TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

ELEKTROTECHNIK UND INFORMATIONSTECHNIK

# Optimizing Interference Situations in IEEE 802.11-Systems using Context Information

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# Outline



- Introduction
- Implementation of the Context-sensitive System
- Method of determining an optimal Radio Channel
- Performance Analysis
- Conclusion

# Introduction



- Wireless transmission of data in smart production sites is one of the most important requirement in Industrial IoT applications

- Determining an optimal radio channel regarding the expected interference situation so critical information can be transmitted with highest probability of success

- Due to hidden node problems, systems can suffer bad interference situations in a wireless network

# Implementation of the Context-sensitive System



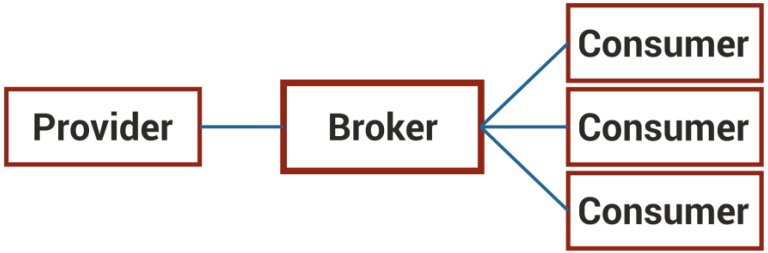
- Context-information
  - Context is any information, which can be used to characterize a situation of an entity
  - Aspects like location, environment, identity or time are used to describe context-information

- Context-sensitive systems
  - To achieve context-sensitivity it is necessary, that only relevant information is provided to the user
  - In this approach a Context-server is used, which stores the relevant data
  - The servers tasks is the gathering, merging and distributing of data
  - All sources must follow the same communication standard so that an exchange is possible
    - An entity with a type and an identifier is defined
    - A scope represents a group of similar context-parameters

- Entity identifier: noisesensor1
- Entity type: sensor
  - Scope1: interference power
    - ParameterA: channel 1
    - ParameterB: channel 5
    - ParameterC: channel 9
  - Scope2: localization
    - ParameterD: position (x/y)

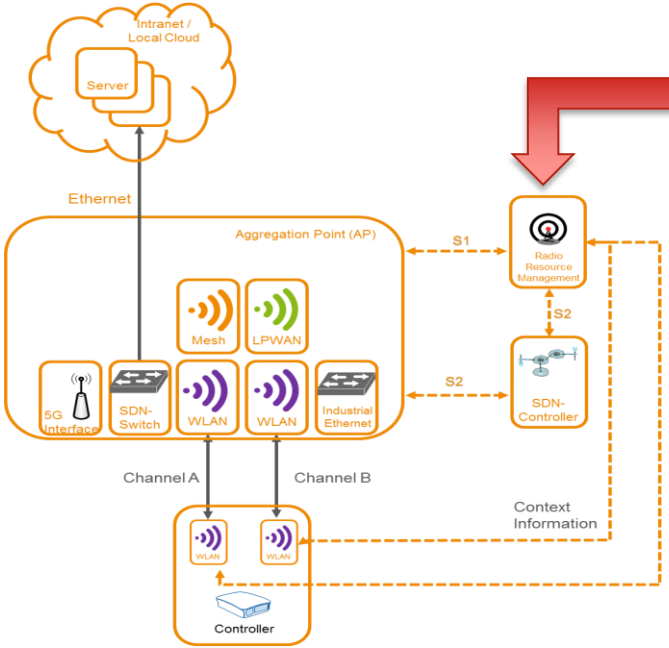
# Implementation of the Context-sensitive System

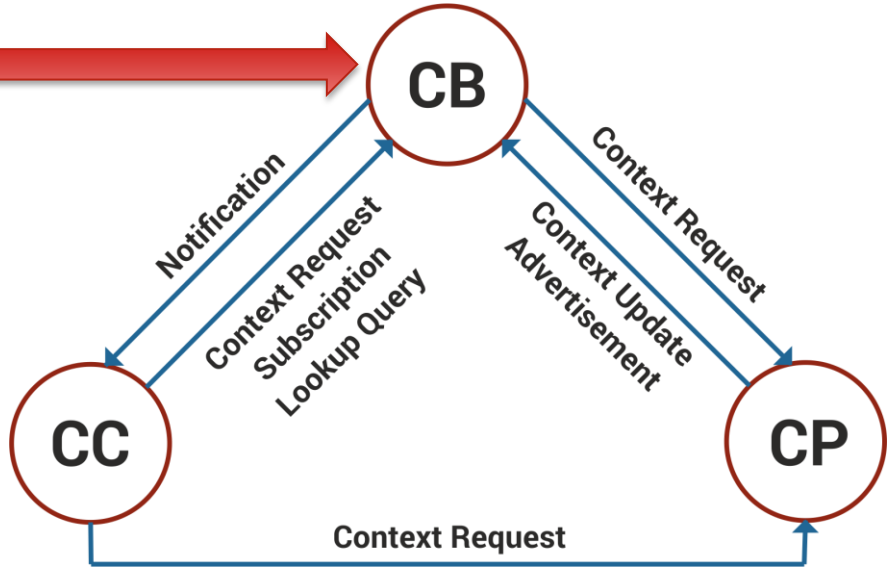
- Centralized Broker Architecture:
  - Sources providing data via a network infrastructure
  - Sources (provider) and broker agree in advance about allowed data types
  - Advantages of this broker architecture:
    - Broker can handle data of multiple providers and distribute it to multiple consumers
    - Distribution process is shifted from simple provider to broker
  - Broker stores data from connected sources; data can be identified by type or id
  - Broker is also responsible for deleting expired data



