R&S Taiwan B5G/6G Webinar

COMPACT SOLUTION FOR 5G FR2 (AND BEYOND) OTA MEASUREMENTS

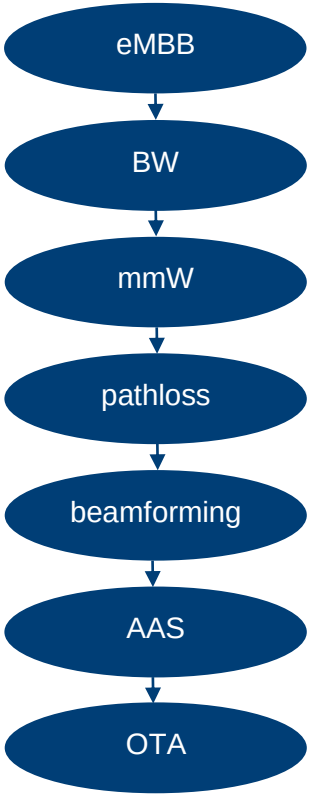
Product Management OTA

ROHDE&SCHWARZ

Make ideas real

WHY OTA TESTING?
TECHNICAL BACKGROUND

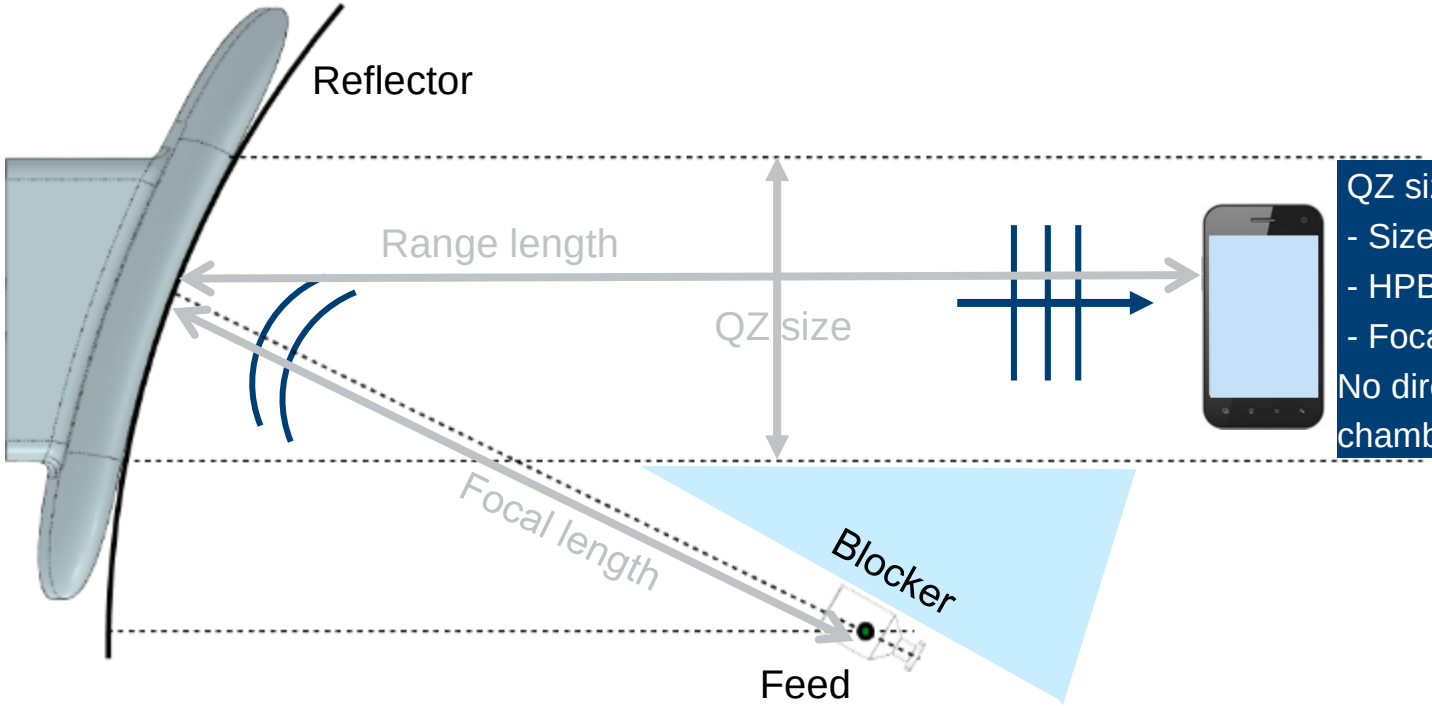
- 5G, B5G and 6G address the need for high data rate (eMBB)
- High data rate needs wide bandwidth (Shannon‘s law)
- Contiguous wide bandwidth available at high frequencies (mmW bands)
- High frequencies – high path loss
- Counter measure – beamforming techniques
- Beamforming needs active antenna arrays (AAS) with multiple phase steered antennas
- Phased arrays do not allow cable connections
- Testing can only be done wirelessly – over the air (OTA)



