

# 1<sup>st</sup> International Conference on Cyber-Physical Systems (ICCPs)

Panel Discussion

## Industrial Challenges in Cyber-Physical Systems

15 April 2010 @ 15:30-17:30

Co-organized by

Janos Sztipanovits, Vanderbilt University

Jorge Pereira, European Commission

Cyber-Physical Systems (CPS) are *engineered systems* constructed as networked interaction of physical and computational components. In CPS, computations and communication are deeply embedded in and interacting with physical processes to add new capabilities to physical systems. Competitive pressure and societal needs motivate industry to design and deploy airplanes and cars that are more energy efficient and safe, medical devices and systems that are more dependable, defence systems that are more autonomous and secure. Whole industrial sectors are transformed by new product lines that are CPS-based<sup>1</sup>. Industry has a unique role in CPS research. Artefacts to be investigated by CPS science are engineered heterogeneous systems - typically produced by industry. Indicators of missing foundations, such as lack of compositionality and predictability in the engineering process and lack of comprehensive design automation tools, are experienced by industry while developing and operating real-life CPS.

There is an emerging consensus that basic research in CPS needs to be performed in the context of real engineered systems – typically conceived, built and deployed by industry. The nature of CPS research requires reinterpreting the usually accepted differences between basic and applied research. The usual model of innovation, where scientific discovery is eventually followed by practical applications, is less prevalent because discoveries will occur while solving challenges of high and immediate practical value. This fact does not change the need for long term commitment in conducting and exploiting full benefits of the research, because general methods and tools cannot be validated and applied without deep domain knowledge.

The panel will focus on the nature of the innovation enterprise in CPS. Industry experts will discuss present and emerging challenges, express their view on barriers that need to be overcome in creating a new science and technology foundation and discuss effective forms of industry- academy interactions.

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<sup>1</sup> Jeannette M. Wing, Associate Director for CISE, National Science Foundation. "Cyber-Physical Systems." *Computing Research News* 21,1 (January 2009). <http://lazowska.cs.washington.edu/initiatives/WingCRN.pdf>

