

# ALCAN

The Future of Smart Antennas



**ROHDE & SCHWARZ**

R&S LEO Webinar – 18 August 2022

## THE UNMET NEED

### **“The big obstacle: Satellite and ground-segment costs**

To unlock the consumer market—the one with the most potential — **the cost of Electronically Steered Antennas (ESAs) antennas must drop by an order of magnitude or more.** While some companies have recently claimed breakthrough reductions in manufacturing costs, none has yet brought a low-cost design to market, nor have any produced ESAs at scale.”

McKinsey  
& Company

“We provide anytime anywhere connectivity via satellite and 5G by combining Liquid Crystal Technology with Phased Array Technology”

ALCAN

# AGENDA

1. Company Overview
2. Liquid Crystal Based Phased Array Antenna Technology

# 01

## COMPANY OVERVIEW

# COMPANY PROFILE ALCAN Systems



**Startup:** Focus on development and marketing of smart flat panel antennas

**Spin-off:** From Technical University of Darmstadt in 2016

**Award-winning:** 5 prizes



**Number of Employees:** 35

**Locations:** Darmstadt (HQ) and Istanbul



**Technology:** Phased Array and Liquid Crystal (LC)

**Production:** LCD Technology

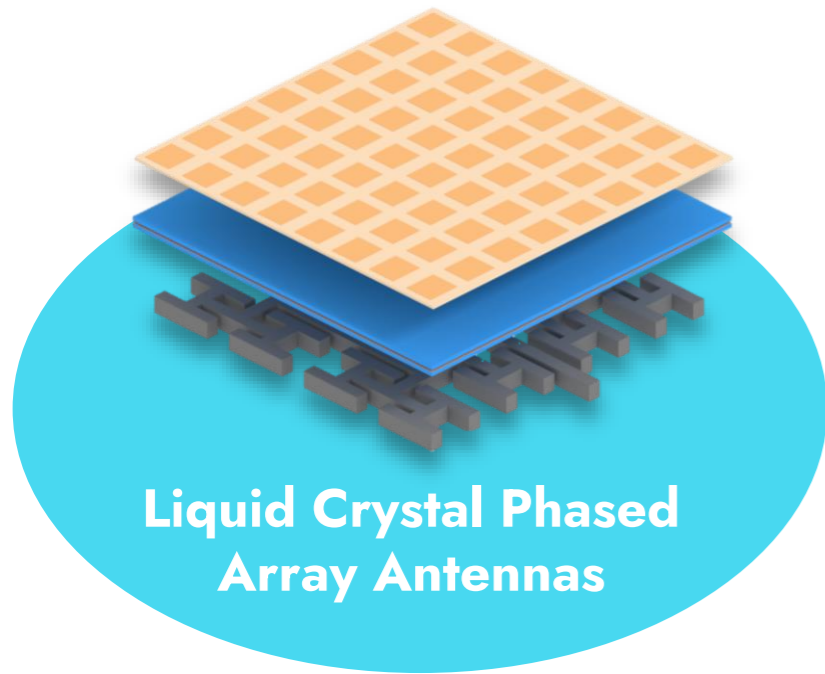


## Key Benefits

**Low Cost:** Standardized Mass Production

**Low Power Consumption:** Passive Solution

# COMPANY PROFILE ALCAN Systems



- Enterprise
- Consumer
- Land Mobile



- FWA
- Repeater
- Land Mobile

# WE DE-RISKED THE MOST CRITICAL PARTS of the technology and demonstrated key features with strategic partners

## Key milestones of the past

SATCOM

**Electronic Beam Steering**  
Demonstration of 2D scan  
Rx performance proven

**LEO Tracking DEMO**  
Tracking accuracy  
First tracking at Ka-band

**Two-way Communication DEMO**  
Transmit and receive at Ka-band  
High beam pointing while continuous steering  
Antenna's co- and cross polarization patterns are approved by the operator;  
Very low power consumption

Q I 2020

Q II

Q III

Q IV 2020

5GMM WAVE

**mmWave 5G Repeater DEMO**  
First 5G Demo  
Dual beam (Receive and Transmit)  
in one aperture

**mmWave 5G CPE DEMO**  
Wide electronic beam steering  
Low power consumption  
demonstrated

**Connected Car DEMO with OEM**  
The first to build a car demo with  
ALCAN's antenna  
The antenna is seamlessly integrated  
into the car sunroof