DOWNSIDE OF OTA FOR MMW (DFF)

- Big far field distance $\frac{2D^2}{\lambda}$; D=aperture size
- Big chamber footprint
- High path loss $\mathrm{FSPL} = 20\log_{10}(d) + 20\log_{10}(f) + 20\log_{10}\left(\frac{4\pi}{c}\right)$; d=distance, f=frequency

POSSIBILITIES TO SHRINK THE CHAMBER SIZE – INDIRECT FAR FIELD (CATR)



QZ size depends on
- Size of reflector
- HPBW of feed antenna
- Focal length

No direct relation between chamber size and QZ size

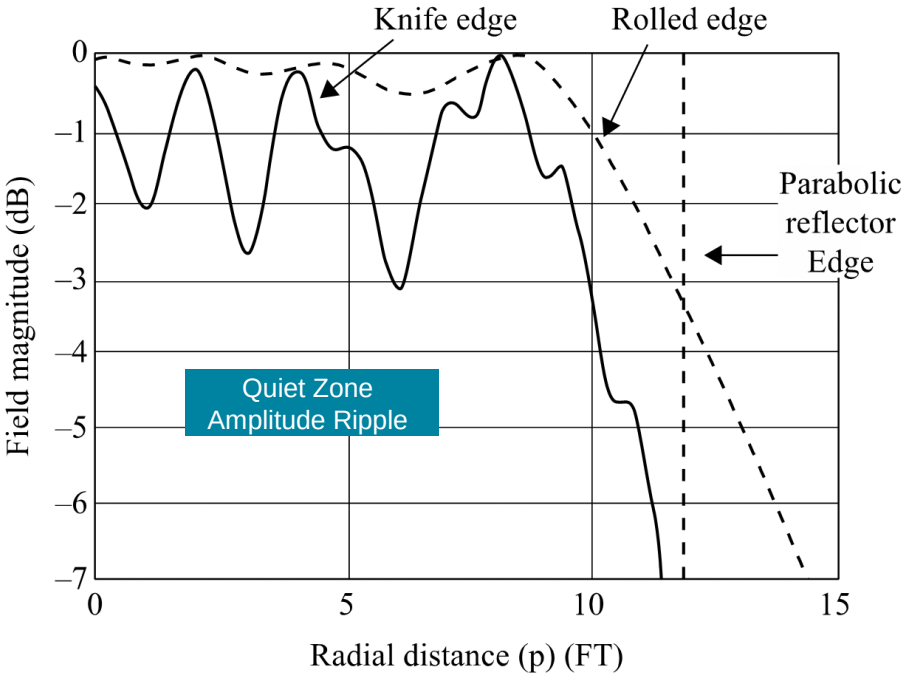
ADVANTAGE OF CATR OVER DFF

- Smaller chamber size
- Lower pathloss / higher dynamic range only dependent on frequency
- Bigger QZ size

