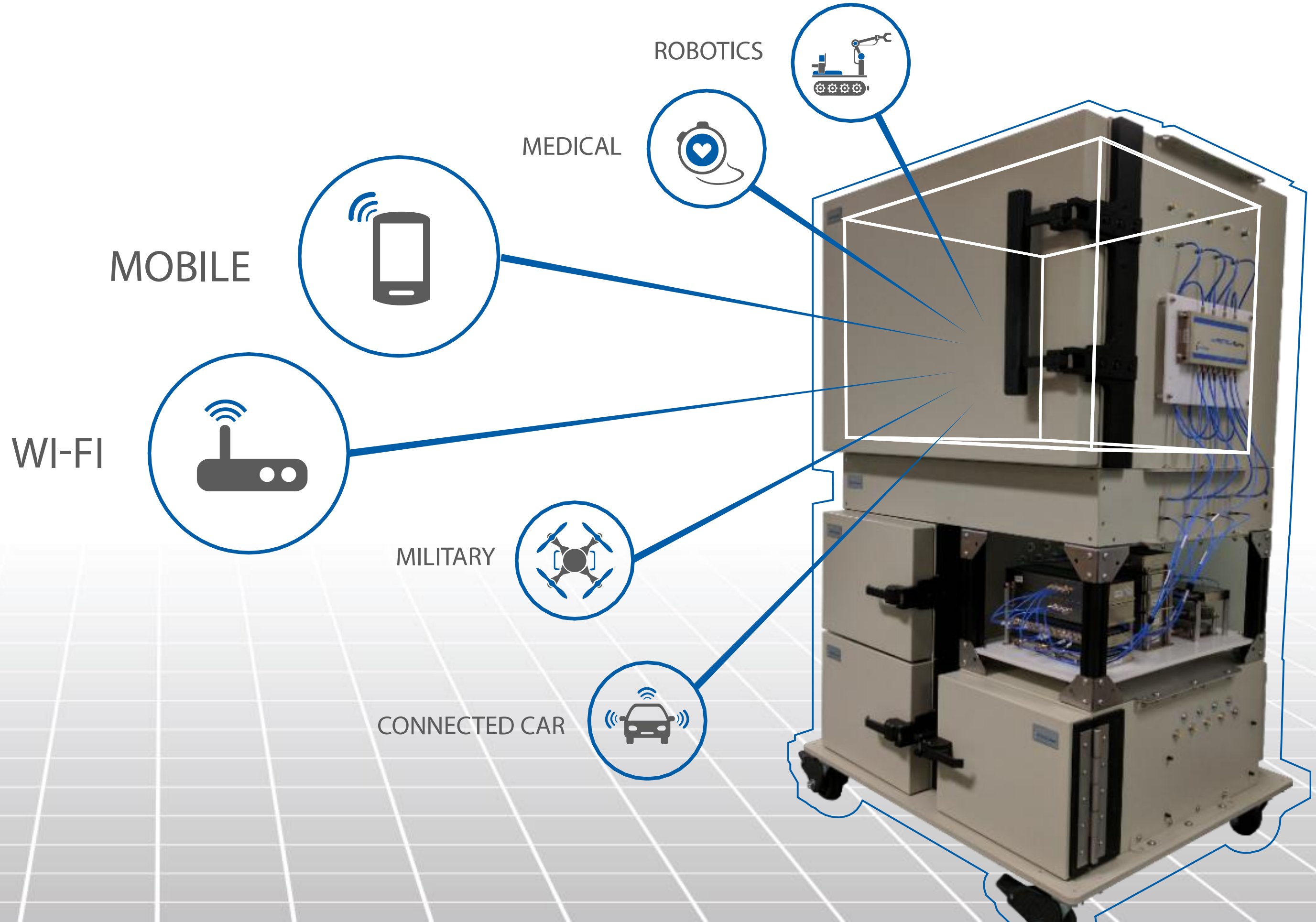
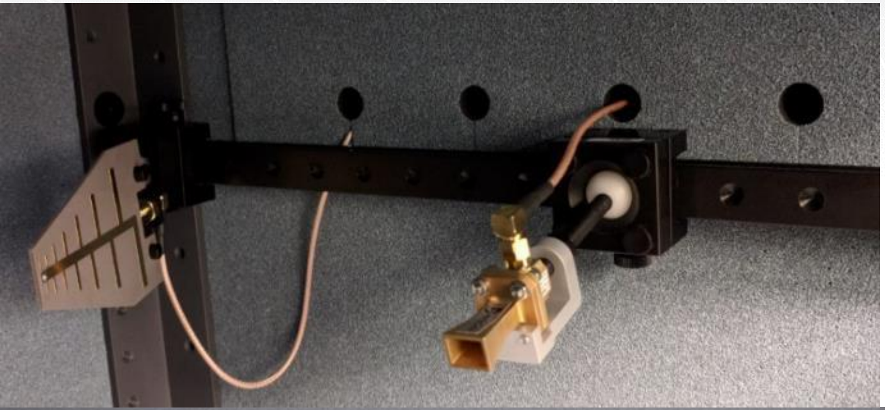
Wireless personal testbeds

