

# New Director CWTe as of September 1<sup>st</sup> 2016

7



**Prof. dr. ir. Sonia Heemstra de Groot**

# Thank You, Sonia!



# The Way Ahead in Wireless Technology – A CWTe Perspective

RESEARCH RETREAT 2023

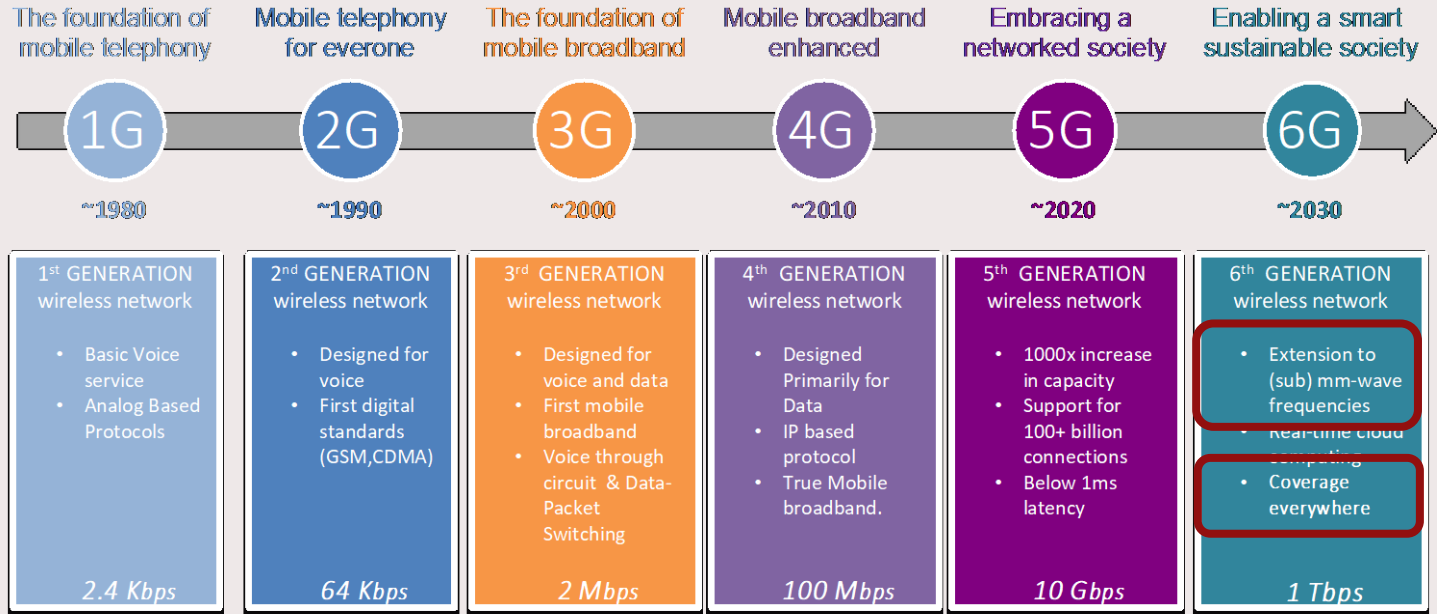
Dr. Ulf Johannsen, Director CWTe

Centre for Wireless Technology (CWTe)

