Deployment Support Network

A toolkit for the development of WSNs

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NCCR MICS
National Competence Center in Research
Mobile Information and Communication Systems

FNSNF
Fonds National Suisse
Schweizerischer Nationalfonds
Fondo Nazionale Svizzero
Swiss National Science Foundation

Overview

1. Introduction
   - WSN System Testing Challenge
   - Related Work
2. Deployment Support Network (Concept)
   - Overview
   - Advantages
3. DSN Prototype
   - Technology Overview
   - Target Interfaces
   - Service Use Cases
4. Industrial Case-Study

Motivation: WSN System Testing is a Challenge

Sensor-Node

Constraints:

- Energy
- Size
- Cost, ...

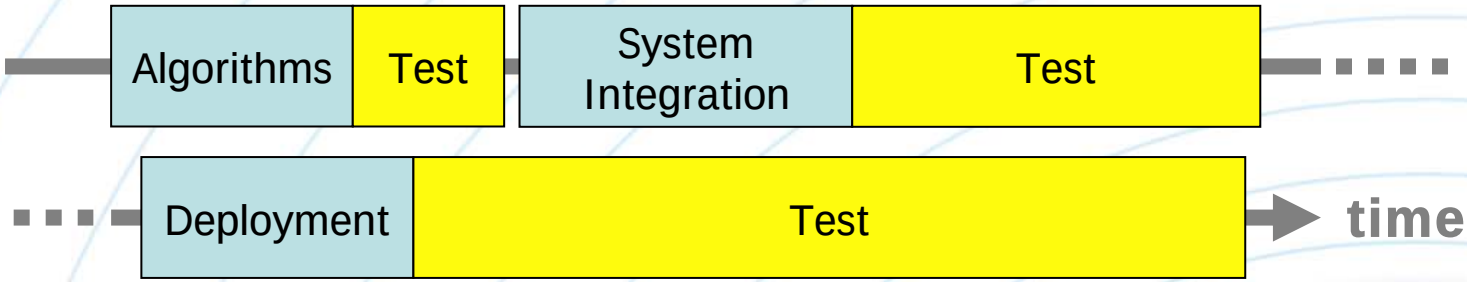
- small memory
- little I/O
- low data-rate radio

→ **hard to debug**

- large scale
- embedded in environment
- no global time

→ **hard to access**

Experience / Lessons Learned:



WSN Development Wish-List

1. Visibility (access to state of the nodes)
2. Control over nodes
3. Tools for 1. & 2.

Related Work

Simulation: TOSSIM

Problem:

- Realism of simulation models

Test-beds: MoteLab

Problem:

- Artificial environment
- Wired infrastructure
- Infrastructure access

Deployment Services:

Problem:

- Limited resources
- Interference (Heisenberg-Effect)
- Robustness/ Reliability

Can we take the best of both sides?

Deployment Support Network: Overview

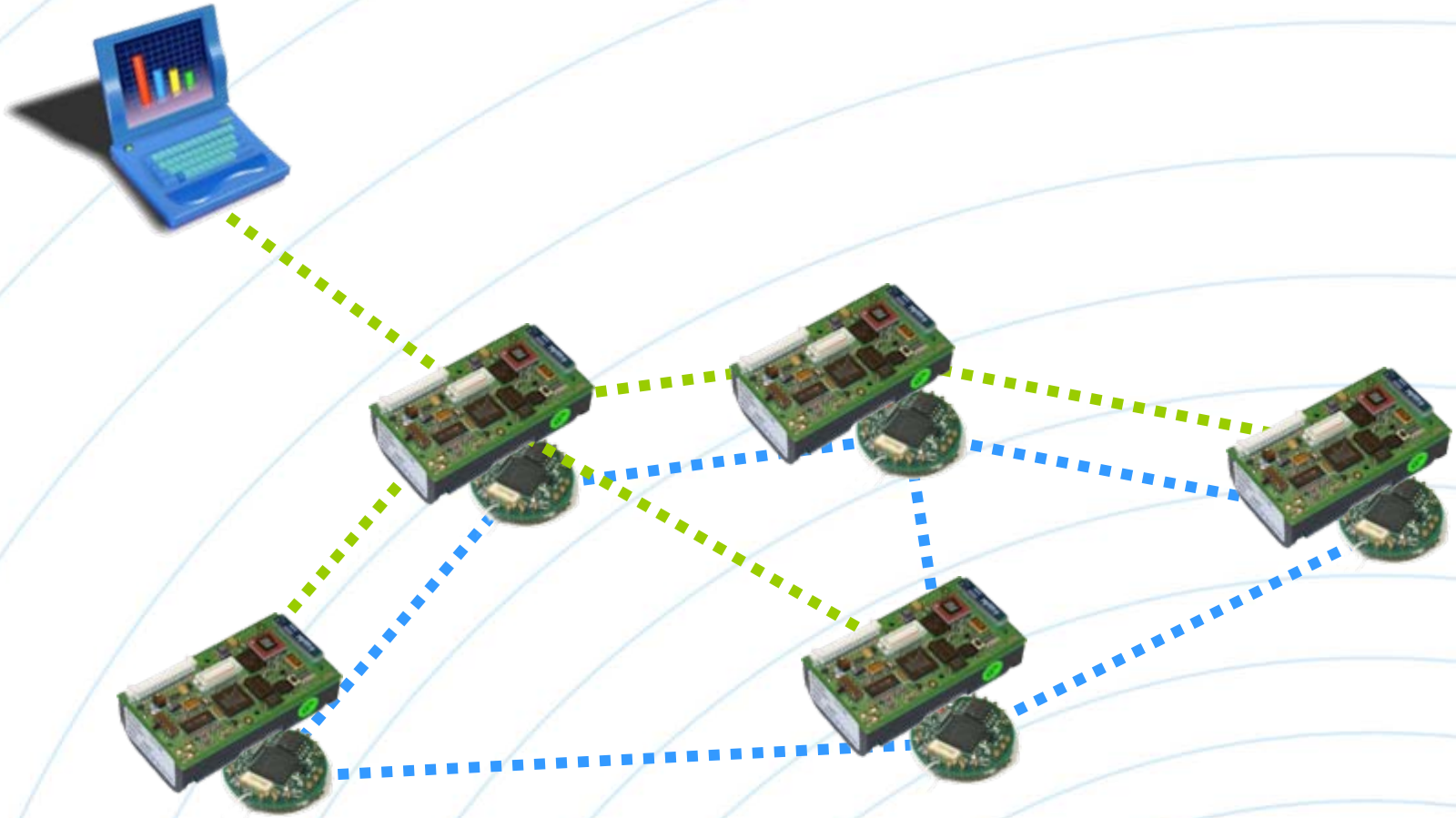
Wireless Testbed with **Deployment Services**:

