21NRM03 MEWS

D4 Report on the generation of a real world sub-THz traceable channel sounding open access database that comprises a description of the data generated using the tools developed (as described in the D3 report) and the relevant open access links

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Deliverable Cover Sheet

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1 Sub-THz VNA-based Channel Sounder Structure and Channel Measurements at 100 and 300 GHz

The uploaded measurement dataset is available at:

https://zenodo.org/records/15474823

For each measured frequency band, channel frequency response is uploaded. Each channel frequency response includes information about magnitude, phase and frequency. The table below represents the main parameters of the measurement setup.

Scenario	Laboratory	Laboratory
Frequency [GHz]	90 – 110	250-300
Tx antenna type, gain, HPBW	Horn, 21 dBi, 19°	Horn, 25 dBi, 8°
Transmitted power [dBm]	9	9
Tx rotation	fixed	fixed
Rx antenna type, gain, HPBW	Horn, 21 dBi, 19°	Horn, 25 dBi, 8°
Rx rotation	[-180:1:179]	[-180:1:179]
Tx-Rx distance [m]	2.25	2.25
Antenna height [m]	0.9	0.9

For more information, please refer to the explanation in the article entitled “Sub-THz VNA-Based Channel Sounder Structure and Channel Measurements at 100 and 300 GHz”. The article can be found here:

https://vbn.aau.dk/ws/files/441017166/1570727693_6_.pdf

10.1109/PIMRC50174.2021.9569702

For more information and questions, please contact Associate Professor Fengchun Zhang at fz@es.aau.dk.

2 Enabling Long-Range Large-Scale Channel Sounding at Sub-THz Bands: Virtual Array and Radio-Over-Fiber Concepts

The uploaded measurement dataset is available at:

https://zenodo.org/records/15475728

The file “directive_vaa_20m” contains the measured channel frequency response at 100 GHz for corridor scenario. More specifically, the variable name “freq_resp” includes an information about magnitude, phase and frequency. The table below represents the main parameters of the measurement setup.

Scenario	Corridor
Frequency [GHz]	99 – 101
Tx antenna type, gain, HPBW	Omnidirectional, 5 dBi, -
Transmitted power [dBm]	10
Tx rotation	Fixed
Rx antenna type, gain, HPBW	ASY-CWG-S-750, 13.5 dBi, -
Rx rotation	virtual array [-180:1:180], radius 5 cm
Tx-Rx distance [m]	20
Antenna height [m]	1.25

Further, a file named “padp_directive_vaa_20m_mbf” contains the variable “padp_data”, which is the PADP obtained after applying the beamforming algorithm presented in the paper “Virtual Antenna Array with Directional Antennas for Millimeter-Wave Channel Characterization” . The article is available at:

https://vbn.aau.dk/en/publications/virtual-antenna-array-with-directional-antennas-for-millimeter-wa

10.1109/TAP.2022.3161334

For more information, please refer to the explanation in the article entitled “Enabling Long-Range Large-Scale Channel Sounding at Sub-THz Bands: Virtual Array and Radio-Over-Fiber Concepts”. The paper can be found here:

https://vbn.aau.dk/da/publications/enabling-long-range-large-scale-channel-sounding-at-sub-thz-bands

10.1109/MCOM.001.2200411

For more information and questions, please contact Associate Professor Fengchun Zhang at fz@es.aau.dk.

3 Large Virtual Antenna Array-Based Empirical Channel Characterization for Sub-THz Indoor Hall Scenarios

The uploaded measurement dataset is available at:

https://zenodo.org/records/15475522

The measurement data is divided into two measurement scenarios (see the deployment.ppt file). Nineteen channel frequency responses (all file names start with 1_) are provided for the first scenario and thirteen (all file names start with 2_) for the second scenario. Each channel frequency response includes information about magnitude, phase and frequency. The table below represents the main parameters of the measurement setup.