## Transparent mmWave Phased Array Antenna: World's First

### All in one Antenna Panel:

- Antenna Feed Network
- LC Phased Shifters
- Radiating Elements

### Main Advantages

- Transparency
- Low power consumption
- Low production cost



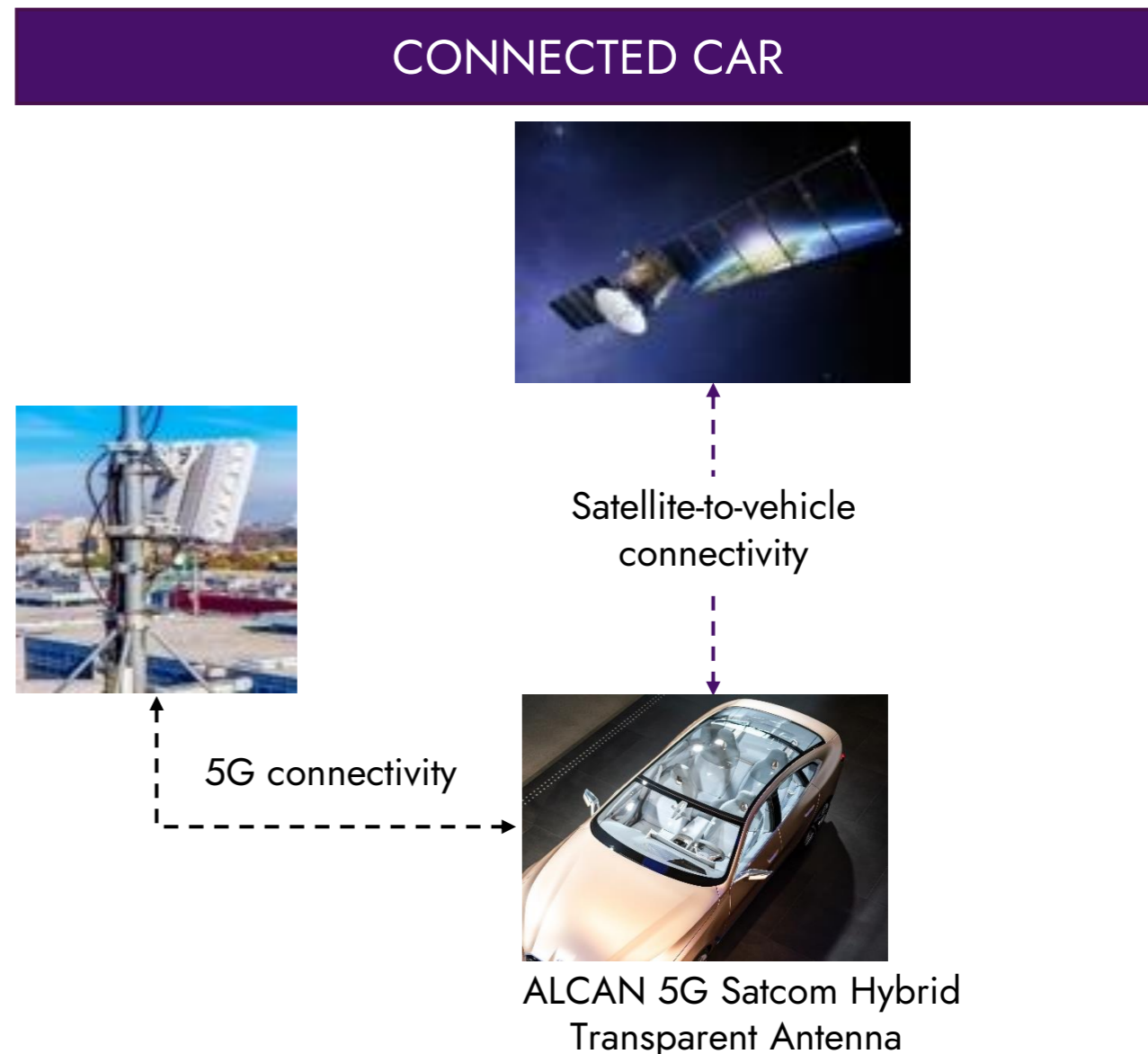
*Transparent Phased Array Antenna Panel*

The Transparent Antenna is a Liquid crystal based **Passive phased array**, Two-dimensional **beam steerable**, and **Dual linear polarized**

## Future Goal: Connected Car with Hybrid Solution

- To achieve full coverage, both satellite and 5G connectivity are needed
- **5G** mobile connectivity (i.e. 5G mmWave) will enable **connectivity in urban areas**
- Future 5G requires denser network to cover whole nation
  - 10x more base stations required
  - **SatCom will complement outside cities**

ALCAN is in a unique position to provide fully integrated Hybrid Solution by leveraging its mature technology and know-how of both industries



# 02

## LC PHASED ARRAY ANTENNA TECHNOLOGY

**OUR INNOVATIVE PRODUCT** is the combination of phased array and liquid crystal technologies

## PHASED ARRAY TECHNOLOGY

- The most mature flat panel antenna approach is phased array and used since 1940s
- The technology is **proven but expensive**
- **Today's applications** are in **radar systems**

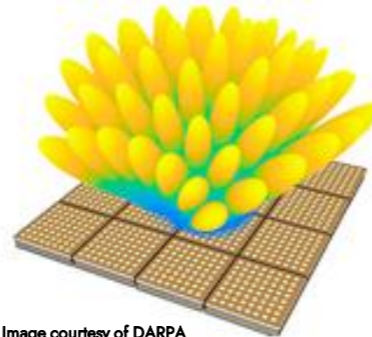
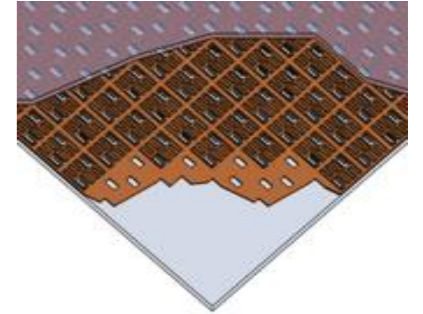


Image courtesy of DARPA

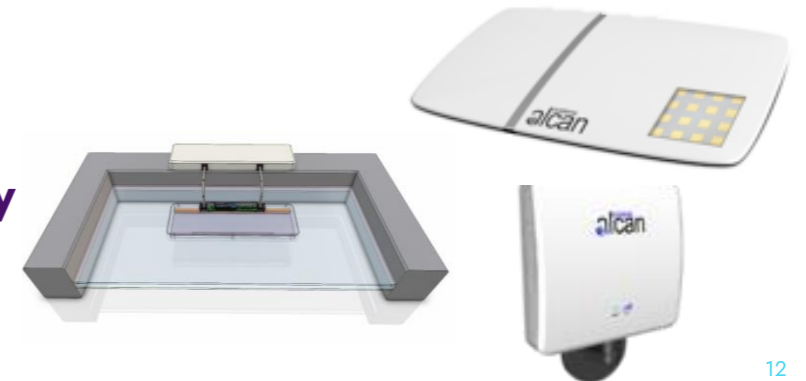
## LIQUID CRYSTAL TECHNOLOGY

- Liquid crystals (LCs) has properties between those of conventional liquids and those of solid crystals.
- **Today, LC** finds a wide **use in liquid crystal displays LCD** within electronic products
- Standardized mass product