- data- and event logging
- node control
- remote reprogramming

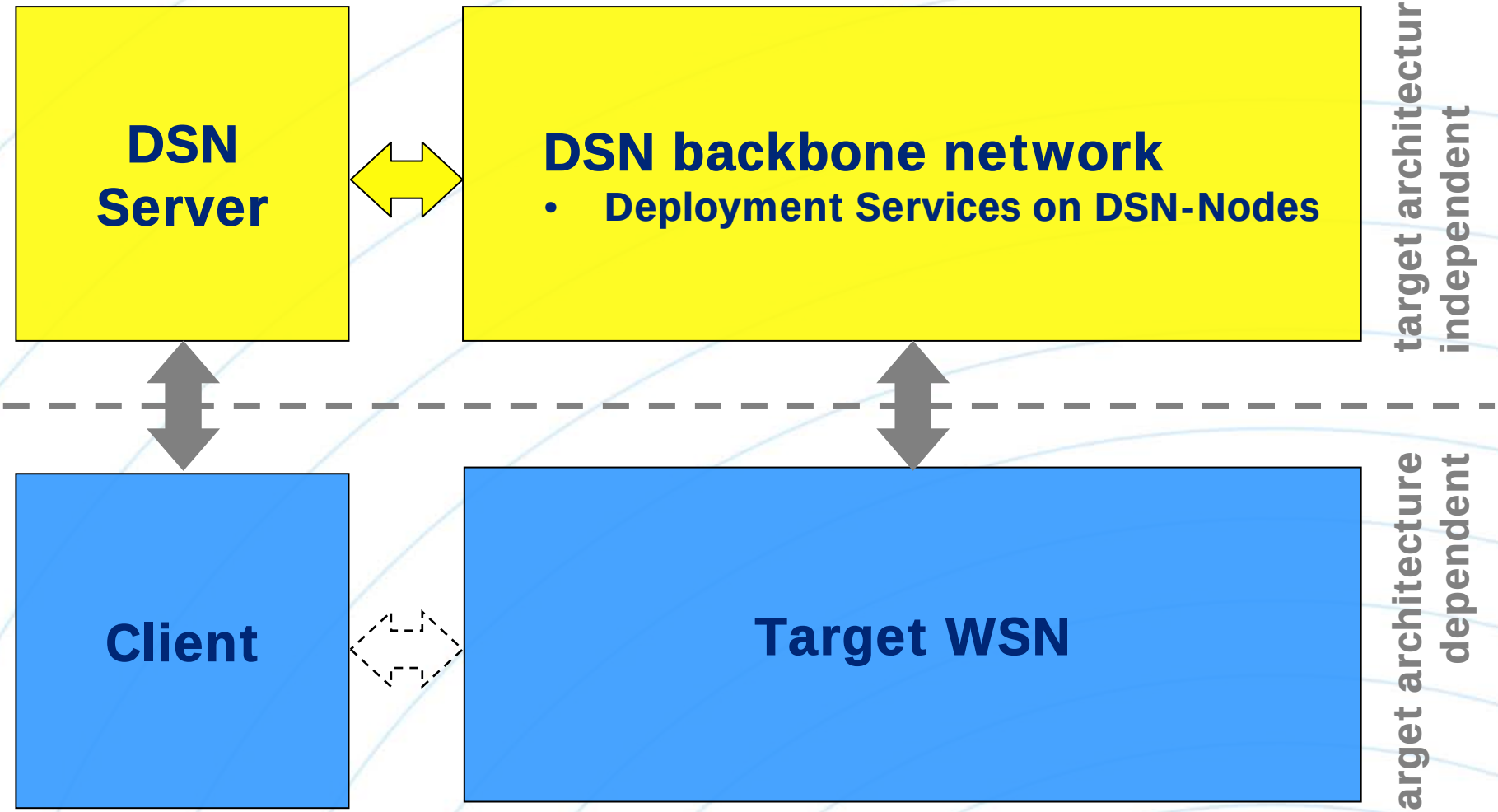
} over-the-air

Deployment Support Network: Overview

Wireless Testbed with Deployment Services



Deployment Support Network: platform independent



Advantages of separation:

- Services are target-architecture independent.
- No more over-provisioning of Target-Nodes.
  - Services provided by the DSN-Nodes:
    - Reliable multi-hop connectivity
    - Adaptive topology control
    - Code distribution
    - Large data- and event buffer
    - Time-synchronization
    - Target control / power
- DSN-nodes are optimized for deployment services.
  - Reliability, Robustness
- Safe reprogramming of Target-Nodes.

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DSN Prototype: Technology Overview

DSN Server:
- Java Server
- mysql DB

Bluetooth multi-hop scatternet

DSN-node:
BTnode rev3
- Atmel AVR
- Bluetooth
- 256k SRAM

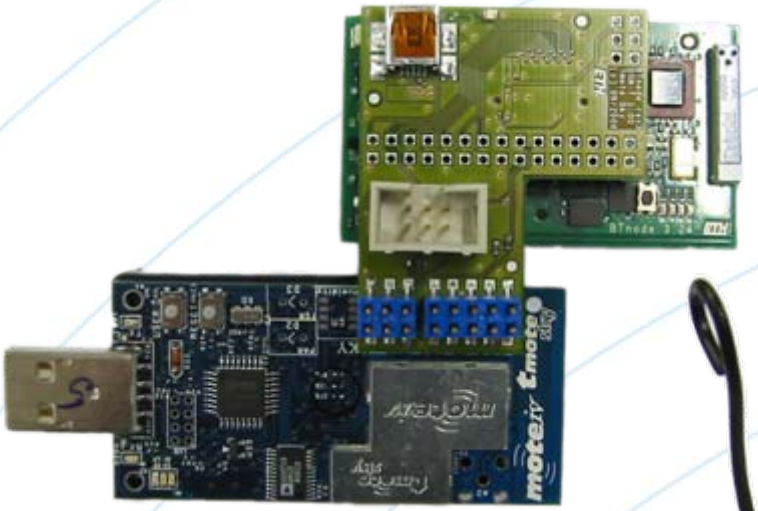
Internet / XML-RPC

Client:
- Java, C++, ...
- Perl, Python, PHP, ...

Wired Target Interface:
- Programming Interface
- Serial Data / Bitwise I/O
- Target Control / Power

