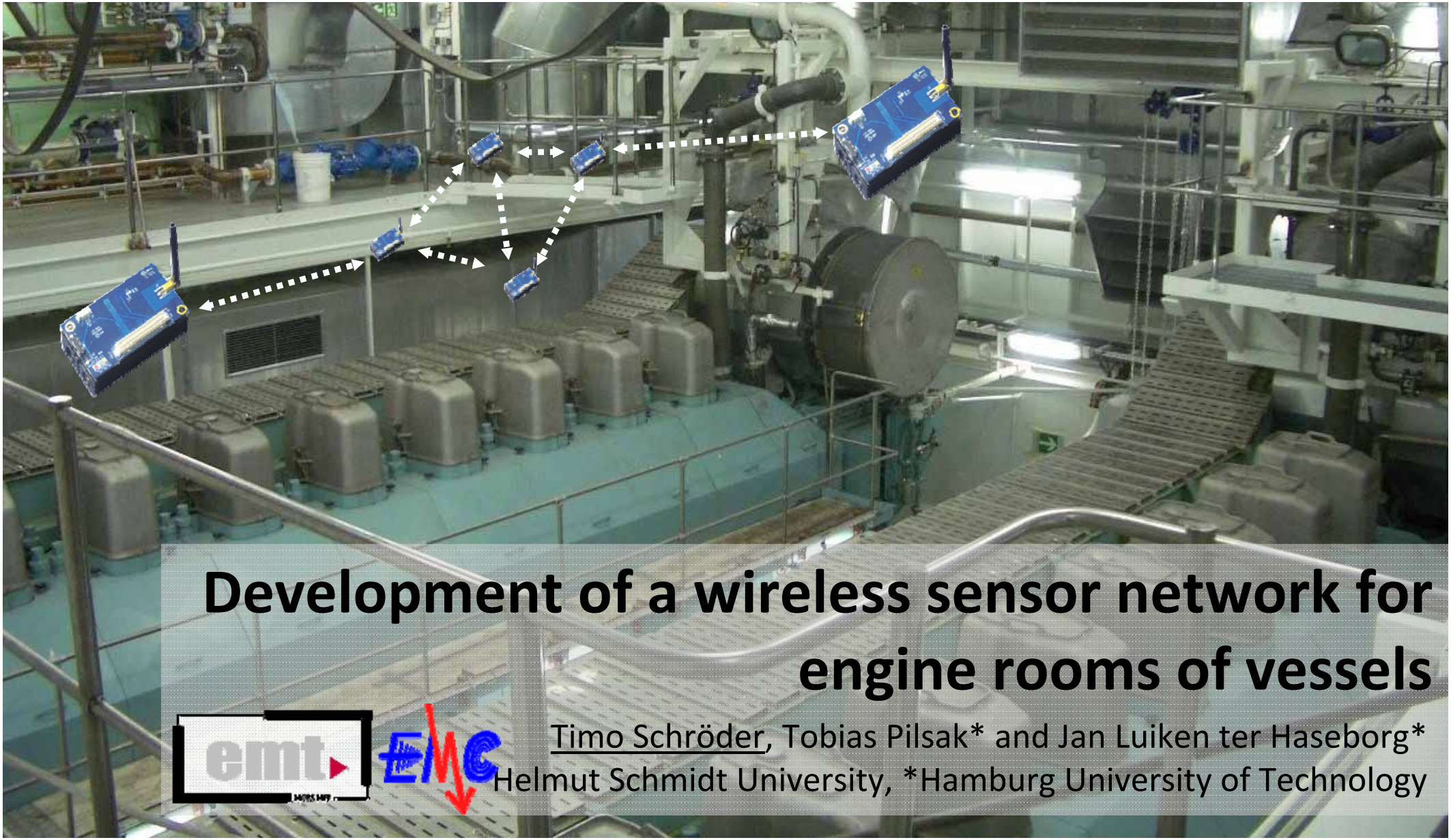

Development of a wireless sensor network for engine rooms of vessels

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Helmut Schmidt University, *Hamburg University of Technology

