Channel Measurement for IEEE 802.11aj (45 GHz)

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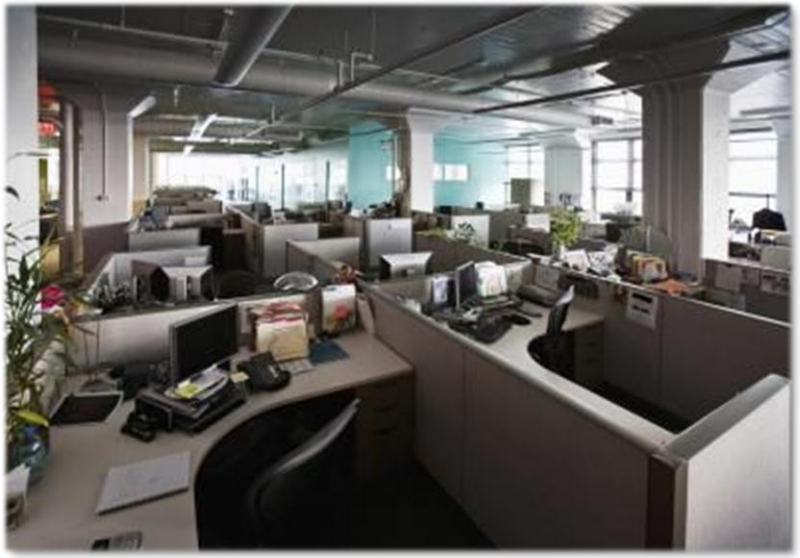
Outline

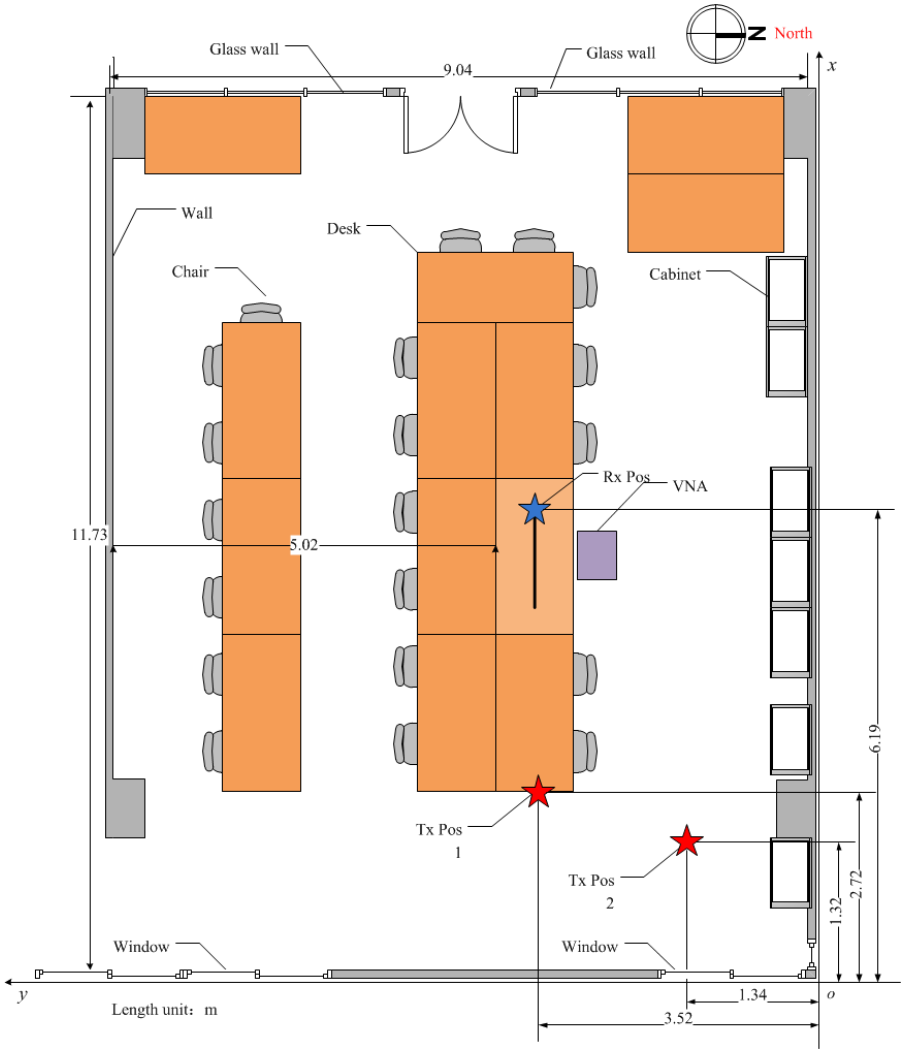
1. **Transmission Scenario**
2. **Measurement Setup**
3. **Channel Measurement Results**