Target-Nodes

DSN Prototype: Wired Target Interfaces



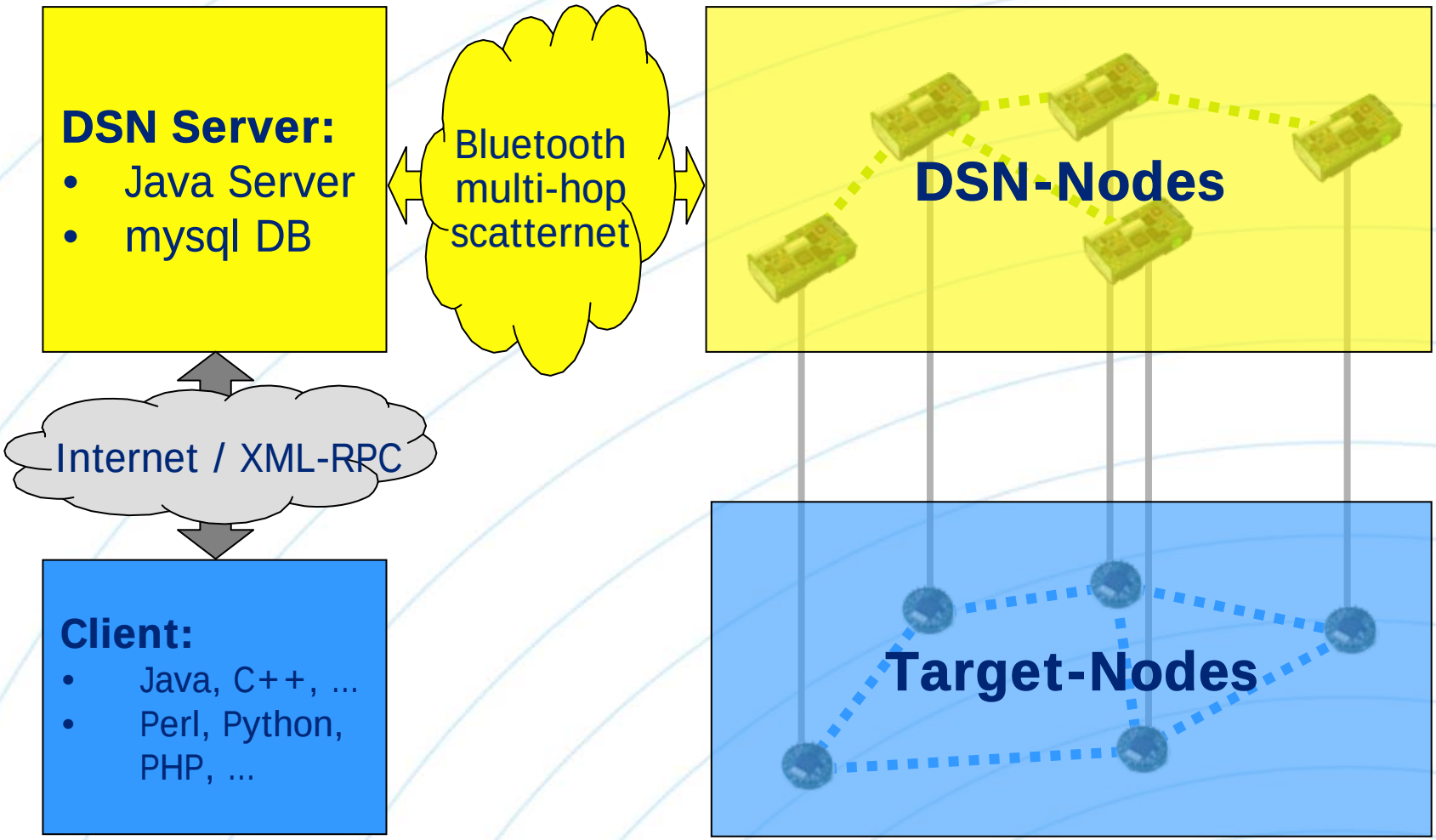
Moteiv Tmote Sky

Siemens A80

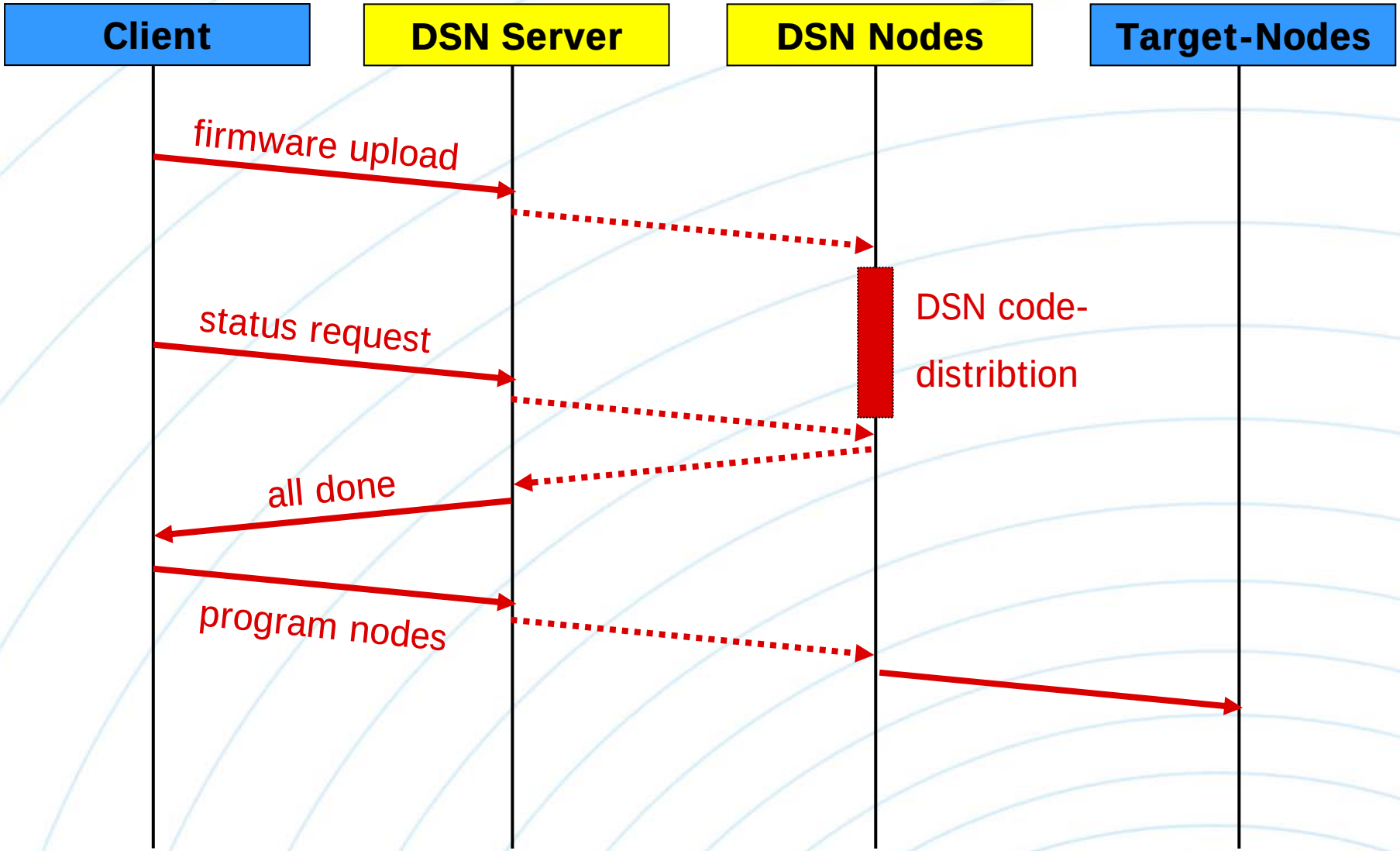
Shockfish TinyNode

BTnode rev3

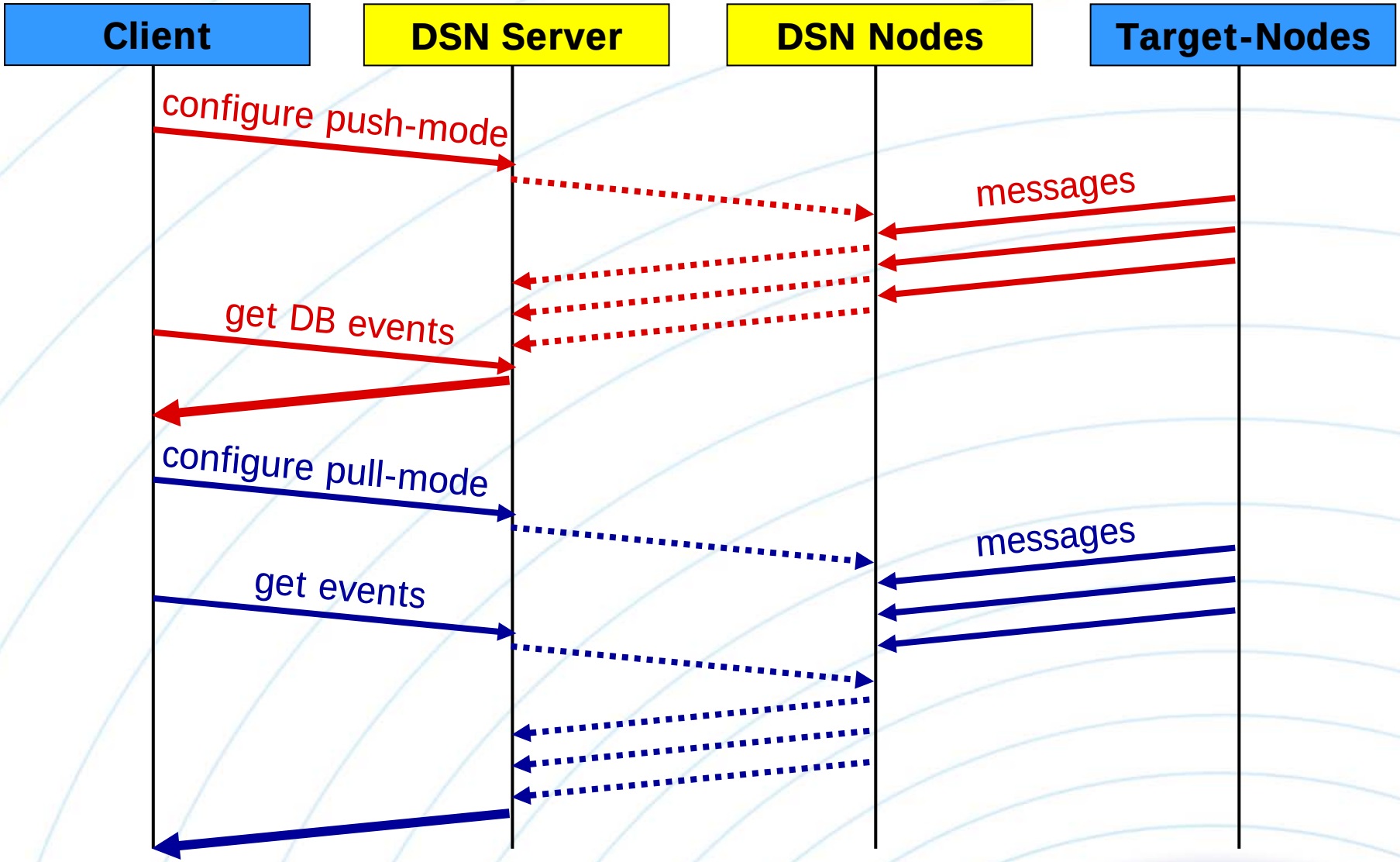
Deployment Support Network: Overview



DSN Service Example: Remote reprogramming