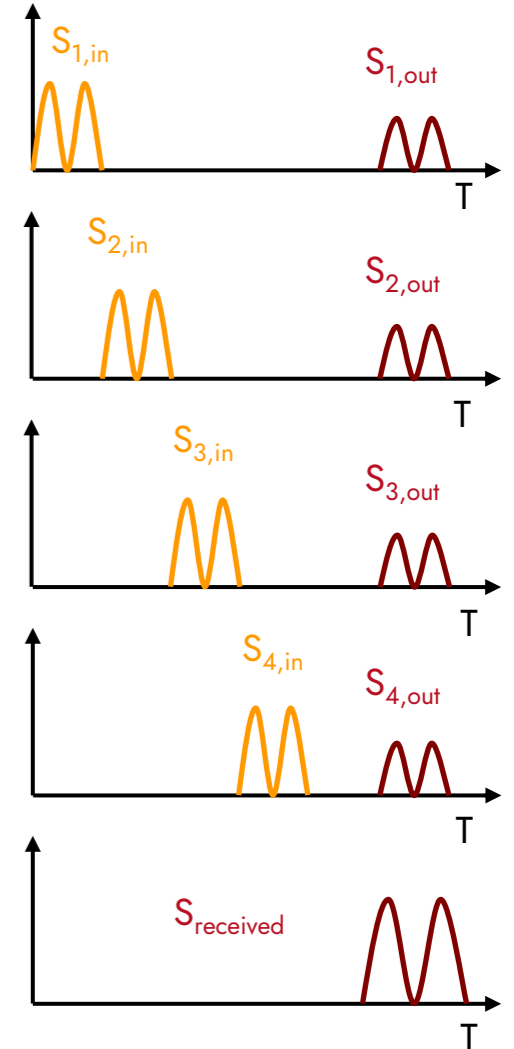
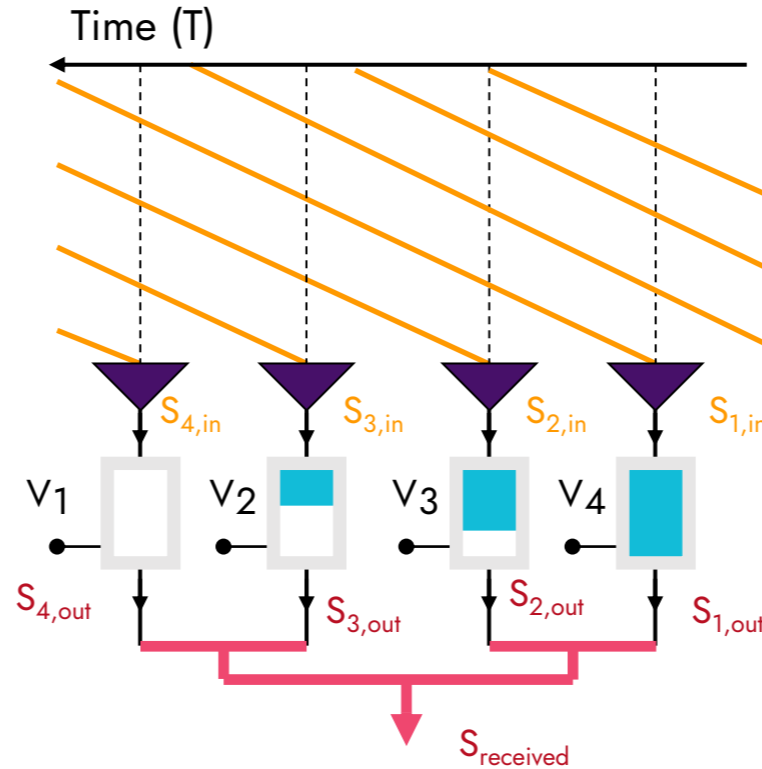
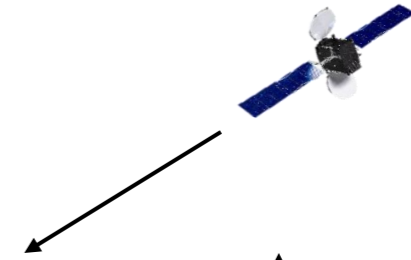





## COMBINATION OF THESE TWO IS ALCAN'S INNOVATION


- ALCAN's phased array antenna **technology** can **scale** to meet product specifications for consumer markets by **combining technologies** from two **legacy industries**.



# HOW THE ANTENNA WORKS - Phased Array Antenna



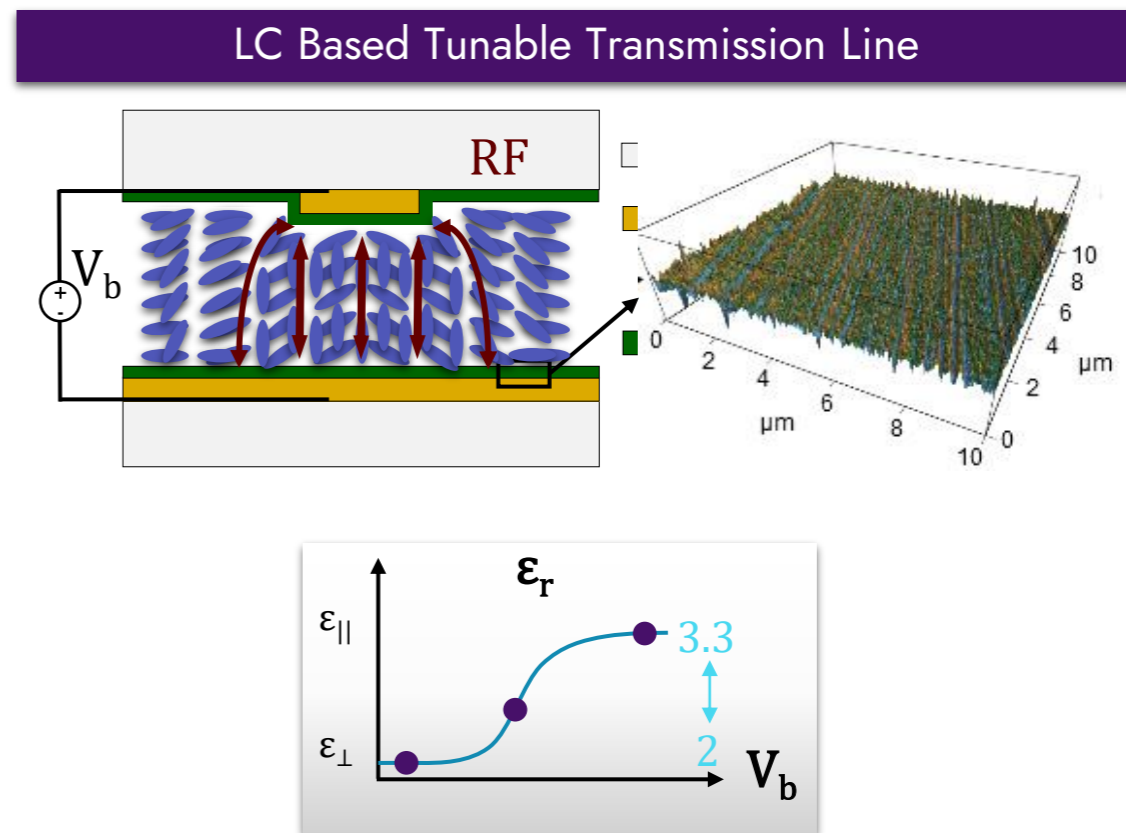
-  Radiating Elements
-  LC Phase Shifters
-  Feeding Network