Transmission Scenarios

- **Conference room**
- **Cubicle room**
- **Living room**



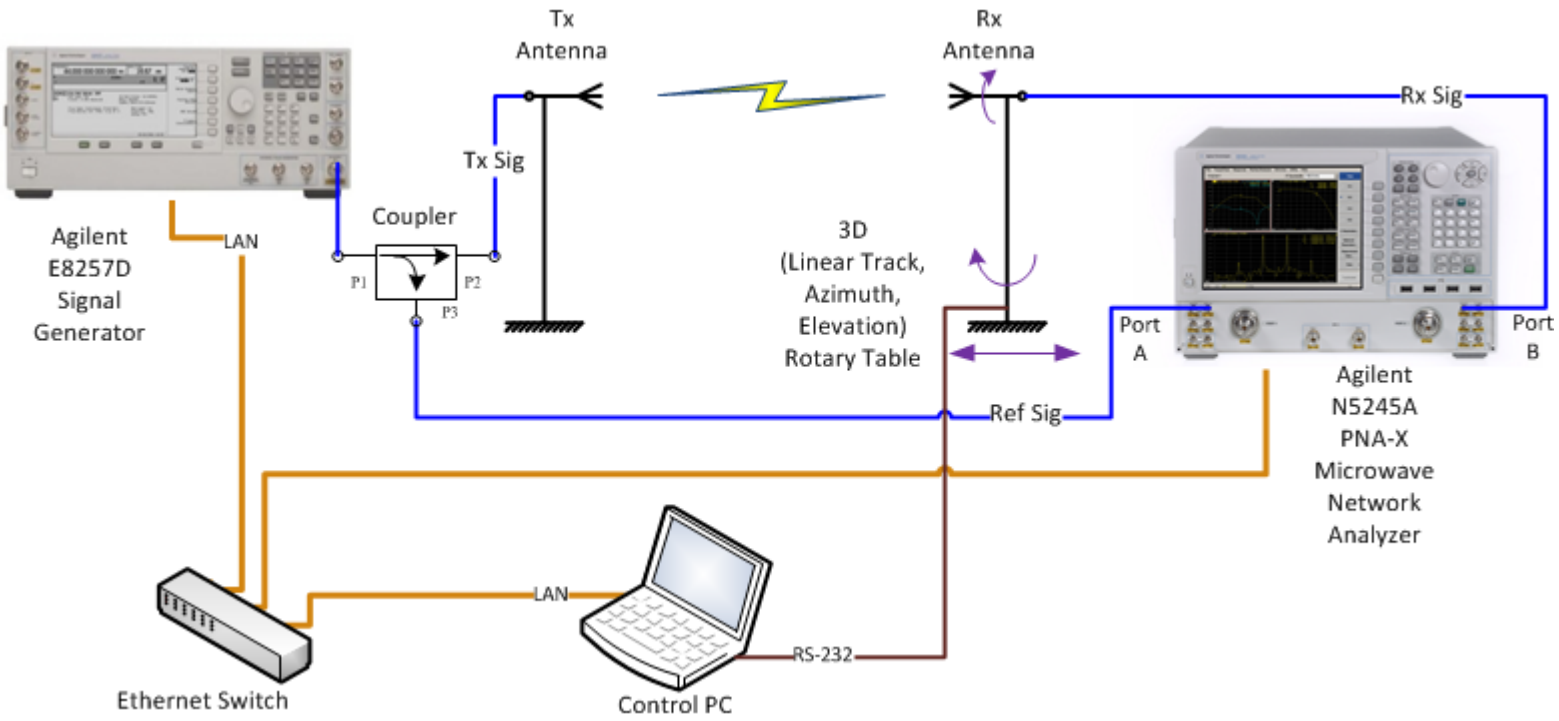
Conference Room



Outline

1. Transmission Scenario
2. Measurement Setup
3. Channel Measurement Results

Channel Measurement Setup



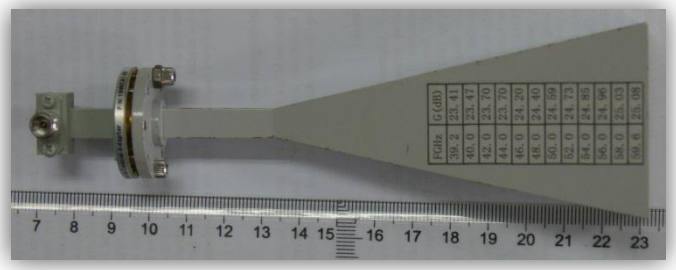
- A PC is used to not only control the rotary table with an RS-232 port but also control the signal generator and network analyzer with LAN ports.
- The signal generator transmits CW signal at each frequency, then Rx power and channel frequency response are obtained by the network analyzer. The positions of Tx and Rx antennas and measured data are simultaneously recorded.