DSN Service Example: Data- and Event Logging



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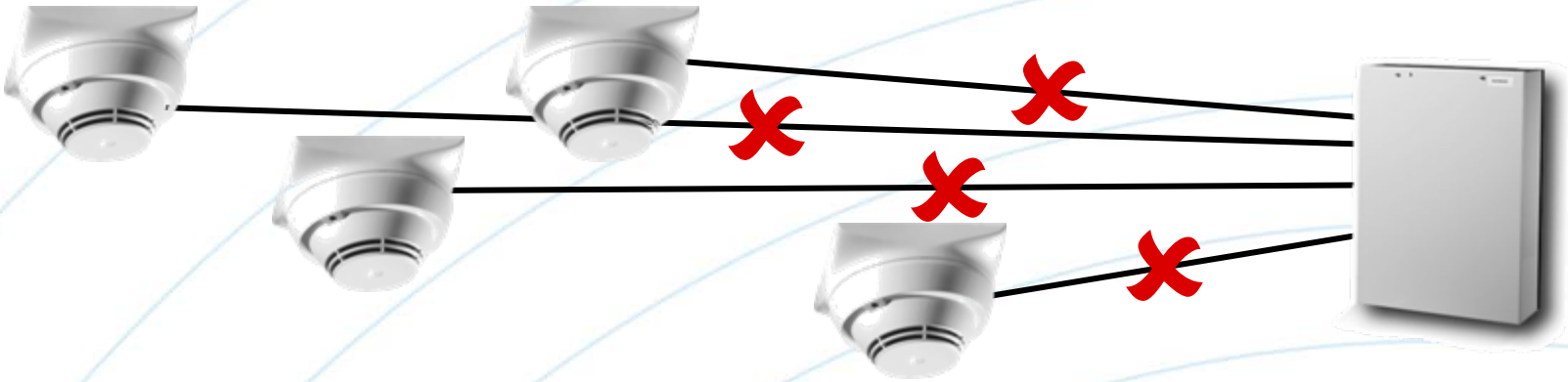
Industrial Case Study

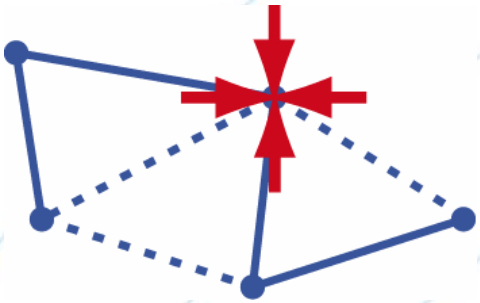
Wireless Fire Detection and Alarm System developed at Siemens Building Technologies Group, Switzerland



Development Approach:

1. Protocol evaluation using simulation
2. Characterization using prototype implementations
3. Semi-automatic testing and verification of prototypes using a Deployment-Support Network
4. Live field testing in different configurations/locations

Why DSN (and not cable-based testing, or over-provisioned fire-detectors with debugging capabilities)?

