Considerations and challenges when integrating systems to achieve smart(er) buildings

Lance Rütimann / SupDet 2015 / 04 March 2015
Integrating systems is not new ...

The technological development has advanced the dimension of integrations, both in quantitative and qualitative terms:

- relay contacts
- parallel data
- serial data

Cumulating events on one central point had its weaknesses.
… but it has become more complex. And we continue to learn.

Numbers of Protocols

- 20+ Building Automation protocols
- 35+ Process Automation protocols
- 4 Industrial Control System protocols
- 4 Power System automation


A protocol is a defined set of rules and regulations that determine how data is transmitted in telecommunications and computer networking.

Distributed systems = increased redundancy

# Overview of Building Automation protocols

1. 1-Wire
2. BACnet
3. C-Bus
4. CC-Link Industrial Networks
5. DALI
6. DSI
7. Dynet
8. EnOcean
9. HDL-Bus
10. INSTEON
11. IP500
12. KNX (previously AHB/EIB)
13. LonTalk
14. Modbus (RTU or ASCII or TCP)
15. oBIX
16. ONVIF
17. VSCP
18. xAP
19. X10
20. Z-Wave
21. ZigBee
### Overview of Process Automation Protocols

1. AS-i  
2. BSAP  
3. CC  
4. CIP  
5. CAN, CANopen  
6. ControlNet  
7. DeviceNet  
8. DF  
9. DirectNet  
10. EtherCAT  
11. Ethernet Global Data  
12. EtherNet/IP  
13. Ethernet Powerlink  
14. FINS  
15. FOUNDATION  
16. HART  
17. HostLink  
18. Interbus  
19. MACRO  
20. MECHATROLINK  
21. MelsecNet  
22. Modbus PEMEX  
23. Modbus Plus  
24. Modbus (RTU,ASCII,TCP)  
25. OSGP  
26. Optomux  
27. PieP  
28. Profibus  
29. PROFINET IO  
30. RAPIEnet  
31. Honeywell SDS  
32. SERCOS III  
33. SERCOS interface  
34. GE SRTP  
35. Sinec H1  
36. SynqNet  
37. TTEthernet
Do we really understand all of this?

- protocol
- data model
- object
- operating system
- application
- digital convergence
- appliance
- node
- code
- serial connection
- wireless access point
- OSI Layers
- network topology
- tool
- media
- telegram
- message
- router
- hub
- rack
- gateway
- modem
- client
- server
- storage
- backbone
- LAN, WAN
- broadband
- bandwidth
- data
- virus
- worm
- Trojan horse
- spoofing
- phishing
- handshake
“In the last few years, ICS technologies have evolved significantly. They have passed from isolated Operational Technologies (OT) to open architectures, highly interconnected with standard Information Technologies (IT) systems. This has lowered overall costs and enabled new functionalities, such as remote control, but at the same time it has led to a significant increase of vulnerabilities related to computer network attacks.”

“ICS security testing is now recognised to be so crucial that several countries within the European Union have already started to work in this direction in public or private initiatives.”

Source: Good practice framework for an EU ICS testing coordination capability (Dec 2013)
Critical Infrastructure in the USA at risk!

Screenshot showing an industrial control system in Idaho that's connected to the internet. The red tag indicates there are known vulnerabilities for the device that might be exploitable. Two known vulnerabilities are listed at the bottom of the text bubble.

(2012)

Source: http://www.wired.com/2012/01/10000-control-systems-online/
The objective of this study is to explore how the European Union actions can be coordinated so to reach a level of harmonised, independent and trustworthy ICS testing capabilities, leveraging current initiatives. ... The methodology included desktop research, an online survey and in-depth interviews with 27 experts from the European Union, the USA, Japan, India and Brazil. (Dec 2013)
This document provides an overview of existing working groups, standards and pilots in the area of Industrial Control System Testing. …

It takes into account activities of international and national organizations, important activities in Europe and the US, as well as the most important branch specific activities (international and national).

(Dec 2013)
This document provides guidance for establishing secure industrial control systems (ICS). These ICS, which include supervisory control and data acquisition (SCADA) systems, distributed control systems (DCS), and other control system configurations such as skid-mounted Programmable Logic Controllers (PLC) are often found in the industrial control sectors. (Feb 2015)
Fire safety integration into building systems

**Case of fire**

- Fire detection system alarms
- Fire doors close
- Voice evacuation
- Extinguishing

- Ventilation in safety mode
- Fire dampers close
- Smoke extraction starts

- Video surveillance recording abled
- Doors of emergency escape routes open
- Revolving doors in panic position

- Lights on
- Blinds open
- Elevators in safety position
- Escalators direction exit

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Buildings are an accumulation of processes

View a building as an accumulation of functions with processes enabling pre-defined activities to take place inside and around it. Therefore:

1. Functional convergence must be the first order of thought.
2. Technical convergence follows to achieve 1.
It is not enough to believe it works

William Kingdon Clifford (1845 to 1879)
Mathematician and Philosopher
1871 to 1876 Mathematics Professor at University College, London
Author of “Ethics of Belief” published 1877 in Contemporary Review.

“To sum it up: it is wrong always, everywhere, and for anyone, to believe anything upon insufficient evidence.”
Assess Purpose and Value before choosing solution

At a meta level, an integration of systems should fulfil two objectives:
1. Measurable customer value is achieved.
2. The system designer(s) can gauge situation and define appropriate measures.
A true smart building

Source: http://www.smartzuerich.ch/images/database/$default/bgimages/all/KETO_AutocenterAG_Wallisellen_1_vonNeugut.jpg
Summary

- View buildings as an accumulation of processes and functions
- Smart integrations contribute to making buildings smarter
- System designers must be smart about their choices
- Functional convergence before technical convergence
- Verify purpose and value before moving onto solution
- Make use of best practices → Learn from other’s mistakes
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### Purpose
- safety
- security
- comfort
- efficiency
- operational
- regulatory

### Value
- tangible
- client request

### Connection
- data transfer
  - none (relay)
  - 1-way
  - 2-way
  - duration
  - continuous
  - as needed

### Security
- accessibility
- physical
- software
- internal
- remote
- encryption

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04 March 2015

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