Mashing Up Manufacturing

Thanks to Java SOAs...

Dominique Guinard, Vlad Trifa, Domic Savio

SAP Research, Zurich and Karlsruhe

4000

Agenda

Motivation

Architecture & Prototype

Wrap Up

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Motivation

> The manufacturing industry is facing a number of challenges:

– Mass customization, last-minute changes

– Cross-organizations processes

– … in a very heterogeneous world.

> Need for increased flexibility and agility in the manufacturing process:

– Enable dynamic reconfiguration and composition

– Enable shop-floor events to be integrated to top-floor enterprise applications (e.g ERP, etc.)

Enterprise

ERP, SCM, PLM, SRM, CRM

DISCONNECT

Factory/ Plant

SCADA/HMI Services | DCS Systems | MES Systems | Custom Database | Plant Historians | SPC/SQC Systems | Laboratory Systems | Maintenance Systems

Heterogeneous Plant Floor IT Infras.

Machinery & Plant Assets

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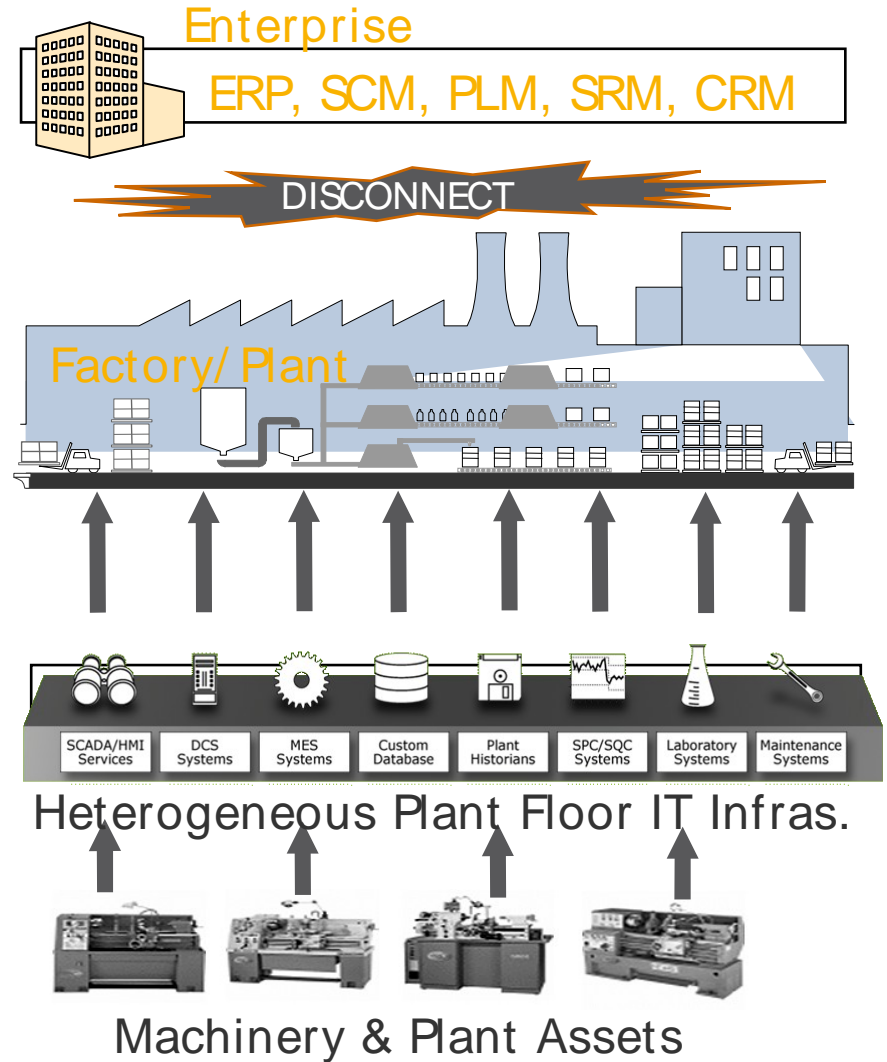
Trends in Manufacturing

Agile Manufacturing + Smart Objects + Service Oriented Architectures = Future Manufacturing

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SOA- Ready Device Integration in Enterprise Systems

> The aim is to develop a **cross- layer infrastructure composed of web service enabled devices (SOA- ready) strongly coupled with enterprise applications.**

> **Mashing- up manufacturing.**

> The project brings together leading competitors in the automation area.

> SAP's contribution is in the **enterprise integration**.

