ALL PART OF THE SERVICE
SERVICE ORIENTED ARCHITECTURE AND MOTORWAY OPERATIONS

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The performance of road operators in fast and efficient demand and response management of their network has improved greatly in recent years. A large proportion of this success can be directly attributed to developments in information and communication technologies. The vast array of sensors and image-capturing devices available, combined with high-speed fiber-optic cabling and wireless solutions, has enabled remote monitoring of network conditions from state-of-the-art centers.

The rapid evolution of technologies, a competitive market and lack of standardization have given rise to the creation of products that generally prohibit the integration of legacy systems, unless significant re-engineering occurs. As a result, the various systems that together provide overall toll and traffic management are normally operated independently from dedicated workstations. However, this inhibits the operator's decision making abilities, especially in real-time solutions, which impacts negatively on the level of end service.

In its development of Traffic Atlas, Brisa launched a process whereby data from disparate systems is collected, harmonized aggregated and enhanced to form a single, optimized interface. The innovative aspect of Traffic Atlas lies on the achievement of real-time integration of fragmented data

Brisa has improved service quality for all those who travel or which to travel on its motorway network

streams sourced from fundamentally differing systems that possess varied operational functionalities. The challenge was heightened by the diversity of these systems in functionality, application (including CCTV cameras, emergency systems, weather stations and toll plaza management systems) and generation.

The Traffic Atlas system represents a novel application of various ICTs which build a common platform middleware, from which the transmission, receipt and recording of data, voice and video information is integrated and displayed in a standard format on a map-based interface.

The result is a vast improvement in the organization, content and presentation of information available to each operator in the control center, allowing quick, highly informed decisions to be made regarding critical issues such as network safety.

Traffic Atlas is a prime example of the benefits that ICTs provide in optimizing ant integrating the output from disparate technical systems. Its success story is encouraging for service-oriented engineering in the increasingly diverging technology market. The high demand for detailed and accurate real-time information is today's society compounds the importance of open-architecture systems and versatile software solutions as provided by Traffic Atlas.

A total of 45 performance indicators where developed in the areas of customer service, business intelligence and technical performance, comparing pre- and post--Traffic Atlas installation performance. These demonstrated a major increase in the efficiency (both technical and economic) of network management operations.

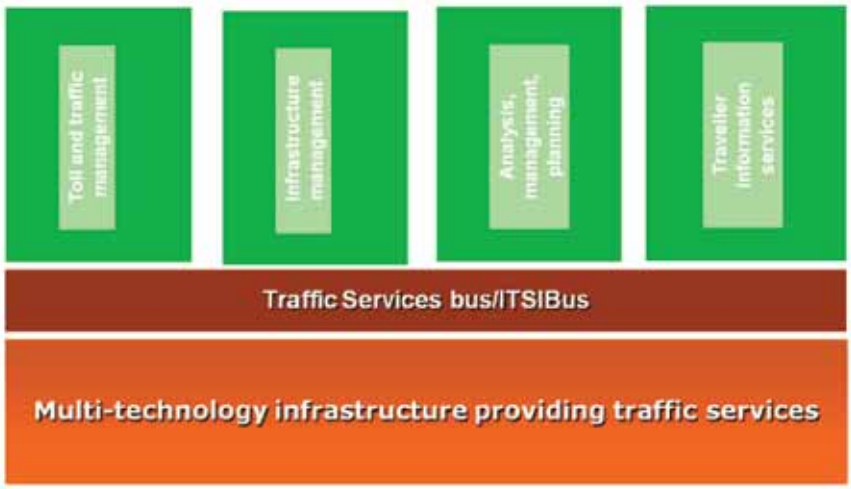
Brisa's Operational Control Center aims at guaranteeing new levels of road safety in the network, better traffic management and better traffic flow.