Outline

I. Introduction

II. Development environment

III. Interferences inside the engine room

IV. Requirements for routing algorithm in the engine room

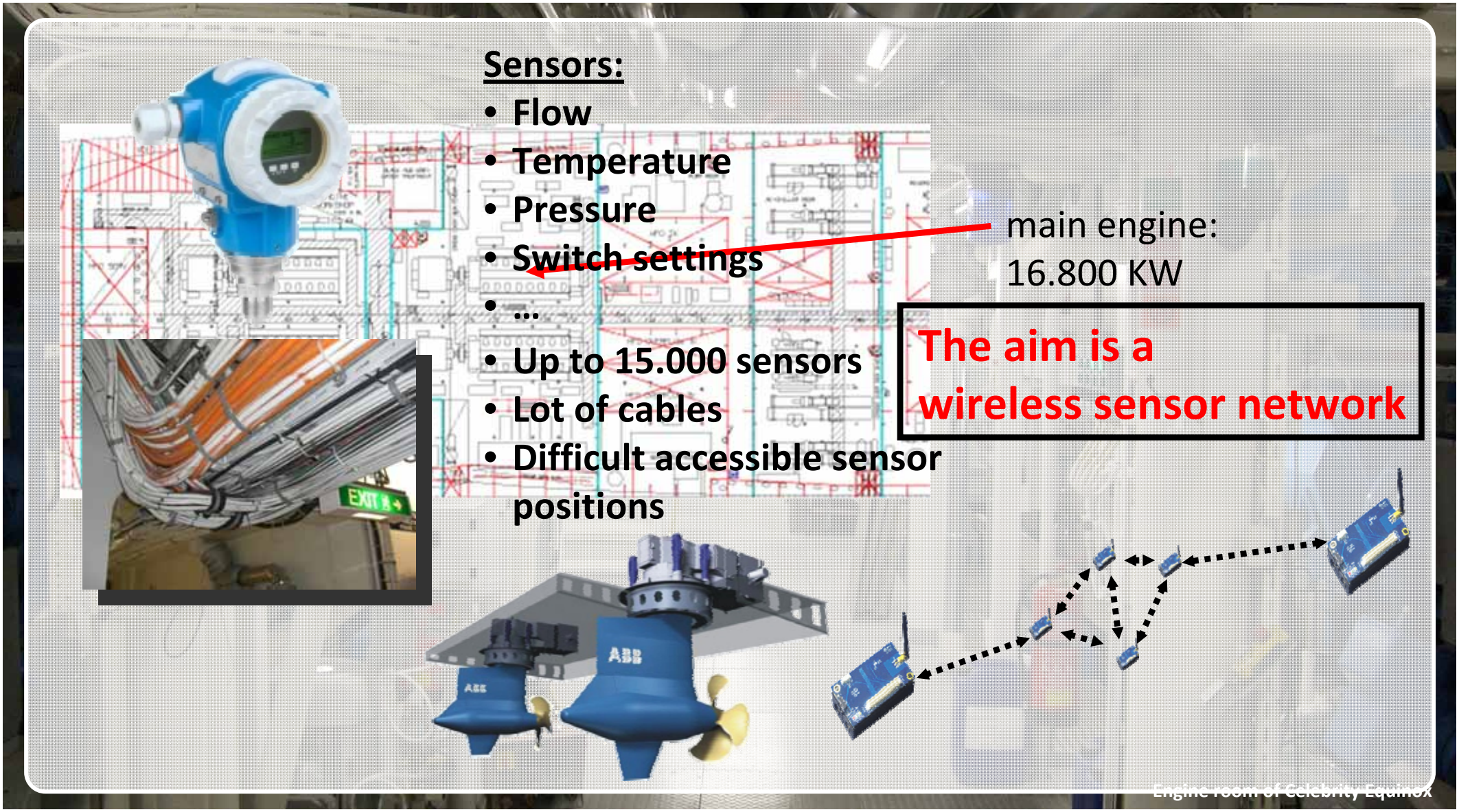
V. Multi-hop routing algorithms

VI. Developed routing protocol

VII. Field test at the engine room

VIII. Conclusion

Introduction



Sensors:

- Flow
- Temperature
- Pressure
- Switch settings
- …
- Up to 15.000 sensors
- Lot of cables
- Difficult accessible sensor positions

main engine:
16.800 KW

The aim is a wireless sensor network

Engine room of Celebrity Equinox

Develoment Environment

- Hardware

  - IRIS Mote
    - Atmega128L
      - Memory : 512 kByte
    - AT86RF230
      - Based on: IEEE 802.15.4-2003
      - max. data rate: 250 kBit/s
      - Operating distance: 50m (indoor)
      - Max. network size: 65 000+
  - Sensor board