Scenario	Large hall and corridor
Frequency [GHz]	99 – 101
Tx antenna type, gain, HPBW	Omnidirectional, 4.5 dBi, -
Transmitted power [dBm]	10
Tx rotation	Fixed
Rx antenna type, gain, HPBW	Omnidirectional, 4.5 dBi, -
Rx rotation	virtual array [-180:1:180], radius 6.7 cm
Tx-Rx distance [m]	3-58
Antenna height [m]	1.3

For more information, please refer to the explanation in the article entitled “Large Virtual Antenna Array-Based Empirical Channel Characterization for Sub-THz Indoor Hall Scenarios”. The article can be found here:

https://oulurepo.oulu.fi/bitstream/handle/10024/51410/nbnfioulu-202408135384.pdf;jsessionid=2FA7735F829D7B355BACF2CBCE46F772?sequence=1

10.1109/TAP.2024.3423470

For more information and questions, please contact Associate Professor Fengchun Zhang at fz@es.aau.dk.

4 Design and Validation of the Phase-Compensated Long-Range Sub-THz VNA-based Channel Sounder

The uploaded measurement dataset is available at:

https://zenodo.org/records/15476080

All measurement results are divided into two groups: “bending_results” and “results_over_time”. The group “bending_results” consists of 6 Excel files considering no bending of the cable and one to five circles of the bended cable respectively. In each Excel file, amplitude and phase of the forward B/A and feedback C/R3 links respectively are recorded for the frequency range (219-330) GHz. There is one Excel file in the group “results_over_time” (with a name “OVER_TIME_DRIFTING”) containing data recorded once every minute and for a period of 12 hours.

For more information, please refer to the explanation in the article entitled “Design and Validation of the Phase-Compensated Long-Range Sub-THz VNA-based Channel Sounder”. The article can be found here:

https://vbn.aau.dk/ws/portalfiles/portal/445940167/Design_and_Validation_of_the_Phase_Compensated_Long_Range_Sub_THz_VNA_based_Channel_Sounder.pdf

10.1109/LAWP.2021.3114626

For more information and questions, please contact Associate Professor Fengchun Zhang at fz@es.aau.dk.

5 Deterministic Ray Tracing: A Promising Approach to THz Channel Modeling in 6G Deployment Scenarios

The uploaded measurement dataset is available at:

https://zenodo.org/records/15476277

The file “phasecomp_nlos22.m” contains the measured channel frequency response at 100 GHz for empty room scenario. The file “Point2_4.2m” contains the measured channel frequency response at 300 GHz for spacious hall scenario. More specifically, both files include information about magnitude, phase and frequency. The table below represents the main parameters of the measurement setup.

Scenario	Empty room	Spacious hall
Frequency [GHz]	97-103	299 – 301
Tx antenna type, gain, HPBW	Omnidirectional, 4.5 dBi, -	Horn, 26 dBi, 8°
Transmitted power [dBm]	0	5
Tx rotation	Fixed	virtual array [-90:4:90], radius 0.5 m
Rx antenna type, gain, HPBW	Omnidirectional, 4.5 dBi, -	Horn, 26 dBi, 8°
Rx rotation	virtual array [-180:0.5:180], radius 0.5 m	virtual array [-180:4:180], radius 0.5 m
Tx-Rx distance [m]	6.5	4.2
Antenna height [m]	1.25	1.25

For more information, please refer to Fig. 2a and Fig. 3c and the explanation in the article entitled “Deterministic Ray Tracing: A Promising Approach to THz Channel Modeling in 6G Deployment Scenarios”. The paper can be found here:

https://vbn.aau.dk/da/publications/deterministic-ray-tracing-a-promising-approach-to-thz-channel-mod

10.1109/MCOM.001.2200486

For more information and questions, please contact Associate Professor Fengchun Zhang at fz@es.aau.dk.

6 Measurement-based channel characterization in a large hall scenario at 300 GHz

The uploaded measurement dataset is available at:

https://zenodo.org/records/15475334

Eight channel frequency responses for different Tx-Rx distances are provided. Each channel frequency response includes information about magnitude, phase and frequency. Both Tx and Rx are rotated, deploying double directional scanning sounding (DDSS) scheme. The table below represents the main parameters of the measurement setup.