*US Panelists*

**David Corman** - Technical Fellow, the Boeing Company

**Shige Wang** - General Motors R&D and Planning

**Clas Jacobson** - United Technologies Research Center

*EU Panelists*

**Nereo Pallaro** - Head of Automation & Systems Department, FIAT Automotive

**Martijn Bennebroek** - Principal Scientist, Electronic Systems and Silicon Integration,  
Philips Research Europe

**Armando Walter Colombo** – Edison L2 Group Senior Expert Schneider Electric

**1<sup>st</sup> ACM/IEEE International Conference on  
Cyber-Physical Systems (ICCPS)  
Stockholm, Sweden**

**Panel Discussion  
*Industrial Challenges in Cyber-Physical Systems***

*15 April 2010 @ 15:30-17:30*

# **SoA-based Automation & Control Framework**

**Dr.-Ing. Armando Walter Colombo**  
*Edison L2 Group Senior Expert*

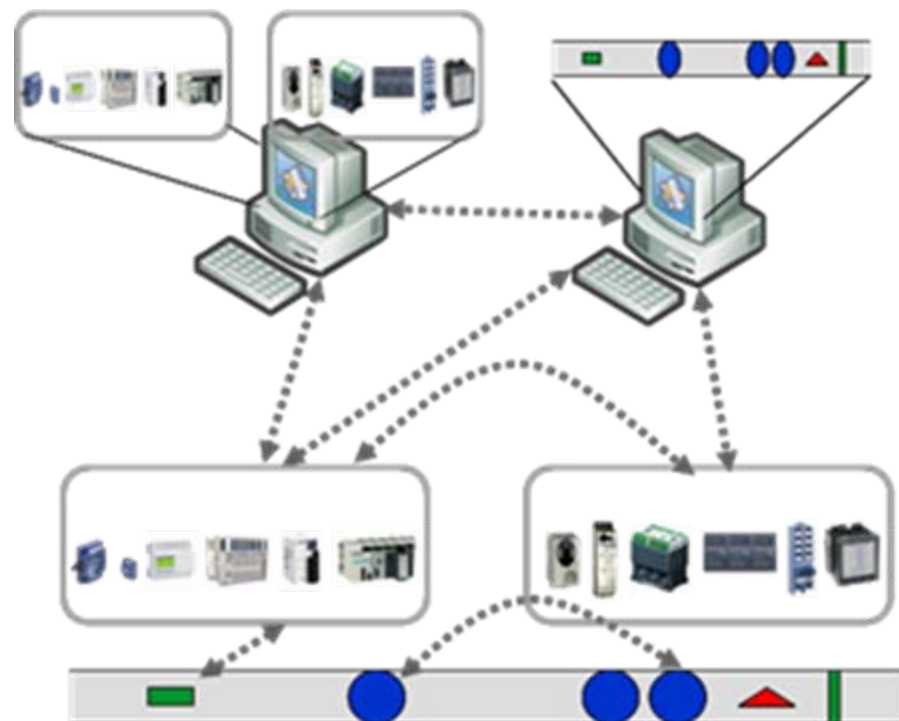
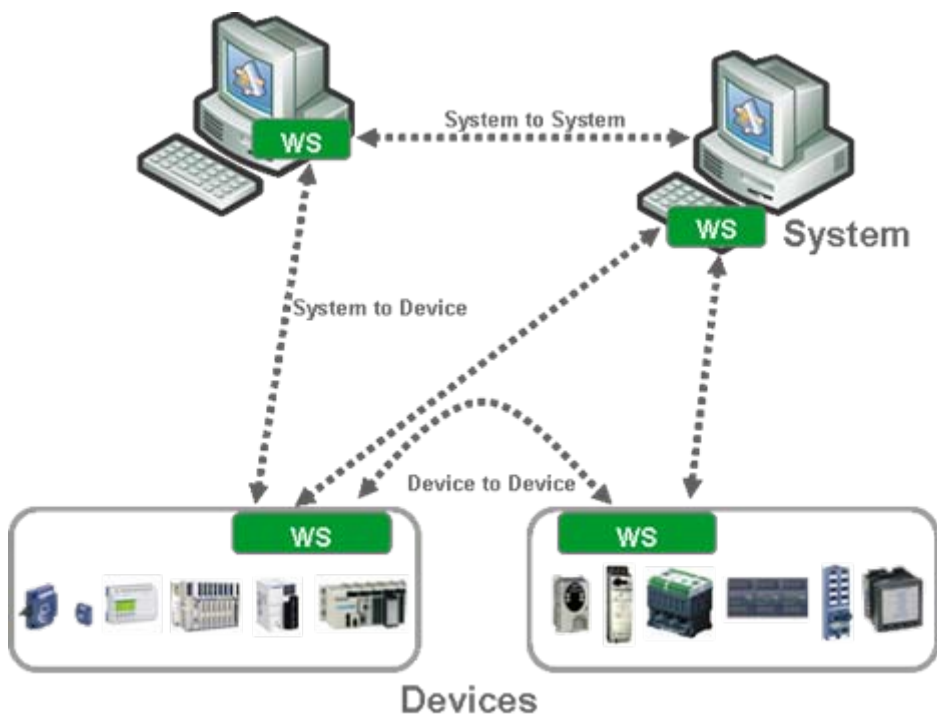


## Innovation: Interoperability

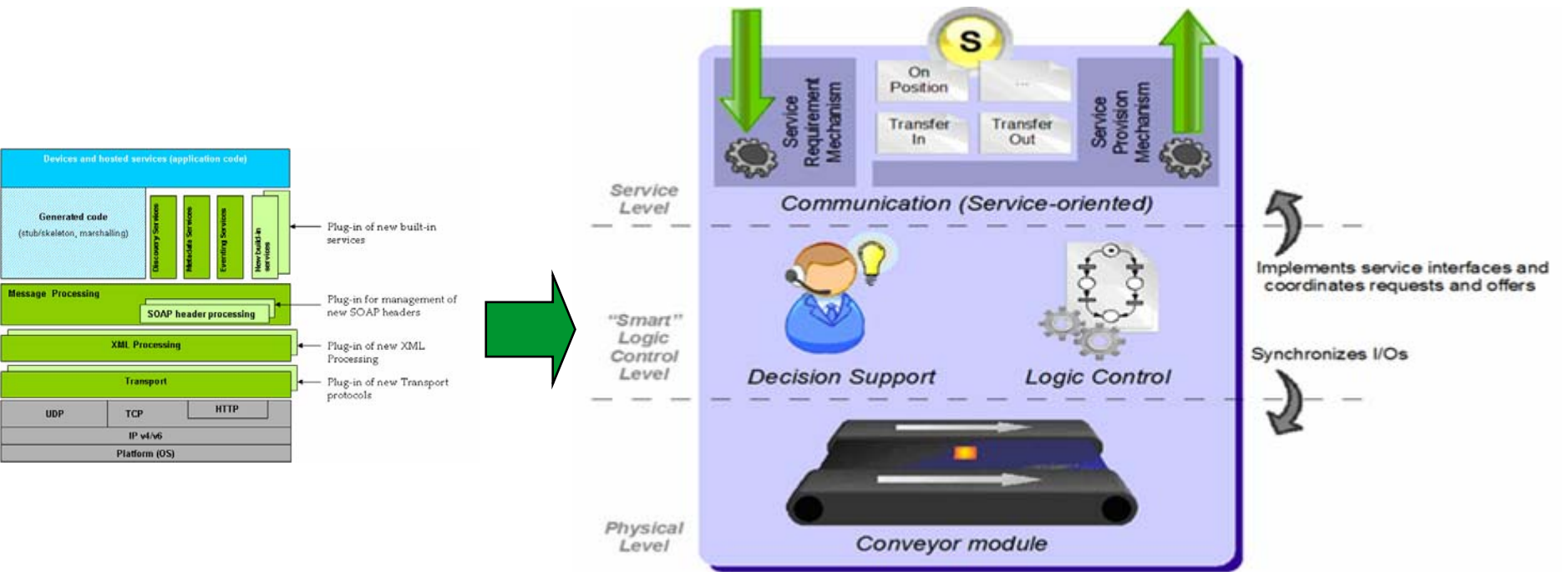
- Devices speaking the language of systems are directly inter-operating with systems