    - Temperature
    - Pressure
    - Humidity

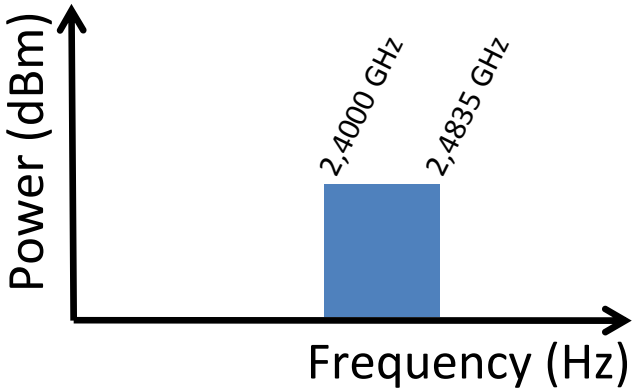
- Software
  - TinyOS 2.x
    - Hardware independent
    - Energy efficient

  - nesC
    - Component based
    - Event based execution model

[1] Crossbow Technology, www.xbow.com

Interferences inside the engine room

Spectrums

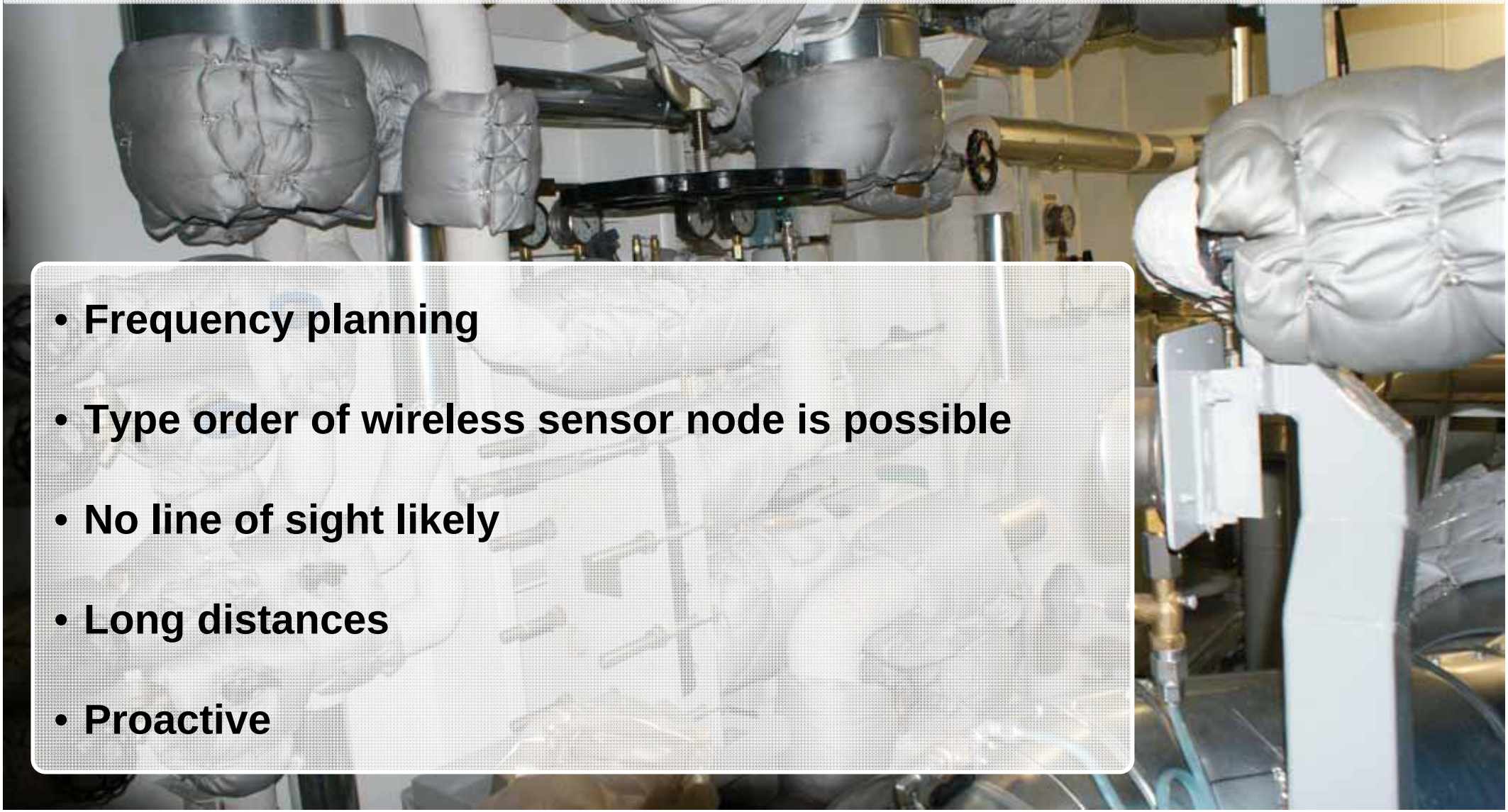


- 2,4 GHZ-ISM-band
- worst case (max. hold)

Measurement equipment:
- Rohde & Schwarz FSL 9kHz…18 GHz