 Amount of the time delays

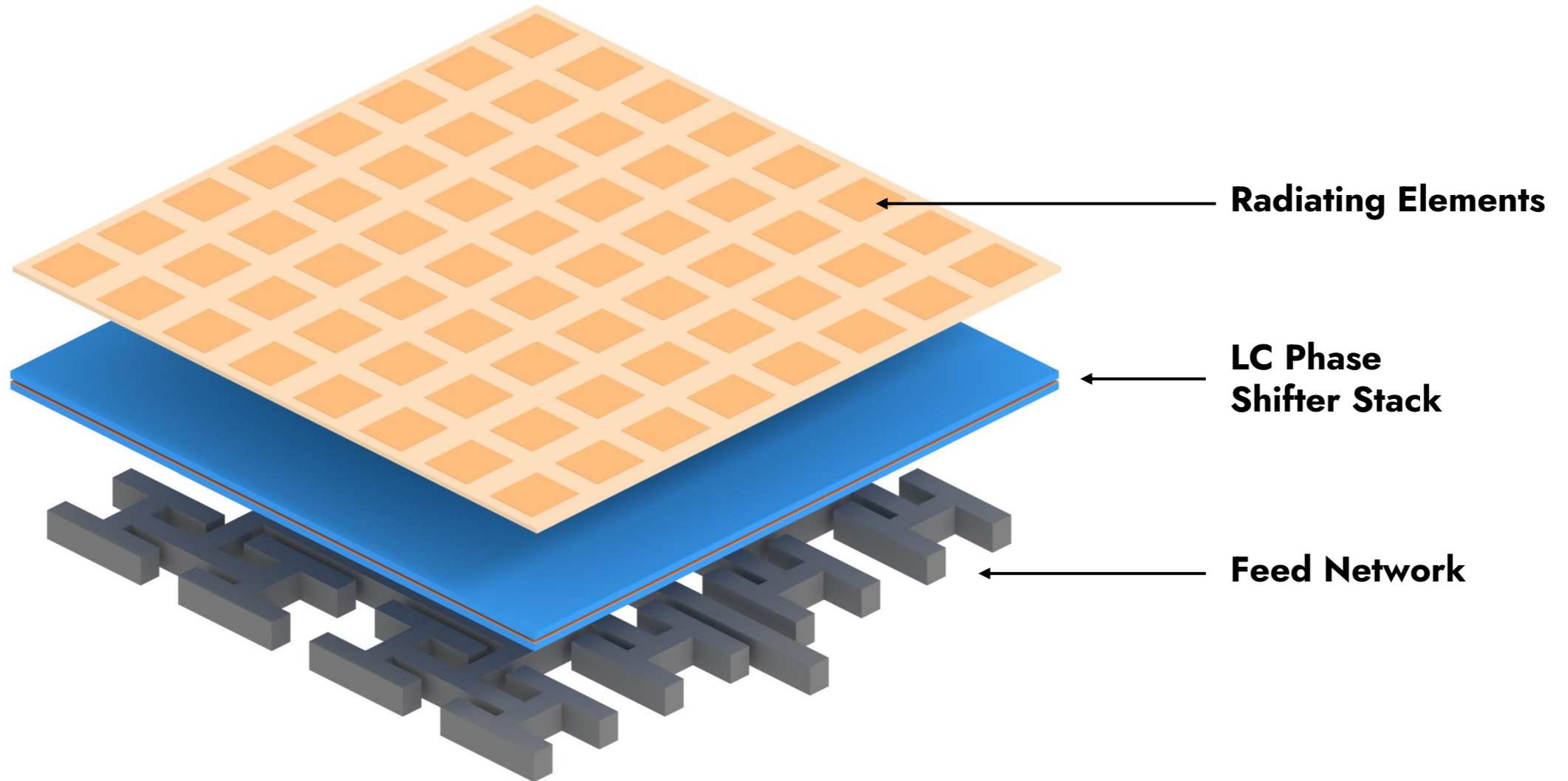
Asynchrony received signals are synchronized by the electrically-controlled phase shifters.

## LIQUID CRYSTAL phase shifters

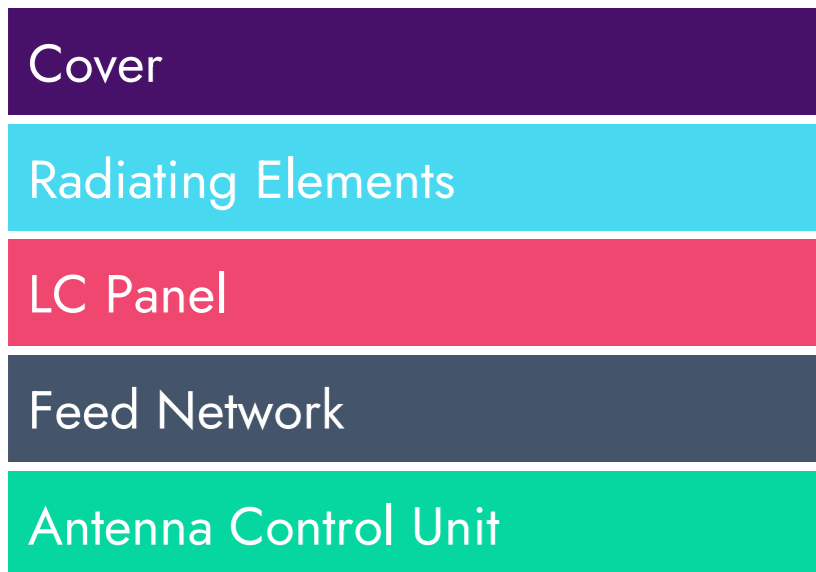
- Liquid Crystal technology is suitable for any antenna application above 10 GHz, hence **Ku-, Ka-, Q-, V-band** satellite antennas, **5G** terrestrial antennas are all within the scope of ALCAN
- **Liquid Crystal is a tunable dielectric material which has lower losses with increasing frequency**
- It is the only known material with this property
- Having low loss at mm-wave frequencies, being **continuously tunable** and not consuming any power for tuning makes LC a strong contender over silicon for phase shifting.