Scenario	Large hall
Frequency [GHz]	299 – 301
Tx antenna type, gain, HPBW	Omnidirectional, 4.5 dBi, -
Transmitted power [dBm]	10
Tx rotation	[-90:4:90]
Rx antenna type, gain, HPBW	Omnidirectional, 4.5 dBi, -
Rx rotation	[-180:4:179],
Tx-Rx distance [m]	3-15.6
Antenna height [m]	1.25

For more information, please refer to the explanation in the article entitled “Measurement-Based Channel Characterization in a Large Hall Scenario at 300 GHz”. The article can be found here:

https://vbn.aau.dk/en/publications/measurement-based-channel-characterization-in-a-large-hall-scenar

10.23919/JCC.fa.2022-0286.202304

For more information and questions, please contact Associate Professor Fengchun Zhang at fz@es.aau.dk.

7 Virtual Antenna Array-Based Channel Sounding at 300 GHz: Implementation and Field Measurements

The uploaded measurement dataset is available at:

https://zenodo.org/records/15474139

Two channel frequency responses (obtained by using horn antenna with narrow HPBW and wide HPBW respectively) and two measured gain patterns for both types horn antennas are listed. Each channel frequency response includes an information about magnitude, phase and frequency. The table below represents the main parameters of the measurement setup.

Scenario	Entrance hall
Frequency [GHz]	295 – 305
Tx antenna type, gain, HPBW	Horn, 15 dBi, 36°
Transmitted power [dBm]	10
Tx rotation	fixed
Rx antenna type, gain, HPBW	Horn, 15 dBi, 36◦/ Horn, 25.5 dB, 8◦
Rx rotation	Virtual array [-180:0.3:180], radius 9.5 cm
Tx-Rx distance [m]	6.5
Antenna height [m]	1.25

For more information, please refer to the explanation in the article entitled “Virtual Antenna Array Based Channel Sounding at 300 GHz: Implementation and Field Measurements”. The article can be found here:

https://oulurepo.oulu.fi/bitstream/handle/10024/51409/nbnfioulu-202408135383.pdf?sequence=1&isAllowed=y

10.1109/LAWP.2024.3437674

For more information and questions, please contact Associate Professor Fengchun Zhang at fz@es.aau.dk.

8 330–500 GHz and 500–750 GHz ray tracing

The uploaded measurement dataset is available at:

https://zenodo.org/records/16635993

For each measured frequency band, channel frequency response is uploaded. Each channel frequency response includes information about magnitude, phase and frequency. The table below represents the main parameters of the measurement and simulation setup.

- ### Equipment List for 330–500 GHz and 500–750 GHz

Equipment	330–500 GHz	500–750 GHz
VNA	Rohde & Schwarz / Keysight	Keysight
Frequency Extenders	Rohde & Schwarz ZC500	VDI WR1.5
E/O Converter	Thorlabs MX40G	Thorlabs MX40G
Amplifier 1	ERZ-LNA-1000-2700	Minicircuits ZX60-06183LN+
Amplifier 2	Mini-Circuits ZFL-500L	Mini-Circuits ZFL-500LN
Horn Antennas	SGH-26-WR2.2	DI WM-380
Photo Receiver	Thorlabs RXM40	Thorlabs RXM40
Coaxial Cable	100 m	100 m
Coaxial Cable type	RG58U	RG58U

- ### Antenna Details: SGH-26-WR2.2

Parameter	Value
Directivity	26 dBi
3 dB Beamwidth, E-plane	7.7 deg
3 dB Beamwidth, H-plane	8.5 deg
Sidelobe, E-plane	-10 dB
Sidelobe, H-plane	-33 dB
S11	-20 dB

- ### Antenna Details: WM-380 (WR-1.5)

Parameter	Value
Frequency Range	500–750 GHz
Polarization	Diagonal 10°
Directivity	26 dBi

• Ray tracing simulation:

Material Properties

	Floor	Ceiling	Poster	Metal
Real Permittivity	2.60	2.12	1.96	1
Loss Tangent	0.05-0.07	0.065-0.085	0.06-0.08	10
Scattering Parameter	0.025	0.03	0.02	0.1
Equivalent Roughness (αR)	1.8	2	6	2

For more information related to scenarios and setup, please refer to the explanation in the D3 report.

For more information and questions, please contact Professor Akram Alomainy at a.alomainy@qmul.ac.uk.