- Schwarzbeck ESLP 9145

Multihop Routing Protocols

Requirements for routing algorithm in the engine room

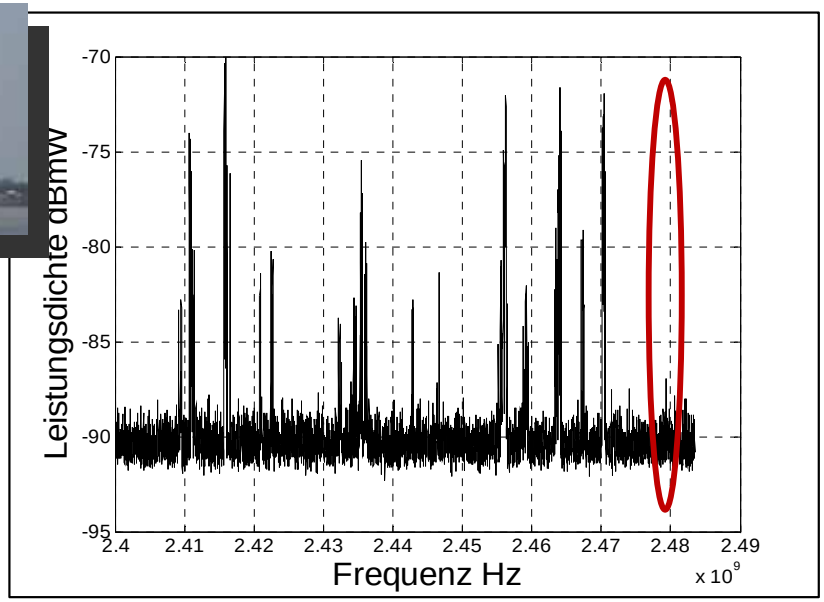


- **Frequency planning**
- **Type order of wireless sensor node is possible**
- **No line of sight likely**
- **Long distances**
- **Proactive**

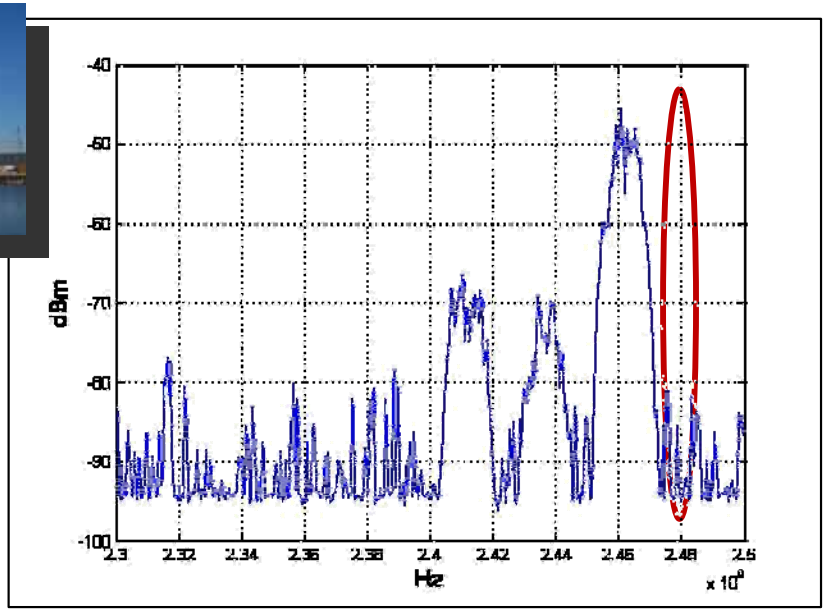
Interferences inside the engine room

Spectrums

Which transmission channel should be used?



