

# VDE ITG WORKSHOP FÜR „ANTENNENKONZEPTE FÜR 3D NETZE DER ZUKUNFT“

5G, 5G-ADVANCED AND THE TRANSITION TO 6G

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Vice President Spectrum & Network Analyzers, EMC & Antenna Test

01.02.2024

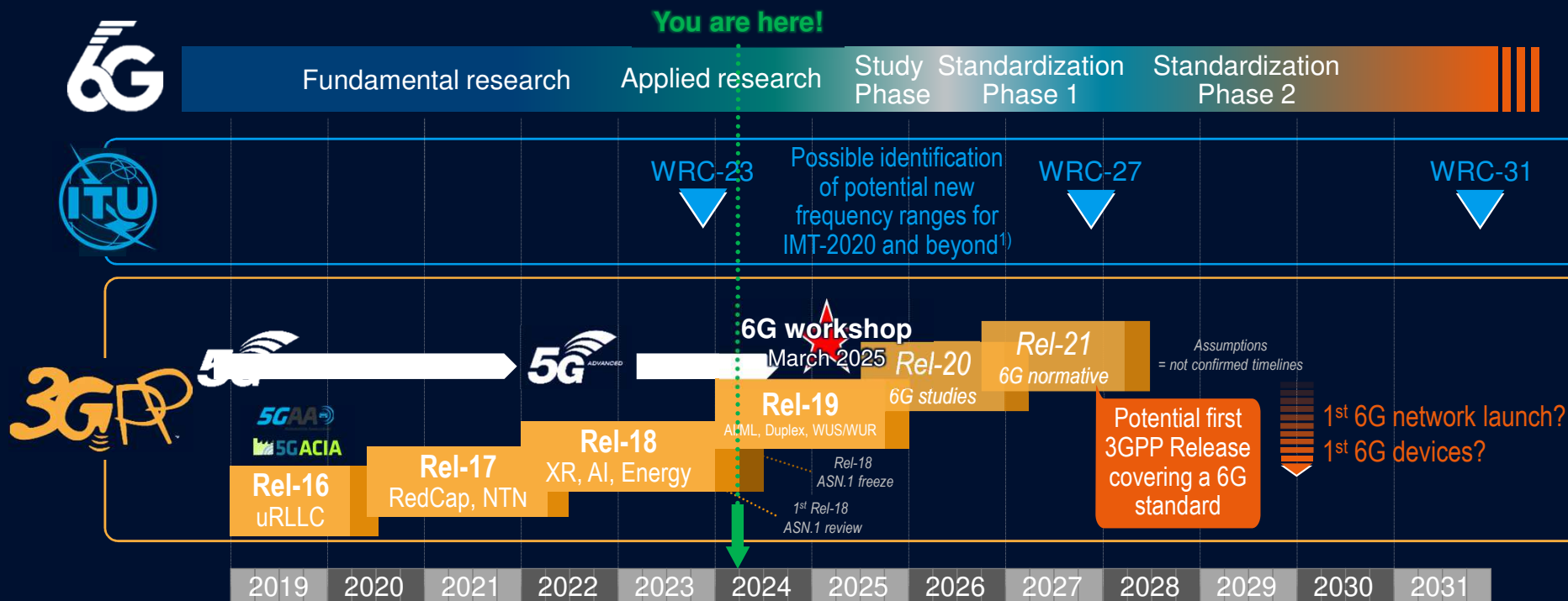
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Make ideas real



# FIRST OF ALL: TIMELINES

## FUTURE STANDARDIZATION AND REGULATORY ROADMAP

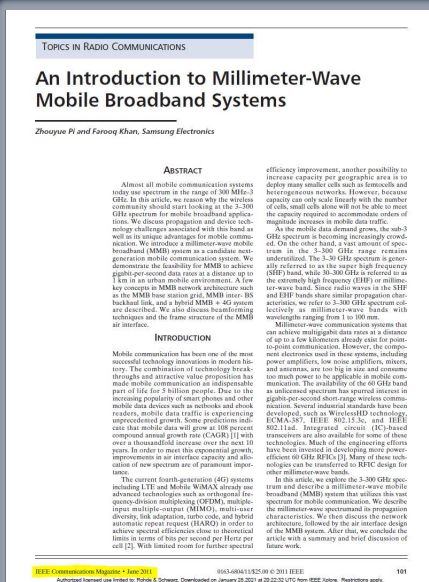


<sup>1)</sup> IMT-2020 systems are called 5G, The ITU has already started a new technology trend report to prepare the work on "IMT-2020 and beyond" that is likely to become 6G