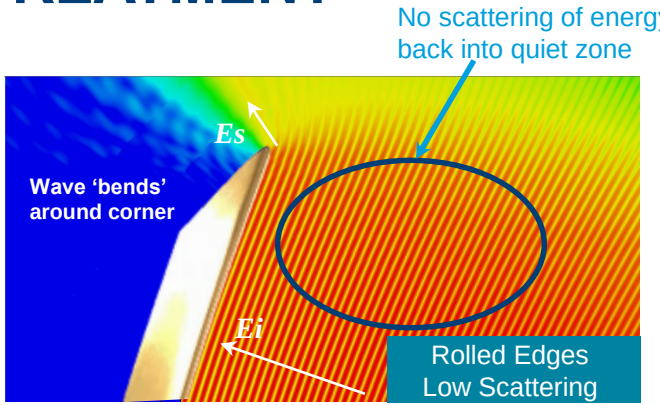
FREQUENCY RANGE OF CATR SETUP

- What defines the useable frequency range of a CATR setup?
  - Low frequency limit
    - Chamber size – longer wavelength need bigger chambers
    - Blocker design – longer wavelength spill over more easy
    - Absorbers – longer wavelength need bigger absorbers
    - Reflector design – see following page
    - Feed antenna – see following page
  - High frequency limit
    - Reflector design – see following page
    - Feed antenna and cables/feedthroughs – see following page

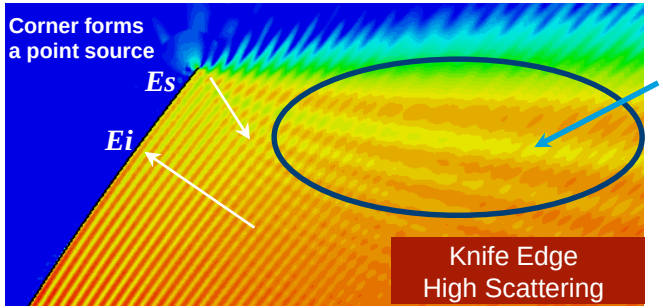
CATR REFLECTOR ERROR: EDGE TREATMENT (LOW FREQUENCY & QZ)



W. Burnside "Curved Edge Modification of Compact Range Reflector", IEEE 1987

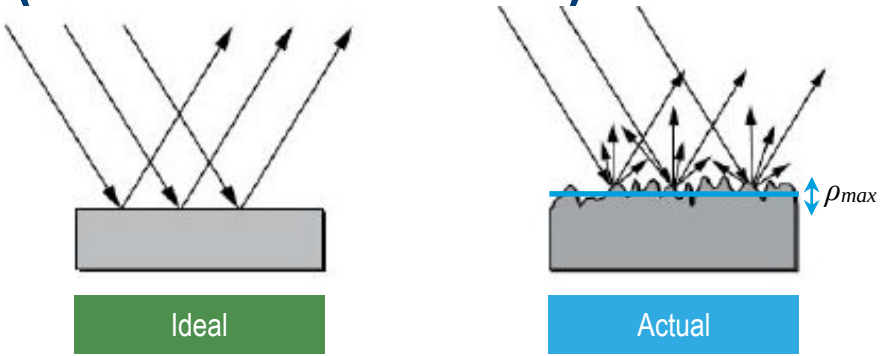


Ei: Initial EM field (from feed horn)

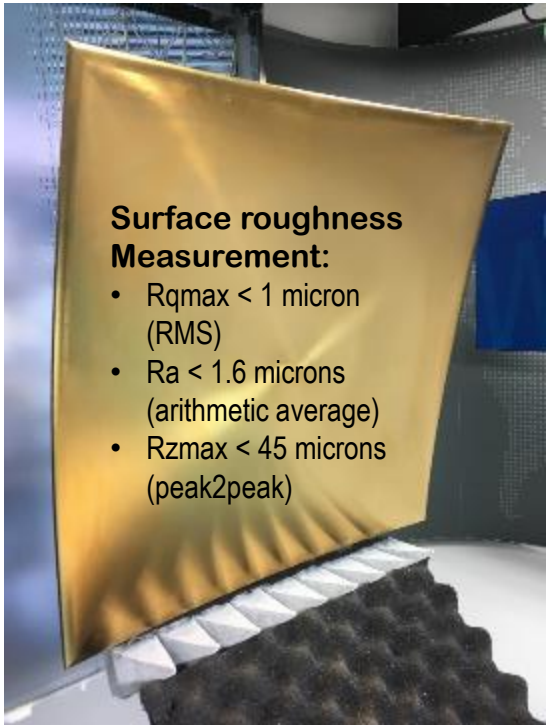


Es: Scattered EM field (from edges)