- max. hold, measurement period: 5 min.
- interferences occur temporarily
- source of interferences not easily detectable
- amplitude depends on location

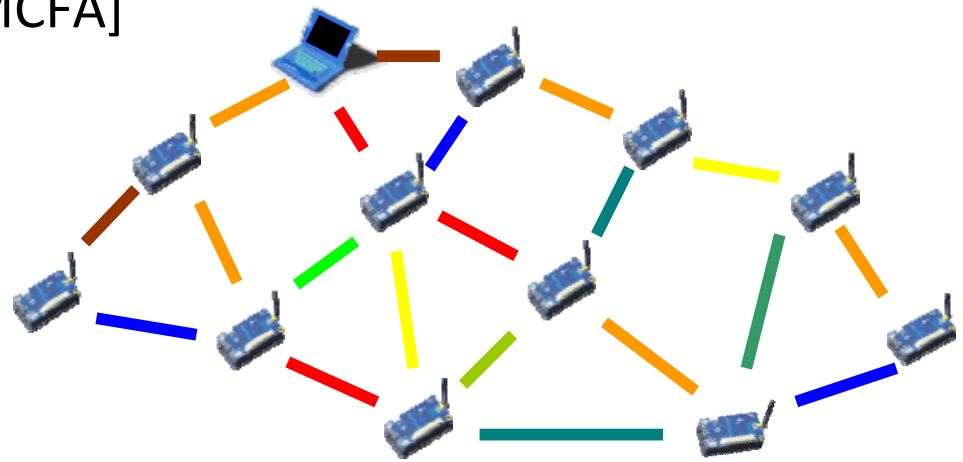


Channel 25 is least disturbed, therefore chosen as the transmission channel!

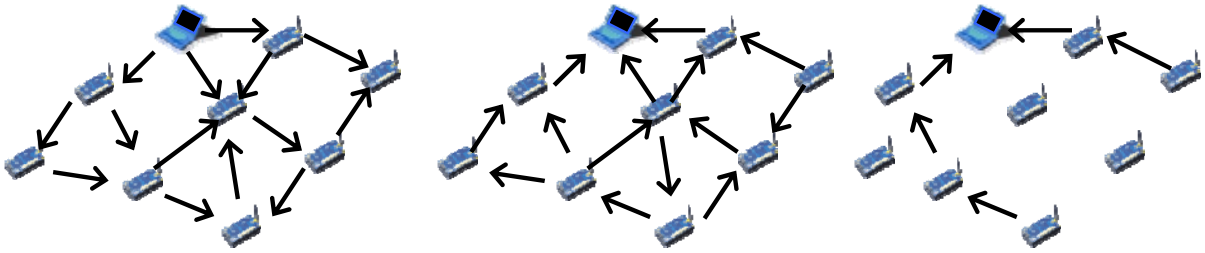
Multihop Routing Protocols

Routing algorithms

- Minimum Cost Forwarding Algo. [MCFA]
  - Table based
  - Proactive
  - Path with minimum cost



