An Open Integration Bus for EFC: the ITS-IBus

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ABSTRACT

The project BRISA ITS-IBus (Intelligent Transport Systems Integration Bus) aims at developing the architecture for a technological platform and business process modeling tools, able to establish a uniform integration framework to toll related system. A general purpose electronic fee collection process requires the support from different technological systems, in most cases integrated one by one on a bilateral agreement basis. The growing flexibility required from the toll infrastructures to support new business models and the need to reduce development and management costs are motivating an extra effort from different players to promote standards or, at least, opened and widely accepted consensus. The CEN initiative to normalize DSRC (Dedicated Short Range Communications) under TC-278 is an example of such an effort to promote interoperability and cost reduction by increasing reutilization.

INTRODUCTION

From the definition of ITS – Intelligent Transport Systems, emerges the need for the integration of a diversity of different enterprise (business) processes. The state of the art in ICT (Information and Communication Technologies) does not cope with the dynamics and flexibility required by those processes. The challenges proposed in the European Programme for European standardization in Intelligent Transport Systems (CEN, 2002) emphasize the weaknesses of current ICT approaches. The generalized Interoperability among services offered by companies and involving different countries requires new technology management frameworks.

Companies are evolving structures requiring continuous processes definition changes (process reengineering) to cope with business challenges. Furthermore, the growing ICT based cooperation among companies provides a new complexity dimension bringing a new dynamics to process automation. Processes automation models follow a strategy leading to "automation islands" usually limited to competence areas. This scenario relies on heavy and monolithic applications which, through the years, have established cultures of specific processes in the productive, engineering, and administrative areas, among others. This model leads to the establishment of exclusive relations between closed systems/applications and businesses processes in opposition to more flexible and integrated views. While this type of systems' integration solves interoperability needs, such a strategy does not emerge from integrated process models, a fundamental requirement for the integrated enterprise.

A fundamental assumption to be considered in ITS is the existence of heterogeneous technologies that contribute to the company business processes, from toll management to other processes that, in cooperation, implement services grounding the ITS vision. Although a growing number of standards exists that contribute to promote ICT cost reduction, there is a lack of a framework able to cope with the holistic view required by the ITS challenges. The need for integrated views for ITS, is discussed in (Eriksson, 2002) by proposing a combination of information from systems and databases through the standardization of interfaces between them.

The strategy discussed by this paper considers a framework based on services implemented by a group of peers interconnected through an Open Integration Bus named ITS-IBus (Intelligent Transport Systems Integration Bus).

This paper will present and discuss the BRISA ITS-IBus project considering two main strategic research lines: the modeling of ITS system with an open interface enabled for integration to ITS-IBus; and the validation of flexible and service based system considering the DSRC and a LPR (License Plate Recognition) system.

THE OPEN INTEGRATION BUS VISION

As an answer to the new dynamics resulting from the extension of the electronic fee collection (EFC) tolling processes, to other complementary services like fuel filling and car parking access and payment, Brisa was confronted with a number of challenges for witch it has established a strategy based on an increased R&D investment in ITS. The need for an innovative relation considering processes management life cycle, on the one hand, and the need for the reduction of infrastructure costs, on the other hand, was the basis for this technological innovative strategy, which aim at the following objectives:

1. to establish an infra-structure with open protocols and interfaces (standards) where different systems, belonging to different suppliers, competing for the same functionalities required by the related business processes, can be interconnected;
2. to answer to the integrated vision of the various processes whether they are related to internal processes such as management of payments or to some other processes involving different organizations.

The fundamental issue at stake relates to the strategy to follow in order to achieve an adequate level of integration for ITC related projects within the company. Most of the enterprise architectures assume the existence of a set of subsystems or company applications. Such monolithic views address a set of business processes limited on scope and confined to specific company areas (sectors). Consequently, each application/system addresses a set of business processes implementing a set of functionalities that, in some situations, is similar to other functionalities also implemented by other systems, (see Figure 1).