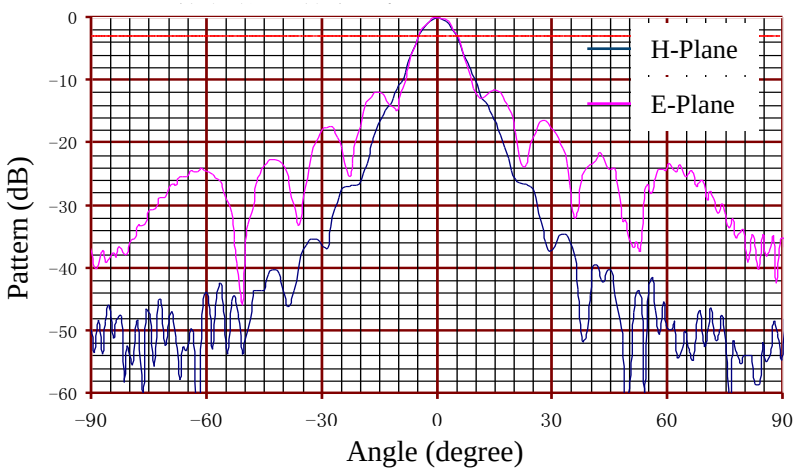
Parameters of Q-band Channel Measurement

Parameter	Value
Frequency band	45 GHz (45. 115~45.385 GHz)
Method	Signal Generator and VNA Sweep Frequency
Subcarrier Spacing	4.21875 MHz (adjustable)
Bandwidth	270 MHz (adjustable, 540, 1080 MHz)
Sweep Frequency Points	64 (128, 256)
Sweep Frequency Duration	80 ms (adjustable)
Tx Power	0 dBm (adjustable, max 10 dBm)
Cable Length	2 m at both ends
Antenna	Horn antenna / Open ended waveguide antenna
Measurement Scenario	Conference room (Cubicle room, Living room)