Video

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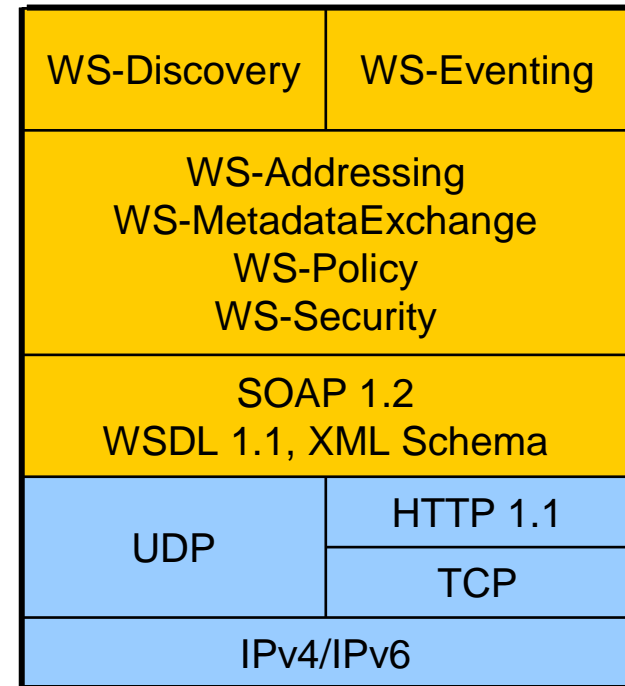# Agenda

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Architecture
& Prototype

Wrap Up

Device Layer: Device Profile for Web Services

> Based on DPWS:
>
>   – Open standard for providing (Big) Web Services at device level.
>
>   – Minimal set of standards.
>
>   – Small footprint.
>
>   – Similarities with UPnP but based on WS standards.
>
>   – DPWS = WS + Discovery + Service Description + Security and focus on Eventing.
>
> Goal: Embedding DPWS in devices and even « in silicon »:
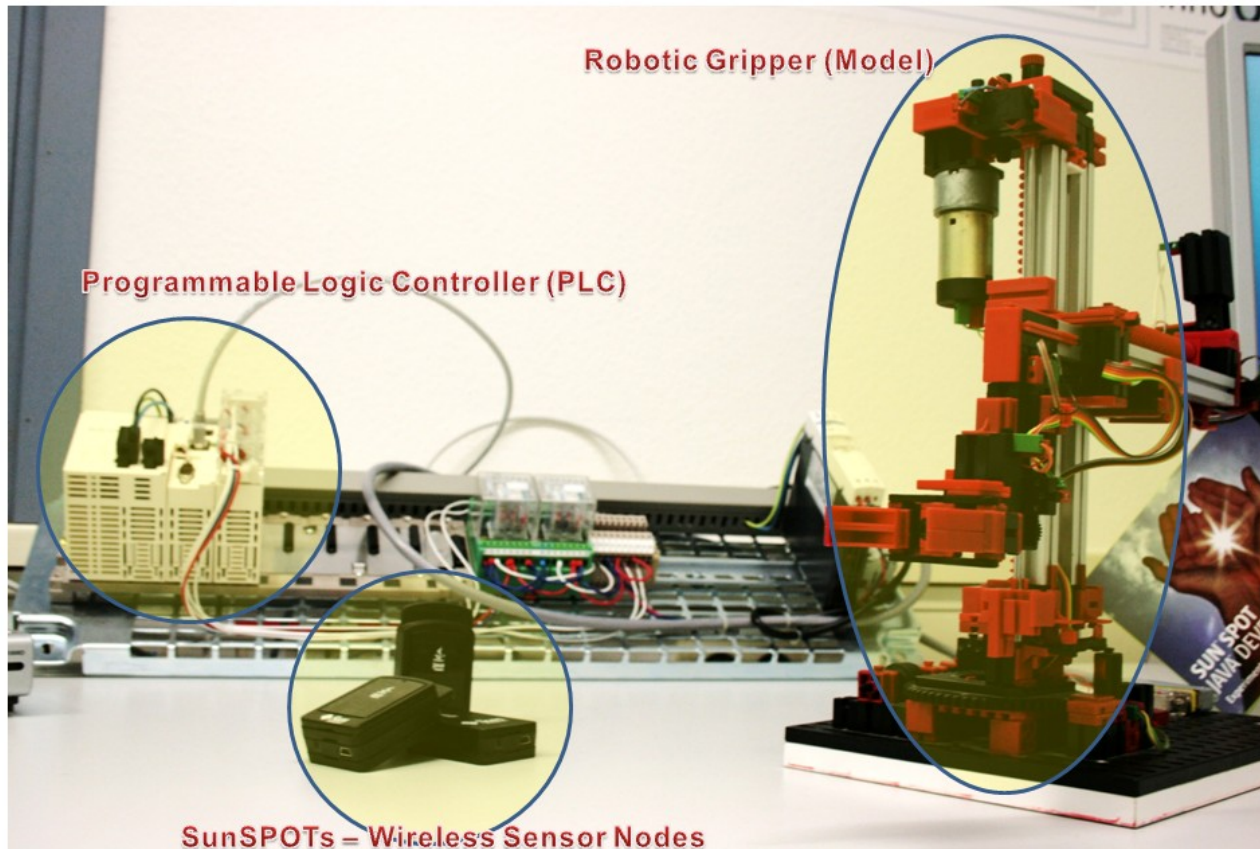>
>   – Schneider Electric, ABB, ARM