## Innovation: Connectivity / Plug-and-Play

- Devices, manufactured pieces of equipment, people entering a building, ... are dynamically automatically discovered and managed



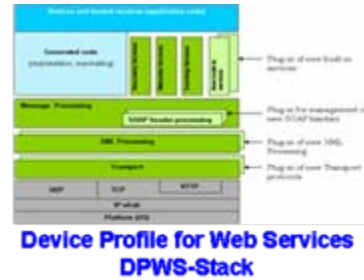
# Innovation: Cyber-Physical System



- Mechatronics, Communication and Control integrated in something called “Collaborative Unit” with embedded Service-capabilities ➡ **Cyber-Physical System**
  - A Gripper offers “Pick” and a Robot-arm offers “Place”, then both offer “Pick-and-Place” when they are composed following architectural and behavioral specifications
  - Mechatronic transport device offers transport functions
- Operations are exposed as Web Service (Transfer Interface)
  - TransferIn(int p), TransferOut(int p), TransferStop(), TransferInCompleted(Pallet p), GetStatus(Status s),...
- Device offers additionally WS standard plug & play functions for description and discovery of the Device / Transfer Service / Supervisory Control Services (Infrastructure Services)

# Innovation: Cyber-Physical System (SW embedded in HW)

Software Platform: Core



Hardware Platform



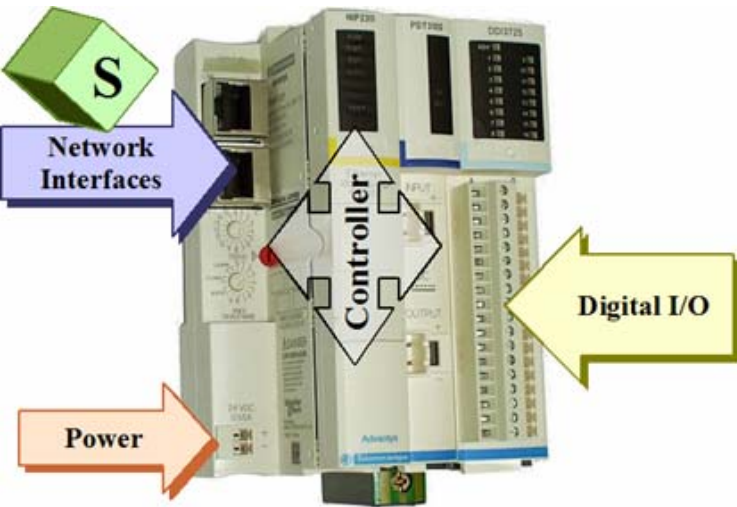
Schneider Electric FTB: 16 digital configurable I/Os