1. TECHNICAL DESCRIPTION

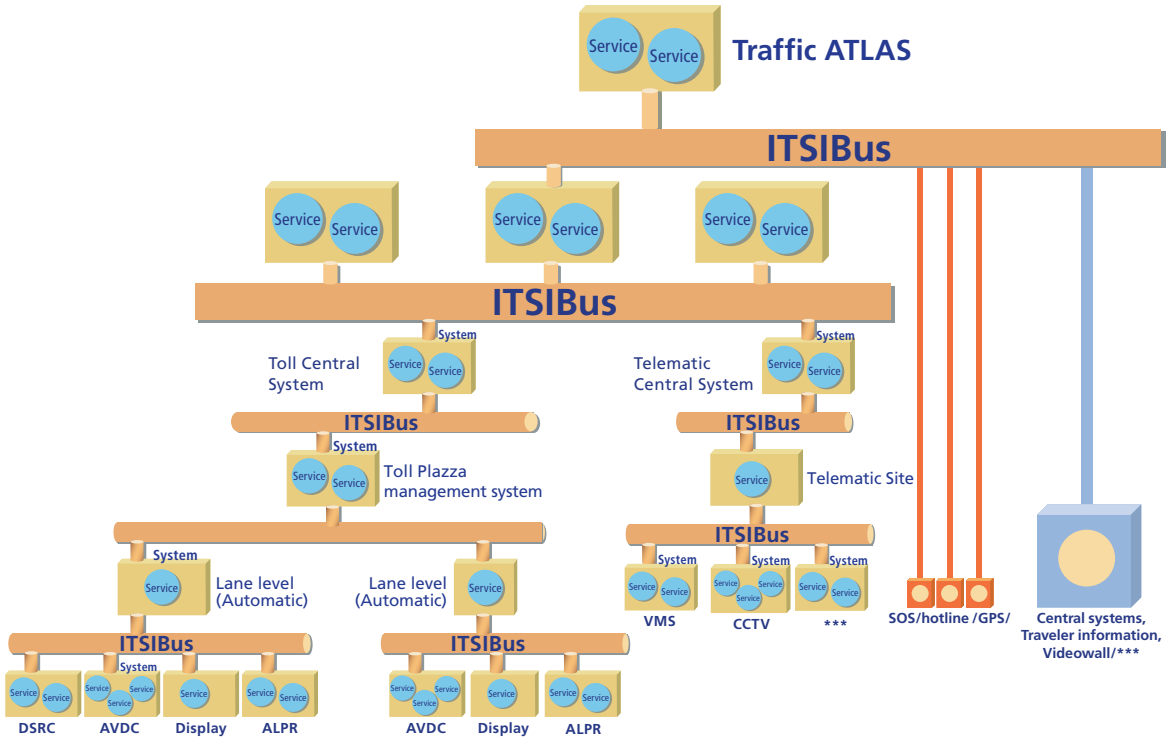
Electronic motorway systems that support toll collection, traffic and weather monitoring, incident detection, breakdown assistance and traffic information services are communicated in real-time to Brisa's control center where remote management of network is undertaken.

Traffic Atlas was developed by Brisa as an intelligent business tool for a variety of reasons, first and foremost of which was optimizing the decision-making process of network managers in real-time conditions. In addition, ti provides a versatile database common platform and GUI to control center operators. While also enabling interaction between and integrating of fragmented data sources by applying an open architecture to toll and traffic management services.

Traffic Atlas takes an all-encompassing view of the various decision-making elements in the operation of Brisa's motorways. Applying a common location reference system, motorway infrastructure is recorded in terms of geographic latitude and longitude coordinates and catalogs of features such as petrol stations, laybys, toll gates and hard shoulders. Meanwhile, ITS deployed on the network monitors ambient and traffic conditions and inform travelers. These include CCTV cameras, inductive loops, VMS, emergency telephones and weather stations. Information is sourced from various systems, including tunnel and toll management systems and motorway exits, while there is also an up-to-date directory of mobile resources in the form of maintenance and recovery vehicles. The strategies for incident and event handling take into account the information above.