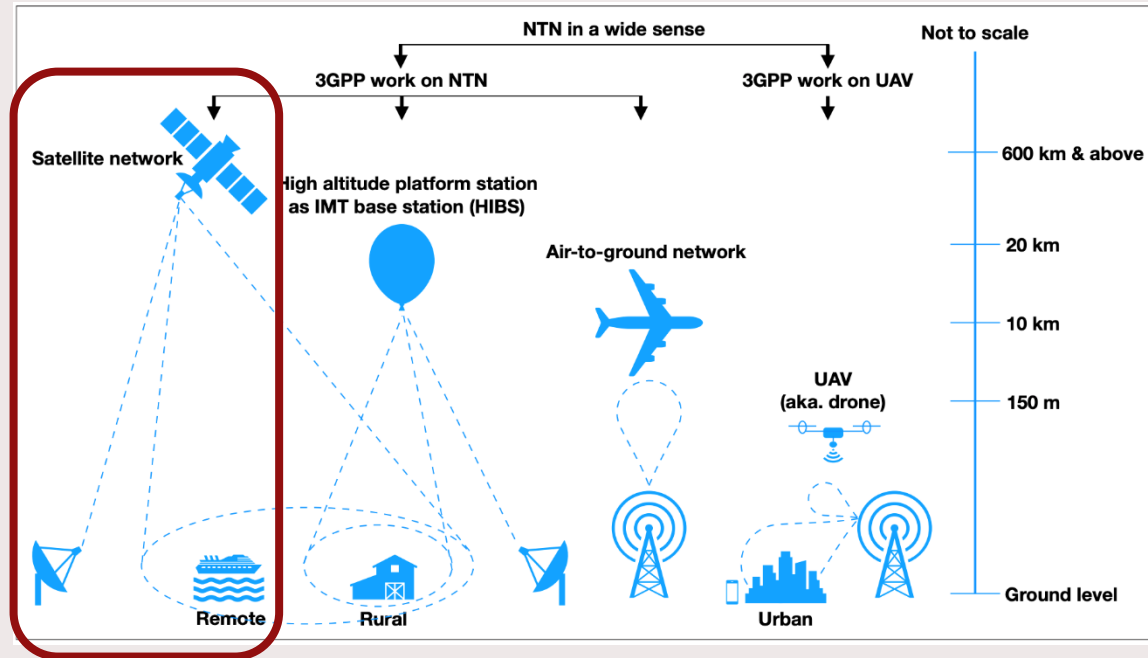
# Contents

- Wireless Communication
- Active Sensing
- Radio Astronomy

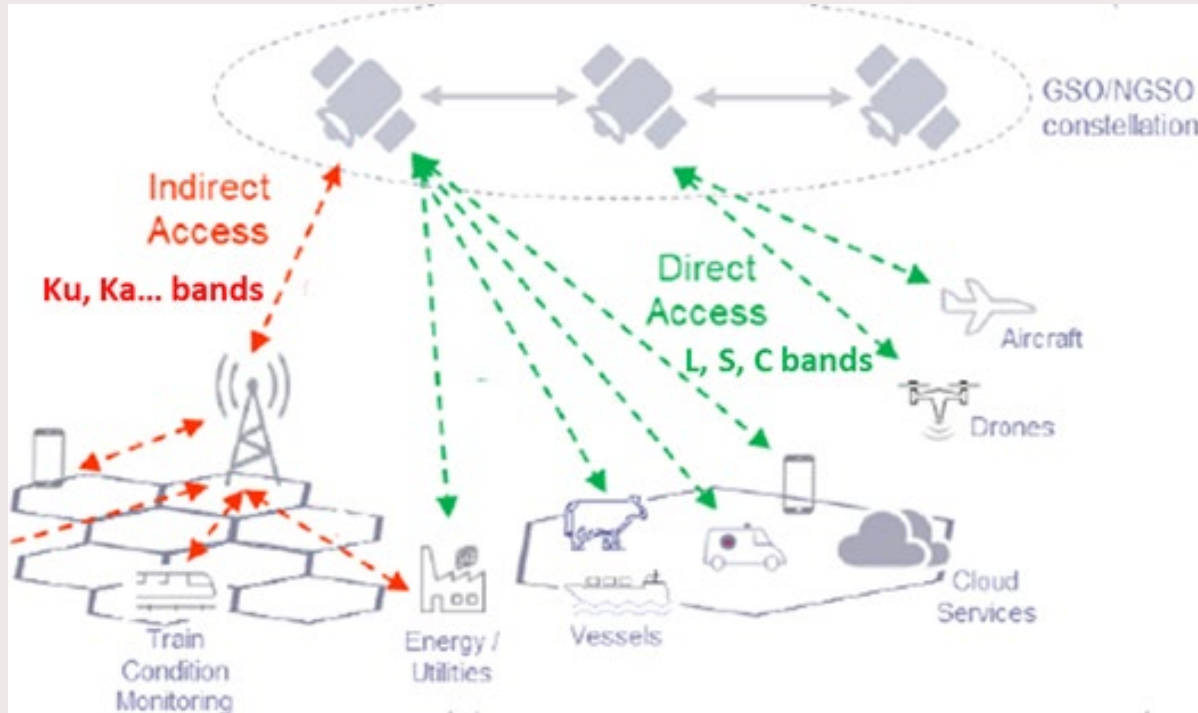
# What is 6G? – Mobile Communications Timeline