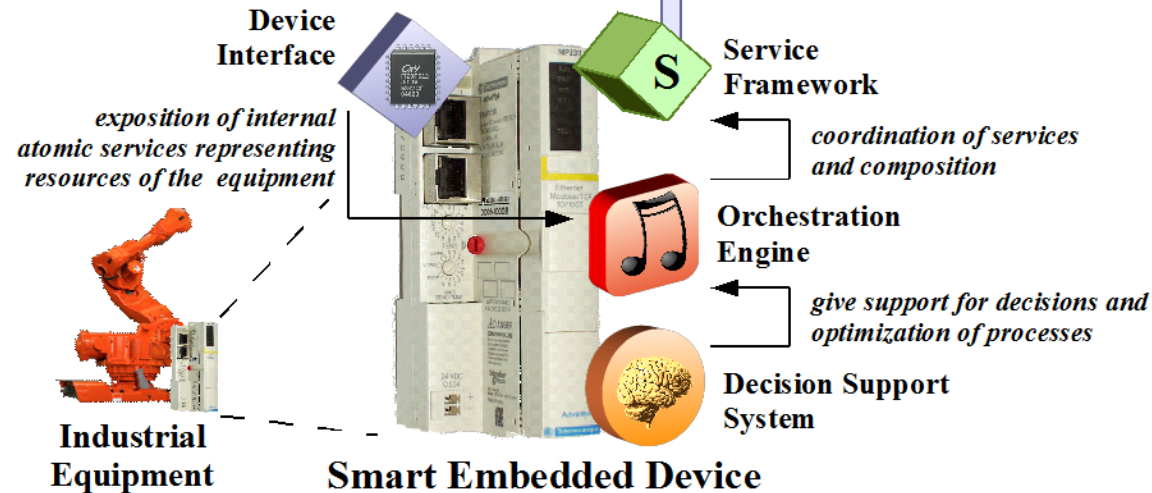
Ethernet hardware



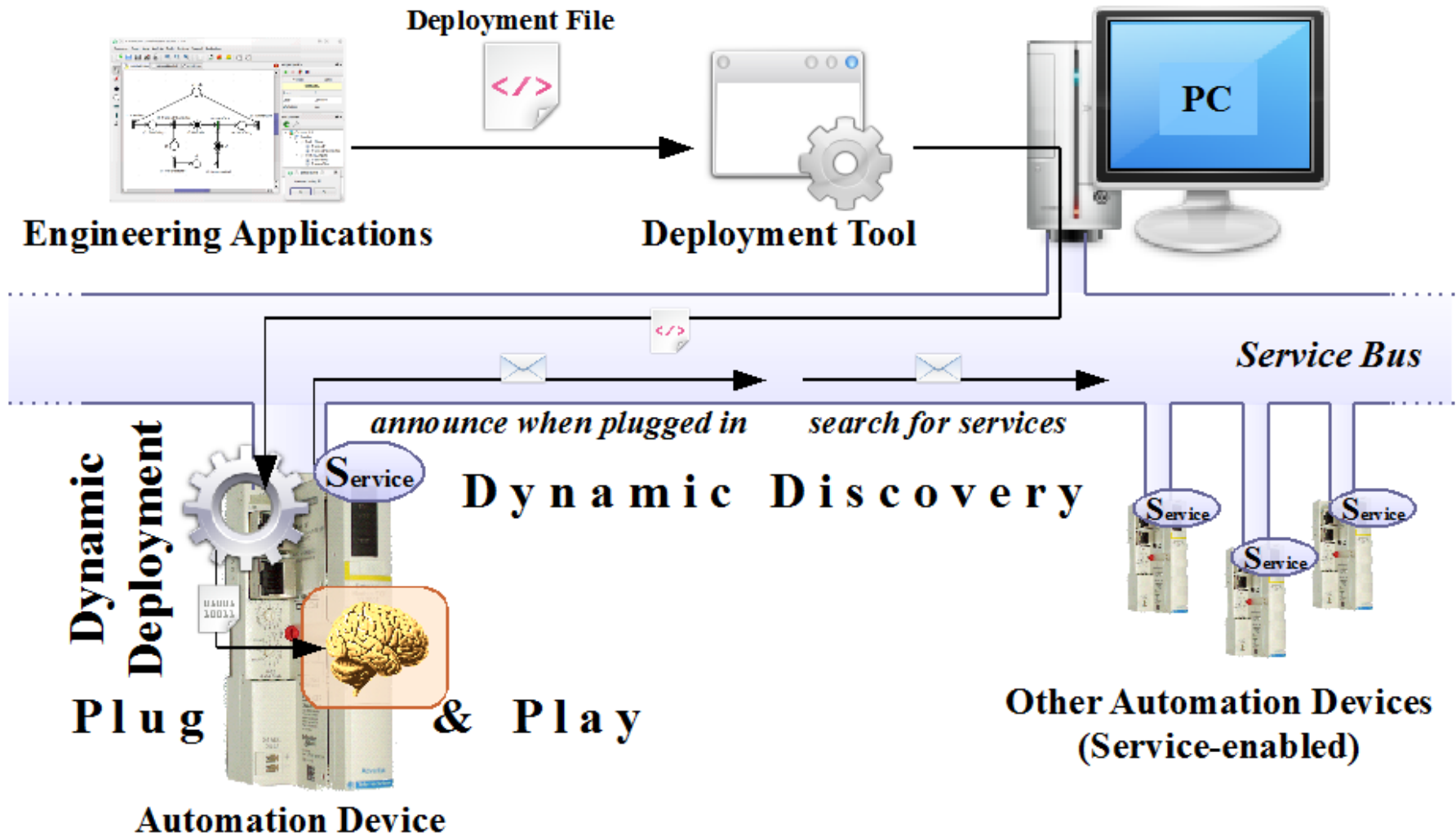
Schneider Electric STB: up to 512 configurable I/Os: Digital, Analog, etc...



Service Bus (Network)