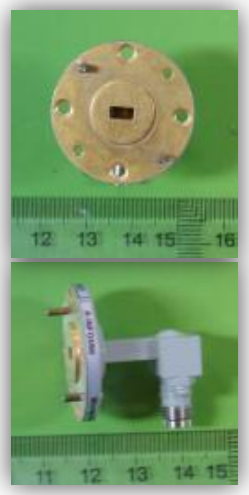
Antennas for Channel Measurement

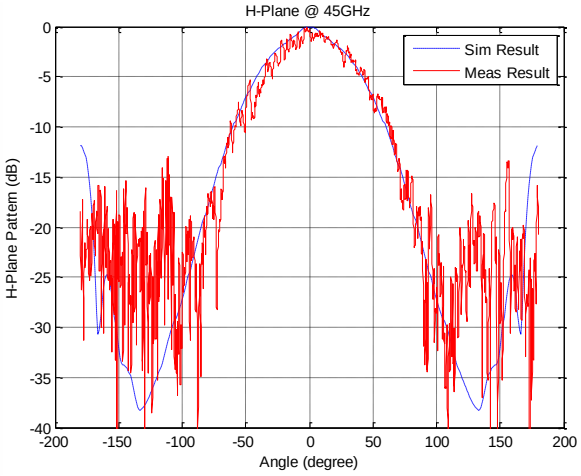
- **Type I: Horn antenna with 23.7-dBi gain**

