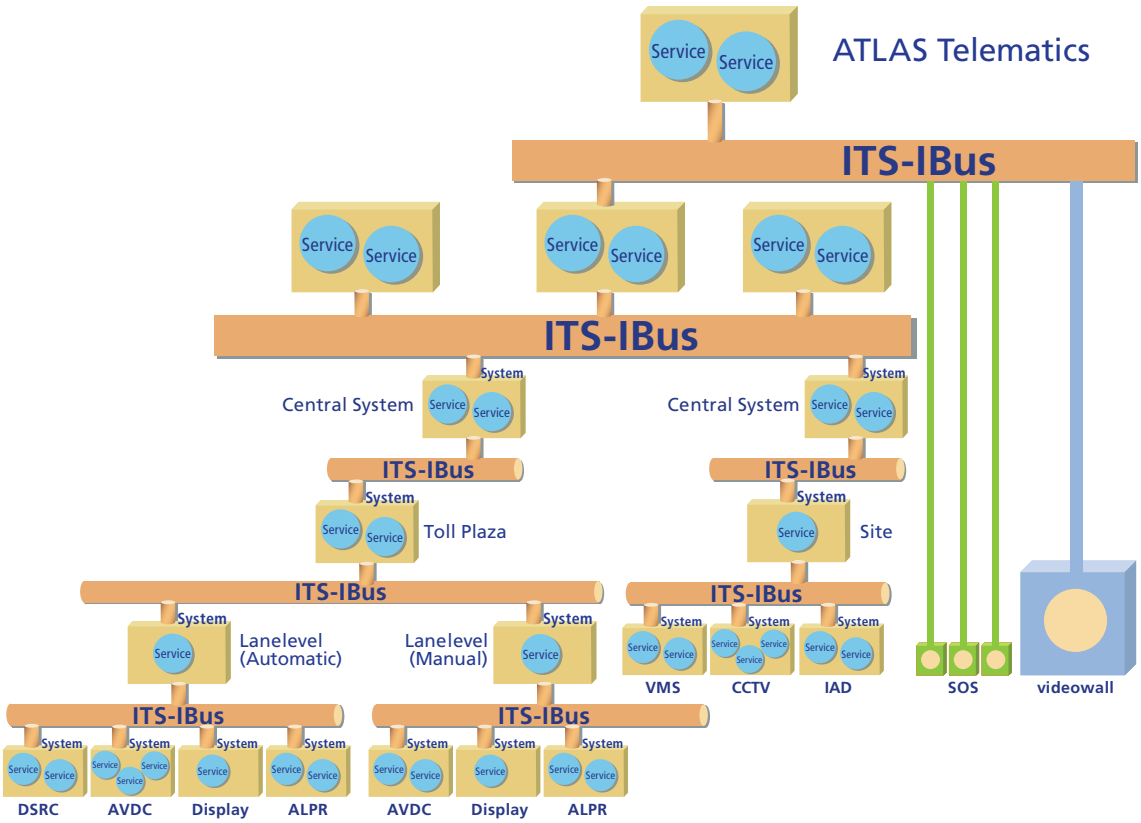


*Fig. 1 – ITS-IBus Architecture*

Atlas telematics services facilitate many activities, included those listed below:

- Schema-driven representation and interaction with the world under control
- Telematic devices control and analysis, including variable message signs, surveillance cameras, weather stations, traffic data collectors, etc..
- Toll system management services
- Incident and event management services

*Fig. 2 – Atlas telematic services interface*

## CONCLUSIONS

In this paper it has been exposed a specification of a conceptualization used to implement an open architecture for road tolling and traffic management services. Here are some conclusions resulting from the process analysis:

1. Existing ITS architectures typically include assumptions regarding specific systems functionality that prohibit integration of legacy systems without reengineering.

2. Efficient use of ITS resources depends on an ICT architecture that enables the efficient use of technology, information and increasingly, services available across the variety of ITS applications and systems.

3. ITSIBus aims is to contribute to an open ITS multi-vendor infrastructure where road systems follow open interfaces and contracts contributing this way to improve the flexibility and ability of the ITS infrastructure to support advanced structural business models.

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