Measurement Approach for Specialized Antennas to Observe the Spectrum Use by PMSE

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Overview

• Motivation
• Antenna
• Measurement
• Outlook
MOTIVATION
Motivation

• Conservative Measurement methods:
  – Spectrum of PMSE/disturber cannot be tracked spatially → location information gives one more term that can be used in the signal processing

• Shown Approach:
  • Use switchable Antenna Array
  • Possibility to get direction of the received signal
Proposed Antenna
Properties

• Nine dual polarized radiator elements in different directions
• 6 for Azimuth direction, 3 for elevation
• Frequency range between 1.43 and 1.63 GHz
• Maximum gain of 7.5 dBi
• Each radiator and polarization can be accessed separately
Picture of Antenna

Elevation elements

Azimuth elements
Hardware

Antenna Control Device

- Spectrum Analyzer
  - SCPI
  - UART
- USB
- Microcontroller
- SMA
- Bias Tee
- Single Ended to RS-485 Driver
- RS-485 To Single Ended Receiver
- RJ-45

Antenna

- Bias Tee
- SMA
- RS-485 To Single Ended Receiver
- Shift Register SIPO 8-Bit
- Single Ended To RS-485 Driver
- Shift Register PISO 8-Bit
- Serial Number
- Switching Network of the Antenna
Advantage of the hardware control

• Easy to built up

• Cheap

• Up to 256 different combinations are possible

• Reliable data transfer through RS 485

• Simple transfer protocol
MEASUREMENT
Explanation

• Antenna is fixed in the middle of a circular rail

• On the rail there is a transmitting antenna which can be moved in an angle step of 0.7 °

• Sending Antenna is moved to the wanted position and then measurements are done with all antenna elements
Construction

• (1) Transmitting Antenna
• (2) Receiving Antenna
• (3) Rails
Devices

• Spectrum Analyzer: Rhode & Schwarz, FSL
  ➢ 1450 MHz – 1550 MHz
  ➢ 100 KHz BW
  ➢ RMS detector

• Signal Generator: Rhode & Schwarz, SMIQ
  ➢ Frequency: 1500 MHz
  ➢ Amplitude: -30 dBm

• Scanning Software: PMSE Occupation Recorder
Setup

• Software switches the 9 Antennas

• Angle Step: 9.5 °

• Measurement Time: 5 min. / step

• Polarization of transmitting Antenna: Horizontal
RESULTS
Measurement Results 0°
Measurement Results 90°

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Measurement Results 180 °
Interpretation

• Highest peak at the antenna element where the transmitter is located

• Rude angle estimation possible

• Further methods are needed to get more exact estimations
CONCLUSION & OUTLOOK
Conclusion

- Antenna with switchable antenna elements and simple switching hardware
- First approach for observing the spatial spectrum use has been showed
- Rude AoA-estimation is possible by amplitude scanning
Outlook

• Develop AoA-Algorithm
• Built more antennas to exactly locate the PMSE device
• New antennas are easy to build up:
  ➢ Dual polarized Patch antenna
  ➢ 300 MHz Bandwidth (S11 < -10 dB)
  ➢ Horizontal to vertical decoupling of < -30 dB
THANK YOU FOR LISTENING

QUESTIONS?