# Non-terrestrial Network Types



# Role of Satellite Communication in 6G



# Example application: Autonomous shipping

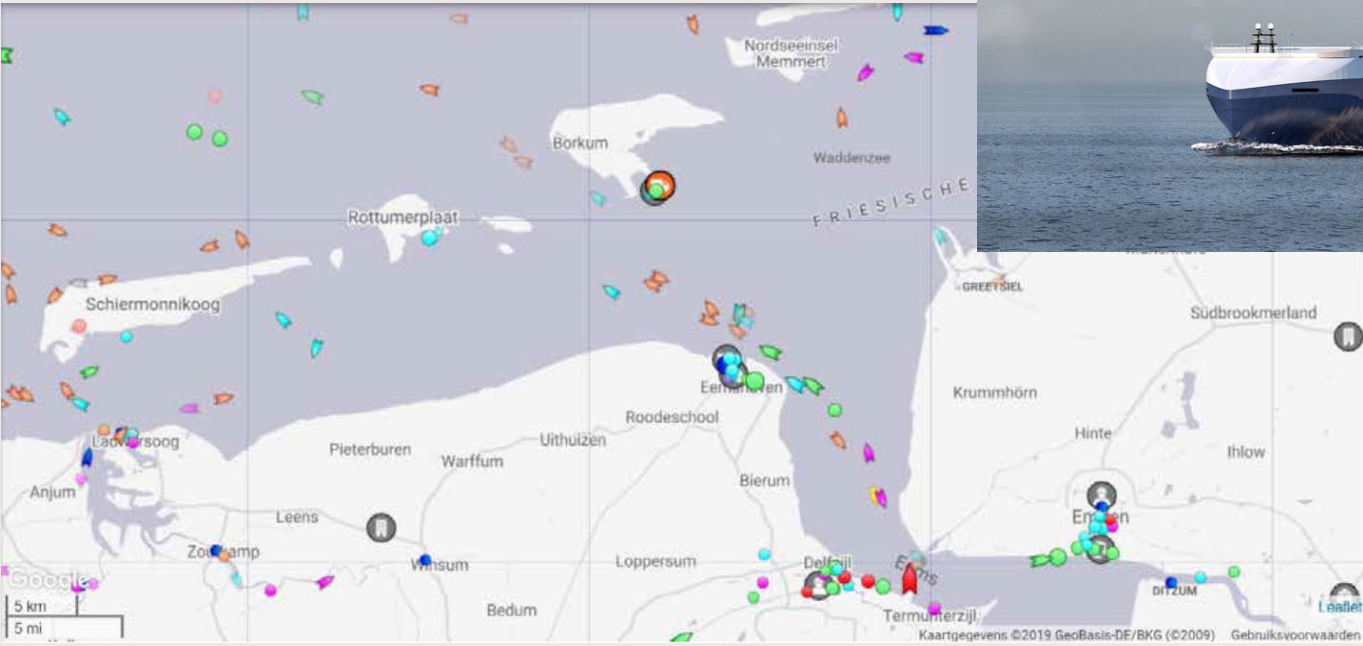
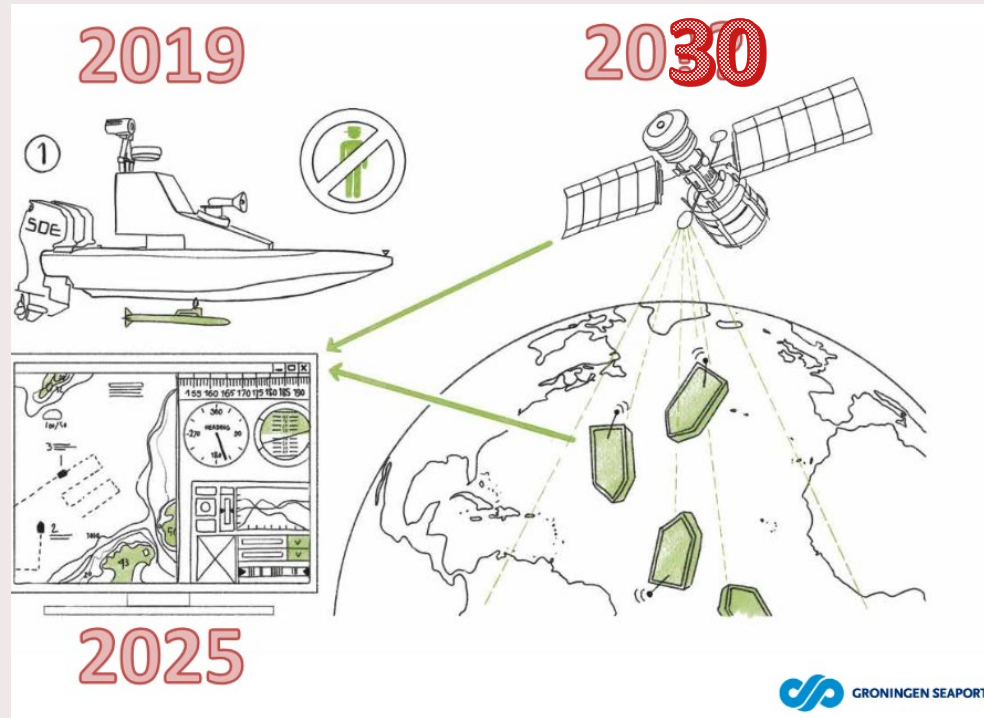


