Initial Interference Scenarios for Indoor Localization Benchmarking in TWIST Tested

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1 Introduction

This document shortly presents initial interference scenarios that will be artificially generated in TKN Wireless Indoor Sensor network Testbed (TWIST) testbed in order to benchmark different indoor localization solutions in the environments with controlled interference. The reason for benchmark representative indoor localization solutions in the environments with controlled interference is to determine if and to which extend different types and amounts of Radio Frequency (RF) interference can influence the indoor localization performance.

2 Interference Scenarios

This section shortly presents the reference scenario and describes three initial interference scenarios that will be used for benchmarking experiments in TWIST testbed.

2.1 Reference Scenario

This reference scenario is instantiated on the 2^{nd} floor of the TWIST testbed in Berlin. It is called "Reference scenario", while no artificial interference is generated and the presence of uncontrolled interference is minimized. According to the EVARILOS Benchmarking Handbook (EBH), this scenario is an instance of the "Small office" type of scenarios. In this scenario 20 measurement points are defined and their locations are given in Figure 1.

At each measurement point the indoor localization System Under Test (SUT) is requested to estimate location. The SUT device is carried to each measurement location using the robotic platform. The navigation stack of the robotic platform gives one order of magnitude more accurate location estimation than considered SUTs and the location obtained from the robotic platform is considered as the ground truth.

The experiments were performed at the weekend afternoon, so the influence of interferers has been minimized. Furthermore, the wireless spectrum has been measured using the WiSpy device attached to the robotic platform and all measurements with the interference threshold above certain level have been repeated. Finally, before each experiment a more detained measurement of the spectrum has been taken with the spectrum analyser at a predefined location.

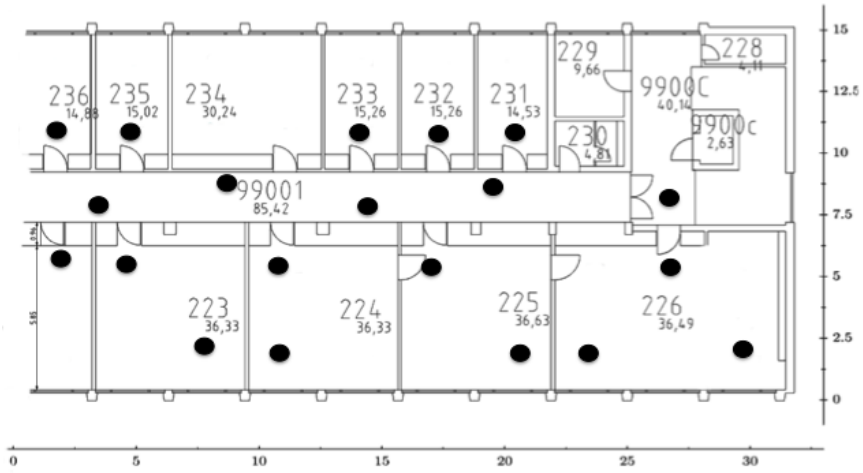

Figure 1: Locations of measurement points

2.2 Interference Scenario 1

First interference scenario instantiated in TWIST testbed uses the testbed's Wireless Fidelity (WiFi) nodes as interference sources. Interference type is jamming on one IEEE 802.11 channel with the maximum transmission power. Three of such jamming nodes are present at different locations in the testbed environment. Summary of this interference scenario is given in Table 1.

Table 1: Interference scenario summary

Types of interference sources	
WiFi	✔
Microwave	✖
DECT	✖
Bluetooth	✖
3G	✖
ZigBee	✖
Parameters of interference sources	
Number of sources	3
Power	20 dBm
Waveform	Carrier jamming
Specific pattern	
Start & stop time	Beginning & end of experiment

Traffic model	
Traffic parameters of interference	
Packet size	
Inter-packet gap	
Bit rate	
File size	
Start & stop size	
Traffic model	
Network parameters	
Network size	
Node density	
Node mobility	
Node failures	

2.3 Interference Scenario 2

In this interference scenario instantiated in TWIST testbed interference is created using the IEEE 802.15.4 Tmote Sky nodes. The interference type is jamming on one IEEE 802.15.4 channel with a constant transmit power equal to 0 dBm. Five of these jamming nodes will be present in the testbed environment. Summary of this interference scenario is given in Table 2.

Table 2: Interference scenario summary

Types of interference sources	
WiFi	✖
Microwave	✖
DECT	✖
Bluetooth	✖
3G	✖
ZigBee	✔
Parameters of interference sources	
Number of sources	5
Power	0 dBm
Waveform	Carrier jamming
Specific pattern	
Start & stop time	Beginning & end of experiment
Traffic model	IEEE 802.15.4 radio

Traffic parameters of interference	
Packet size	
Inter-packet gap	
Bit rate	
File size	
Start & stop size	
Traffic model	
Network parameters	
Network size	
Node density	
Node mobility	
Node failures	

2.4 Interference Scenario 3

Second interference scenario instantiated in TWIST testbed defines interference types that is usual for the office and home environments. Namely, interference is emulated using 4 WiFi embedded Personal Computers (PCs), namely a server, email client, data client, and video client. The server acts as a WiFi Access Point (AP) and a gateway for the emulated services. The email client will "check email" once every 15 seconds for a duration of one second. The data client is emulated via TCP streams one starting at 45 seconds for a duration of 22.5 seconds and the other starting at 105 seconds for a duration of 45 seconds. The video client is emulated as a UDP stream of 100 kbps for half the experiment cycle and it will start at the middle of the experiment. In total, the experiment takes 150 seconds. Summary of this interference scenario is given in Table 3.

Table 3: Interference scenario summary

Types of interference sources	
WiFi	✔
Microwave	✖
DECT	✖
Bluetooth	✖
3G	✖
ZigBee	✖
Parameters of interference sources	
Number of sources	3

Power	20 dBm
Waveform	
Specific pattern	
Start & stop time	Beginning & end of experiment
Traffic model	WiFi traffic
Traffic parameters of interference	
Packet size	
Inter-packet gap	
Bit rate	
File size	
Start & stop size	
Traffic model	
Network parameters	
Network size	
Node density	
Node mobility	
Node failures	

3 Conclusion

First two interference scenarios use jamming on a wireless channel. Intuitively, this type of interference should harm badly indoor localization performance (at least I hope so). These scenarios have been chosen in order to answer if interference at all influences any indoor localization SUTs. Third scenario is more realistic in terms that it captures normal interference types in home or office environments.