# ARCHITECTURE of LC based antennas



# ANTENNA LAYER STACK-UP - Overview



*Note: Layer thicknesses are not scaled*

- **Cover:** Protects antenna from elements
- **Radiating elements:** Radiates fixed/agile circular/linear polarized signal
- **LC panels:** Delay the signal propagation by LC based phase shifters
- **Feed network:** Combines signals from each phase shifters into a powerful antenna output signal
- **Antenna control unit:** Controls the beam steering by the help of direction finding sensors





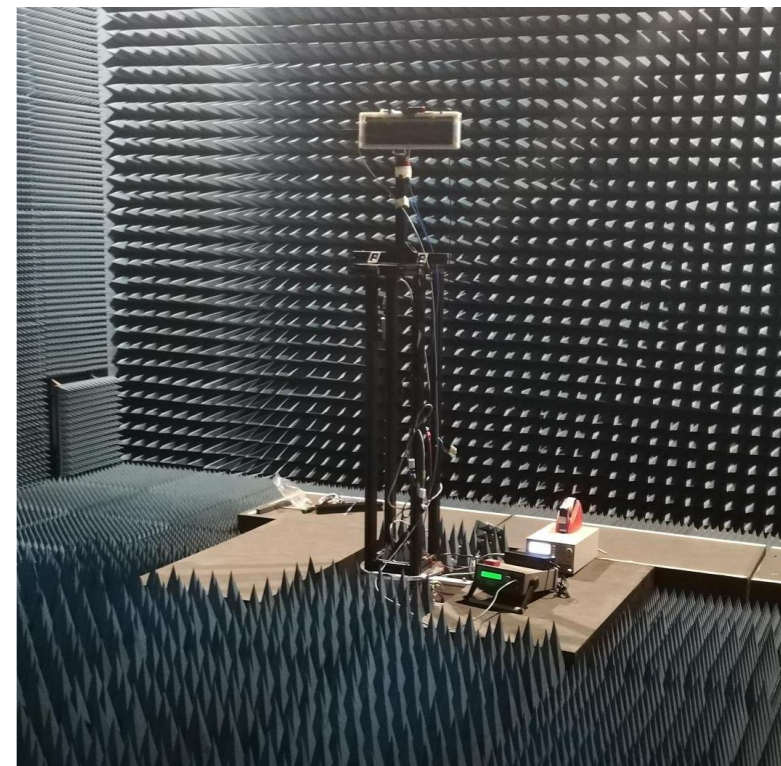
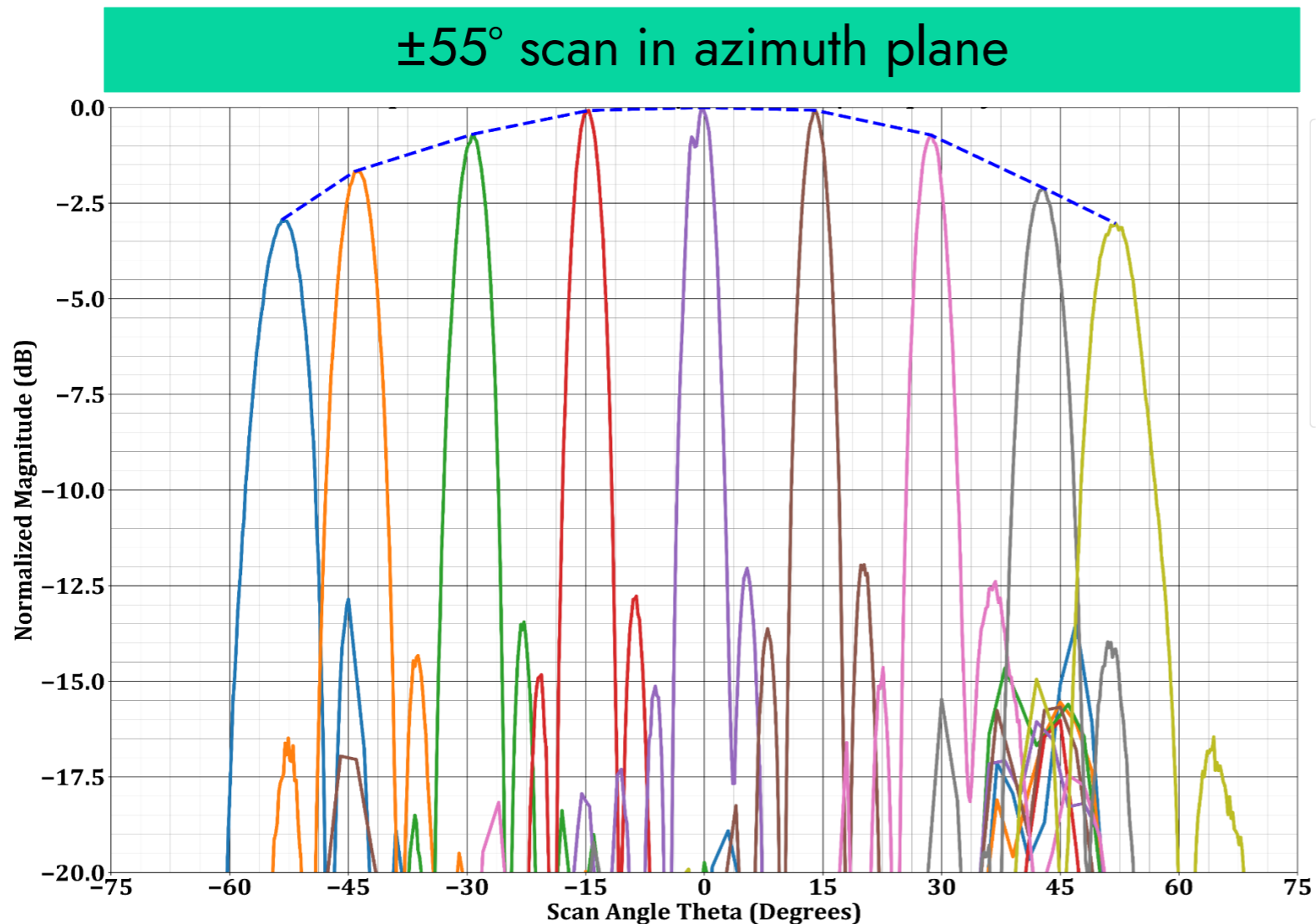
## Transparent Phased Array Antenna: Fully Validated

- The World's first Transparent mmWave beam steerable antenna was successfully tested in:
  - Anechoic chamber
  - Test & Measurement partner (ROHDE & SCHWARZ) facility using 5G NR 3GPP test signal
- All measured data matched expectations/simulations