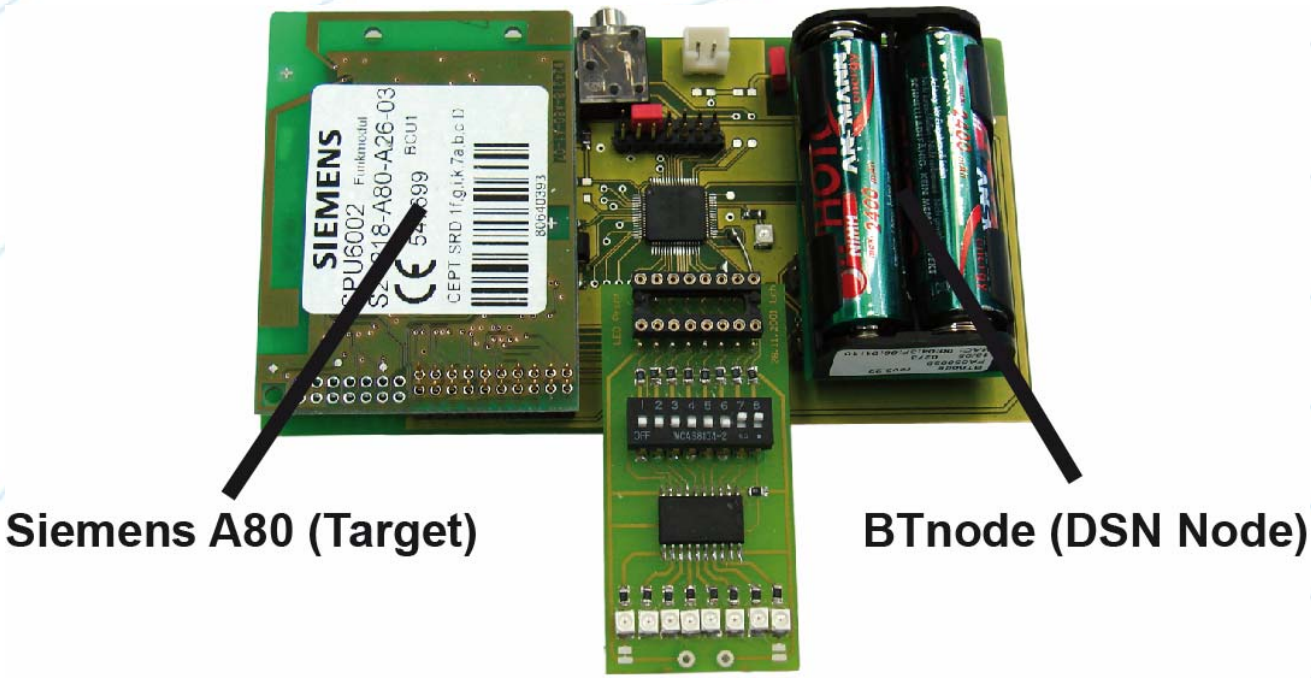


wireless & battery-operated

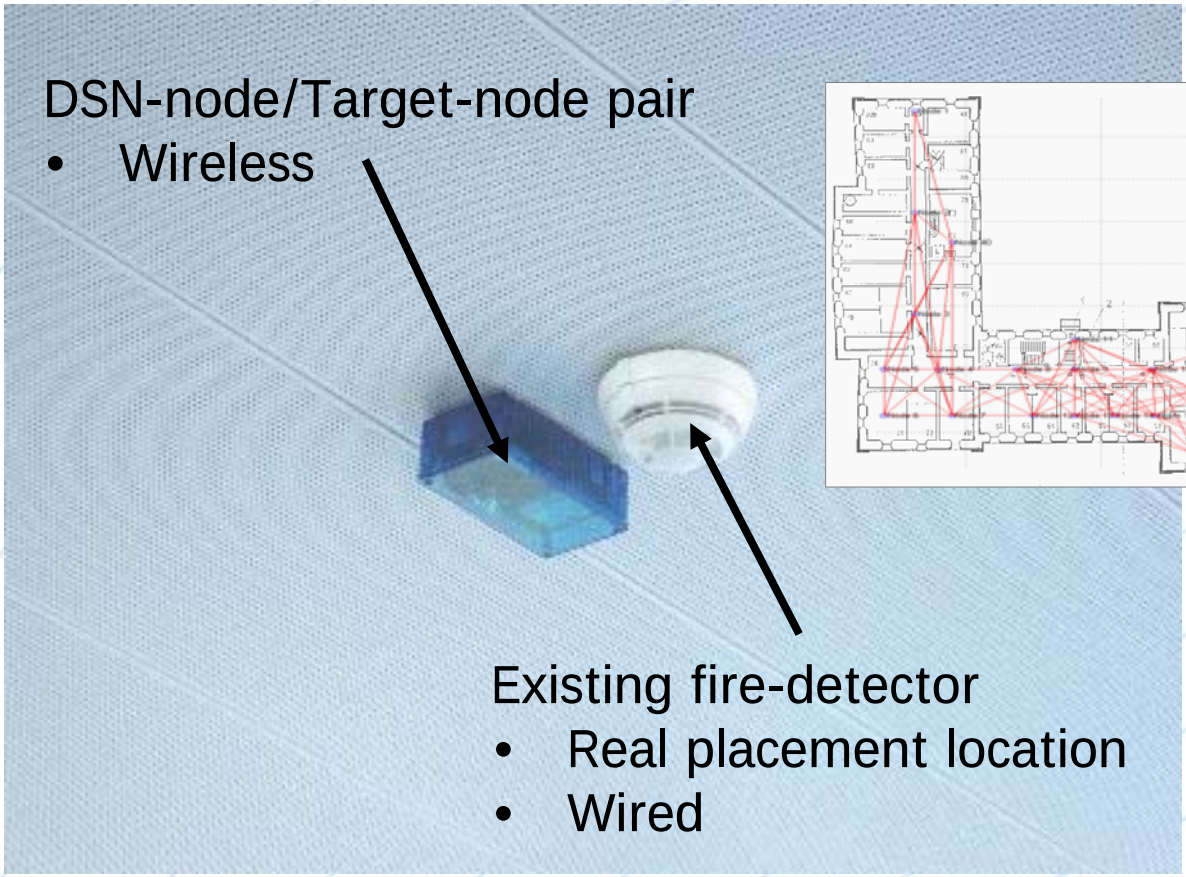
→ allows for realistic placement of nodes

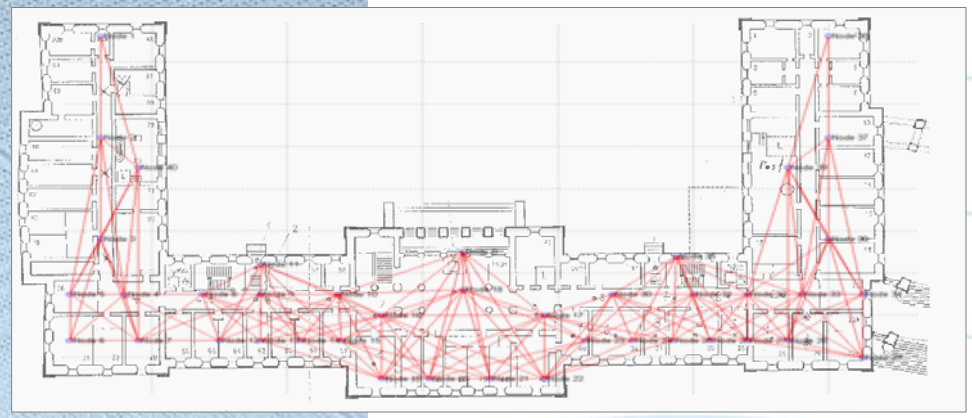
- no modification of target hardware
- no implementation of debugging services on the target
- easy setup & deployment