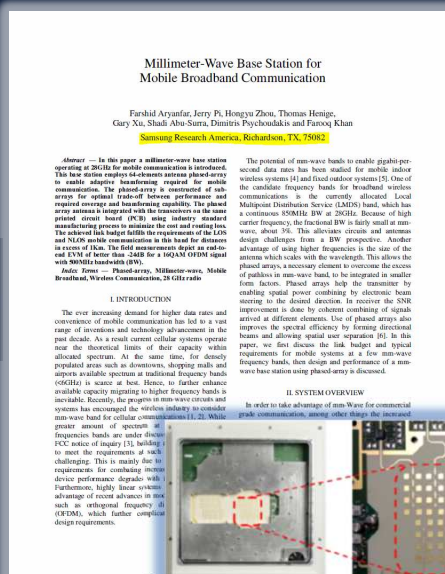


# TIMELINES

## IS THIS THE RIGHT TIME TO TALK ABOUT 6G? YES!



The support of mmWave was one of the revolutionary elements in 5G!



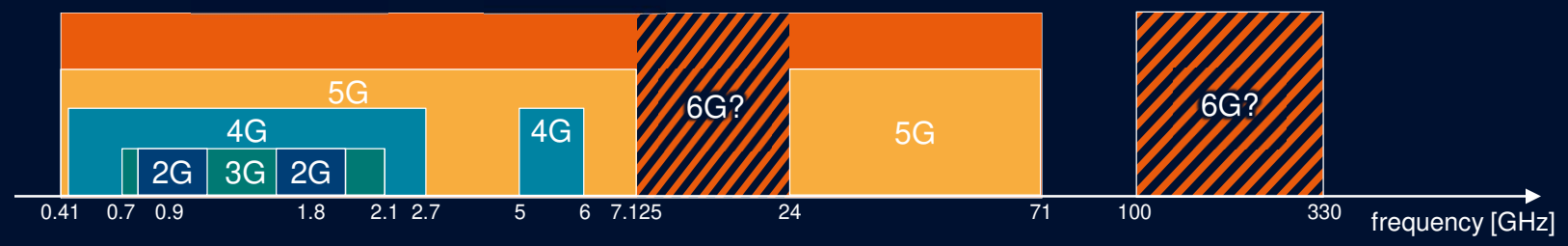
28 GHz base station with 64-element antenna array



Rohde & Schwarz Dec 2023 5G, 5G-Advanced and the transition to 6G

# FROM 5G TO 6G BEFORE WE CONTINUE, FIRST SOME OBSERVATIONS...

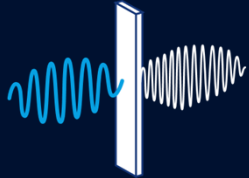
Application richness,  
Complexity & Efficiency





# RESEARCH AREAS FROM A T&M PERSPECTIVE

THz communication,  
and "FR3"



Integrated sensing  
& communication



Artificial Intelligence  
and Machine Learning



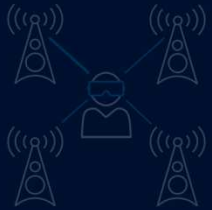
Reconfigurable  
Intelligent Surfaces



Photonics, Visible  
Light Communication



The Metaverse and  
eXtended Reality (XR)



Multiple access,  
new waveforms,  
channel coding



Ultra-massive  
MIMO



New network topologies,  
distributed computing



Full-duplex  
communication



Security &  
Trustworthiness

*A high-level overview of all these research areas is provided in one of our [#THINKSIX](#) videos*