The above chart shows a model of a Service Oriented Architecture (SOA) for traffic management



The ITSIBus also defines an ETC architecture a (SOA) based on a hierarchical toll management system based on lane management services (LMS), toll plaza management services (TPMS) and central coordination system (CCS) and the respective systems.

Information is processed and analyzed to provide a detailed real-time picture of network conditions. The integrated data informs algorithms that generate strategic responses to a variety of events, such as incidents or flow breakdown. These can be automated or effective upon authorization from the network operator.

The key enabler of efficient remote management of Brisa's network is its state--of-the-art communications infrastructure, comprising two fiber-optic pairs installed throughout the entire motorway network (one forming the backbone and the other linking access and intermediate sites) and a bandwidth that varies between 1-8 GN/ /Ethernet. Data, voice and image transmission is effective over IP.

The open architecture is based on the ITS Interoperability Bus (ITSIBus) – a multi-technology service-oriented infrastructure where specialized systems that can be plugged in run services in a peer-to-peer architecture. Acting as a framework platform, ITSIBus supports all middleware roadside services for tolling and traffic management.

The various hardware elements (servers and equipments) that form disparate clusters are integrated through the installation of adaptors, which employ conventional parameters to analyze and send data to the clusters further along the chain of services. These adaptors are preferably located at the support system site for each piece of kit – however, sometimes dedicated industrial PCs are required. The central system is supported by a farm of servers, which accommodate balanced application, database and middleware services.

A comprehensive framework protocol was developed for each level in the system architecture, exclusively based on web services and JINI technologies. C++ or Java was developed to undertake low-level functionalities within the adaptors for each piece of kit. The common platform middleware aggregates processes developed in Java or .NET, which are integrated with high-level services through web services. At this particular level, all of the processes are developed for web-based interfaces, comprising once again Java and .NET solutions.

In terms of computational functionalities, Traffic Atlas can be described as an open framework architecture of collaborative services, grouped in clusters representing autonomous systems and services. It provides an application interface for operation, maintenance, and management and traveler information, making use of services, processes or applications available anywhere in this collaborative world. The system's versatility allows each cluster of services to adopt the most appropriate platform. So, for example, tolling and telematic systems are implemented in Linux/JINI, whereas emergency SOS utilizes Windows. Lower- level information, such as equipment registers and event logs, are fed to the higher-level services, which are then processed and analyzed either for direct consumption, or processed further.

2. REPLACEMENT THERAPY

In 2004, Brisa undertook an initiative to replace most of its decentralized operations coordination by a centralized control neat its corporate headquarters. This was made possible given the availability of bandwidth, previously installed in the motorways' telecommunication ducts.

Traffic Atlas has brought added value to this strategic move by enabling the technical centralization of know-how accumulated over 30 years that had previously been held regarding a specific region or specific piece of equipment. The provision of a global data pool and map-based GUI that is securely and efficiently operated, user-friendly and ergonomic allows traffic operators to manage each region under Brisa's authority in a consistent manner. The depth of information offered also helps operators to understand the bigger picture and therefore improve their decision-making capacities.

While the direct end user of the Traffic Atlas tool is Brisa's traffic control center, it's open architecture allows the generated information to be tailored to meet the needs of other relevant stakeholders, namely other departments in Brisa, such as sub-contractor companies, public sector roads authorities, traffic police and the public in general. By enabling coordinated operational excellence, Traffic Atlas benefits a number of sectors in within Brisa involved in the upkeep of infrastructure, maintenance of equipment and the provision of assistance to road users.

Through efficient operation in Portugal's tolls and motorways, Brisa strives to provide an optimal level of service to its customers – the road users. Off the road, Traffic Atlas enables the provision of real-time information regarding network conditions (congestion, road closures, roadworks, incidents) through Brisa's website, which allows users to make informed decisions regarding travel times and routes.