# Implementation of the Context-sensitive System

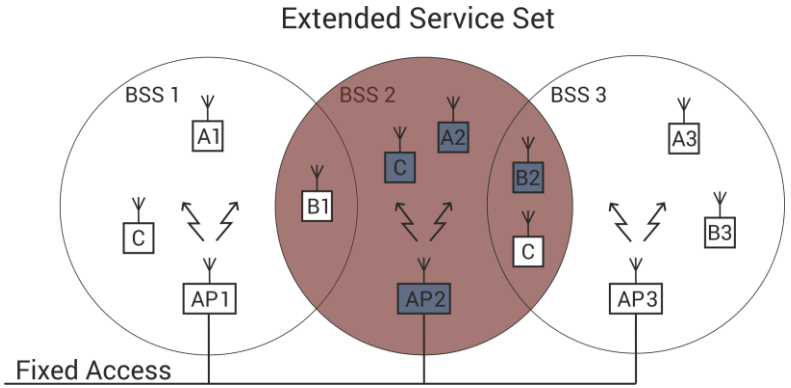
- Components of implemented systems:



# Method of determining an optimal Radio Channel

- Technical fundamentals
  - Data transmission via wireless LAN
  - 802.11n standard at 2.4 GHz with 20 MHz bandwidth is chosen
  - To ensure that the used radio channel is not interfering close-by networks the usage of four non-overlapping carrier frequencies are defined
  - All Participants in a wireless network have to use the same frequency
  - Control and organization functions are done in the access point



# Method of determining an optimal Radio Channel

- Deployment of the protocol
  - A well-defined communication is necessary, to keep latency low and calculated data up-to-date
  - Communication between all components uses the same set of strings for efficient proceeding
  - By using this strings providers can register at an context-broker with there entity id and type
  - The transmitted payload is then used for the determining process and follows the scheme:

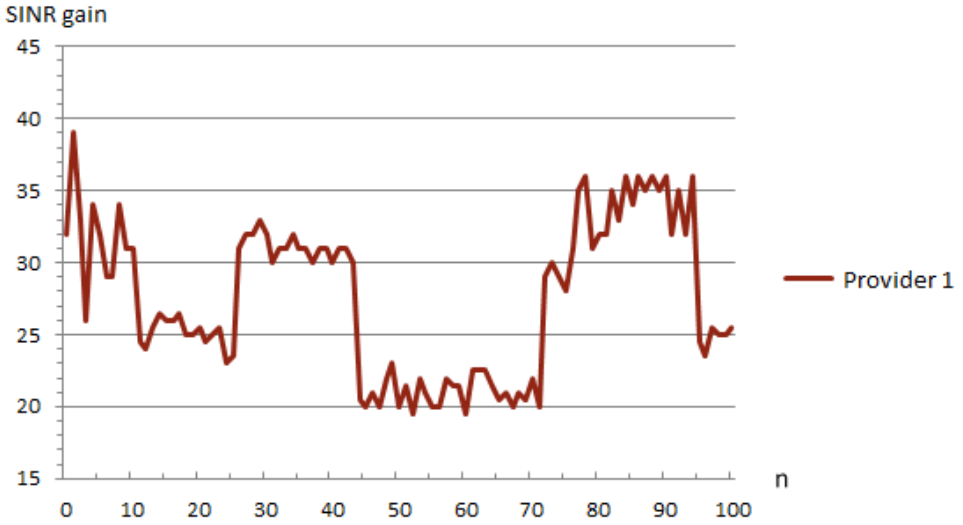
*Security channel/Channel recommendation/Channel switch/Interference power/Position X/Position Y*

# Method of determining an optimal Radio Channel

- Deployment of the determining process
  - In order to achieve a continuously process, it is necessary to caluclate and transmit data in fixed time intervals
  - Provider:
    - Initializing the systems to realize an easy ad-hoc usage
    - Analyze current radio link
    - Scan all SSIDs in range and calculate the interference power of each SSID
    - Filter the calculated results to avoid wrong measurements
    - A radio channel will be recommended, when its averaged interference power is the lowest
    - Create payload and transmit it to the context broker
  - Broker:
    - Stores data from all connected providers

# Performance Analysis

- Determination of the best radio channel
  - Provider recommends channel 9
  - Possible SINR gain due to a channel switch is shown
  - Multiple sharp decreases of the SINR gain
  - The reason for that behavior of the provider 1 is due to a change in channel recommendation



# Conclusion



- Main contributions:
  - Developed algorithm determines an optimal radio channel regarding the SINR at a provider
  - By shifting the calculation of interference to the provider also the hidden node problem is faced

- Next steps:
  - Implementation of consumer to achieve better overview of wireless link situation at an AP
  - Realization of a solution for mobile providers

# Thank you.

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