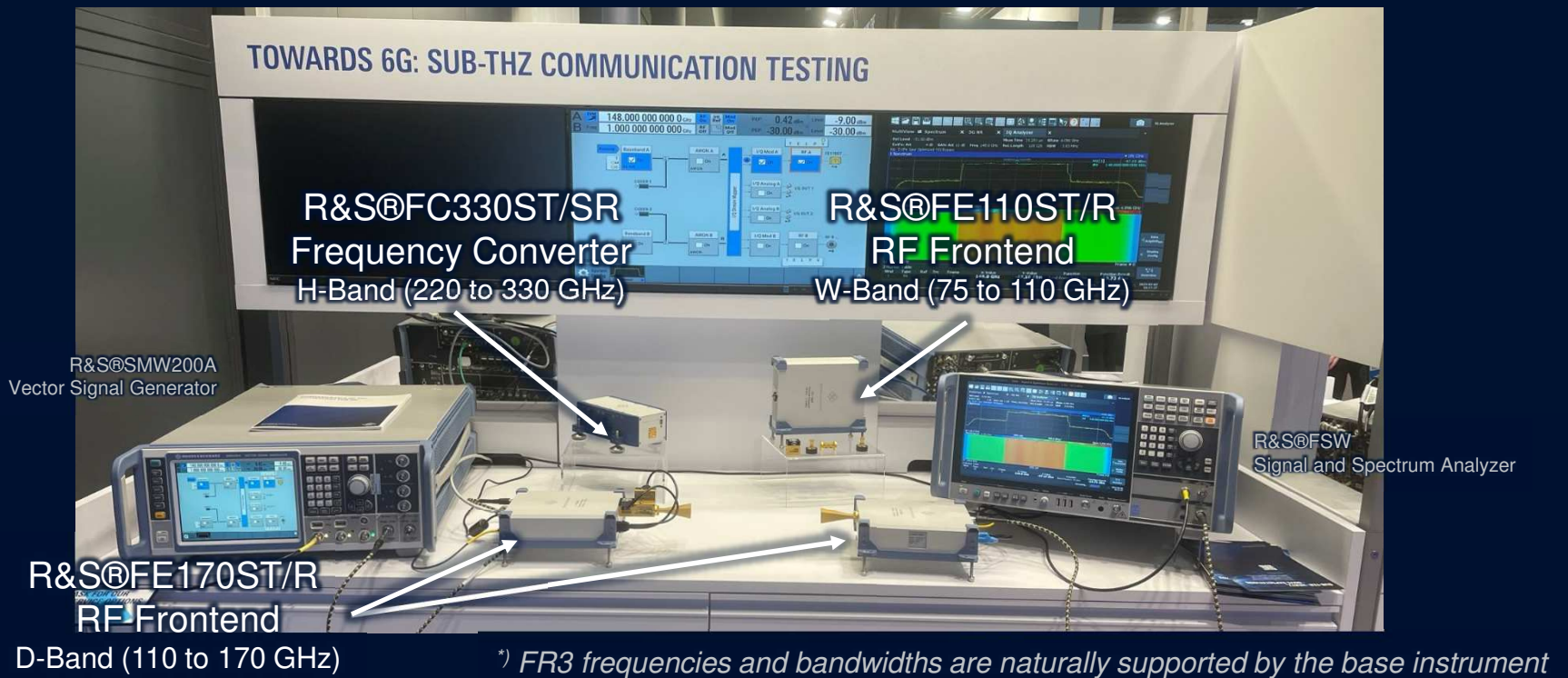
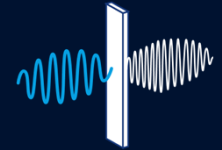


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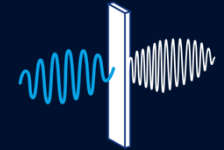
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5G, 5G-Advanced and the transition to 6G

# DEMONSTRATED OUR (SUB-)THz PORTFOLIO AT MWC 2023 IN BARCELONA AND AT IMS 2023



# BOTH PRODUCTS ANNOUNCED AND SHOWCASED END OF SEPTEMBER AT EUMW 2023




Planner... Calculate Duration... Market Research D...

## SUB-TERAHERTZ, ABOVE EXPECTATIONS

### REDEFINING THE FUTURE OF SUB-TERAHERTZ SOLUTIONS

Journey with us as we introduce our groundbreaking portfolio, spearheaded by the unparalleled R&S®SFI100A. Each component has been meticulously designed to usher in the era of sub-terahertz innovation, ensuring you're always a step ahead in the realm of 6G research and beyond.



#### Coming soon - R&S®SFI100A: Unleash unprecedented control

The essential foundation for your sub-THz solution, enabling precision and innovation above expectations.