mmWave octoBox
May 2019

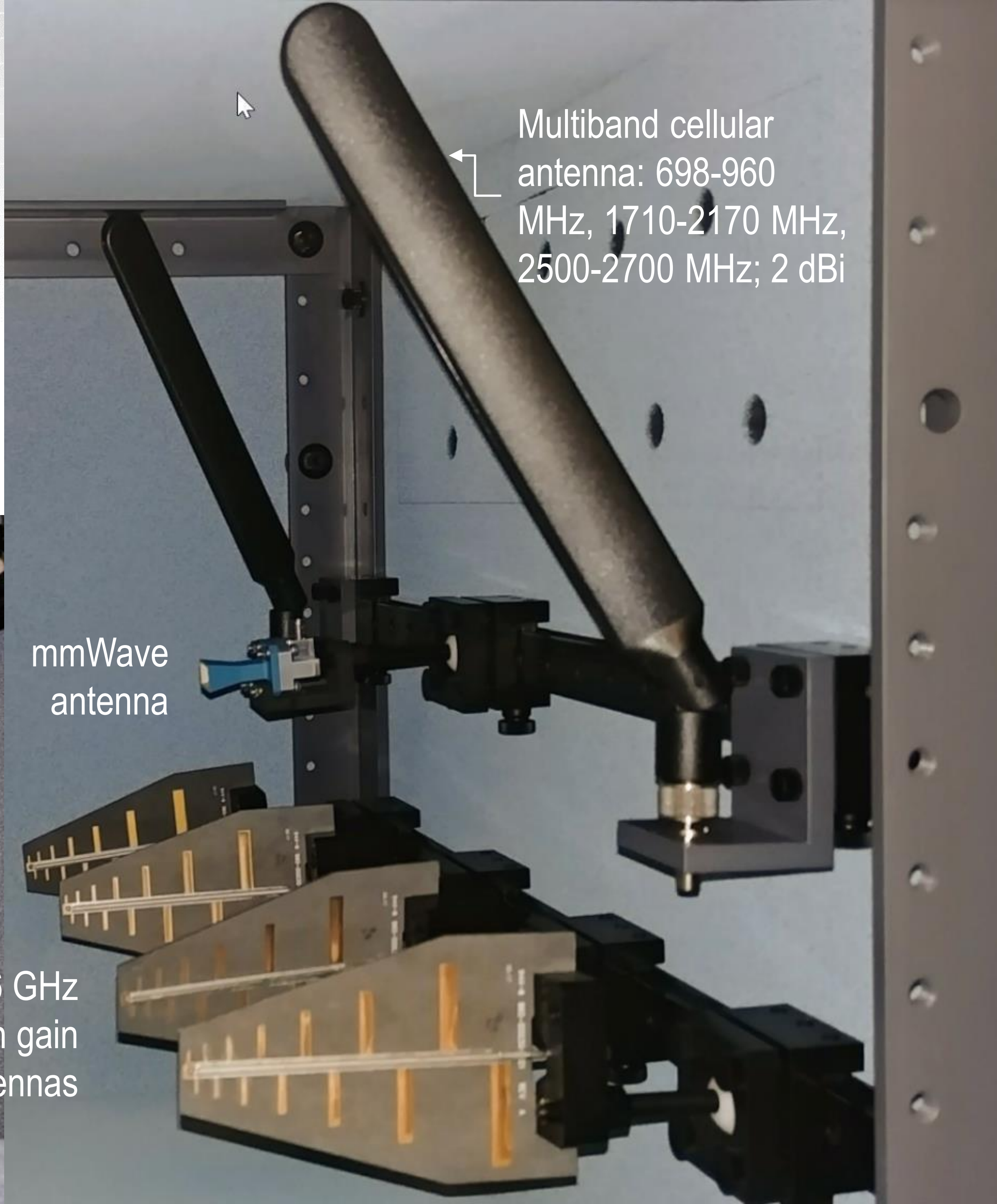


BOX-MMW antennas



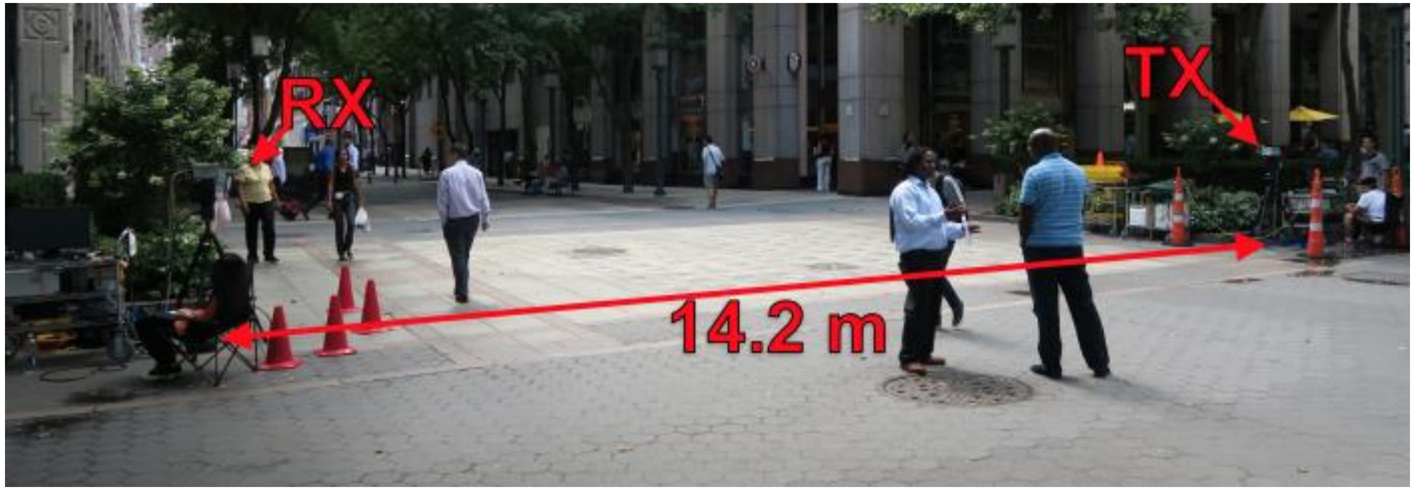
Configurable antenna arrangement for Wi-Fi, LTE and mmWave