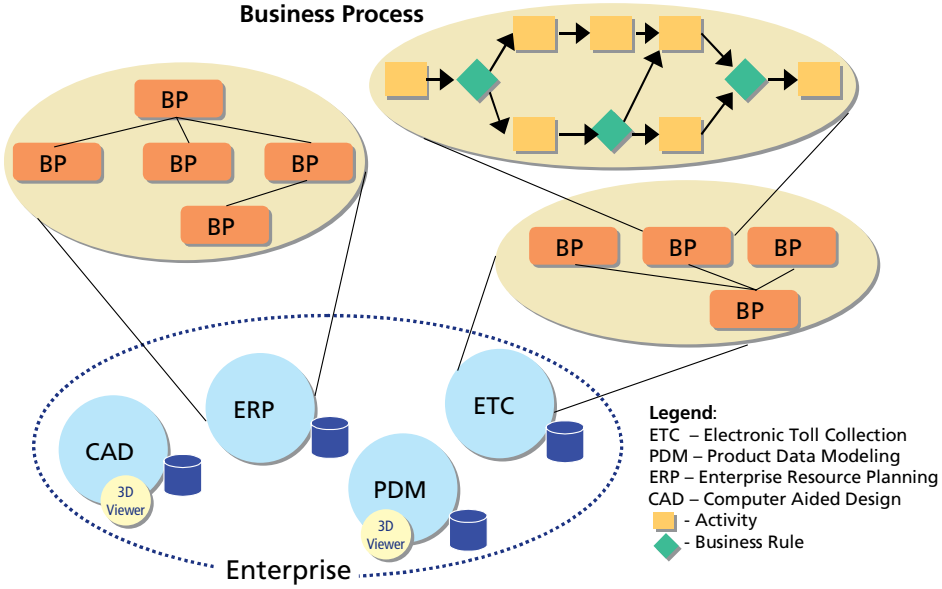

Figure 1 – The monolithic enterprise applications perspective

One example of the consequent lack of reutilization is the visualization of three dimension models associated to both a CAD and PDM systems: 3D Viewer functionality shown in Figure 1 in both CAD and PDM applications. In the ITS industry this

model leads to an added difficulty to share functionalities among different processes. A closed system implementing EFC services and integrating DSRC, classification (AVC) and vision enforcement do not facilitate the share of the vision enforcement by other application (service implementation). Figure 1 is intended to clarify this constraint showing a closed relation between heavy applications and the business processes they contribute to.

In order to cope with this lack of flexibility there is a need to explode (fragmenting) those monolithic systems and establish a new systems organisation based on light units implementing a limited set of functionalities as shown in Figure 2.

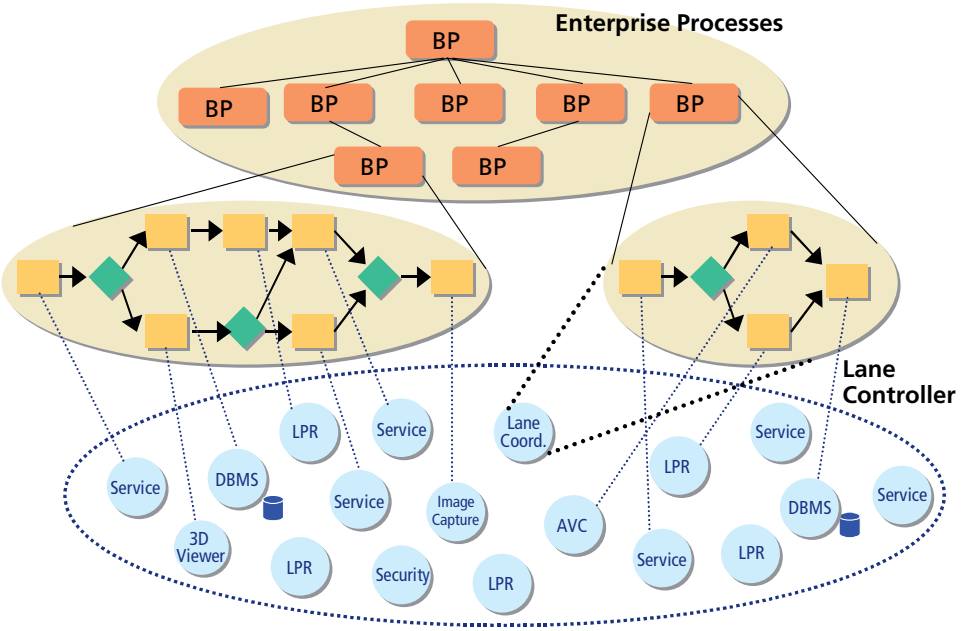

Figure 2 – Service vision of the enterprise functionalities

This perspective follows other works pointing to a world of services where business processes are coordinating structures of a sequence of services execution. These services can be offered in different granularity from high concentrated service implementations to small-grained services able to be assembled (integrated) to commit business process requirements. This changing process can be done by the disintegration (breakdown) of monolithic applications into a set of small execution units offering specialized services to be used in enterprise processes, as shown in Figure 3. An important contribution to the standardization of business process definition is be-

ing promoted by the Business Process Management Institute (BPMI). One important result from this group is a process definition language (Assaf, 2002) as a specification of an abstract model for expressing business processes and supporting entities.

A complementary strategy can be followed to integrate monolithic applications or enterprise ICT systems that are important to be considered in the new framework. For these legated applications a wrapper strategy can be used in order to implement an interface to make available the equivalent services.