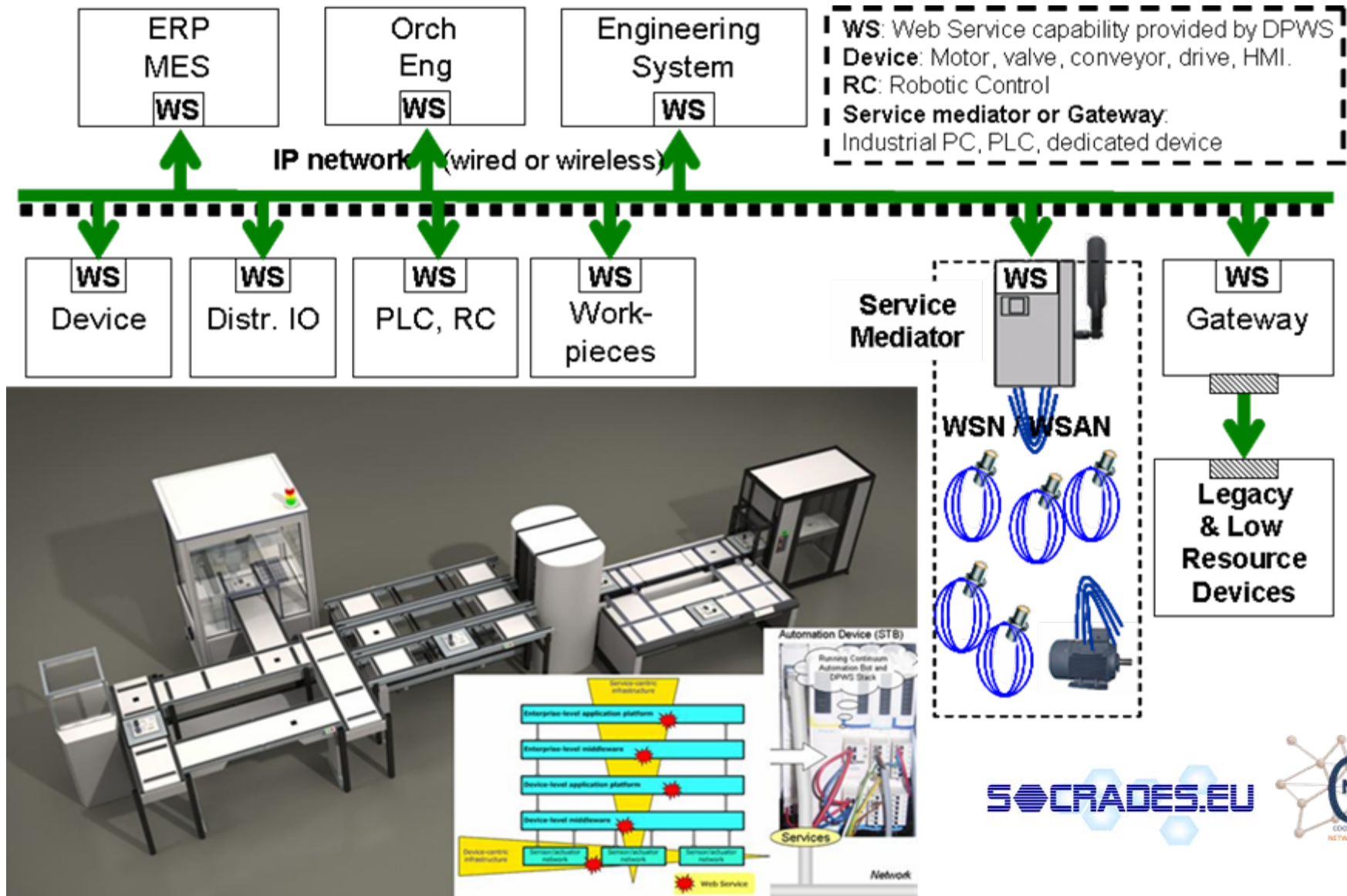


# Innovation: Cyber-Physical System (SW embedded in HW)





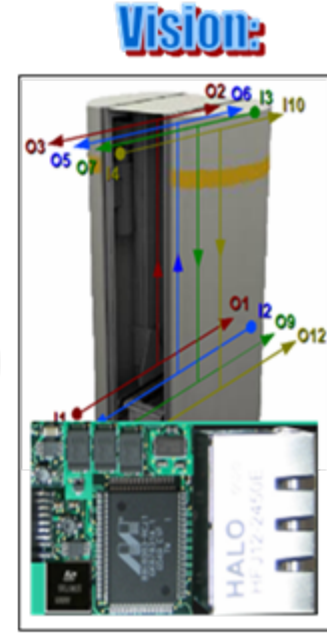
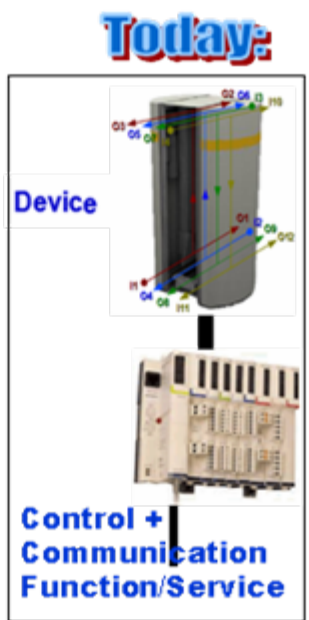
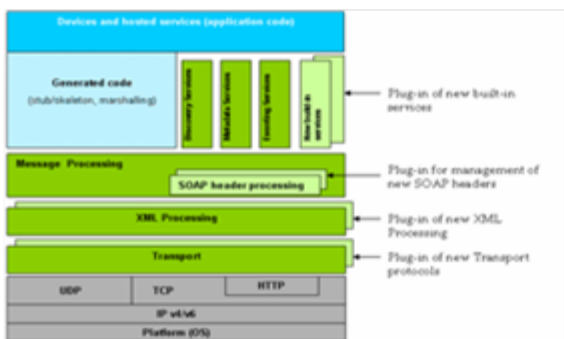