*Transparent Phased Array Antenna Installed on a double glaze low-E glass setup*

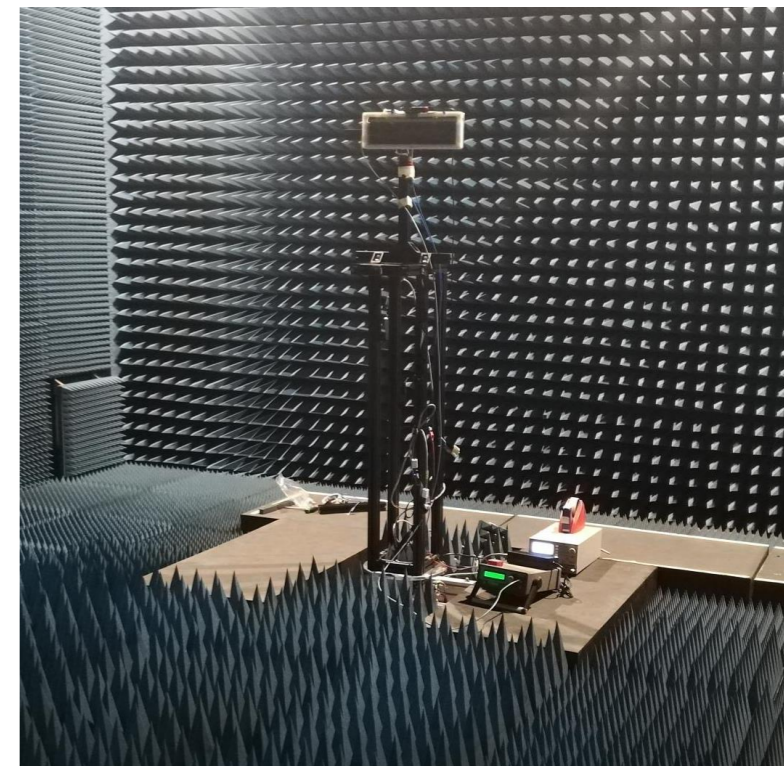
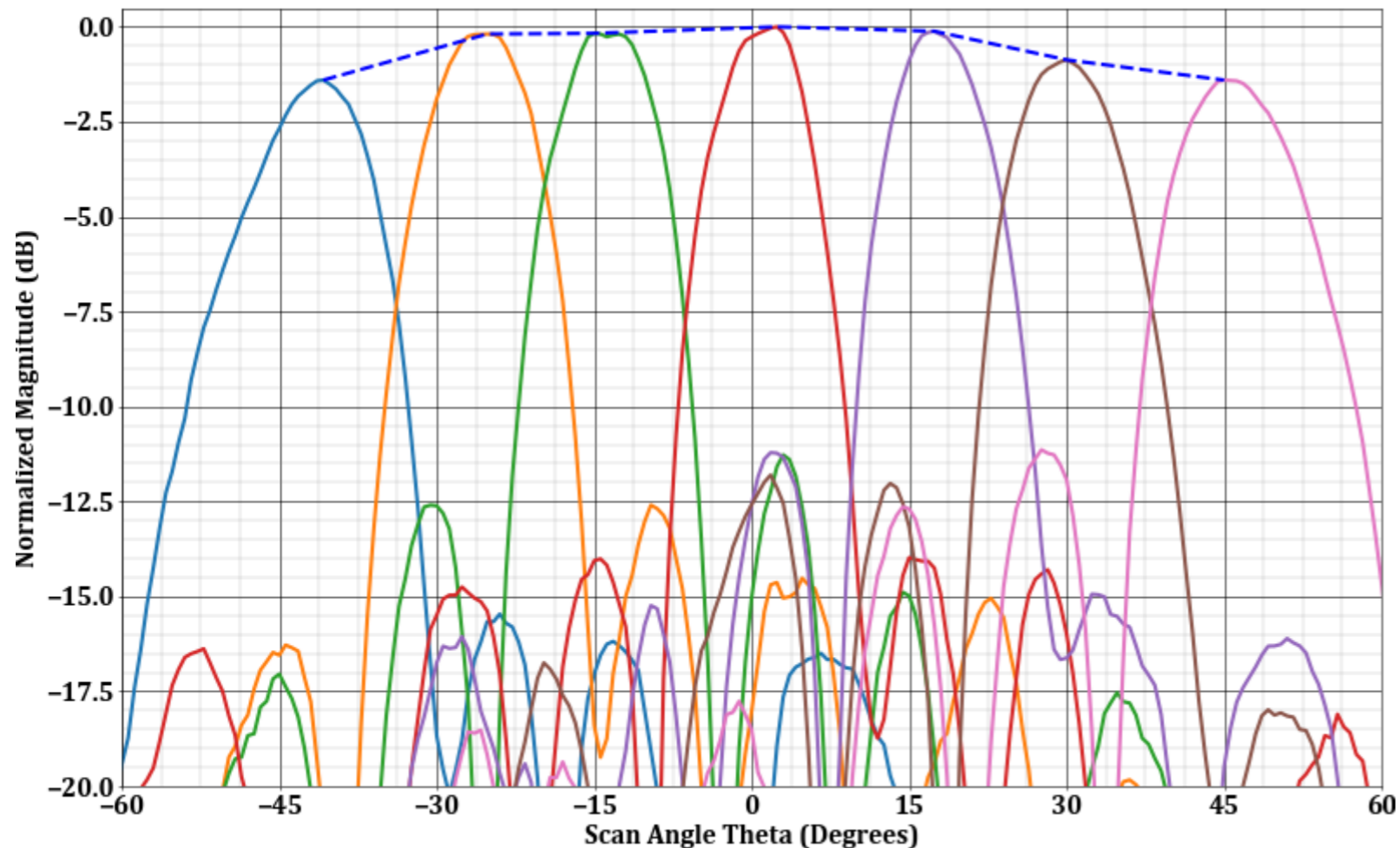
# Transparent Phased Array Antenna: Anechoic Chamber measurements



Note: Example beams are presented. Antenna can scan continuously with  $<1^\circ$  scan steps.