1. Connect Target-Nodes to DSN-nodes



- Deploy Target-/DSN-node pairs in real scenarios





3. Server and client setup

DSN Server:

- DSN-access node
- DSN server app
- MySQL database

Client:

- Test-Case generator
- Analysis Tools
- Communicate to server via XML-RPC (remote access)

Industrial Case Study: Test-Case

Test Example:

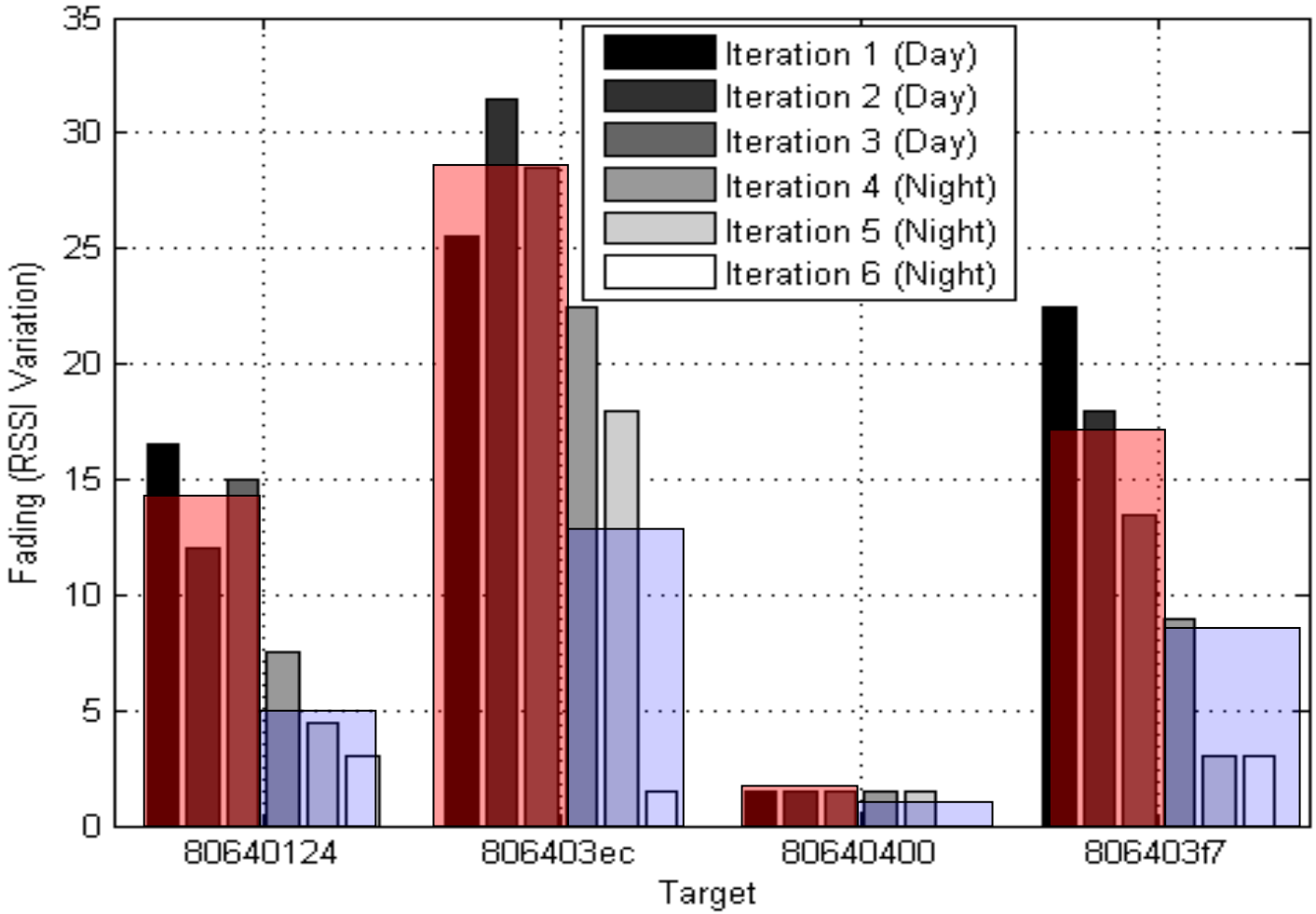
- Measurement of channel quality between different pairs of deployed nodes.
- Quality difference between day and night?
- High-resolution measurements but also long term average.
- Fault injection (“jamming”, connectivity changes, ...)
- Reproducability of test scenarios

Test Automation and Evaluation:

- 2 firmware images: “Sender” and “Receiver”
- Client: test-case generator / analysis tools
  - Schedules automated tests on different daytimes with different parameters
  - Evaluates results

Industrial Case Study: Test-Case

Industrial Case Study: Test-Case



The Deployment Support Network

- Features:
  - Wireless
  - Target-architecture independent
  - Easy to set-up
- Supported services:
  - Data- and event logging
  - Target control
  - Remote reprogramming

} real-world deployments

} visibility & control

Thank you for the attention

More information on the Project Webpage:

- http://www.btnode.ethz.ch
- http://www.btnode.ethz.ch/Projects/Jaws

Questions?