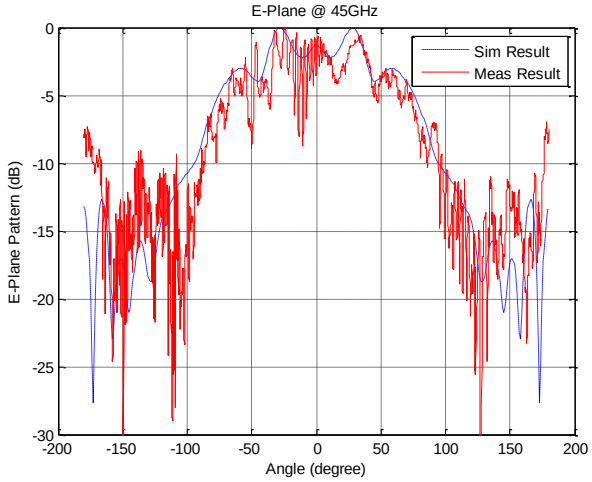




- **Type II: Open-ended waveguide (OEW) antenna with 6-dBi gain**







Power Delay Profile (PDP) of STA-STA

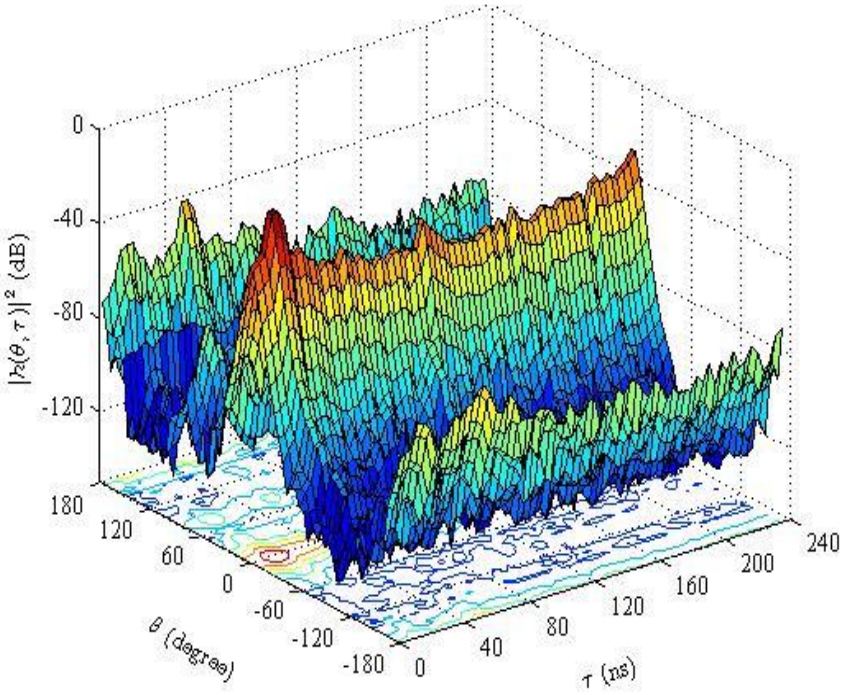


Fig. 1 STA-STA Transmission

d_{TR} = 3.47 m, h_T=h_R = 1.04 m, φ_T =φ_R = 0^0, P_T= 0 dBm

BW: *270 MHz*, f_c: 45 GHz

Tx Ant: Type I, Rx Ant: Type I

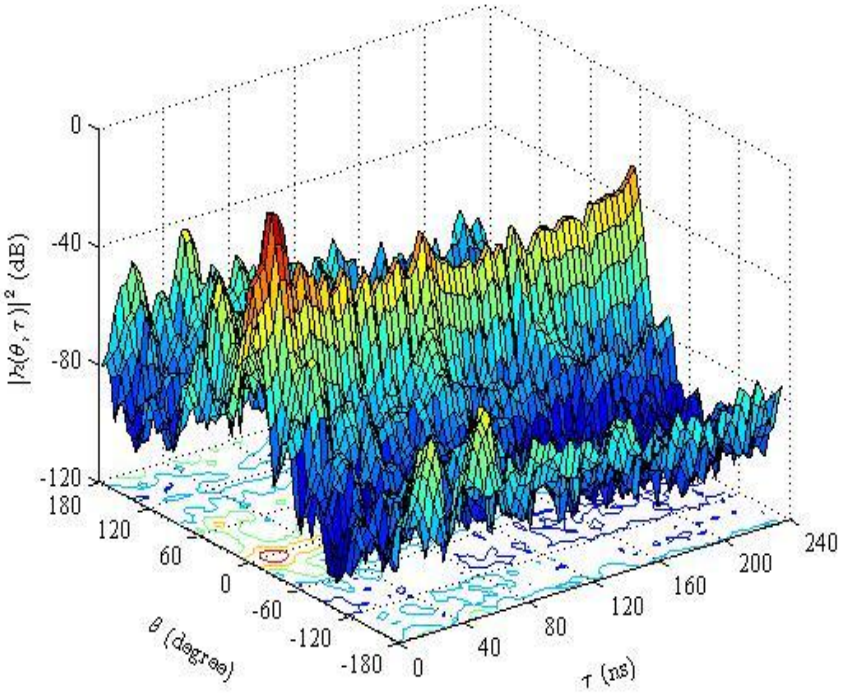


Fig.2 STA-STA Transmission

d_{TR} = 3.47 m, h_T = h_R = 1.04 m, φ_T = φ_R = 0^0

P_T= 0 dBm, BW: *270 MHz*, f_c: 45 GHz

Tx Ant: Type II; Rx Ant: Type I

$16.3\ \text{ns} \le \bar{\tau} \le 117.4\ \text{ns}, 14.7\ \text{ns} \le \sigma_\tau \le 75.2\ \text{ns}$

$15.8\ \text{ns} \le \bar{\tau} \le 79.8\ \text{ns}, 16.4\ \text{ns} \le \sigma_\tau \le 52.5\ \text{ns}$