Built-in turntable

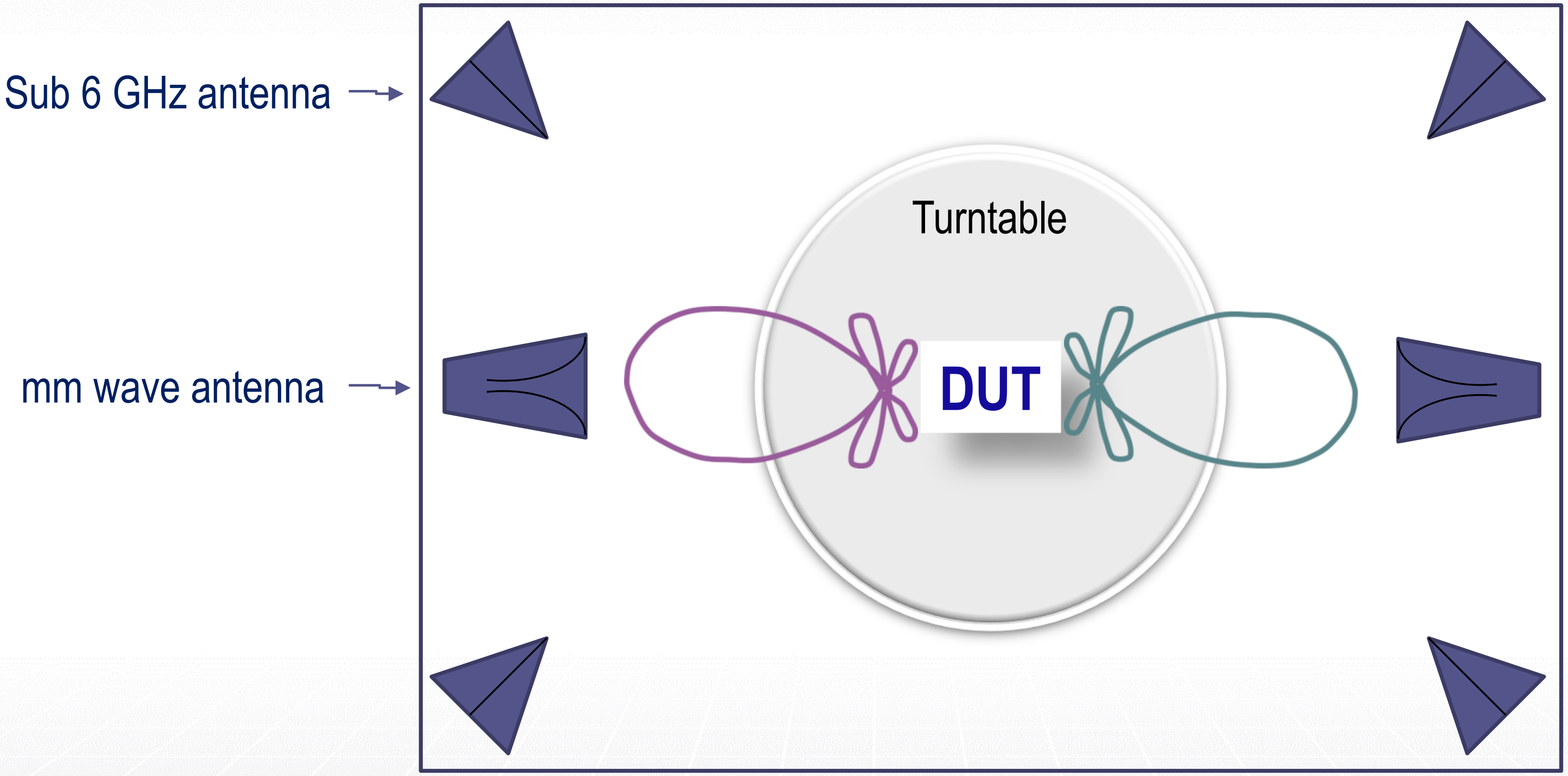


mmWave wireless channel

Frequent beam interruptions
Motion of both the gNB and the UE



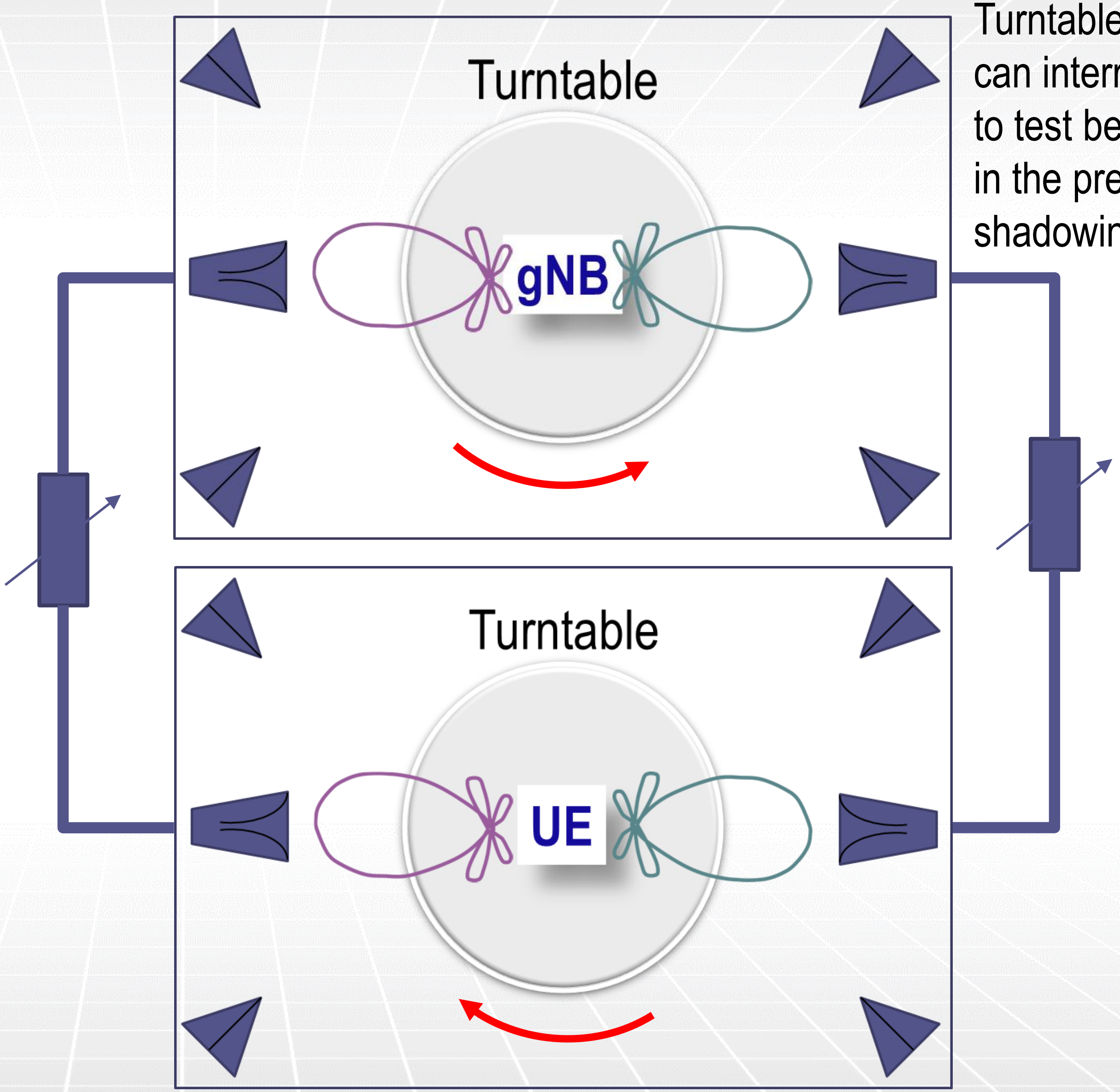
Antenna Arrangement – View from Top



Need 2-axis positioner

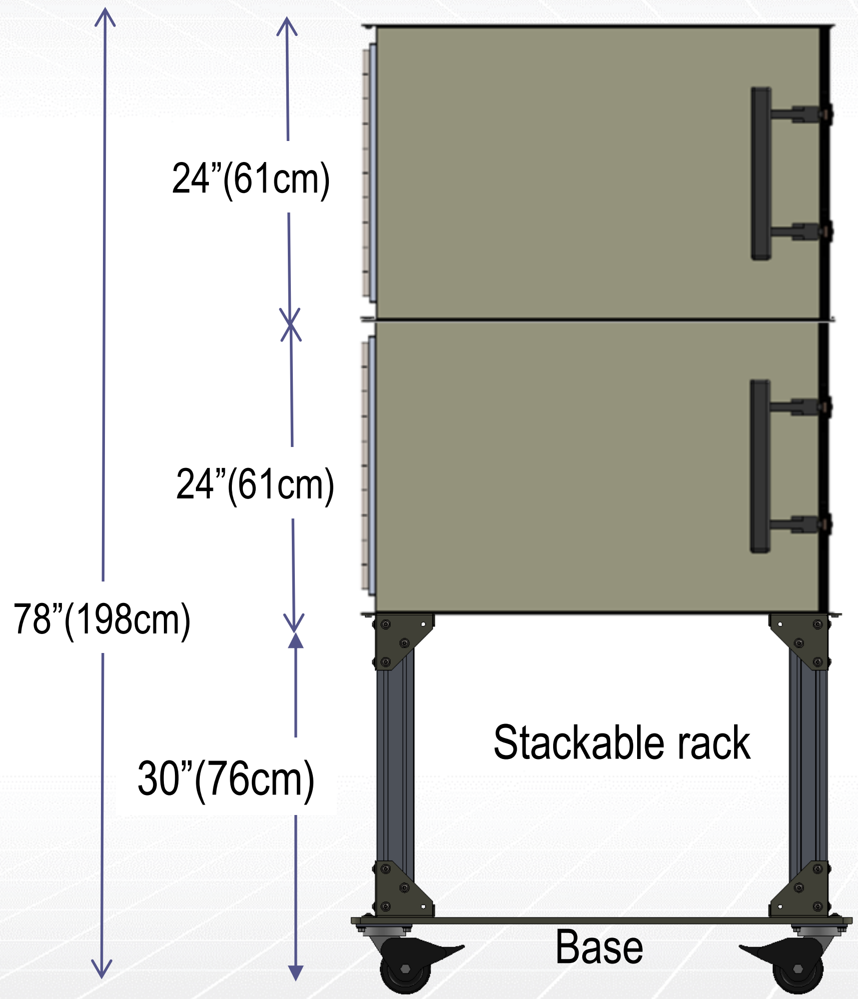
UE to gNB link

Stand-alone isolated testbed