CATR REFLECTOR ERRORS: SURFACE ROUGHNESS (HIGH FREQUENCY)



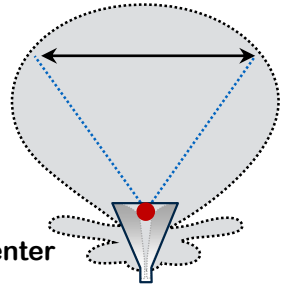
Maximum Frequency	Surface Roughness (microns)
28 GHz	75
43 GHz (in band)	49
87 GHz (spurious emissions)	24
220 GHz (FCC 5th Harmonic)	< 1



FEED ANTENNAS

Requirements for Ideal CATR Feed

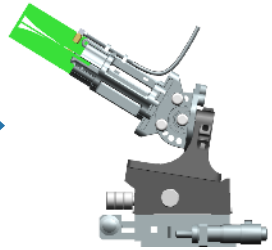
HPBW > 50 degrees



Dual Polarized
- Same Pattern
- XPOL > 30-40 dB

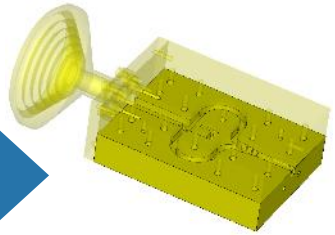
- Constant Phase Center
  - Polarization
  - Frequency

Non-Ideal Wide-Band



Wideband Vivaldi Antenna
Dual Polarized
Frequency: 10-90 GHz
HPBW: 10-50 degrees
XPOL: 15-30 dB

Ideal Band-Limited



Circular Waveguide Horn
Dual Polarized WR28 (OMT)
Frequency: 23-44 GHz
HPBW: 50+ degrees
XPOL: 35 dB

Small footprint 30/40cm QZ vertical CATR

Ventilation

High shielding

3D Positioner

Various Link Antennas

Lots of additional feedthroughs

Multiple connectivity options

23-92GHz support
(higher frequencies coming)

Automatic feed switcher
(e.g. for OOB)

Camera incl. thermal vision

3D Extreme Temperature Testing

3D Phantom testing

Multiple AoA (30cm) extension

CATR SOLUTION – ATS1800C

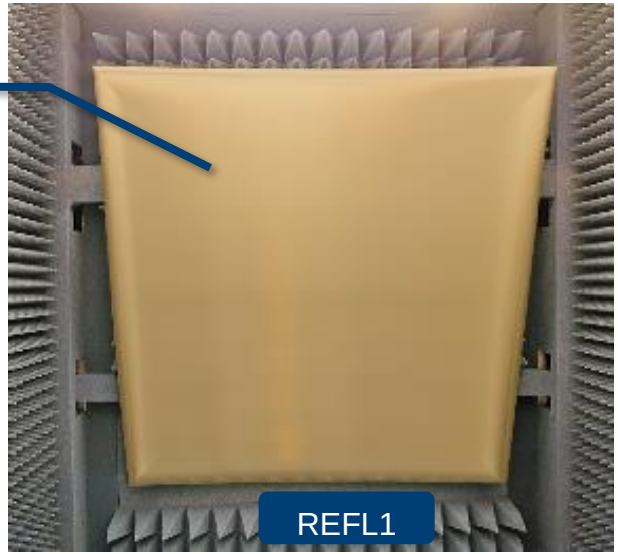
CTIA approved!

mmW test plan V4.0 (June 2022)