WS-Discovery	WS-Eventing
WS-Addressing WS-MetadataExchange WS-Policy WS-Security	
SOAP 1.2 WSDL 1.1, XML Schema	

UDP	HTTP 1.1
	TCP
IPv4/IPv6	

Devices Profile for Web Services
(DPWS)
protocol stack

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DPWS: continuing

> Initial open standard:

  – First published in 2004, revised in 2006.

  – Standardization driven by several actors (Microsoft, Intel, Lexmark, etc.)

> The DPWS stack is implemented in Windows Vista

> Various implementations:

  – http://www.soda-itea.org/ , opensource, C, Java SE stack driven by Schneider Electric.

  – http://ws4d.e-technik.uni-rostock.de/ , opensource, C, Java, Java ME driven by University of Rostock, Dortmund and MATERNA.
    Forge on: https://forge.soa4d.org/

Using DPWS in the SOCRADES Prototype

ENTERPRISE APPLICATIONS

HTML-GUI / Applets

SAP Protocols

Web Services

SAP MII

Visualization Services
- Applets
  - Display Controls
    - Displays
      - GUI Widgets

SAP Connectivity

SAP Transaction Access

SOCRADES MIDDLEWARE APP SERVICES

Invoker
- Asynchronous Buffer

Eventing
- Notification Broker

(Event) Pull Point

Web Services

Business Logic Services

Business Process Monitoring

Alert

Data Services

Legacy Connector

SOCRADES Connector

Cross- layer Service Catalogue
- Composed Services Runtime
- DPWS Back- end Services

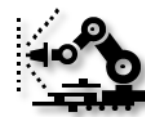Shop floor standard

Web Services

SOCRADES MIDDLEWARE DEVICE SERVICES

Device Manager and Monitor

Middleware Historian

Service Discovery

Service Lifecycle Management

Service Mapper

Services Repository

Service Access Control

Hardware Vendor Implementation

Proprietary Protocol

OPC UA over DPWS

OPC UA over DPWS

Gateway

Web Services

DEVICE LAYER

SAP Manufacturing Integration and Intelligence

> SAP MII is a visualization and composition software tailored to manufacturing:

  – Reads datasources (DB, MES, etc.).

> In the current version of the SOCRADES middleware it is extended and used as a:

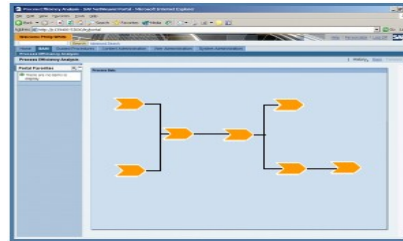 – As UI to visualize shop-floor data.

  – As a mashup editor.

Using MII in the SOCRADES Prototype

Maintenance Application
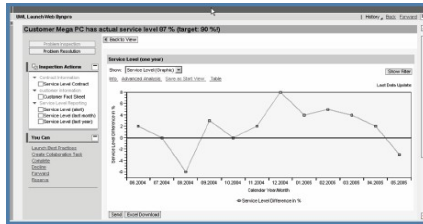
Production Planning

Customer Relationship Management
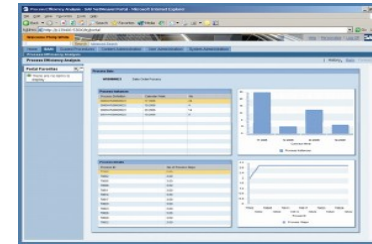
Business Rule Engine

Business Process Monitoring

Alert

DPWS

alert

Overheating Alert

stop

DPWS

```
If(OverheatingAlert) then
    stopProduction()
    triggerMaintenance()
    rescheduleProduction()
    informAccountManager()
```