fits into a 40"W x 31"D footprint

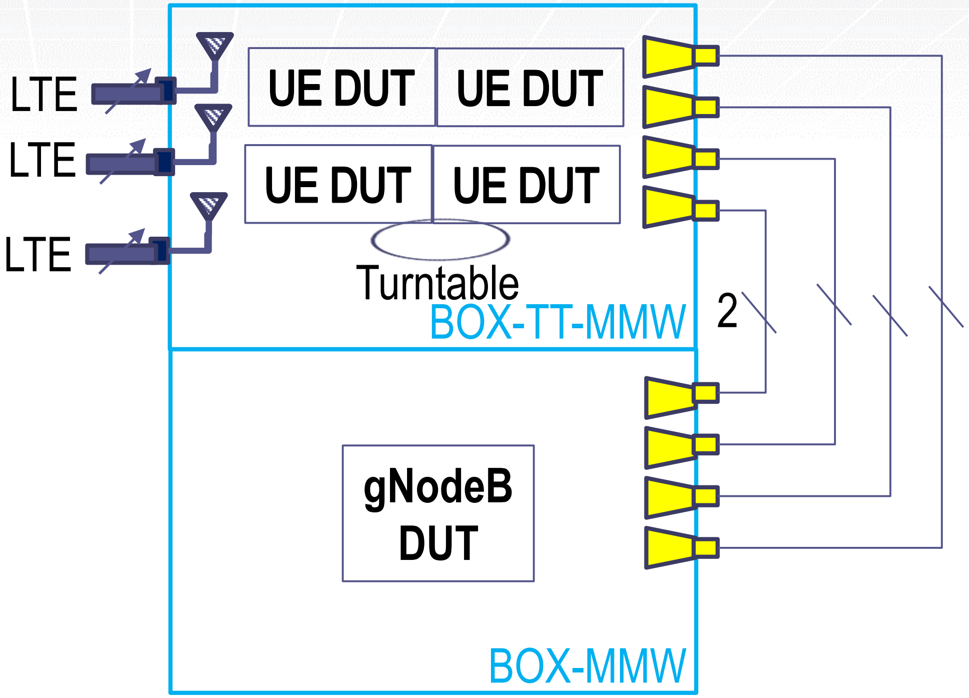


Turntable rotation can interrupt a beam to test beam steering in the presence of shadowing

Operator use case – mmWave and LTE



I/O: Fiber through the waveguide



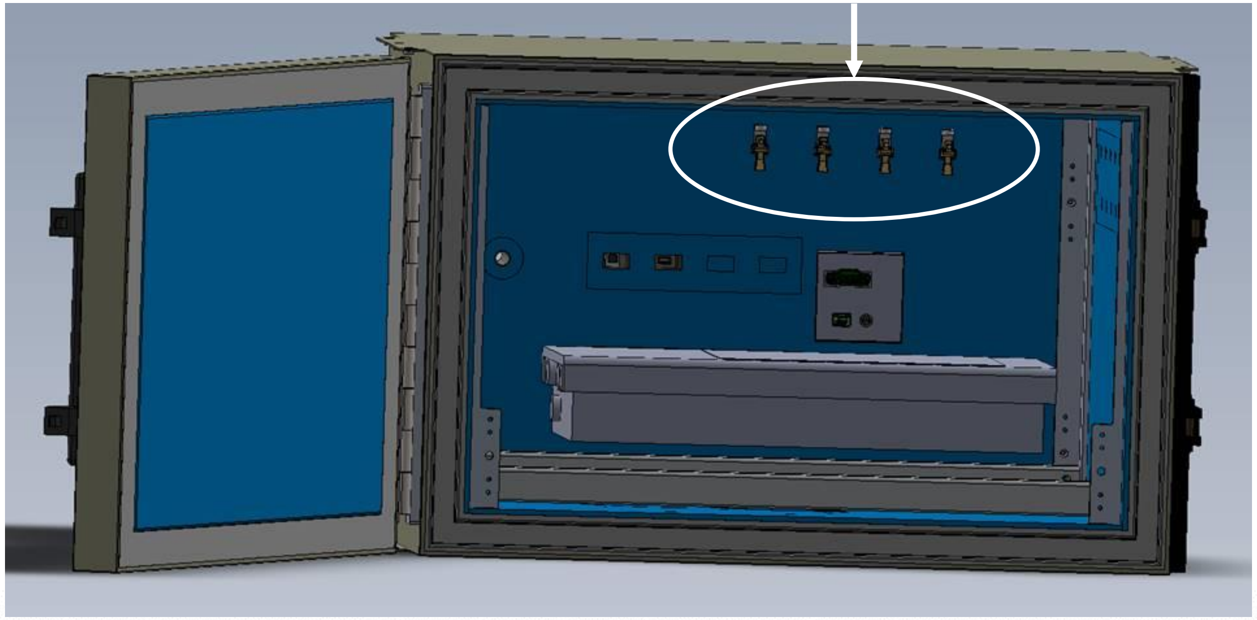
33-50 GHz test antennas (SAR-1532-224-52-DP) with SAGE WR-22 End Launch Adapter