ATS1800C – GOLD PLATED REFLECTOR FOR 30CM QZ SIZE

Ultra-wideband reflector with rounded edges

Frequency range: 6..90 GHz +

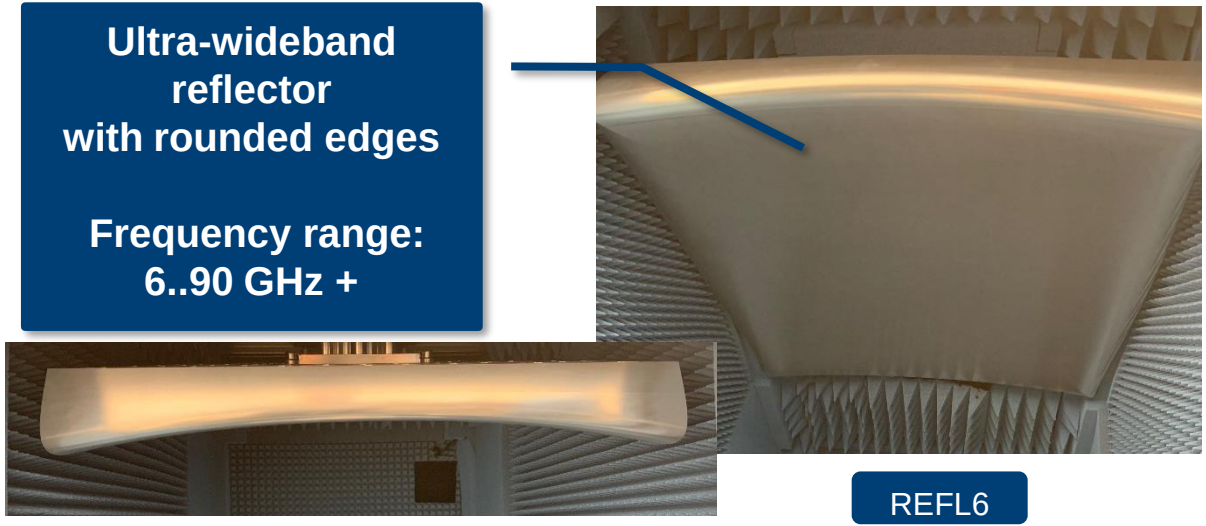


Specification	Value
Frequency Range	6 GHz to 90 GHz +
Quiet Zone Ø	30 cm
Average Amplitude Taper (Inband)	< 1.5 dB
Average Amplitude Ripple (Inband)	< 0.5 dB
Surface roughness (RMS)	< 1 µm
Dimension	54 cm x 56 cm

ATS1800C – PASSIVATED REFLECTOR FOR 40CM QZ SIZE

Ultra-wideband reflector with rounded edges

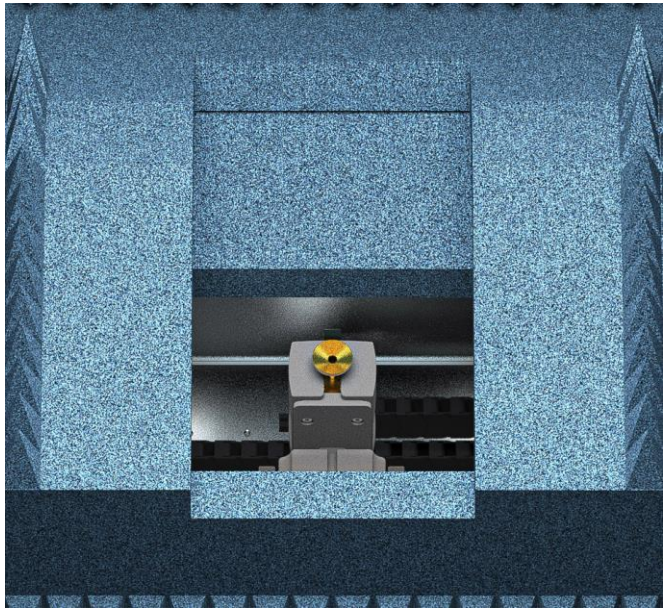
Frequency range: 6..90 GHz +



REFL6

Specification	Value
Frequency Range	6 GHz to 90 GHz +
Quiet Zone Ø	40 cm
Average Amplitude Taper (Inband)	< 1.5 dB
Average Amplitude Ripple (Inband)	< 0.5 dB
Surface roughness (RMS)	< 1 µm
Dimension	69 cm x 69 cm

