Web of Systems for a digital world

Siegfried Russwurm | Dubai, December 7, 2015
From the Internet to the Web of Systems

Internet

ARPANET

~1969

World Wide Web

TCP/IP

~1990

http

VoIP

~2005

Web 2.0

Mobile web

Social media

~2020

Web of Systems

Smart grid

I4.0

Smart city
A typical Internet of Things setting of today – Infrastructure for collection of big data

Large volume of raw big data
Context and know-how of the manufacturer and machine users remains unused
Process details are exposed

Big data processing in the cloud
Data processing & evaluation by an analytics service provider
Obtains deep domain insight
Web of Systems – Smart data processing and automation anywhere on the web

Data processing and automation functions ...

...by smart combination of physical and virtual world...

... can flexibly be integrated as applications anywhere

Knowledge
Information
Data
Automation & Services

Smart device

Cyber (digital twin)

Physical (smart device)

Knowledge
Information
Data
Automation & Services
Web of Systems – Smart networked systems for industry and infrastructure solutions

Ubiquitous communication
- Internet
- Web/2.0 technologies

Smart networked devices
- Autonomous
- Interacting
- Local analytics
- App-enabled

Domain context
- Domain-specific requirements
- Cross-domain integration
- Semantics

WoS combines web technologies with smart networked devices and domain context
A device centric and system aware approach – Bridging digitalization and automation

Connected devices
- IP connected devices supply “big data” to cloud based data analytics
- Improved asset analytics and process optimization by streaming data analysis

Smart devices
- Web enabled smart devices provide local automation, analytics and other services
- Local decision making at the point of influence for operation fidelity, scalability and data ownership protection

Interacting devices
- Distributed interacting autonomous devices negotiate and coordinate processes
- Maximum structural flexibility and robustness in complex, large-scale distributed systems

App-empowered
- Highest functional flexibility and evolution over device and system lifetime
Web of Systems addresses the specific requirements of Siemens domains while facilitating cross domain integration.

- Energy Management
- Digital Factory
- Process Industries and Drives
- Healthcare
- Grid Infrastructure
- Turbine Monitoring
- Manufacturing
- Building Infrastructure
- Wind Power
- Power and Gas, Power Generation Services
- Mobility
- Building Technologies

300,000 connected devices – 17 terabyte of data per month.
Web of Systems for optimizing infrastructure operations – Example “ICeWater”: optimizing water networks

“ICeWater”: optimized water network operations

- **Smart devices**: Online monitoring of water infrastructure supported by smart sensors and smart metering
- **Interacting devices**: Enables energy optimization, leak detection/localization and asset/customer management
- **Interacting devices**: Decision support making use of contextualized smart data
- **App-powered devices**: Easy integration of new smart sensors and Apps
- **Cross domain integration**: “Smartification” of legacy sensors

**Cost efficient**: Noninvasive approach using WoS technologies to extend existing infrastructure like SCADA

**Flexible**: Open for integration of new services

**User experience**: Web-based user interface for access everywhere and with any device
Web of Systems makes resources as easily and flexibly accessible as webpages – Example “Smart Freight Wagon”

“Smart Freight Wagon”

- **Smart devices**: WoS box; Measures global position and collects/analyzes data from sensor modules, communicates to cloud, thereby making the wagon smarter

- **Interacting devices**: Intra-train ad hoc network\(^1\); e.g. capable of understanding and describing the whole train, including wagon sequence, thereby making the wagons interacting devices

- **App-powered devices**: WoS box to host applications such as freight document app, wagon service information app, rail track condition monitoring app, thereby making wagon an app powered-device

**Efficient system integration**: Potential ecosystems

**High extensibility**: Allows for integration of all stakeholders, e.g. tracking service offered directly to freight owner, freight documents uploaded by the freight owner

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\(^1\) Optional component
Web of Systems for distributed autonomous control – Example “Intelligent Secondary Substation” in a smart grid

“Intelligent Secondary Substation” for reliable, stable and cost efficient smart grids

- **Smart Devices**: Local control (e.g. voltage control) using attached sensors & actuators, plug-and-play device2cloud connectivity (e.g. for grid management, monitoring, data analytics)

- **App-powered devices**: Dynamically add features (e.g. control, metering, monitoring, add-on services) and keep ISS “fresh”

- **Interacting devices**: Mesh network of ISSs for fast fault localization and self healing, decentralized operation coordination

- **Cross domain integration**: interlinked infrastructures of smart grid, power network and buildings

**+ Minimized engineering effort**: Plug-and-play capabilities, remote software update and feature enhancements, asset monitoring

**+ Reliable system operation at lower cost**: Supervised autonomous local control enables reliable and stable smart grid operation although making use of highly cost efficient but unreliable Internet connections to the operation center
Web of Systems “Joiner” helps migrating legacy devices of the installed base to the Web of Systems

- **High acceptance:** Well-introduced through numerous existing web services. Easy to deploy and use
- **Wide distribution:** Independent from computing platforms and inherently network-enabled. Can be deployed even down to very constrained devices
- **Better cost efficiency:** Reuse and integration of existing resources. Reduced implementation costs and time-to-market
Web of Systems – A device centric and system aware approach
Foundation for new business opportunities and increased customer value

Summary

– Web of Systems – Smart networked systems for industries and (critical) infrastructures
– Device centric and system aware approach supporting digitalization and automation
– Applying proven and widely used Web/2.0 technology and semantics within and across domains
– Sovereignty on value creation: The customer flexibly decides on data processing and automation as application anywhere
– Investment protection and migration of the installed base