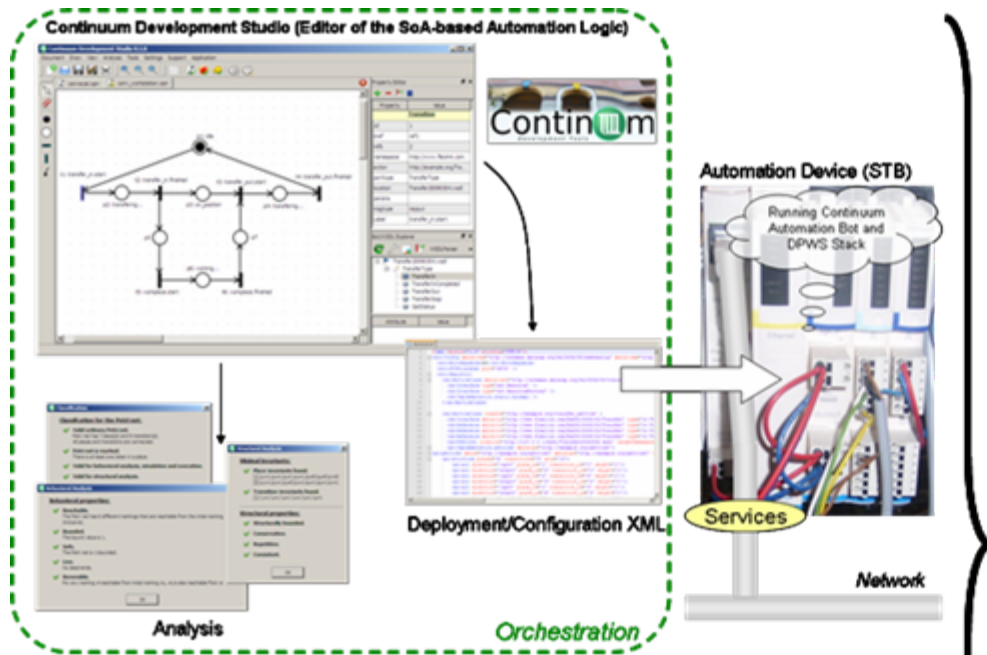
# Innovation: Cyber-Physical System (System of Systems)





# Innovation: Cyber-Physical System (SW embedded in HW)

Smart Embedded Devices: where to go?