- Direct Diffusion [DD]
  - Table based
  - Reactive
  - Data centric

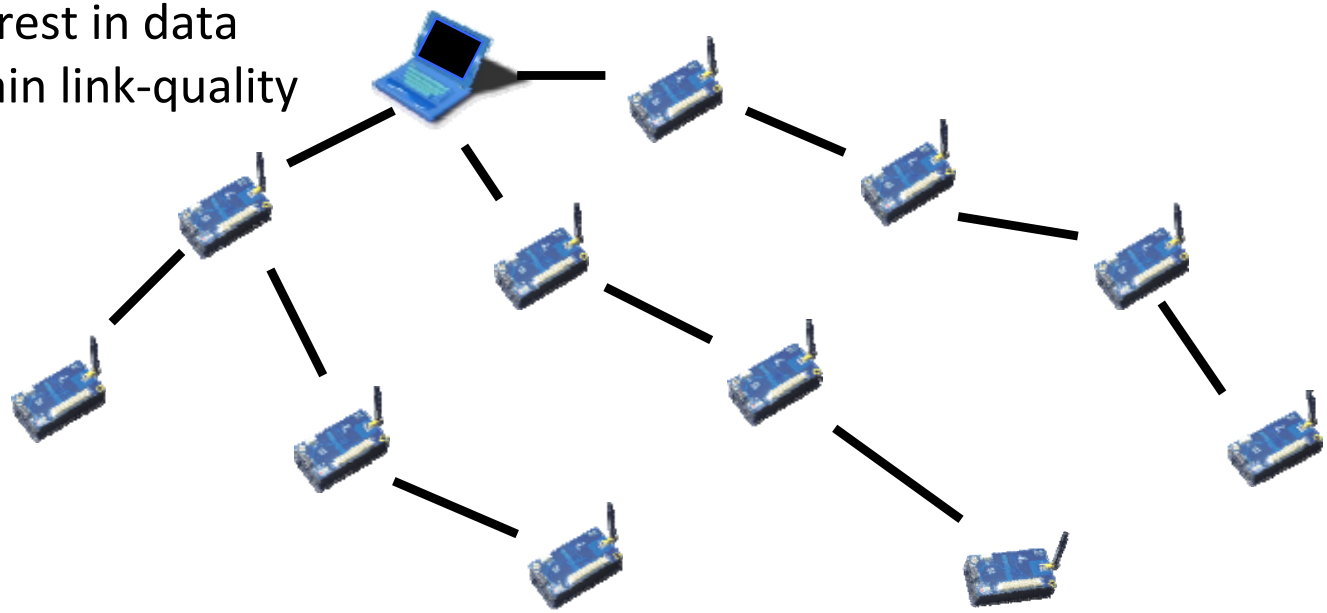


Propagation interest | Set up gradient | Send data

Multihop Routing Protocols

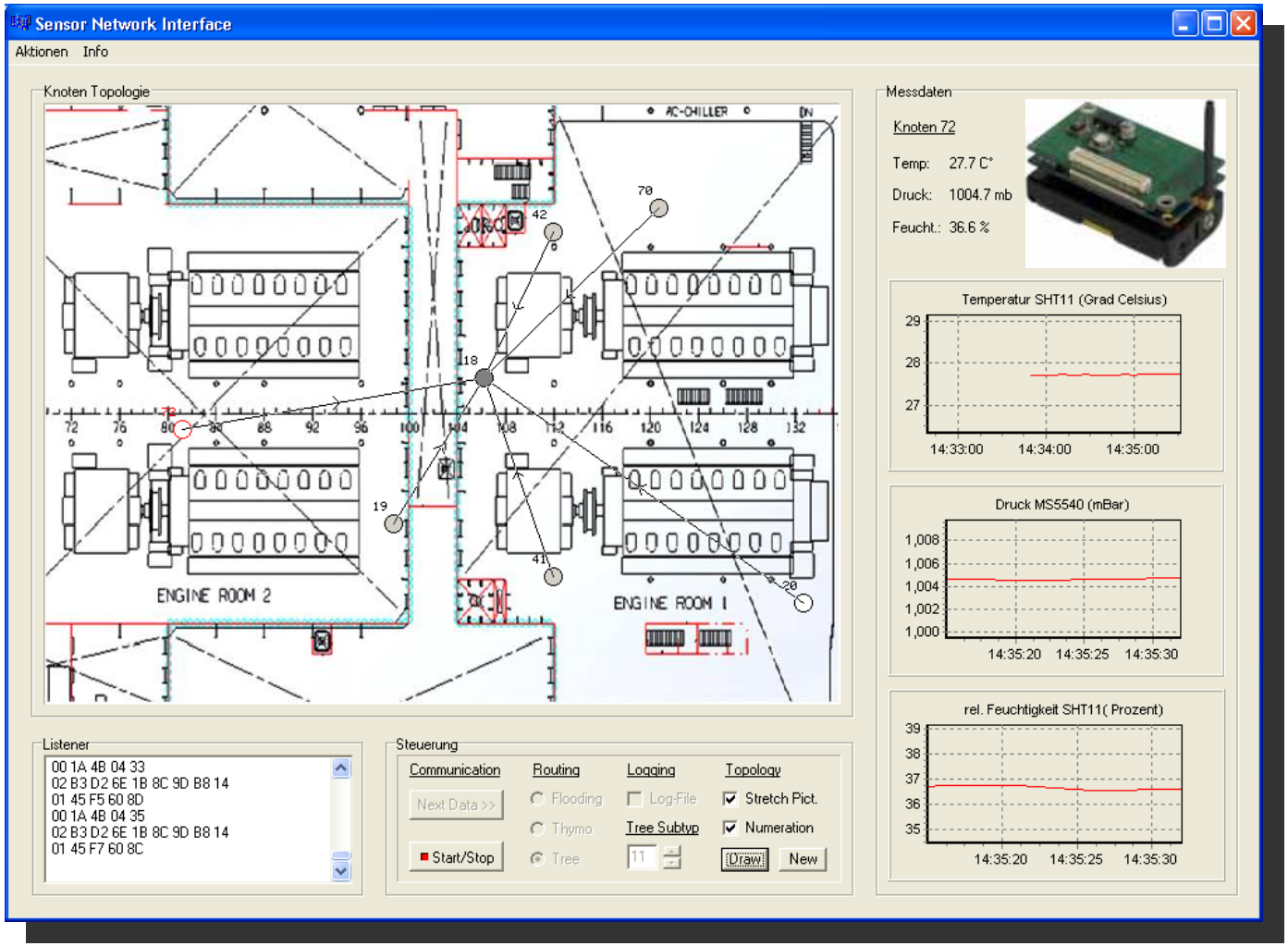
Developed routing Algorithm

- Initialize routing tree for data of interest
  - Use flooding for tree creation
  - Choose shortest path in respect to RSSI
- Transmit data of interest from nodes to sink via tree.
- Periodical tree reconstruction