Add mmW quadAtten when available

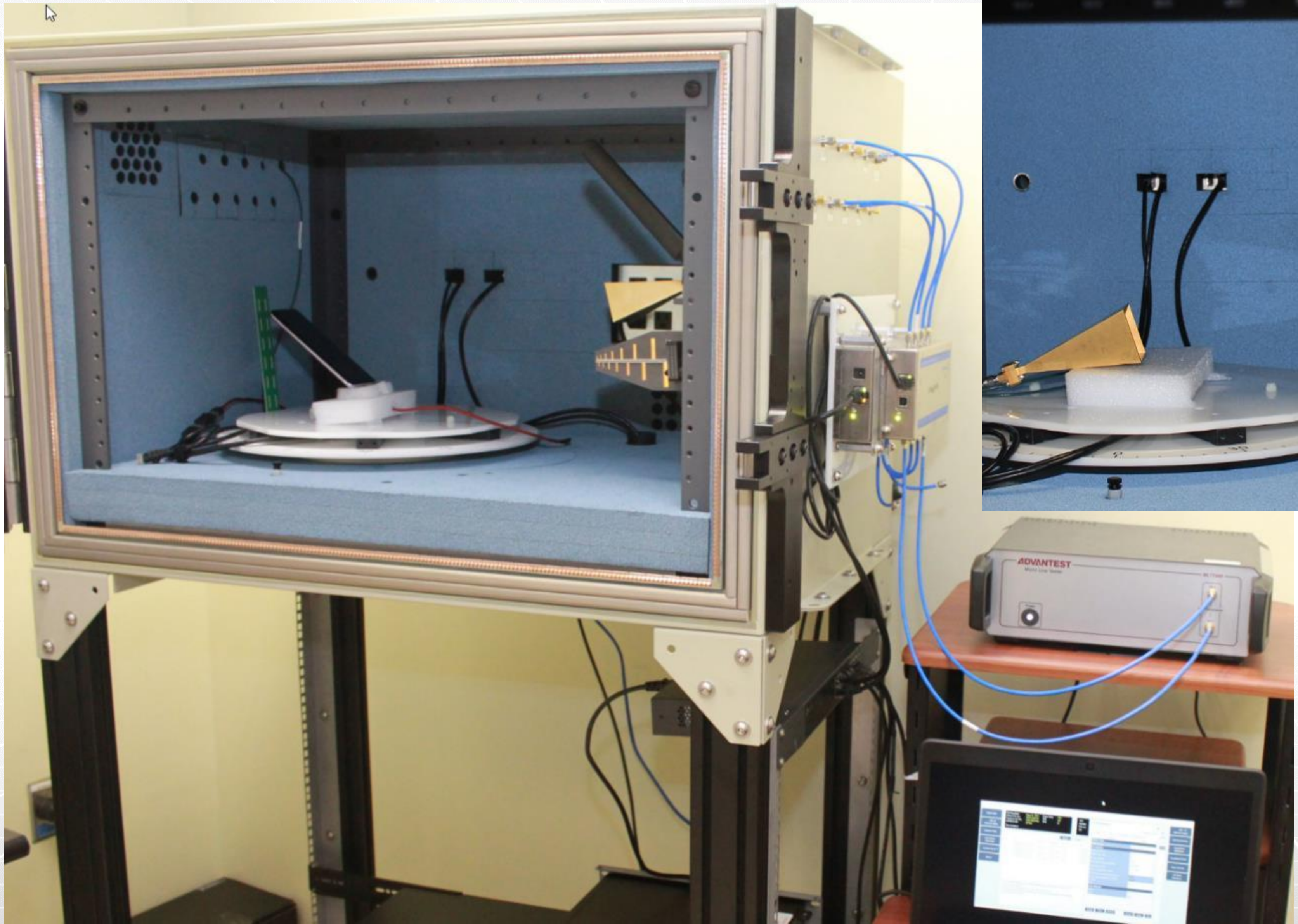
gNodeB mmWave

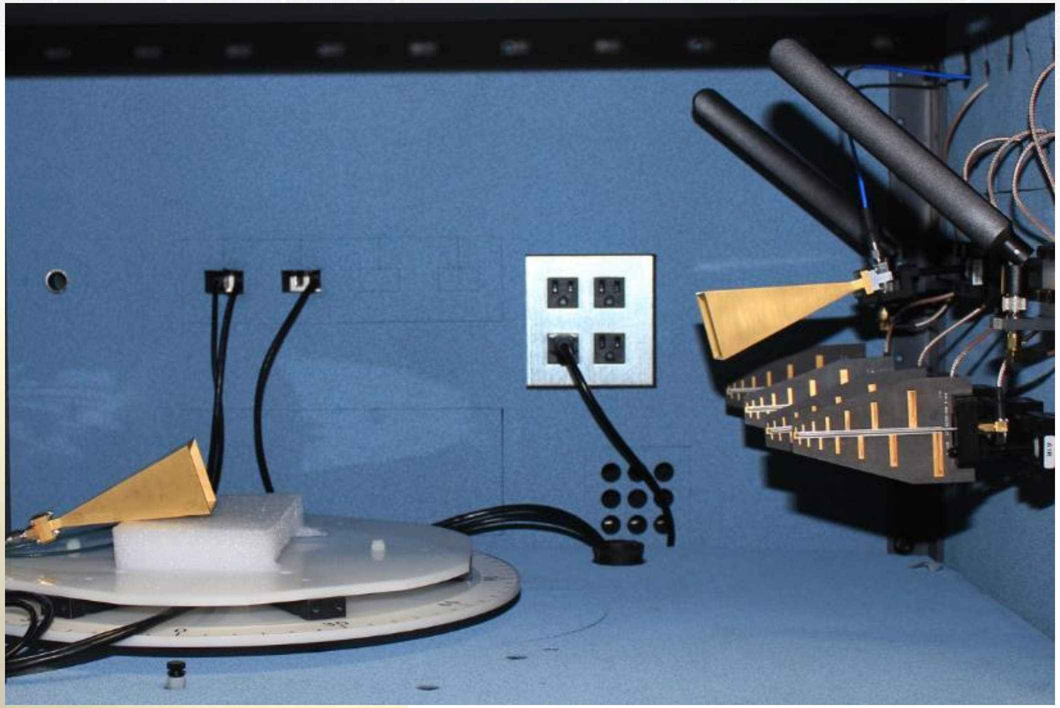
Ericsson gNodeB

4 mmWave antennas pointing to 4 antenna arrays of gNodeB



octoBox Advantest integrated testbed





Wi-Fi
LTE
mmWave

http://www.w2bi.com/

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Supported Tests

Test	Description
Functional testing (signaling)	Connections for the instruments, such as gNB emulators will be provided via mm wave connectors to the internal test antennas for signaling layer functional testing.
UE performance (throughput)	Throughput measurements will be supported via a connection to either a gNB emulator or to an RRH placed into a BOX-MMW-RRH. A programmable attenuator can be connected between the RRH and UE enclosures to perform measurements vs. dynamic range, as shown above.
Beamforming	Beamforming can be tested by rotating the DUT while observing beam formation aimed at the test antennas. This can be observed by measuring coupled power, for example, as the DUT rotates on the built-in turntable. The beam will be expected to remain focused on the test antenna to which a partner device (e.g. RRH or gNB) is coupled. Controlling the speed of the turntable will let you measure how fast the beam adapts to motion and changes in the orientation.
TX spectrum	TX signal can be measured using a spectrum analyzer, a VSA or other such instrument coupled via the test antenna.

Frequency Band Considerations

Sub 40 GHz	Readily available 2.92mm RF cabling and connectors; off-the-shelf antennas also with 2.92mm connections; attenuators for throughput vs. range testing with 2.92mm connectors [10-12], making it possible to build a cost-effective sub 40 GHz mm wave link with variable attenuation [13] to test throughput vs. range
60-70 GHz	Waveguide coupling, specialized antennas that may not cover the sub 40 GHz frequencies, waveguide to 1mm cable adapters, expensive 1mm cables typically costing over $7k each [3-6] and waveguide based attenuators [7-8]