- Up to 10 GHz RF modulation bandwidth
- ARB with up to 8 GSample memory
- Wideband single-ended or differential analog IQ outputs
- Perfect IF source for R&S®FE170ST and R&S®FE110ST frontends
- Full integration with R&S®FE170ST and R&S®FE110ST frontends

**The cornerstone of your sub-THz solutions.** Integrating seamlessly with our frontends and power sensors.

Register now and get more information about the new R&S®SFI100A wideband IF vector signal generator.

[Register now](#)

Discover Rohde & Schwarz's latest innovations at EuMW 2023

## R&S®NRP170TWG(N): Measure Power with Confidence

### Precision Analysis in the D-Band Realm

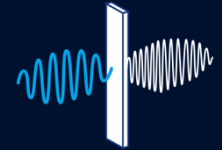
With its eyes set firmly on the D-Band spectrum (110 - 170 GHz), the R&S®NRP170TWG(N) thermal power sensor is an indispensable tool for meticulous research and analysis. Designed to work seamlessly with the R&S®SFI100A signal generator, this power sensor not only measures but ensures every signal is captured with utmost precision. Experience full D-Band coverage, reliable connections, and traceable measurements to elevate your research to new heights. Dive into the intricacies of sub-THz with clarity and confidence.



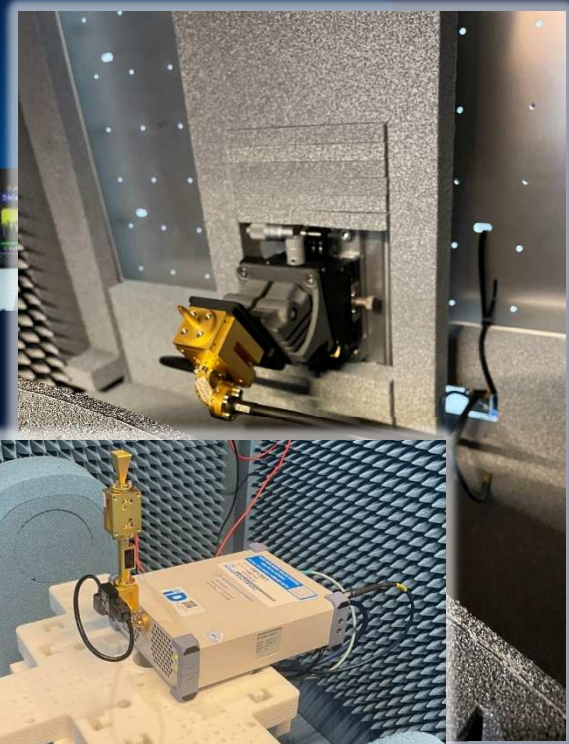
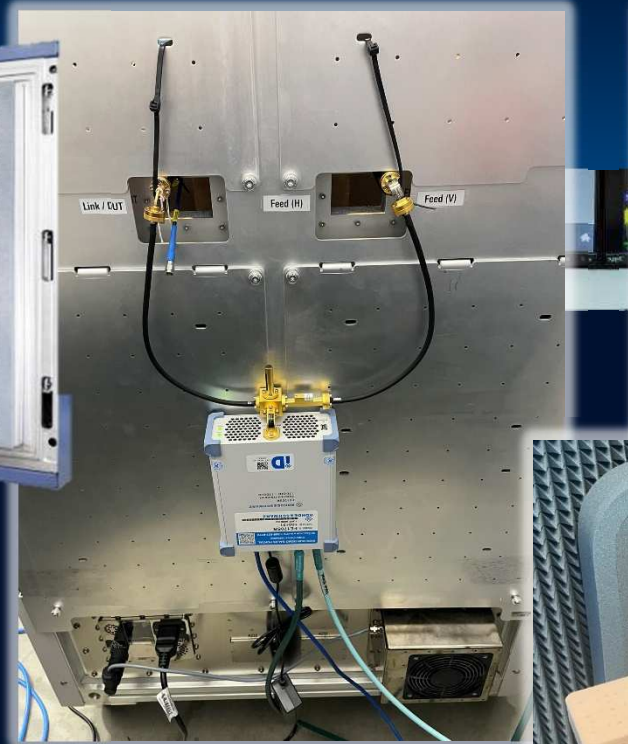
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[https://www.rohde-schwarz.com/products/test-and-measurement/rf-and-microwave-power-sensors/rs-nrpxxt-tn-twq-thermal-power-sensors\\_63493-197529.html](https://www.rohde-schwarz.com/products/test-and-measurement/rf-and-microwave-power-sensors/rs-nrpxxt-tn-twq-thermal-power-sensors_63493-197529.html)



