Towards Service-oriented Smart Items in Industrial Environments

Stamatis Karnouskos[1], Armando Colombo[2], François Jammes[2] and Martin Strand[3]

We are moving towards the "Internet of Things", where each device will be smart, interconnected and collaborate with other smart devices and business services. Such service-oriented infrastructures emerge slowly also in the industrial domain and will revolutionize business processes and capabilities of industrial IT landscape. Under the coordination of Schneider Electric, several Industrial partners (among others SAP, ABB, SIEMENS, Jaguar, Boliden, ARM etc) have joined forces with top European Universities and institutes in order to investigate and deliver a Service-Oriented Cross-Layer Infrastructure for Smart Embedded Devices (SOCRADES) that can be used in real-world industrial environments.

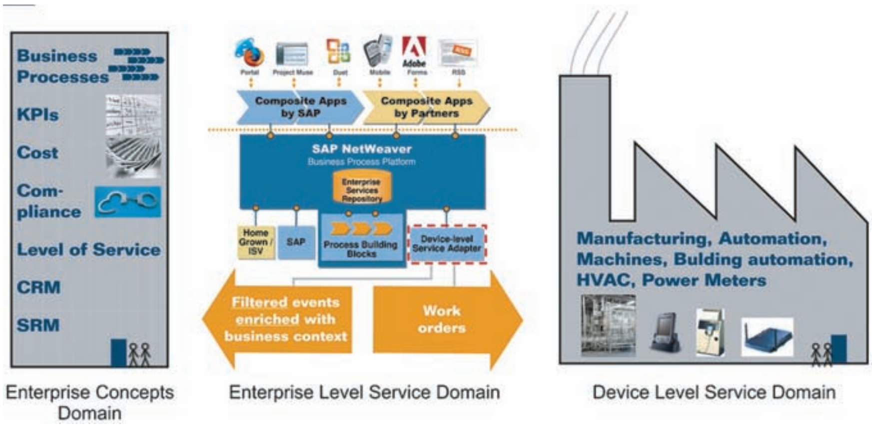

Figure 1: Connecting Enterprise Services with the Shop Floor

Target of the SOCRADES project is to work towards creating new methodologies, technologies and tools for the modeling, design, implementation and operation of networked systems made up of smart embedded devices. Achieving enhanced system intelligence by cooperation of smart embedded devices pursuing common goals is relevant in many types of perception and control system environments. In general, such devices with embedded intelligence and sensing/actuating capabilities are heterogeneous, yet they need to interact seamlessly and intensively over a (wired or wireless) network. In next generation industrial environments, enterprise services will be strongly interconnected with the shop-floor activities and will be able to directly access and cooperate with the embedded systems there in order to build more sophisticated services and support more efficient approaches.

As depicted in Figure 1, business applications will be able to provide a more accurate view based on real-time data received from the devices in a service-oriented way. The middleware technologies under development will be based on the Service-Oriented Architecture (SOA) paradigm, will be neutral with regard to networking technologies, and will provide open interfaces enabling interoperability at the semantic level. As depicted in Figure 2, services will be encapsulating device-specific functionality, which is advertised to the outside world, so as to be located and invoked by other networked devices and/or applications, without the latter being aware of how the functionality is actually implemented.

Moreover, manufactured pieces of equipment may also provide the same service vision. This will lead

[1]SAP Research, [2]Schneider Electric, [3]ABB

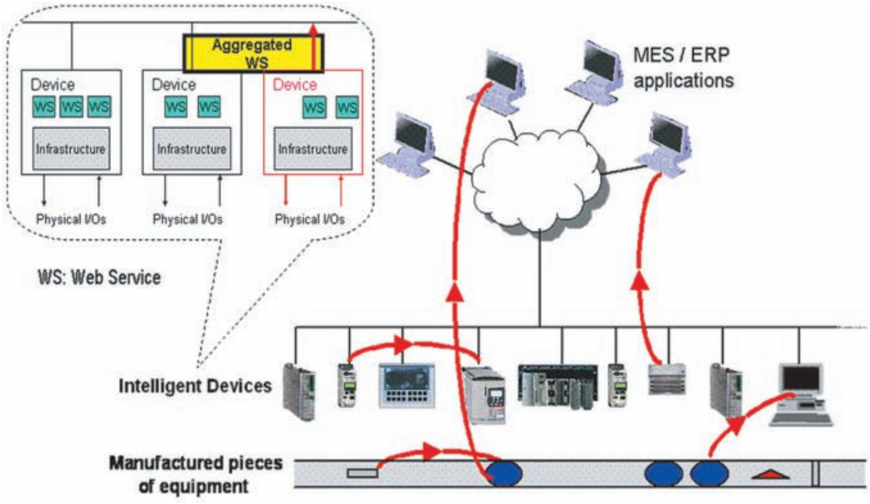

Figure 2: Web-service oriented decentralized Architecture

to seamless integration also with business services running in state-of-the-art enterprise systems and empower them. The service-oriented ecosystem envisions networked systems that are composed from smart embedded devices and smart manufactured pieces of equipment interacting with the physical and enterprise environment, pursuing well-defined system goals.

As demonstrated in Figure 1, the adoption of a uniform service-oriented communication infrastructure at all levels of an industrial enterprise, down from the "shop floor" up to the "top floor". At the device and manufactured pieces of equipment level, it allows them to expose high-level service interfaces, using protocols of the same web service family as those employed by higher-level business processes. This evolution is made possible by the unprecedented and ever-increasing horsepower that can be incorporated into very tiny and cheap processing components. Harnessing this computing power, devices of all kinds gain more and more intelligence.

In SOCRADES we follow two approaches i.e. one that focuses on device-centric functionality at the lowest level of the embedded device hierarchy, i.e. sensors and actuators, and another that adopts a service-oriented view in order to cut across, not only all levels of the embedded device hierarchy, but also the higher-level business processes of which the device-level processes are a constituent part. Major objectives in this context are to allow devices to directly communicate, both amongst themselves and with applications, through the same service-oriented high-level communications infrastructure. Wireless communication is particularly addressed as a mean to increase the flexibility and agility of the communication infrastructure.
The SOCRADES approach is largely technology-neutral and is highly generic in nature. It is therefore applicable to a wide range of devices, not only in the industrial automation sector, but also in adjacent domains like home automation and building automation. The service-based communication infrastructure is also applicable to devices in disparate technology domains, e.g. automotive, telecommunications, medical instrumentation, telemetry or even consumer electronics. This wide application perspective and the correspondingly achievable economy of scale create an opportunity for the development of a generic electronic component capable of supporting the intelligence of a wide variety of devices with a broad spectrum of usage requirements, including those of low-power wireless sensors. Therefore, the SOCRADES project includes an architectural design study with the objective of proving the feasibility of realizing a wide range of linearly scalable processor performance. This design study will be based on the ARM architecture, which is very widely used in embedded devices and has been designed from the outset for low-power consumption. Furthermore, the consortium is composed of several leading companies in their domain, which will guarantee the wide spectrum of applicability of the concepts for embedded devices developed within the project. Finally, live demonstration scenarios are planned that will validate the technology and the approaches in real-world industrial environments.

Figure 3: Smart Embedded Devices for a wide spectrum of applications

Contact:
Stamatis Karnouskos
SAP Research Center CEC Karlsruhe
Vincenz-Priessnitz-Strasse 1
D-76131 Karlsruhe, Germany
Phone: +49 721 690215
Fax: +49 622 77845799
E-Mail: stamatis.karnouskos@sap.com
www.sap.com