2.92mm connector

Waveguide

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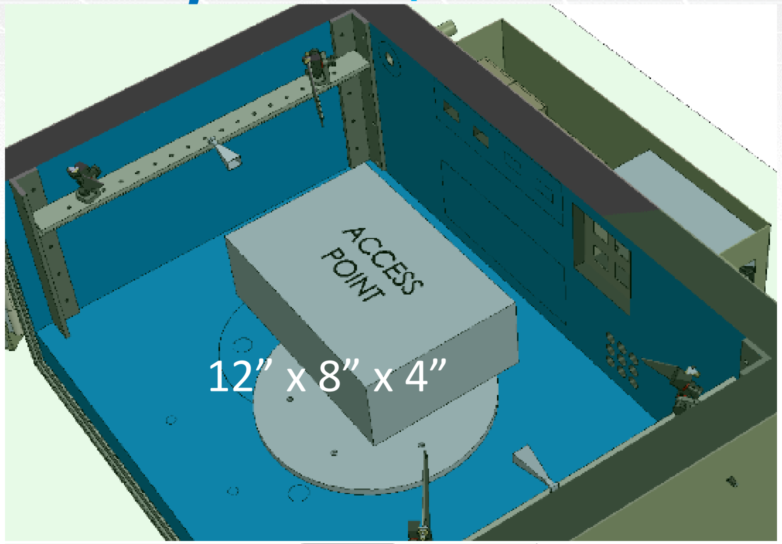
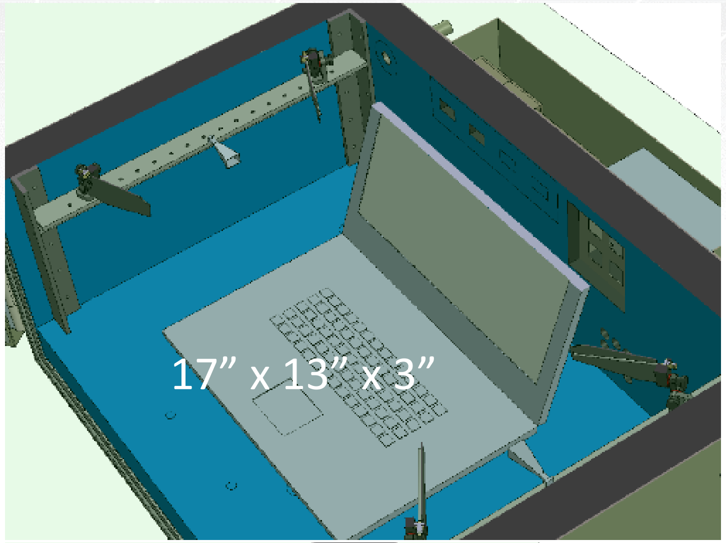
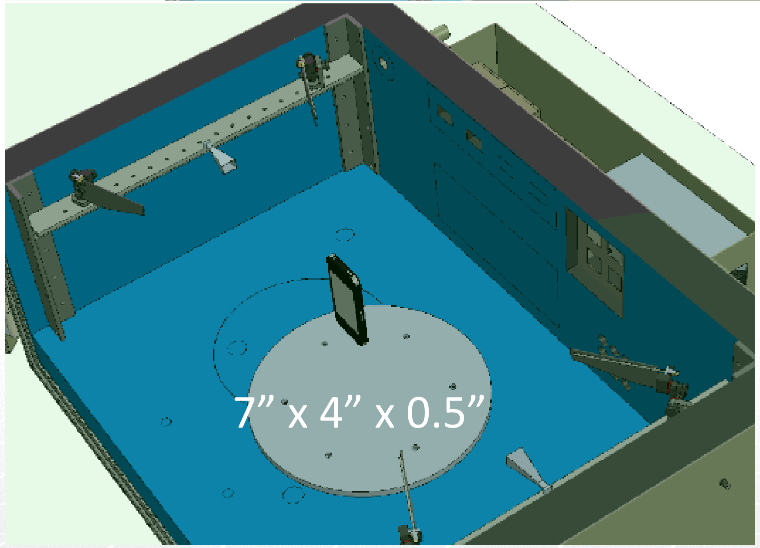
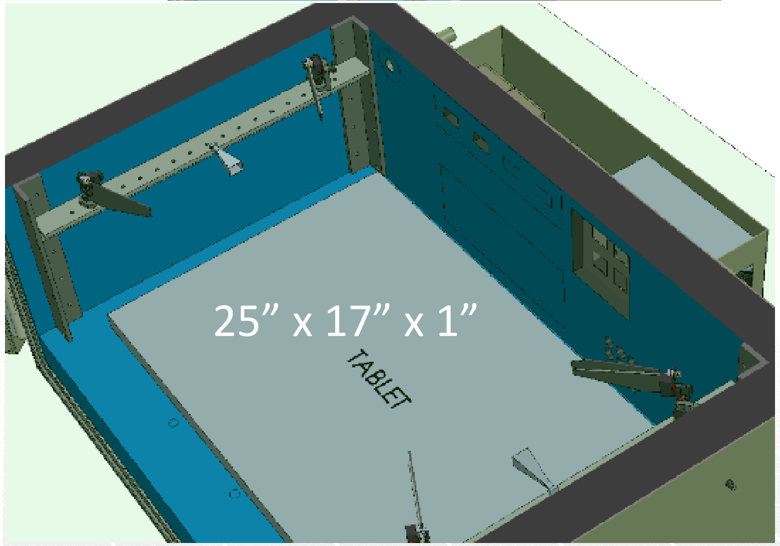
Representative DUT Formfactors vs. Enclosure Dimensions









	American	Metric
Outside	24" H x 38.35"W x 31.2"D	61cm H x 97cm W x 79cm D
Inside	19.35"H x 31.5"W x 21. 5"D	49cm H x 80cm W x 55cm D
Weight	172 LBS	78 kg