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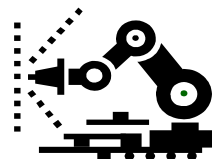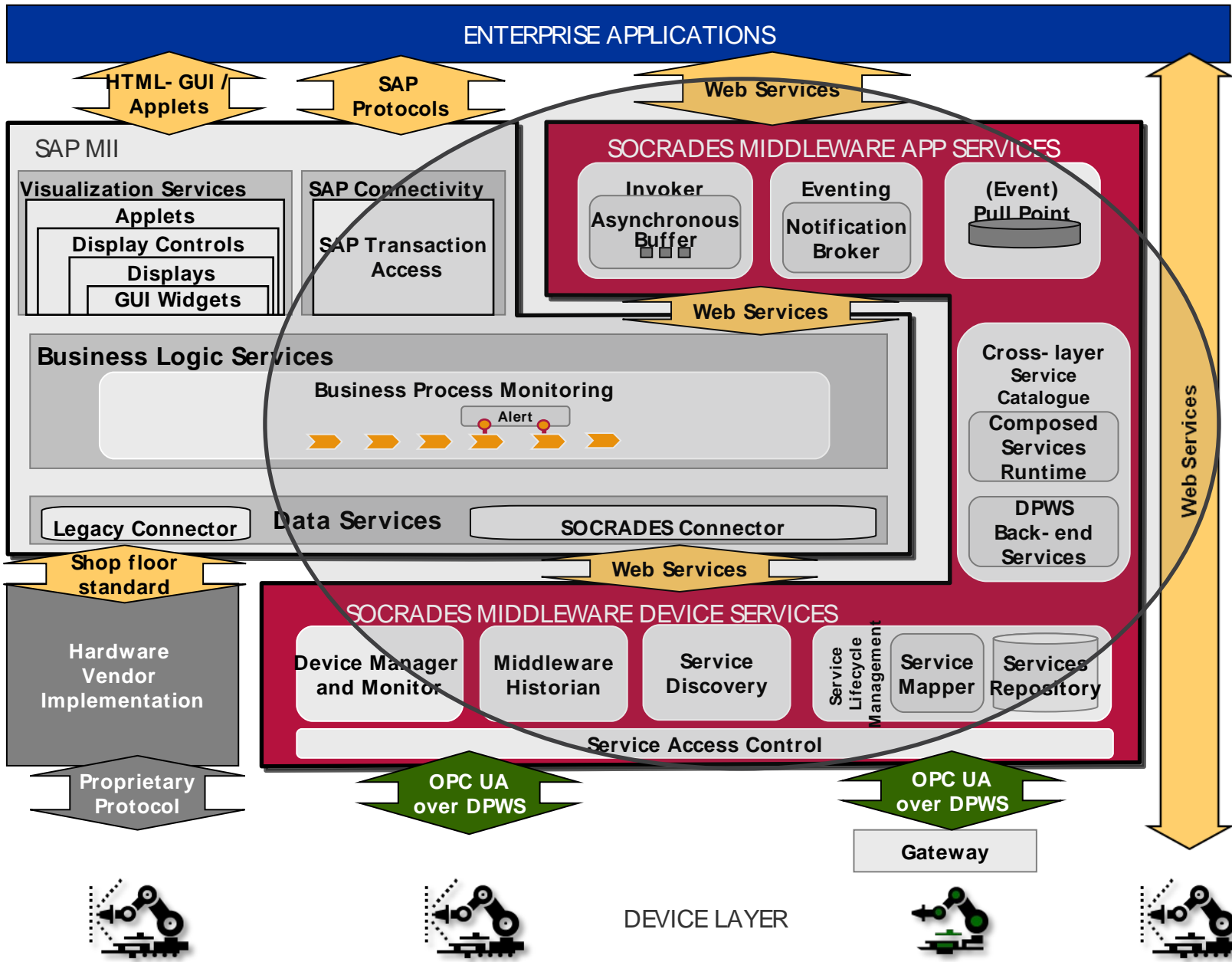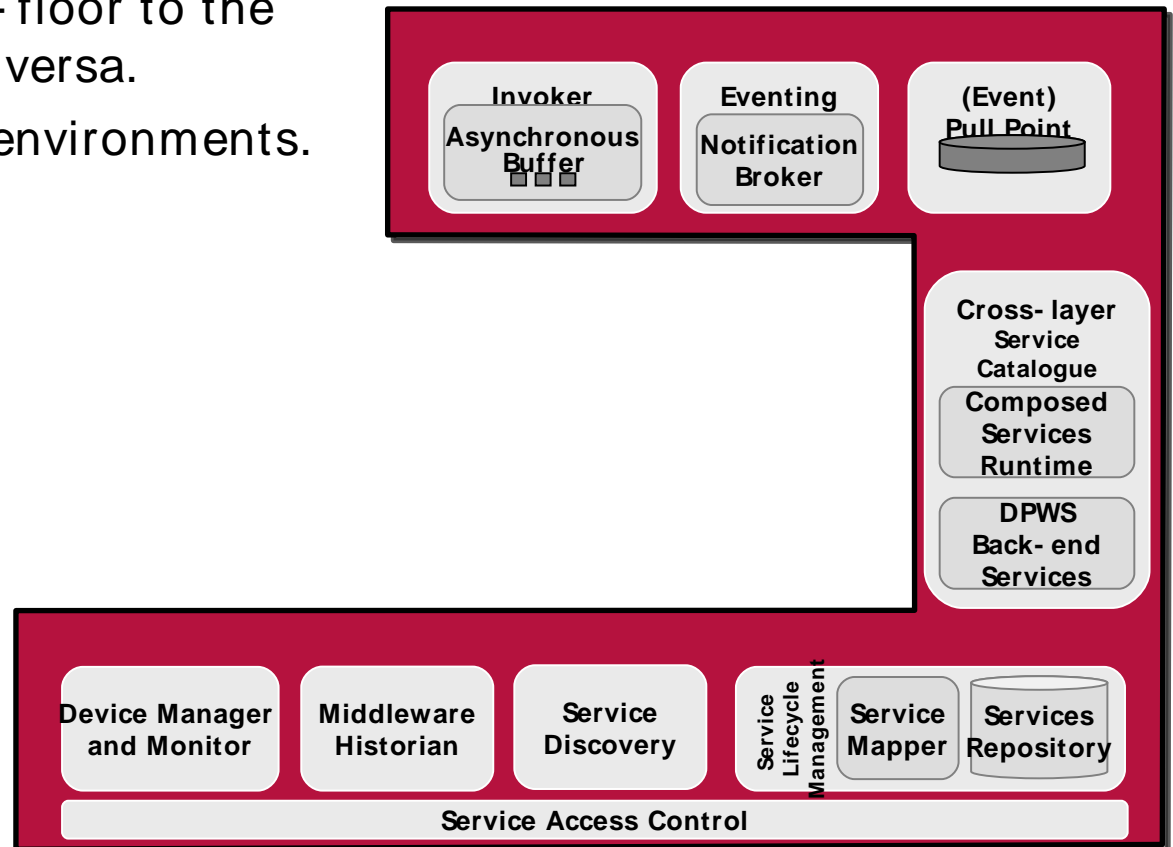
SAP MII