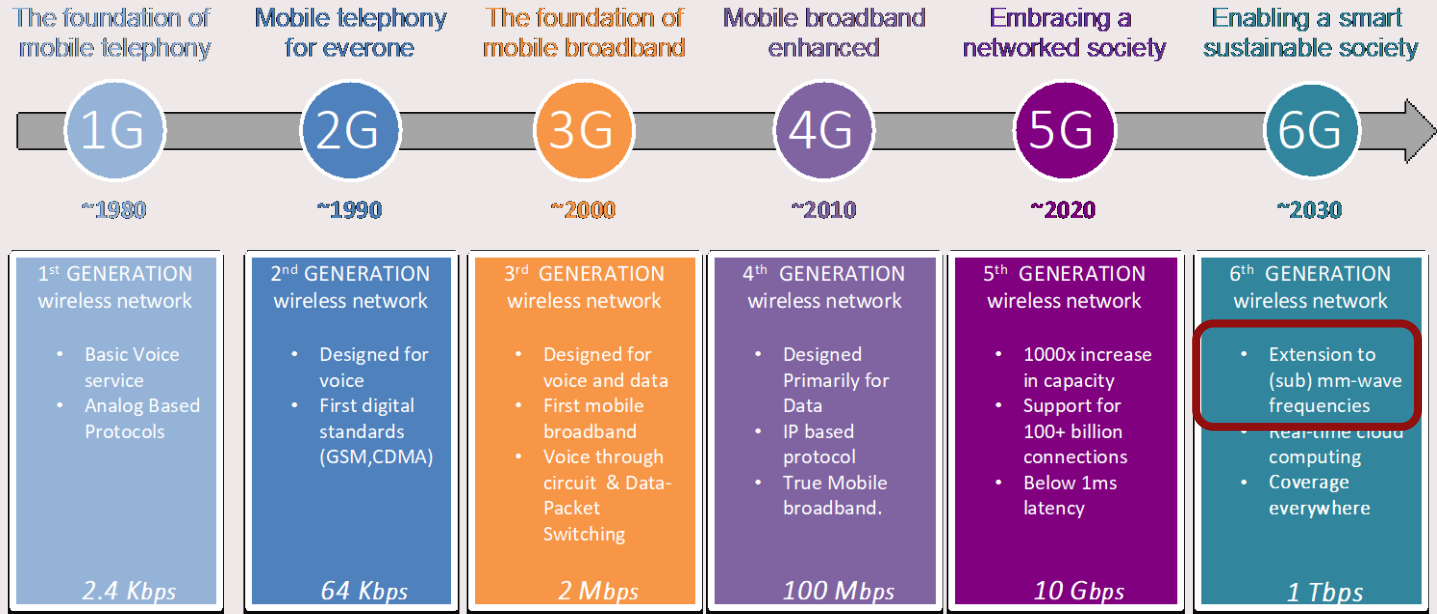
Photo: Roels-Royen

# Example application: Autonomous shipping

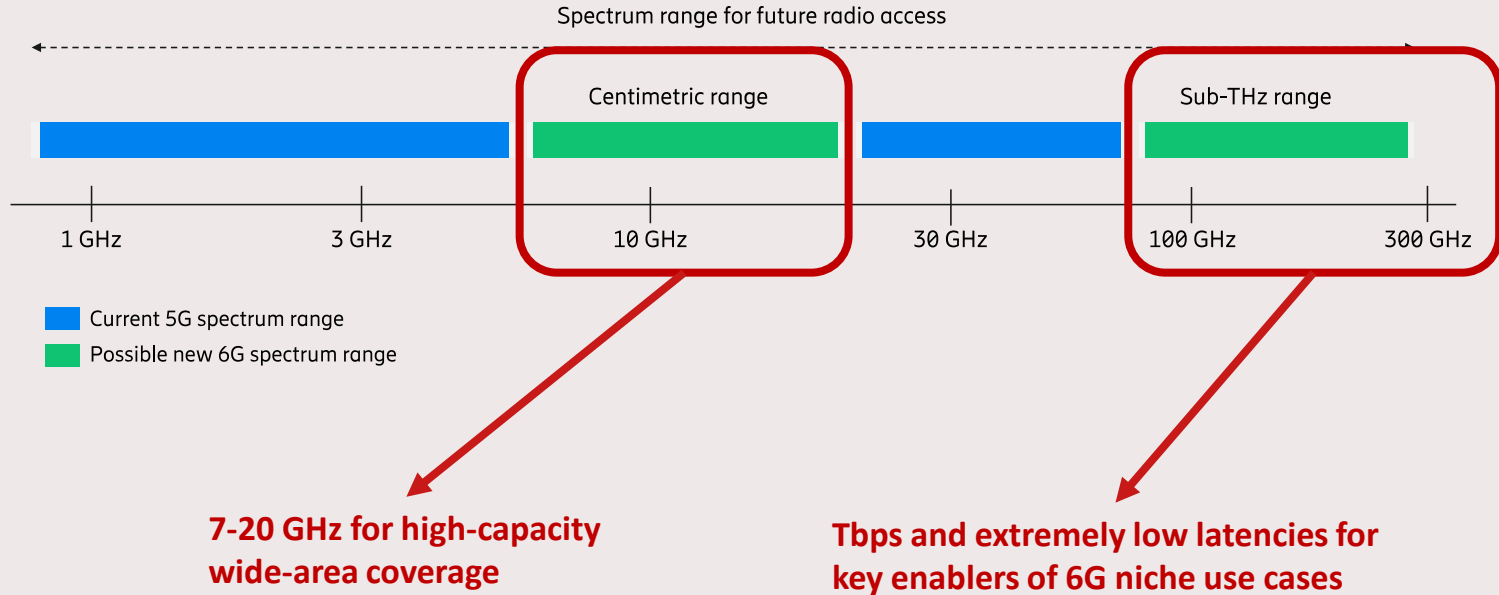




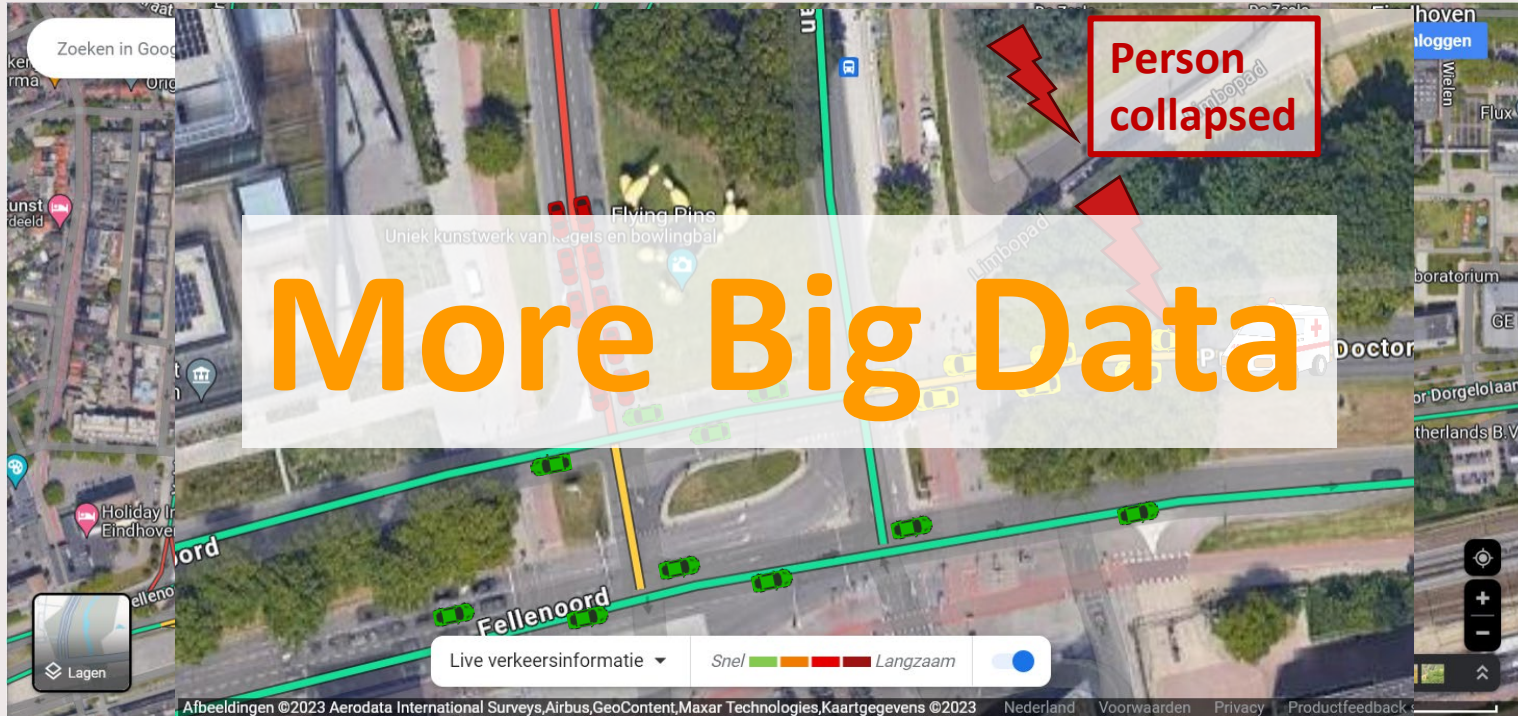