Power Delay Profile (PDP) of AP-STA

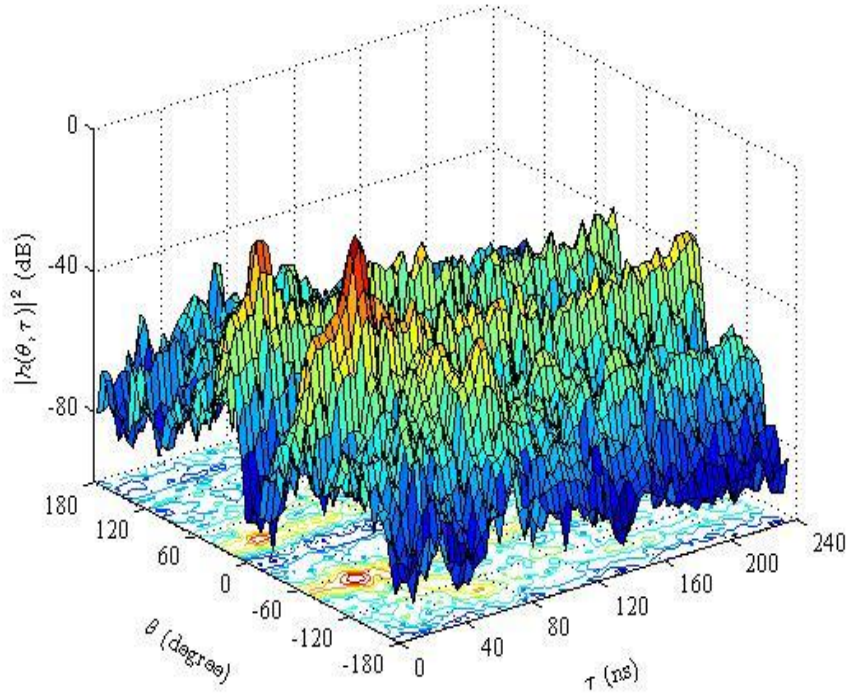


Fig. 1 AP-STA Transmission

d_{TR} = 5.59 m, h_T = 2.72m , h_R = 1.04 m, φ_T = -15^0 , φ_R = 0^0

BW: 270 MHz, f_c: 45 GHz

Tx Ant: Type I, Rx Ant: Type I

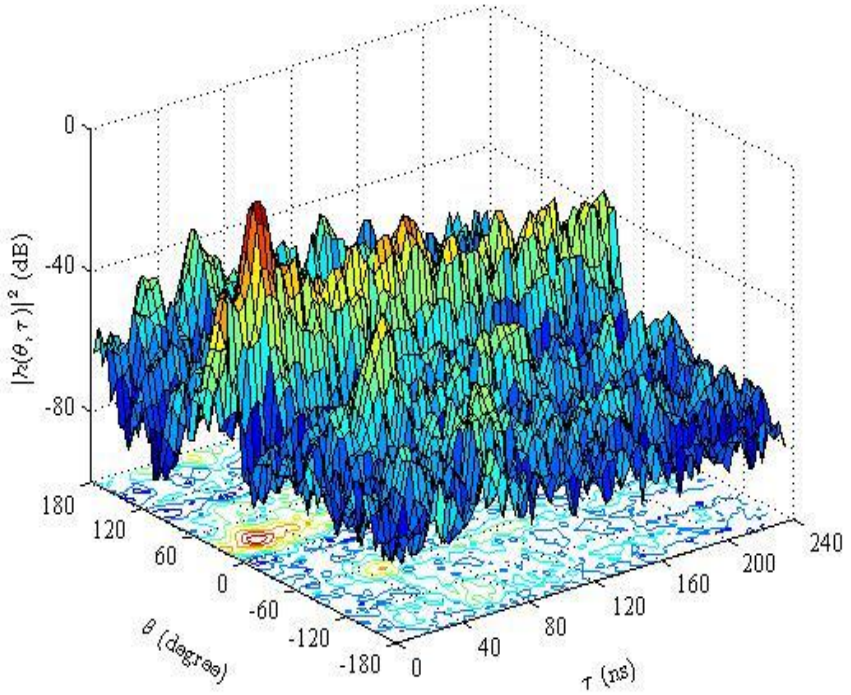


Fig.2 AP-STA Transmission

d_{TR} = 5.59 m, h_T = 2.72m, h_R = 1.04 m, φ_T = -15^0 , φ_R = 0^0

P_T= 0 dBm, BW: 270 MHz, f_c: 45 GHz

Tx Ant: Type II; Rx Ant: Type I

$30.3\,\text{ns} \le \bar{\tau} \le 132.1\,\text{ns}, 16.2\,\text{ns} \le \sigma_\tau \le 61.7\,\text{ns}$