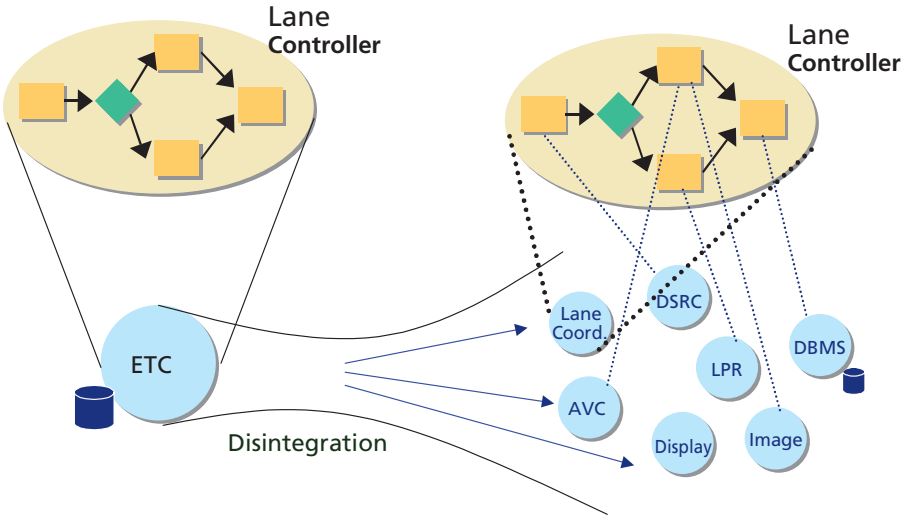

Figure 3 – Disintegration process of a monolithic application/system

Furthermore, this services oriented enterprise execution view (organization) might contribute to cope with the integrated and holistic approach required by quality standards like the ISO 9000/2000. This release of the standard provides a process orientated perspective requiring horizontal views in opposition to the mentioned partitioned or "island" approaches.

THE ITS – INTEGRATION BUS

To cope with the requirements associated to new business models, Brisa has initiated an R&D project in cooperation with ISEL (Instituto Superior de Engenharia de Lisboa) and other universities and research groups to establish a new approach to ICT management. The challenge involves the proposal of a new organization for executive systems based on "plugable" services. The strategy is to promote an open integration bus based on opened interfaces able to plug a number of different sys-

tems. This open integration bus will be supported by an open reference implementation aiming to contribute to a generalized consensus. To achieve this goal, three concepts were defined. The system concept identifies an execution container of a set of services (the second concept) see Figure 4. These services are the implementation of functionalities grouped on a fine-grained based strategy. The third concept is related with the standardization of the execution container and the service definition and deployment framework. The systems are plugged to the ITS-IBus following the concepts proposed by the UPnP (Universal Plug and Play) forum (UPnP, 2000). Beyond the UPnP service, a system (service execution container) should hold monitoring and security services. The monitoring services are an important piece to contribute to the management of quality of services (QoS) and also to contribute to coordinating decisions when fault tolerance is required to comply with critical processes. These security services are important when Web based (Internet/remote) accesses are required.

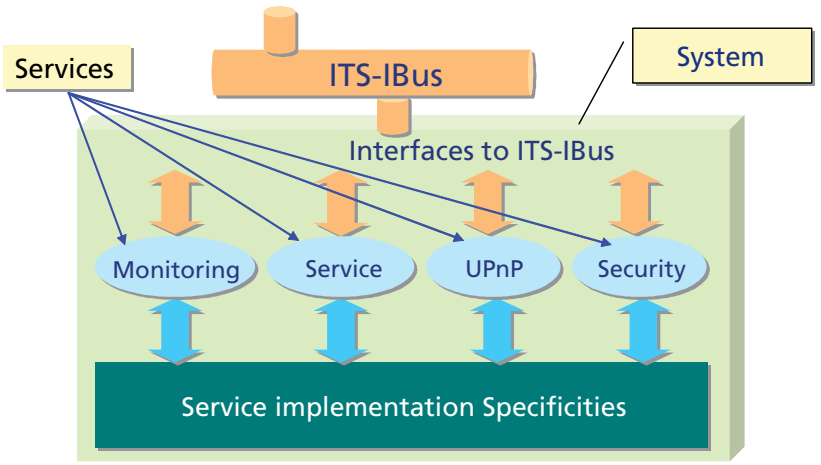

Figure 4 – The proposed execution container for the ITS-IBus services

Based on the UPnP characteristic, the services are registered into systems and identified by service class, service provider, version and other profile information. As an example, in the toll arena, some service classes can be considered:

- DSRC (TC278) compliant services;
- AVC car classification services;
- Display and light services;
- Vision acquisition services;
- LPR services;

- Lane coordination services;
- Toll coordination services.