ATS1800C – RF FEED ANTENNA OMT WITH HORN



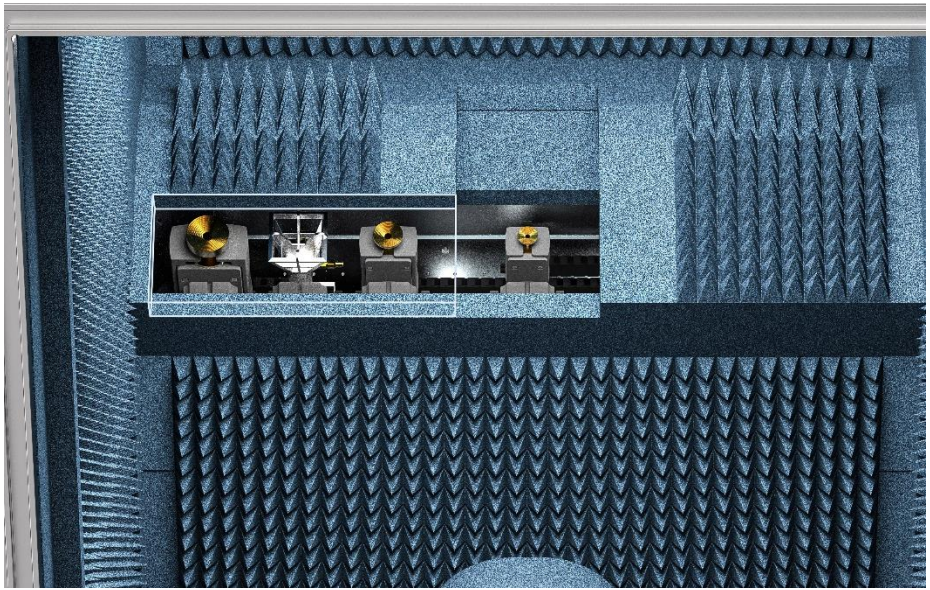
Specification	Value
Frequency Range	23.5 GHz to 44 GHz
Polarisation	dual polarized
RF connectors	2 × 1.85mm

Choose between different feed antennas for different frequency ranges

Alternative feed	Frequency range
CATR-FE40	23.5 GHz to 44 GHz
CATR-FE60	37 GHz to 61 GHz
CATR-FE90	59 GHz to 92 GHz

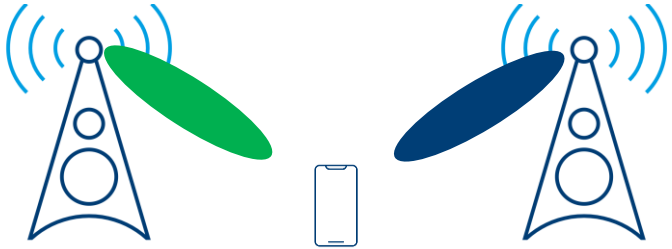
AUTOMATIC MULTI-FEED SWITCHER (OPTIONAL) CATR-FESWA

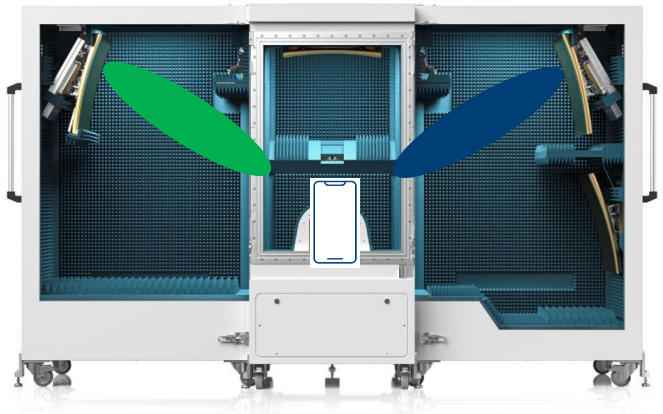
- ATS1800C automatic feed switcher
  - OOB solution ex factory or for later upgrade
    - Convenient motorized operation