# OUR R&S®FE170 FRONTENDS FOR D-BAND WILL BE INTEGRATED WITH OUR MMWAVE CHAMBERS



**R&S@ATS1800C**  
Compact 3GPP-compliant  
OTA chamber for 5G NR mmWave signals





Trends

# TOWARDS HIGHER FREQUENCIES

- ▶ Latest ITU filing by SpaceX for 29.988 satellites in D-band

ITU e-Submission of Satellite Network Filings

Home As-Received Help

Published Comments

TON2023-63966 Details Frequencies

Notice ID	Administration / Network Org.	Satellite Name
123545340	TON	'ESIAFI II
Submission Reference Number	Act. Code	Type of Submission
TON2023-63966	A	Advance publication information
Provision	Orbital Position	Reference Body
9.1/IA	NGSO	T
Number of Planes	BR registry date	Date of Receipt
288	11.10.2023	11.10.2023
Number of satellites	Short Duration Mission	
29988	NO	

Operating Agency

SPACE EXPLORATION HOLDINGS, LLC

Document Type	File Name	Size	#	Actions
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STARLINK STARLINK SATELLITE COMMUNICATIONS PRIVATE LIMITED

Ku band	10.7-12.75	12.75-13.25 13.75-14.0 14.0-14.5 14.5-14.8 17.3-18.1	FSS
Ka Band	17.7-21.2	27-31	FSS /MSS
Q/V Band	37.5-43.5	47.2-50.2 50.4-51.4	FSS
E Band	71-76	81-86	FSS
D Band	123-130 158.5 to 164 167 to 174.5	Please see comment.	FSS



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# ROHDE & SCHWARZ SUPPORTS 6G RESEARCH GLOBALLY

## Academia & Research



## Alliances & Organizations





# RESEARCH AREAS FROM A T&M PERSPECTIVE



THz communication, and "FR3"

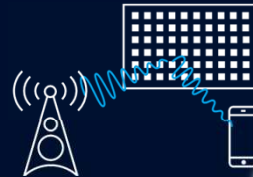
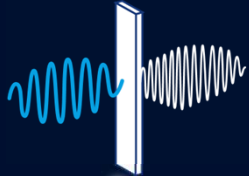
Integrated sensing & communication

Artificial Intelligence and Machine Learning

Reconfigurable Intelligent Surfaces

Photonics, Visible Light Communication

The Metaverse and Extended Reality (XR)



**6G-ADLANTIK**  
Laser-Architekturen zur Nutzung des Terahertz-Frequenzbereichs für die 6G-Kommunikation

**6G-TERAKOM**

Schlüssellokomponenten der Terahertz-Kommunikation für intelligente Funkzugangsnetze der 6. Generation



**KOMSENS-6G**

Perzeptive Kommunikationsnetzwerke mit integrierter Funk-Sensare für die 6. Generation des Mobilfunks



**6G-ANNA**

Ganzheitliche Ansätze für Mobilfunknetze der 6. Generation



**6G-LICRIS**

Rekonfigurierbare Oberflächen erweitern 6G-Netzabdeckung



A high-level overview of all these research areas is provided in our 6G Technology Overview



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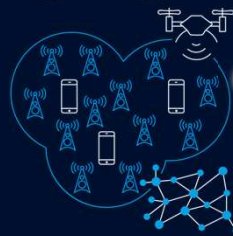
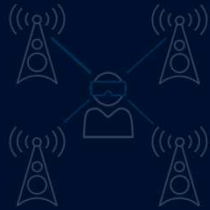
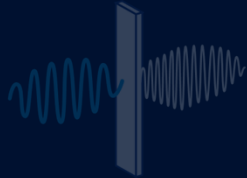
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**THANK YOU!**

**“No one can whistle a symphony. It takes a whole orchestra to play it.”**

*Halfrod E. Luccock (1885-1960)*