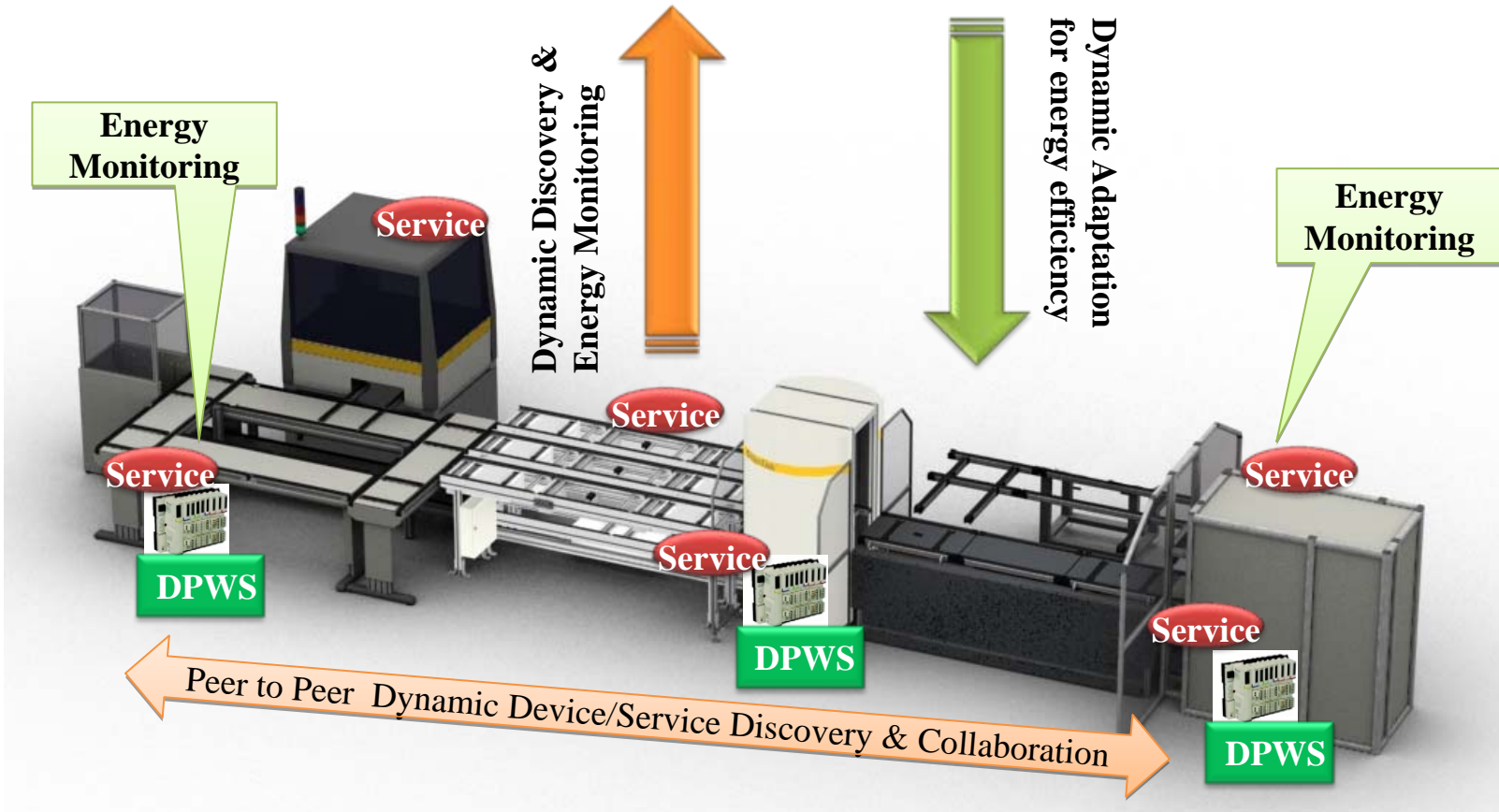
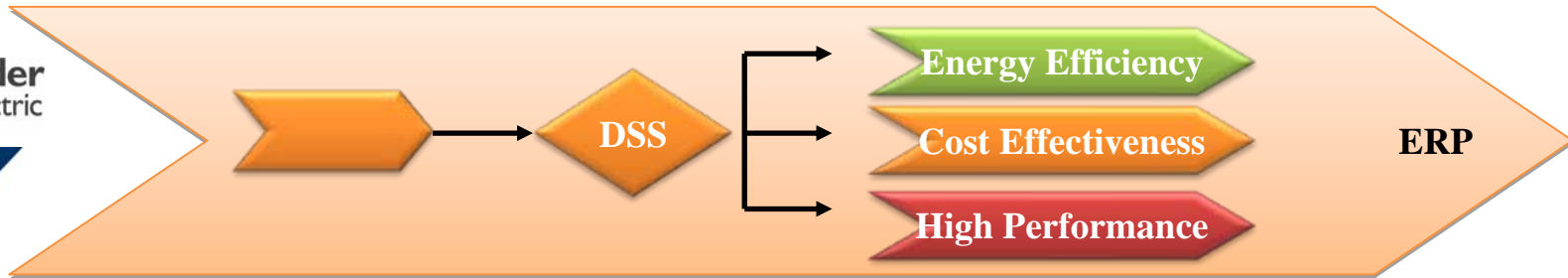
**Web Service Embedded in Controller**