ATS1800M – INSIDE VIEW

TYPICAL ATS1800M TEST SCENARIO – TODAY (REL.15)
RRM TESTING IN 5G FR2 WITH MULTIPLE ANGLES OF ARRIVAL





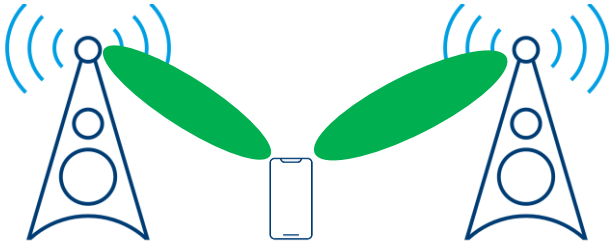
Neighbor cell measurements

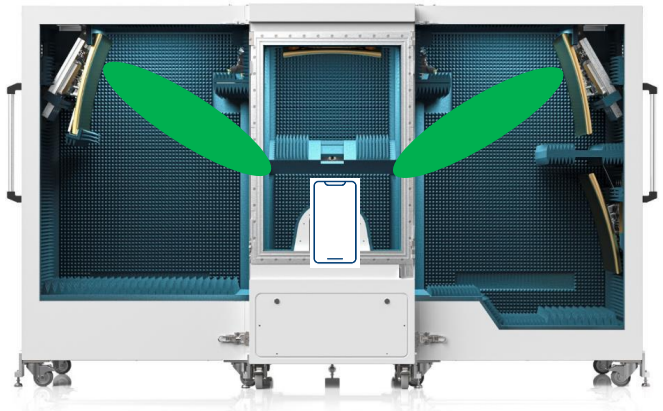
- ► Measurement accuracy
- ► Event-triggered (e.g. Neighbor becomes better than threshold)

Mobility

- ► Beam Failure Detection and Link Recovery
- ► Radio Link Monitoring

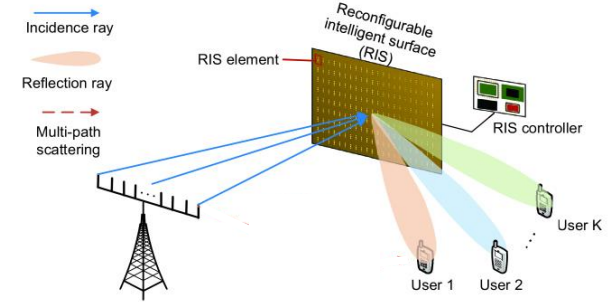
TYPICAL ATS1800M TEST SCENARIO – TOMORROW (REL.18) MULTI-PANEL RECEPTION FOR INCREASED THROUGHPUT

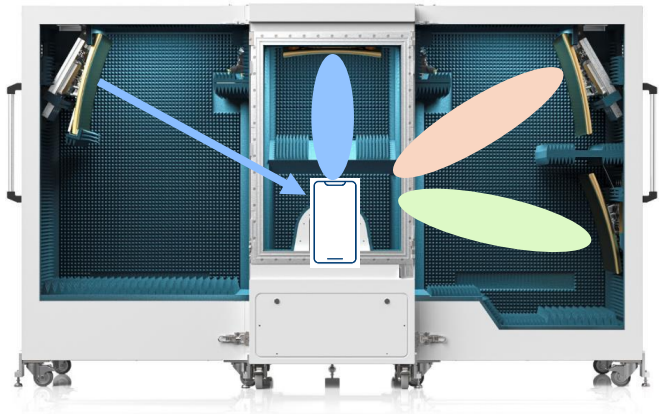




- NR FR2 UEs with multi-beam simultaneous reception and multiple RX chains
- High-order MIMO in FR2:
  Spatial MIMO:
  2DL@AoA#1 +
  2DL@AoA#2 → 4DL MIMO
- NonCoLocated-CA:
  CC1 2x2@AoA#1 +
  CC2 2x2@AoA#2

TYPICAL ATS1800M TEST SCENARIO – TOMORROW (REL.18) SMART REPEATERS OR INTELLIGENT REFLECTING SURFACE





New network components:

Meta-material based RIS allows control of radio channel propagation

To test RIS modules, multi-angle OTA test setups required for both, multi-angle reception and multi-angle transmission

Thank you very much

ROHDE&SCHWARZ

Make ideas real