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Display Controls

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OPC UA over DPWS

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DEVICE LAYER

The SOCRADES Middleware

> The SOCRADES middleware is the bridging technology:

- Connects the shop-floor to the top-floor and vice-versa.

- Supports dynamic environments.

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Brokered Access to Devices & Discovery

> Brokered Access to Devices:

- Creates an **intermediate** party in the communication.

- Asynchronous invocations and defered invocations.

Invoker
Asynchronous Buffer

Eventing
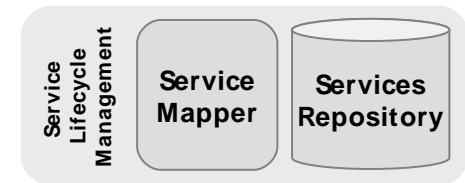Notification Broker

(Event) Pull Point
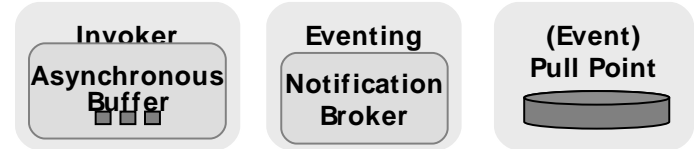
> Service Discovery and Monitor

- Enables **dynamic** environments.

- **Dynamic** and **static** information about devices « available » in the system.

Service Discovery

Device Manager and Monitor

> Service Lifecyle Management

- Maps service types to devices.

- Enables service **injection**.

Service Lifecycle Management

Service Mapper

Services Repository

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Wrap-up and Future Work

> SOCRADES is a Webservice based Service Oriented Architecture:
  - Which supports the connectivity of Smart Devices (i.e. machines on shop-floor) to high-level backend systems (e.g. ERP).
> Approach motivated by:
  - Emerging importance of Enterprise Service Oriented Architecture
  - Emerging importance of Smart Objects
  - Changes towards agile manufacturing.
> Our contributions are in:
  - Proposing a concrete architecture realizing the requirements.
  - A first (minimal) implementation of the SOCRADES architecture.
> We are currently working on a full implementation of the middleware components (expected by September 2008).

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