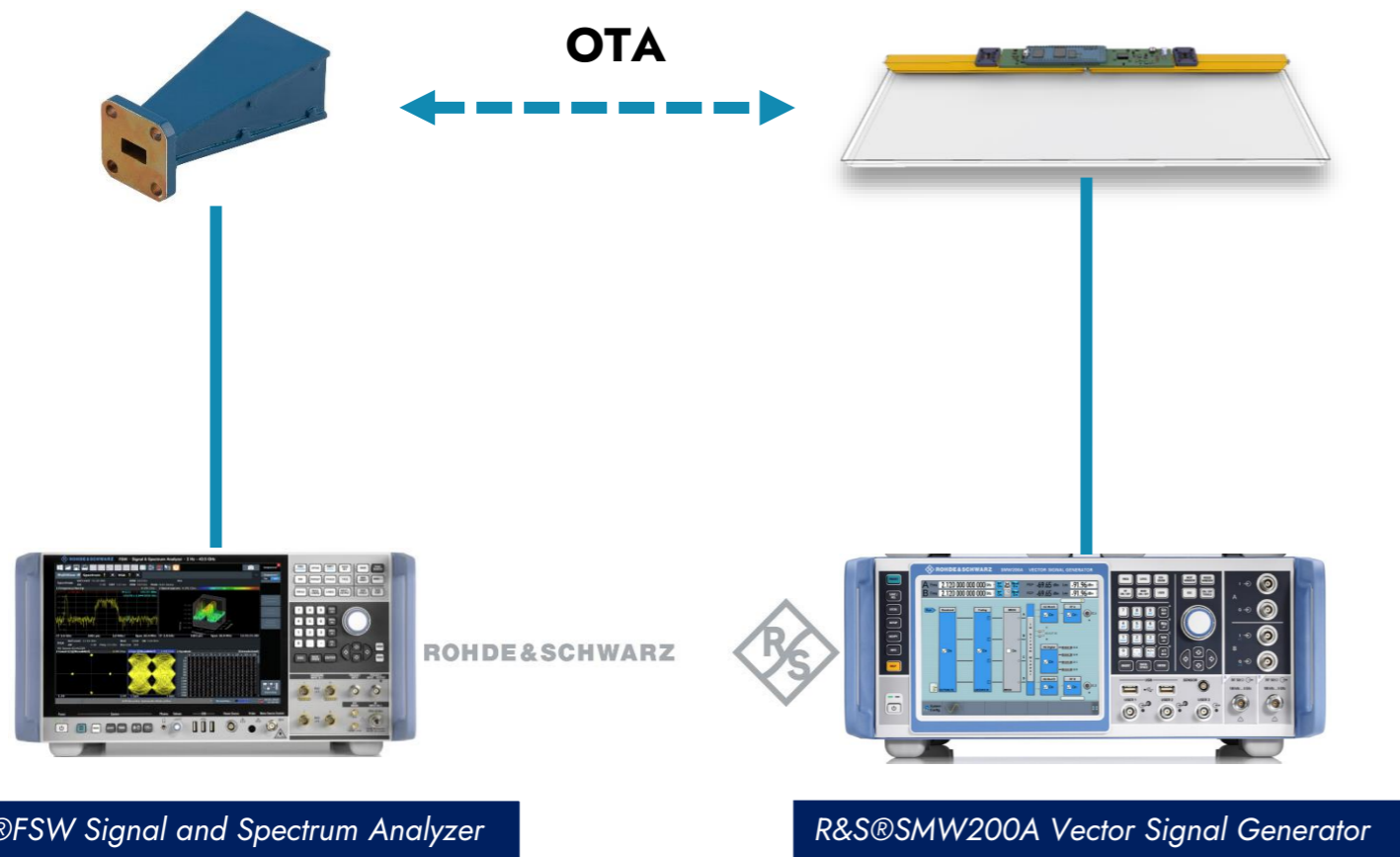
# Transparent Phased Array Antenna: Anechoic Chamber measurements

$\pm 45^\circ$  scan in elevation plane



Note: Example beams are presented. Antenna can scan continuously with  $<1^\circ$  scan steps.

# Transparent Phased Array Antenna: 5G Measurement Setup at R&S



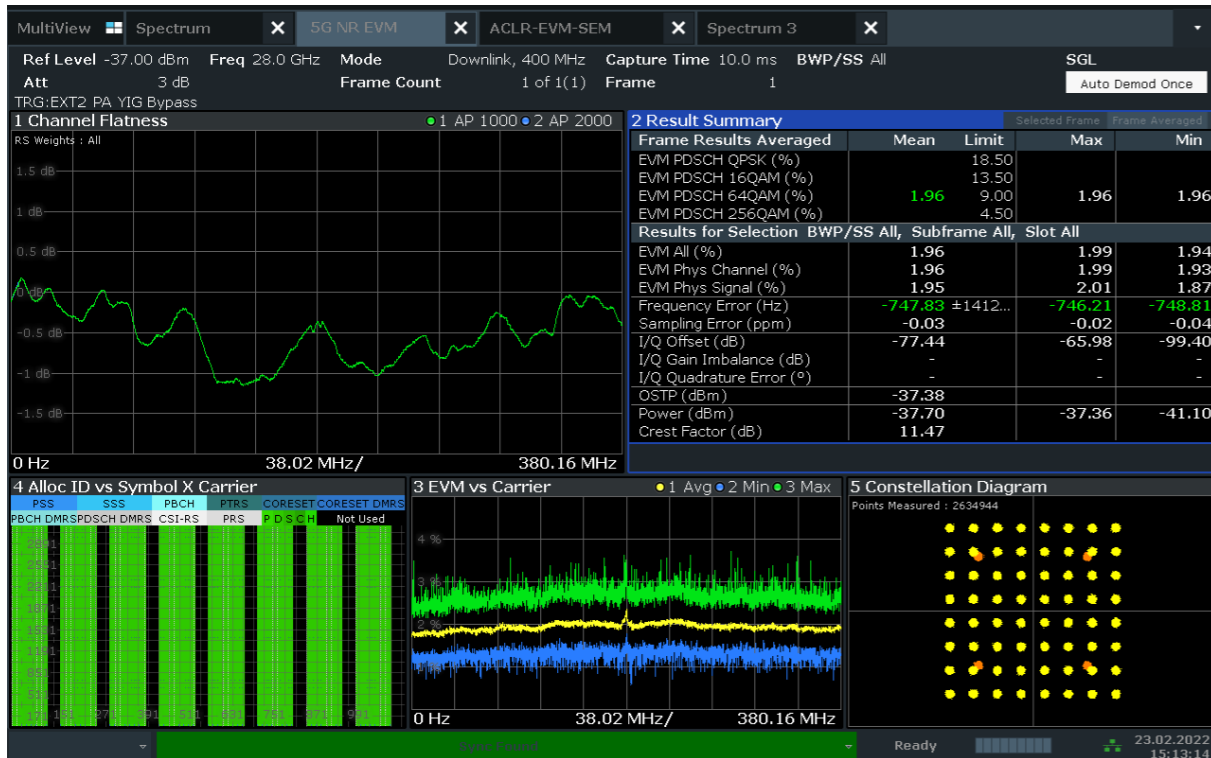
5G NR Measurements were done at R&S Labs in Munich