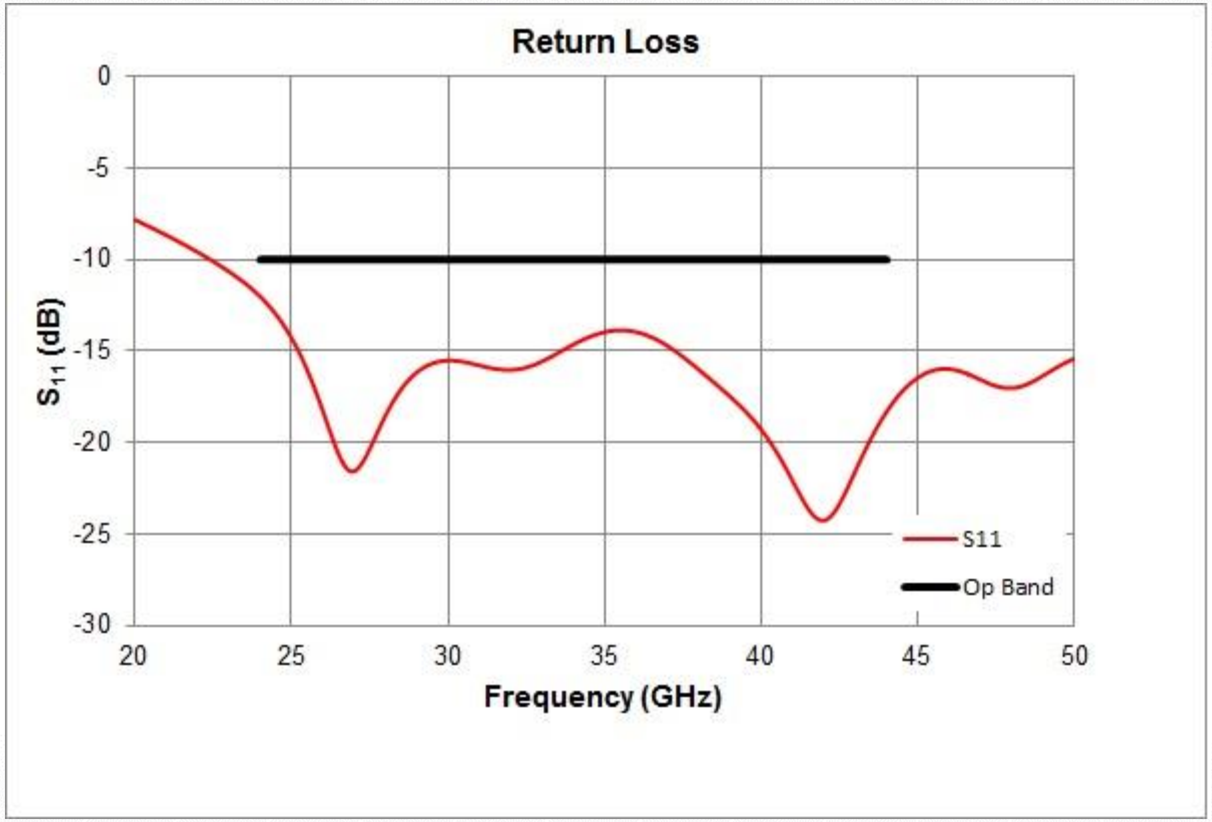
Path Loss Estimate

	DUT formfactor	Path loss (dB)	RX power (dBm) assuming +20 dBm TX beam from the DUT
28 GHz	Handheld	54.6	-19.7
	Laptop	52.3 – 55.5	-18.3 – -21.6
	AP, set top box or CPE	52.5 – 55.4	-18.5 – -21.4
	Tablet	53.2 – 56.4	-19.2 – -22.4
39 GHz	Handheld	56.5	-22.6
	Laptop	55.1 – 58.4	-21.2 – -24.4
	AP, set top box or CPE	55.4 – 58.25	-21.4 – -24.3
	Tablet	56.1 – 59.2	-22.1 – -25.25
70 GHz	Handheld	61.6	-27.6
	Laptop	60.2 – 63.5	-26.3 – -29.5
	AP, set top box or CPE	60.5 – 63.3	-26.5 – -29.4
	Tablet	61.2 – 64.3	-27.2 – -33.3

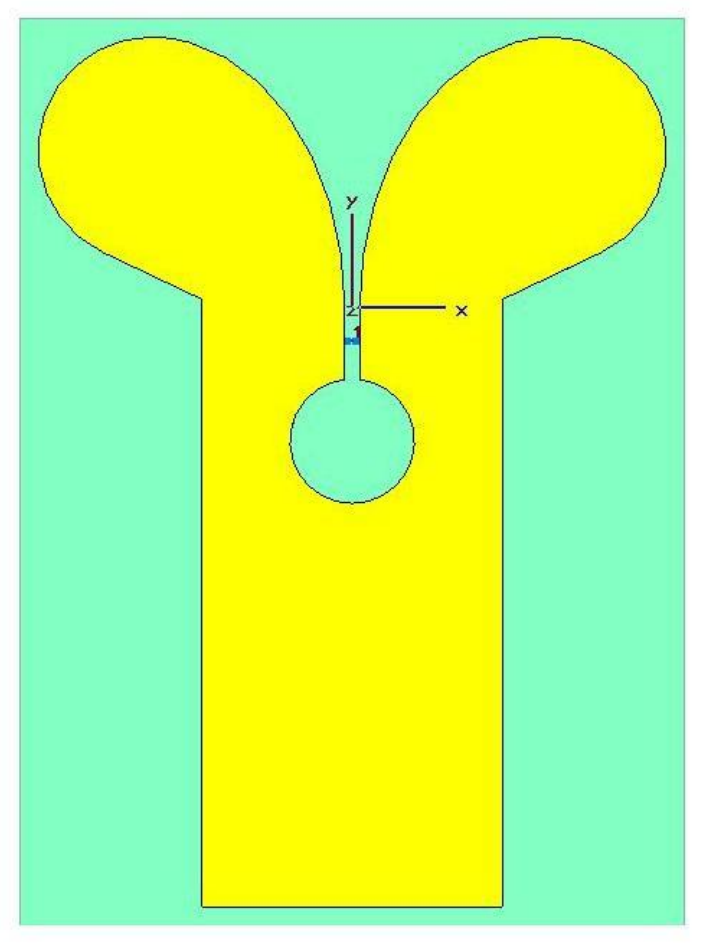
Distance between mm antenna and DUT antennas, assuming the horn is 40cm up from inside floor of chamber:

1. For handheld device: Assumed that the handheld antenna is in the approximate center of the chamber resulting in a distance of 41cm between horn antenna and DUT.
2. For laptop: 35 cm is the closest-point approximation to the edge of the laptop on the floor of the chamber and 51cm is the worst-case distance to the middle of the top edge of the DUT.
3. For access point: 36cm closest-point approximation to edge of DUT and 50 cm worst-case distance to middle-top edge of the DUT.
4. For tablet: 39cm closest-point approximation to edge of DUT and 56cm worst-case distance to middle-top edge of tablet.
5. For receive power calculations: Transmit power is assumed to be 20dBm, receiver and transmitter antenna gain is 10dB, and antenna efficiency is 80%.