  - Renew and modify interest in data
  - Update paths to maintain link-quality



Application at the engine room

Field test



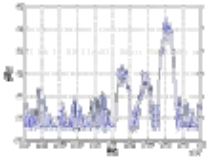
Test duration: 24h

Data range: 1 data packet per second

Conclusion

Hardware and Software

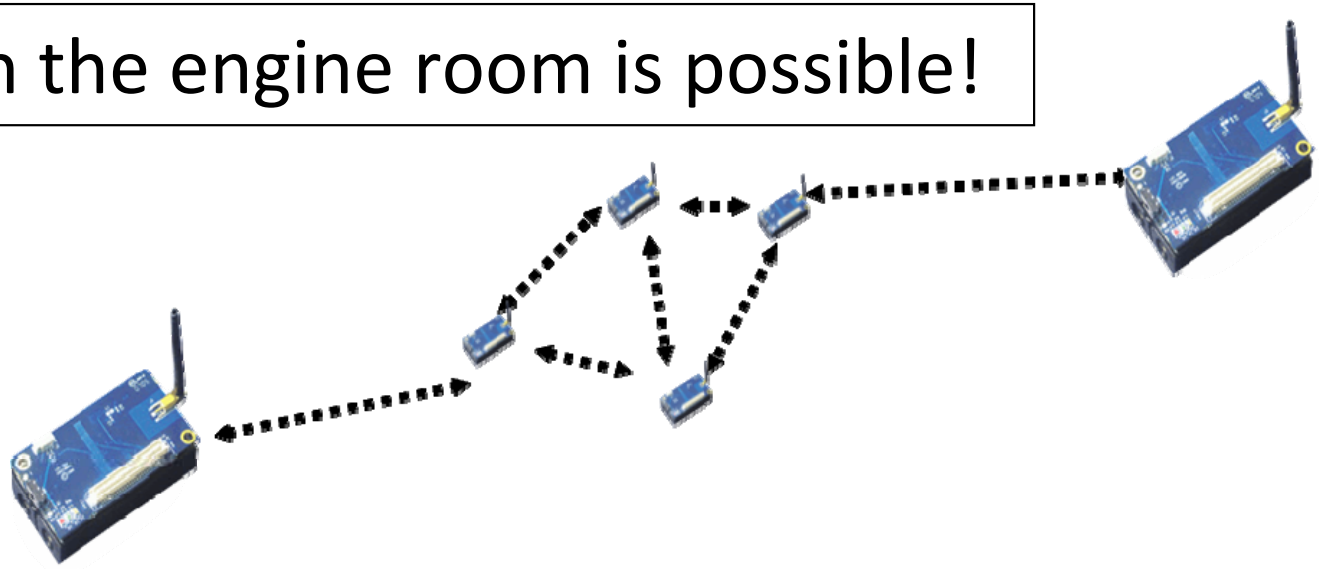
Interferences



Routing Algorithms

Application at engine room

A WSN within the engine room is possible!



Thank you for your attention!

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