# Transparent Phased Array Antenna: 5G Measurement Result

Antenna without Window

Reference Horn Antenna

Transparent Antenna

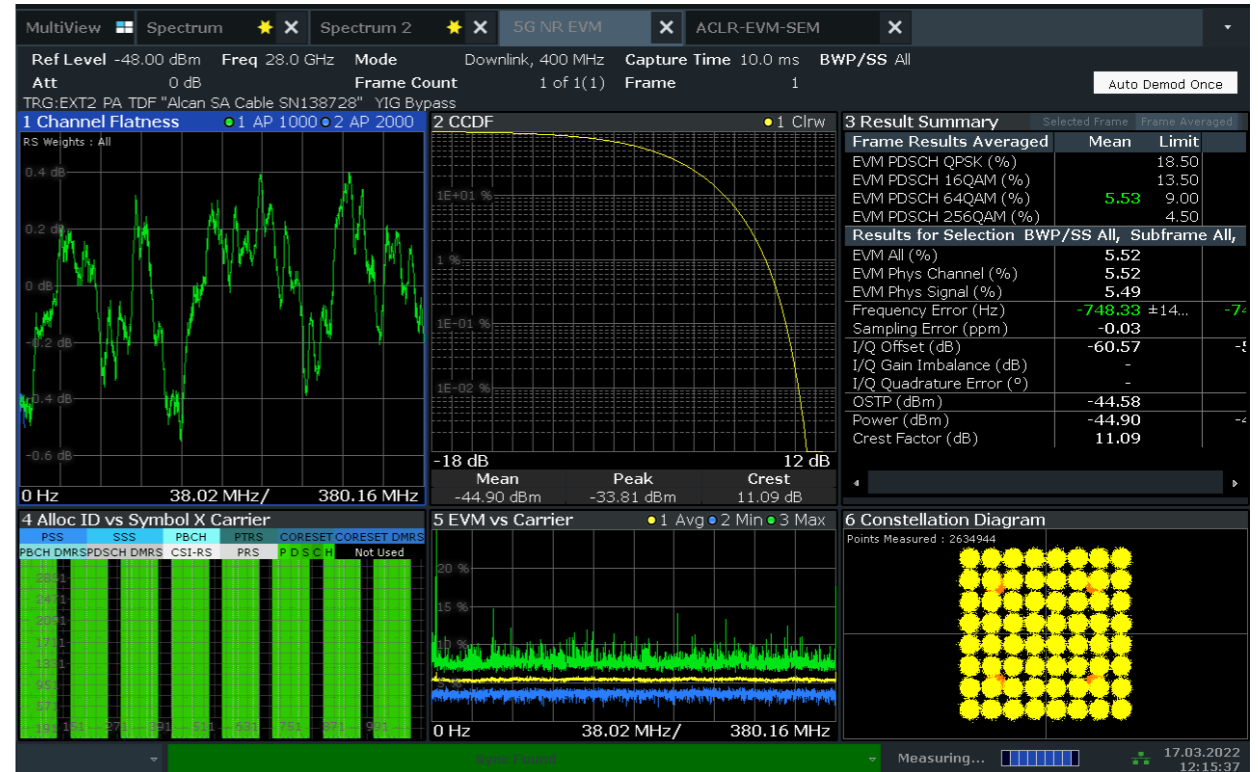
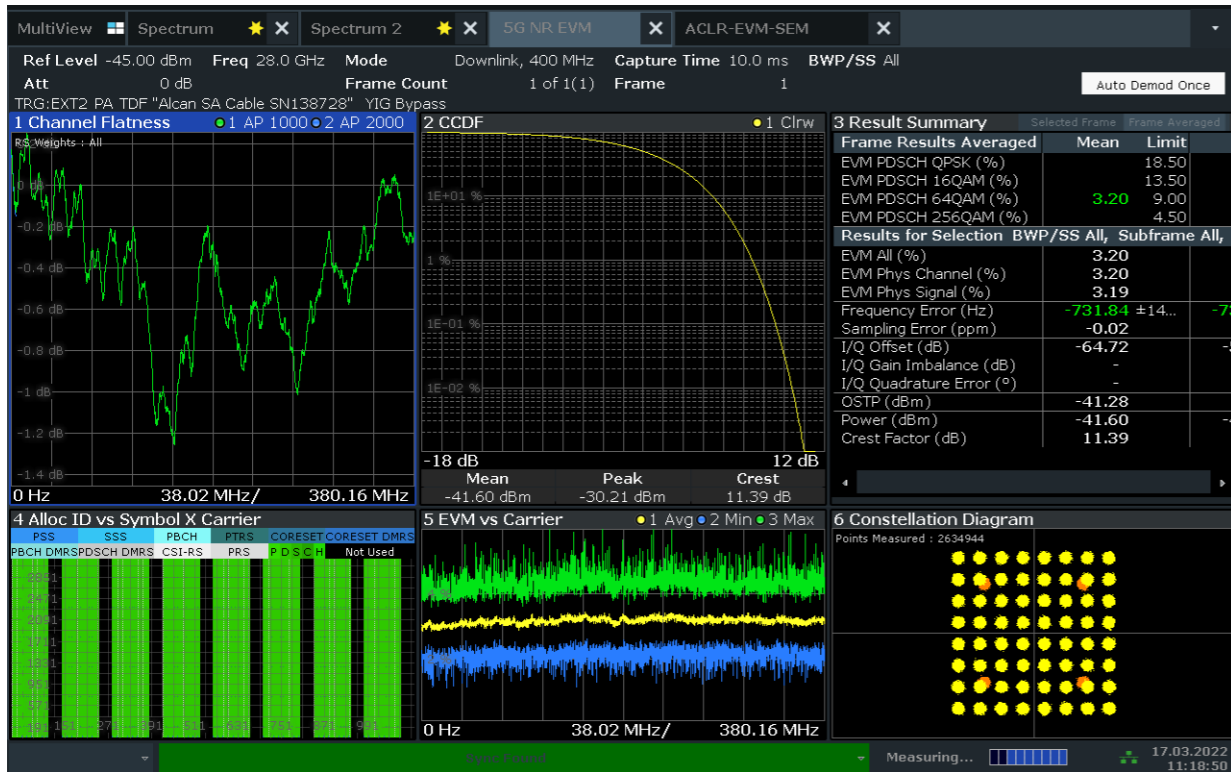


# Transparent Phased Array Antenna: 5G Measurement Result

Antenna behind Low-E Window

Reference Horn Antenna (without window)

Transparent Antenna behind window



# Thank you for listening!

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