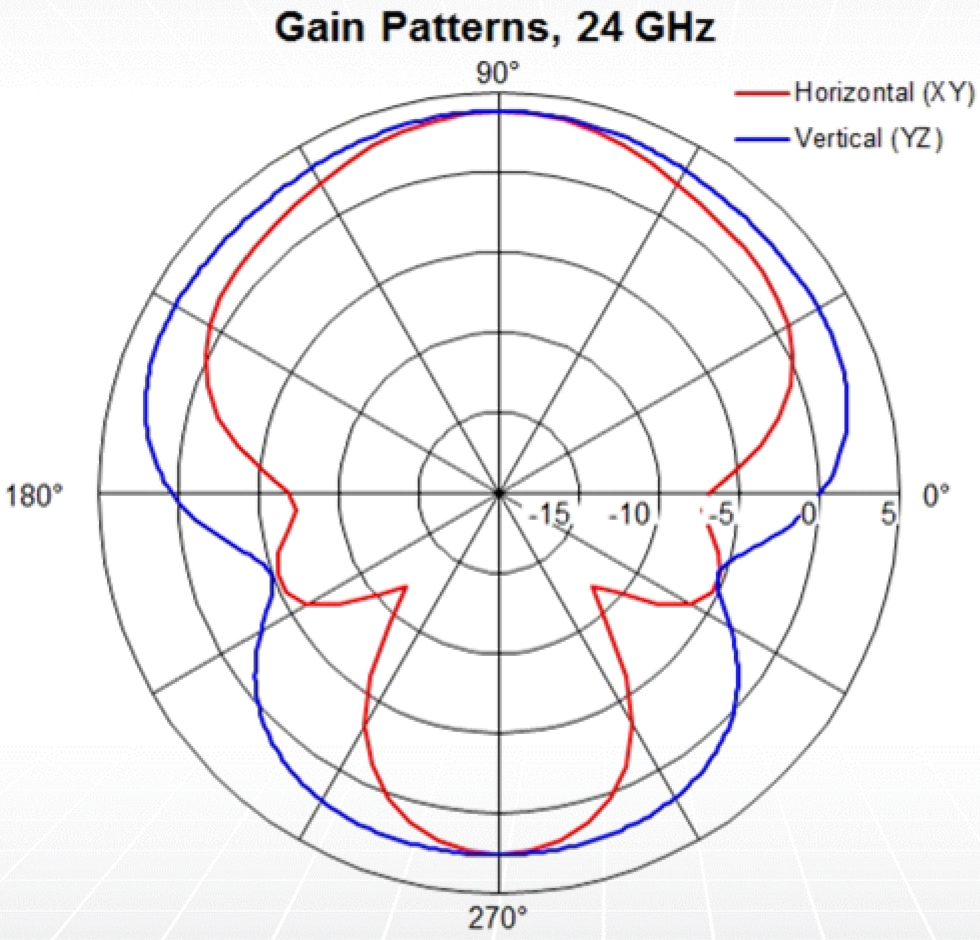
octoScope's new wide beam antenna



Vivaldi structure



Vivaldi antenna pattern – 24 GHz



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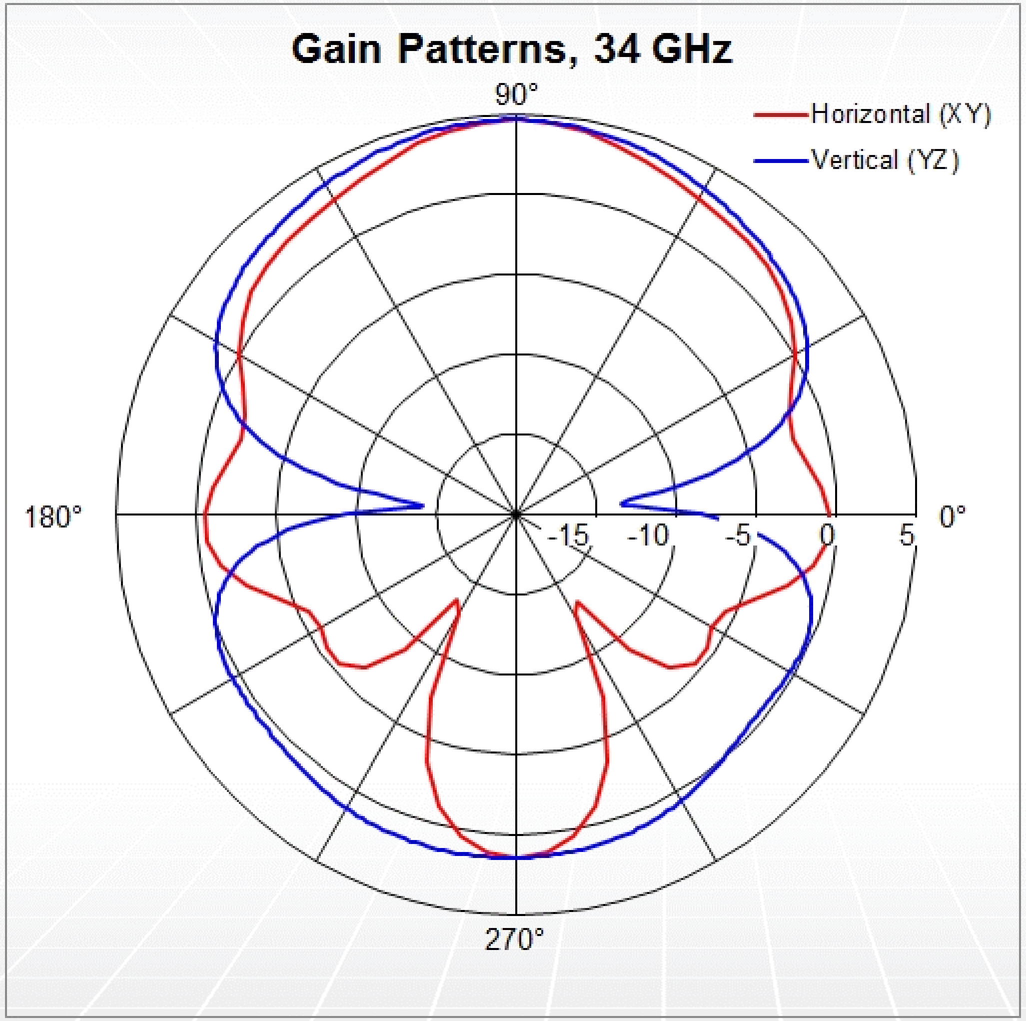
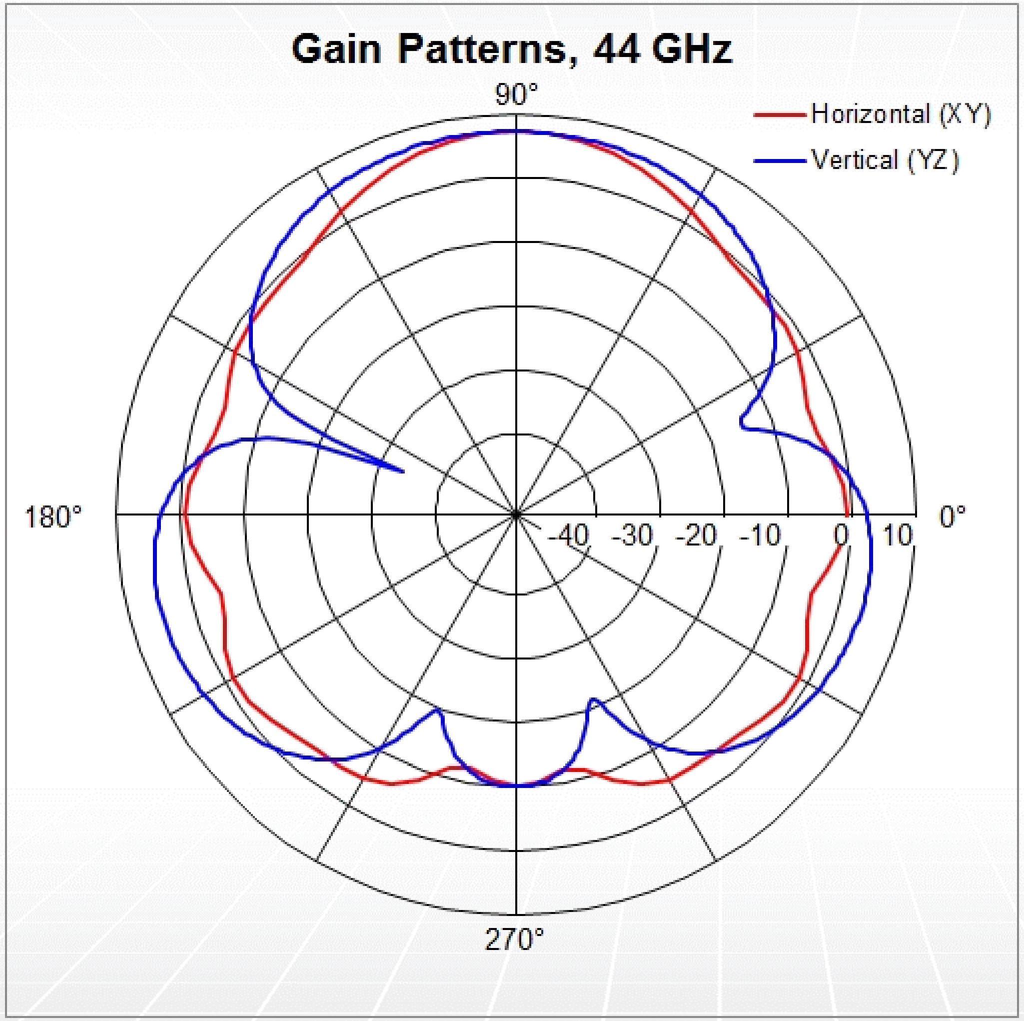
Vivaldi antenna pattern – 34 GHz



Vivaldi antenna pattern – 44 GHz



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