All (business) process implementation are able to offer services. The idea is to limit the scope of processes to the execution of focused activities as well as to export the services required by other processes. In this way, the end user companies (like BRISA) have an added flexibility to arrange their ICT resources according to their (business) process needs. This might contribute to cope with business process reengineering and also to increase supplier competitiveness. In fact, end user enterprises might increase the flexibility of their decisions about how to choose different system and service suppliers given that they all comply with ITS-IBus services reference framework.

There is another flexibility offered by the ITS-IBus initiative considering specific execution environments. One or more systems can be executed on a specific execution environment (Windows or Linux) or in a virtual machine, Java or .NET frameworks. There is only a constraint specific for each implementation related with the required connected devices, (Figure 5). As an example a DSRC service implementation needs a RSU (Road Side Unit) device to be connected to the system that implements it.

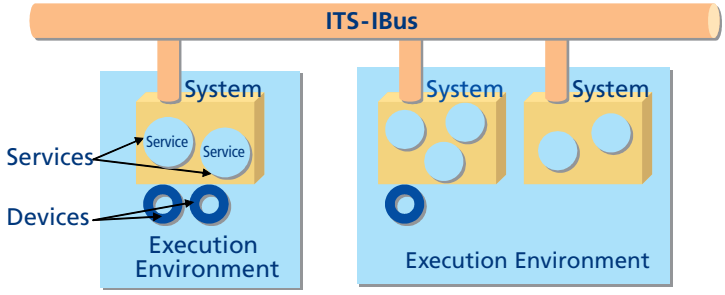

Figure 5 – Details of the ITS-IBus enabled system as a service container

In Figure 6 a scenario is presented considering a toll management system based on four (business) process levels. There is a set of lane coordinators implementing the process business logic associated to the lane process control. Furthermore this process implementation offers a set of services that are used by the toll manager. The toll manager implements the process business logic associated to the coordination of the set of lanes in a toll. Again this implementation exports a set of services that are used by a central toll infrastructure management to coordinate all the tolls. The architecture reflects the hierarchy found in a real toll system and, based on the adopted strategy, changes in specialized process implementations do not influence the overall system.

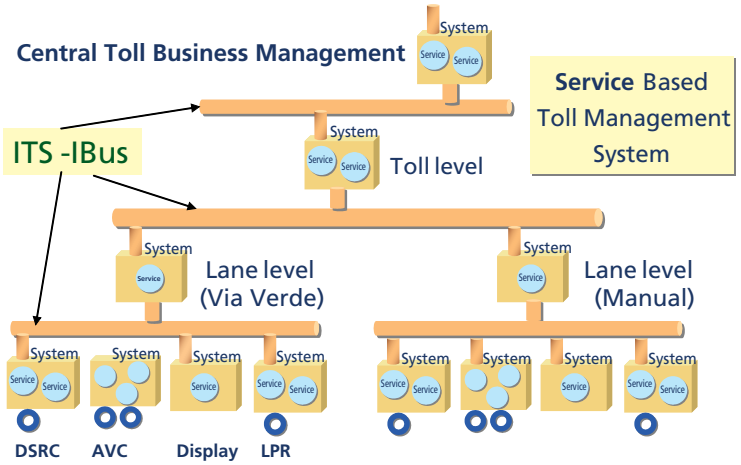

Figure 6 – General ITS-Ibus architecture for a toll application domain

All the units contributing to the execution of (business) processes are integrated into the ITS-IBus framework as services. This strategy flavours the concentration of the business process execution coordination into specialized service implementations. Furthermore, it is an objective of the ITS-IBus project the development of a set of tools contributing for a high level design of toll related (business) processes with the help of a simple interface (graphical or not). This might contribute to elite technological complexities and involve on process design the persons really specialized on those matters.

There is another important aspect related with the open perspective of the ITS-IBus specification. The success of this initiative is deeply related to the consensus the ITS-IBus might obtain from other end-user companies and from system manufacturers. To the moment the number of companies and research groups interested on the ITS-IBus concept has been growing. A first version of the ITS-IBus specification is planned to be published until the summer (of 2003).

CONCLUSIONS

This paper presents the main motivations of BRISA to initiate an open initiative to define an integration bus for ITS related ICT systems. The paradigm shift, from ICT based on monolithic applications with embedded "hard coded" business logic to a light service model, was presented as a main strategic line underlying the ITS-IBus project. The architecture of a system was described as an execution container for services "pluggable" to the ITS-IBus. It was also discussed the new flexible organiza-

tion of the light execution units (services), considering the case of a toll management system. The establishment of an open integration bus supported by reference implementations (generalized consensus) will contribute to promote interoperability among heterogeneous services (systems) and to improved market competitiveness.

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