$25.2\,\text{ns} \le \bar{\tau} \le 113.9\,\text{ns}, 20.7\,\text{ns} \le \sigma_\tau \le 58.2\,\text{ns}$

Power Angle Profile (PAP) of STA-STA

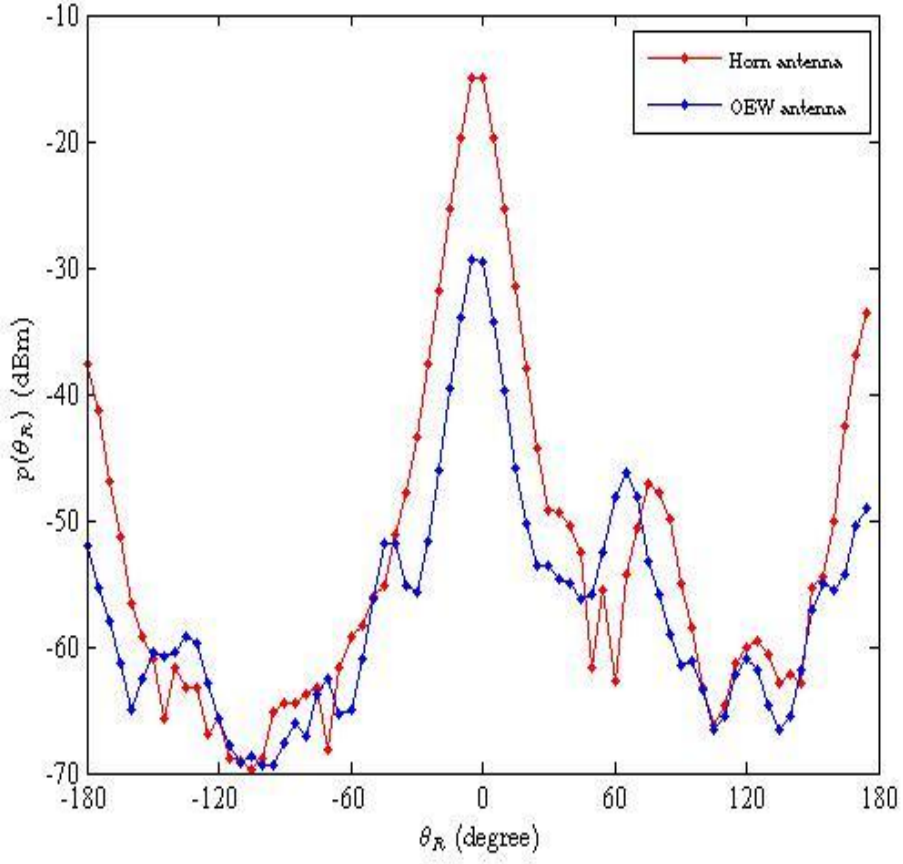


Fig. 1 PAP of STA-STA Transmission

d_{TR} = 3.47 m, h_T=h_R = 1.04 m,

φ_T =φ_R = 0^0, P_T= 0 dBm

BW: 270 MHz, f_c: 45 GHz

Tx Ant: Horn antenna or OEW antenna

Rx Ant: Horn antenna

- For horn antenna,

  $\Lambda = 0.23, \gamma = 0.58, \theta_{max} = -5.0^{\circ}$

- For OEW antenna,

  $\Lambda = 0.32, \gamma = 0.40, \theta_{max} = -21.3^{\circ}$

Power Angle Profile (PAP) of AP-STA

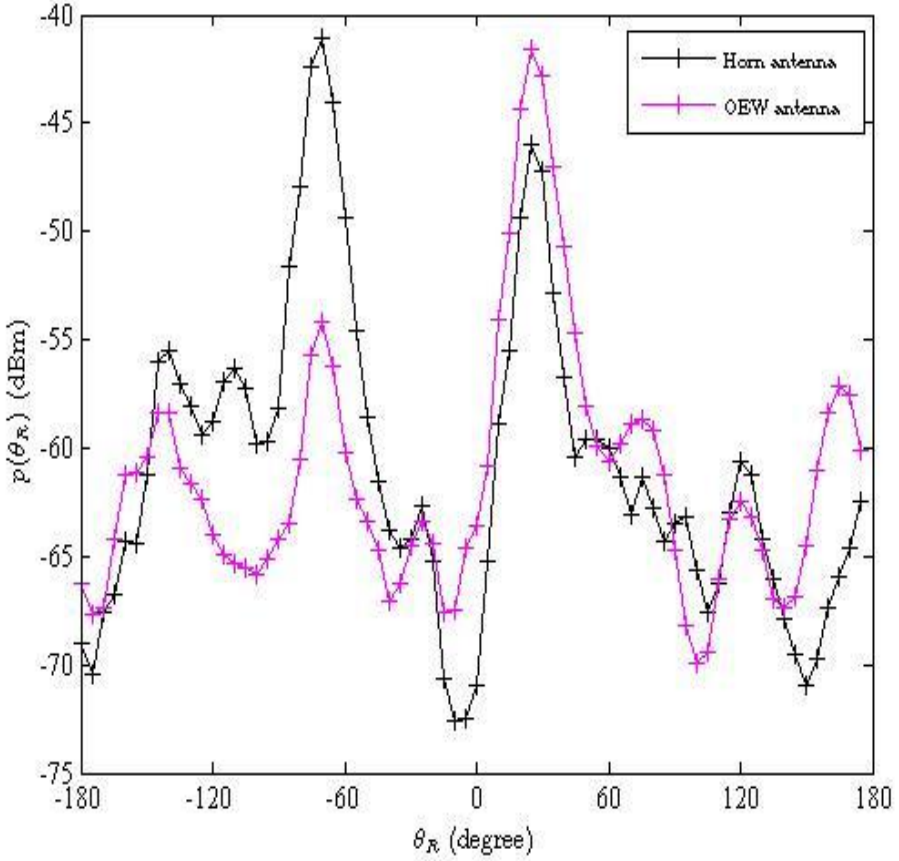


Fig. 1 PAP of STA-STA Transmission

h_T = 2.7m , h_R = 1.3 m, d_{TR} = 5.83 m

φ_T = -15^0 , φ_R = 0^0

P_T= 0 dBm

BW: 270 MHz, f_c: 45 GHz

Tx Ant: Horn antenna or OEW antenna

Rx Ant: Horn antenna

- For horn antenna,

  $\Lambda = 0.74, \gamma = 0.71, \theta_{max} = -68.1^{\circ}$

- For OEW antenna,

  $\Lambda = 0.62, \gamma = 0.43, \theta_{max} = 33.1^{\circ}$

Future Works

- **The 45 GHz band channel will be measured in conference room, cubicle room and living room;**
- **Transmission scenarios will include LoS and NLoS;**
- **Channel measurement for 3 bandwidth configurations (270, 540 and 1080 MHz) will be compared;**
- **More measurement data will be obtained, which will be used for statistical channel modeling;**
- **Penetration losses for different kinds of walls and blockage objects will also be measured;**
- **Some parameters, for example penetration losses, PAP and PDP of multipath will be compared between 45 GHz and 60 GHz bands.**

Thank you very much for your attention!