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Embedded Web Services for Industrial TCP/IP Services Monitoring
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motivation

• Importance of ICT as support for the human activity
• More technology and more complex
• Simpler technology for end users, more complex become backend systems
• Complex systems supported by lots of small services: DNS, DHCP, …
Problem & Proposal

- Which is the problem?
  - Huge increment of maintenance tasks

- Which is our approach?
  - Use of physical devices especially designed to offer a single network service
  - With abilities for its initial setup and its following management
  - Compatible and interchangeable with traditional approaches
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• A service for the TCP/IP network service monitoring (NSM)

• Main goal is to check the correct operation of the TCP/IP network applications and services running in manufacturing components

• The embedded Network Service Monitoring (eNSM) is the version of the monitoring service embedded in a network device (eNSM Device)
example of a monitoring service

- eNSM Device
- Work Plans
- HTTP Request
- HTTP Response
- Manufacturing component
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- Based on TCP/IP standards
- Work over Internet
- Management over HTTP, SNMP,…
- Service compatible with WebService technology
- Service offered by …
  - Physical Network Device with
  - Small size and
  - Minimal maintenance
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background

- Management protocols (Jeong et al, 1999)
- SOA (Boutaba and Xiao, 2002)
- Web Services & Semantic Web (Sloten et al, 2004)
- Embedded systems (Toop et al, 2002)
functional elements of the NSM service

Manufacturing Components
- Goal of the network monitoring service
- Comprise all industrial devices connected to the TCP/IP network

NSM Agent
- Ensure the execution of the scheduling (work plans)
- Delegate specific monitoring task to a monitoring agent

eNSM Device
- Represents the core of the system
- Provides a container in which different agents ensure that the services can be executed
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security

- Connection and functional level
  - From inside a DMZ
  - Active and passive mode

- Communication level
  - SSL, HTTPS, …

- Security Policies level
  - User/password
  - Directory Integration
Sequence diagram: NSM passive mode

NSM client
Management Agent

NSM center
Planning Agent

eNSM device
SOA – CS Interface Agent
Work Plan

MSNP:MONITOR
set_work_plan()

MSNP:GET STATUS

LAN
Internet
(TCP/IP)

NSM Client

Discovery Service

Search

SOA / CS Interface Agent

NSM Device

NSMP:MONITOR

MSNP:GET STATUS

Manufacturing component

Monitoring Agents

SOA / CS Interface Agent
Sequence diagram: NSM schedule

- NSM client
  - Management Agent
  - Planing Agent
- NSM center
  - SOA – CS Interface Agent
  - Work Plan
- eNSM device
  - MSNP:GET STATUS
  - MSNP:MONITOR
  - set_work_plan()
eNSM Device Architecture

- **eNSM Device**
- **NSM Agent**
- **Monitoring Agents**
- **SOA Interface Agent**
- **CS Interface Agents**
- **Register Agent**
- **Employer Agent**

**Agent middleware services**
- **SOA NSMP**
- **SOA Services**
- **Client-Server Services**

**Operating System**

**Hardware**

**TCP/IP Network**

- **Configuration Services**
- **Others Services**
eNSM device prototype
Architecture of the eNSM device prototype

TCP/IP Stack
- HTTP
- TFTP
- DHCP
- SMTP
- cSOAP v. 1.0
- UDDI v. 2.0
- NSMP
- eNSM Kernel
- ePython v. 2.5
- System Library

Embedded OS (Evolution OSTM 3.0)

Embedded Device Server (Lantronix XPort® ARTM)

TCP/IP Network
• Valid proposal under certain conditions:
  
  – Simple and repetitive services (DHCP, clock synchronization, …)
  
  – In highly distributed environments, invaded by hundred or, even, thousands of devices and network services
  
  – With an almost untenable increment of maintenance tasks
• The proposal can help:
  – To mitigate the additional management work
  – to some acceptable costs for the most adjusted budgets
  – Maintaining and taking advantage of the existent infrastructure

• Advantages:
  – Robustness
  – Integrity
  – Zero maintenance
  – Specialized skills aren’t necessary
  – Plug and Play
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and now...

• Work in other embedded network services
• Development of a Web Service on Chip (WSoC)
• Integrate them all in a model based in Semantic Web Services
• Assuring continuity in the manufacturing process
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