**Web Service Embedded in Mechatronics**

**SoA, WS, Collaborative Automation / Embedding in smart devices**

# Innovation: Cyber-Physical System [Capabilities (I)]

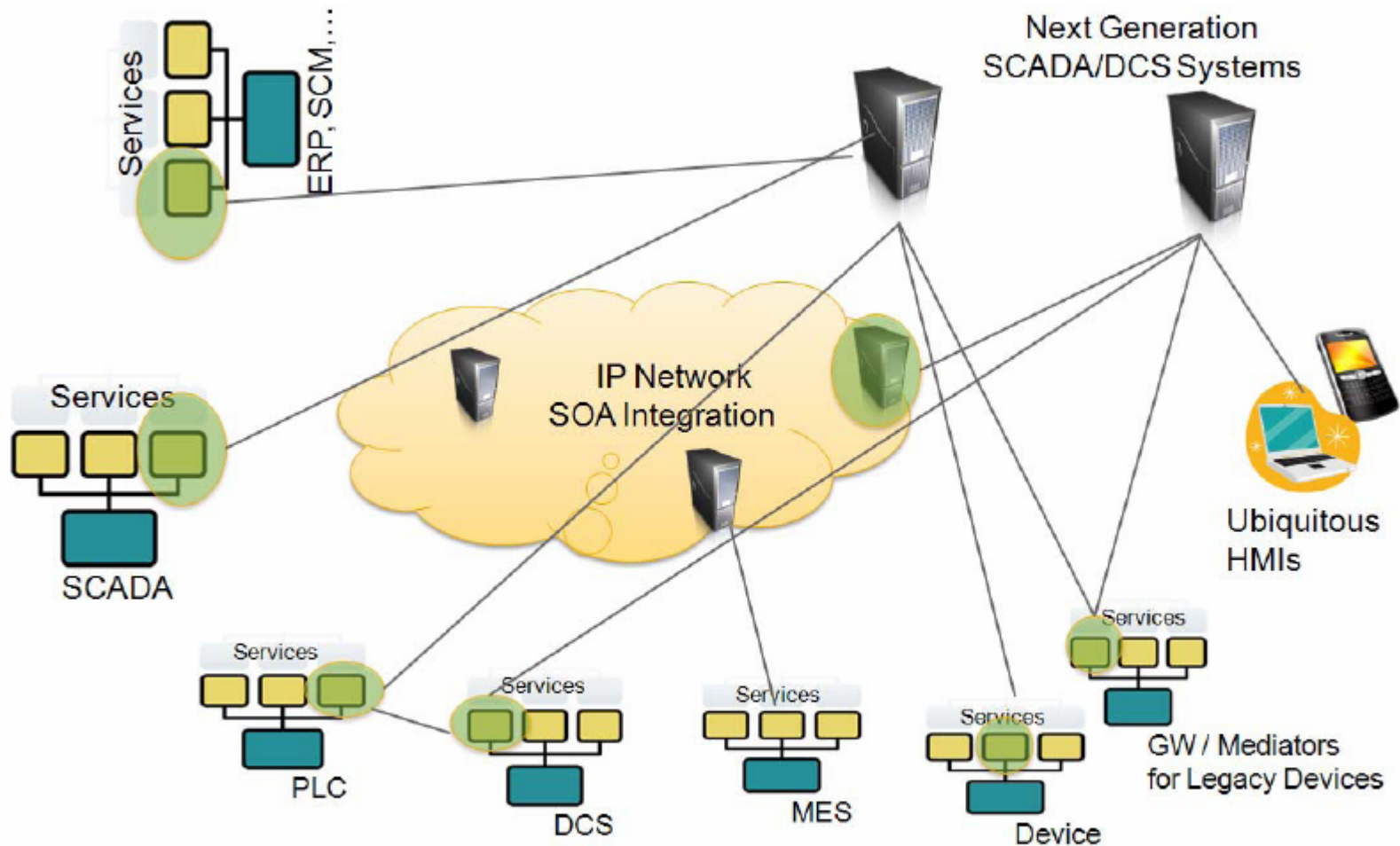
*Intelligent Supervision: where to go?*





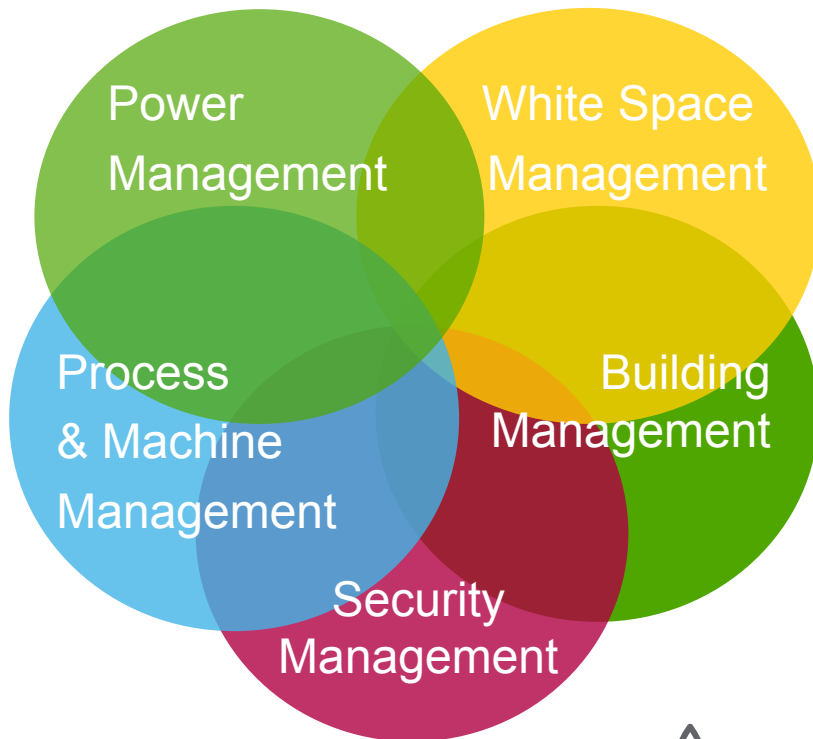
# Innovation: Cyber-Physical System [Capabilities (III)]

## Intelligent Supervision (SCADA): where to go?



# Schneider Electric's EcoStruxure™

Schneider Electric develops the “EcoStruxure” project to integrate Building / Power / Data centers / Industry solution in “One” Schneider solution based on SoA



EcoStruxure™ promise :

- Guaranteed compatibility / synergy / capability between the 5 domains of expertise
- Enabled by the right connecting technologies :
  - Internet as a common highway
  - Web services as a common language (SOA architectures)