# Mobile Communications Timeline



# Spectrum is Key



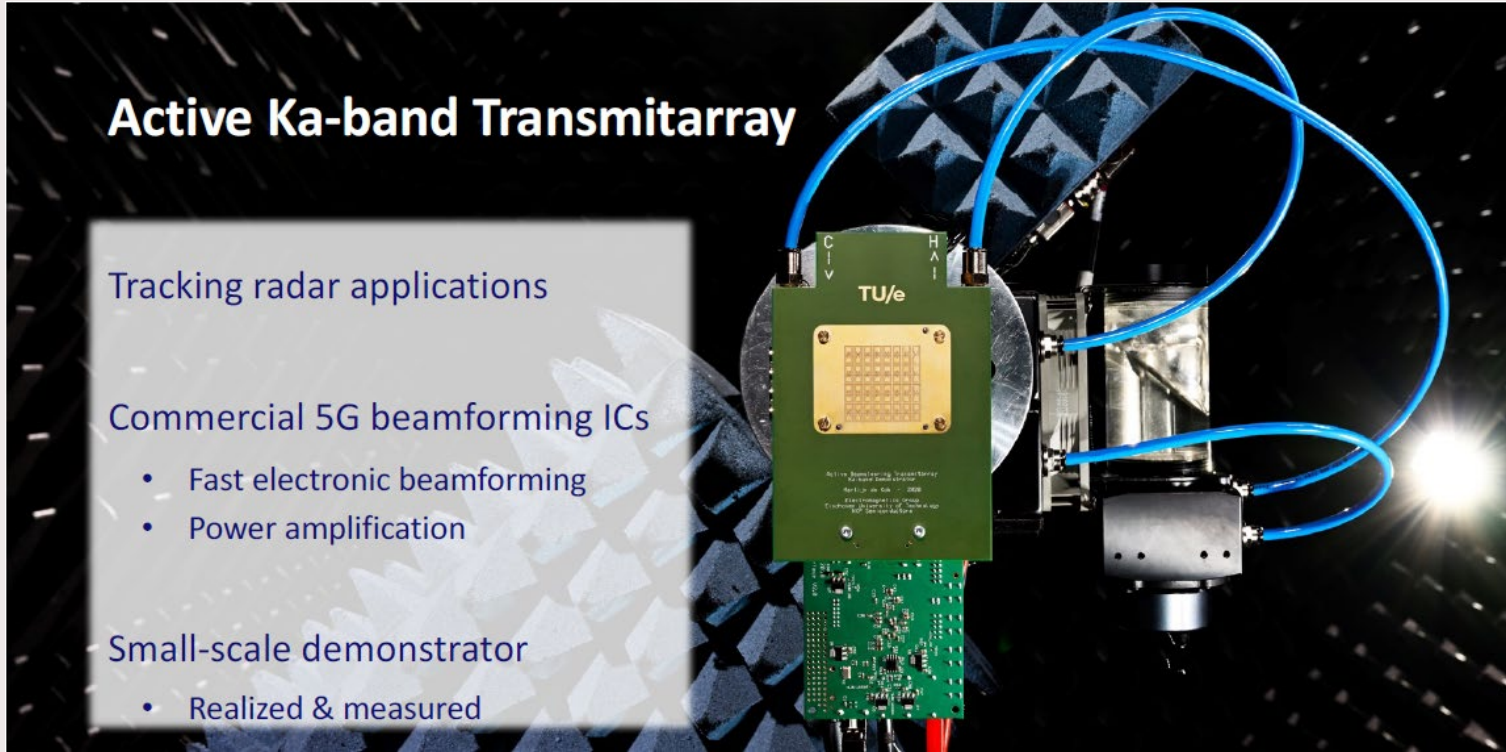
# 6G Niche Use Cases: Joint Communication and Sensing



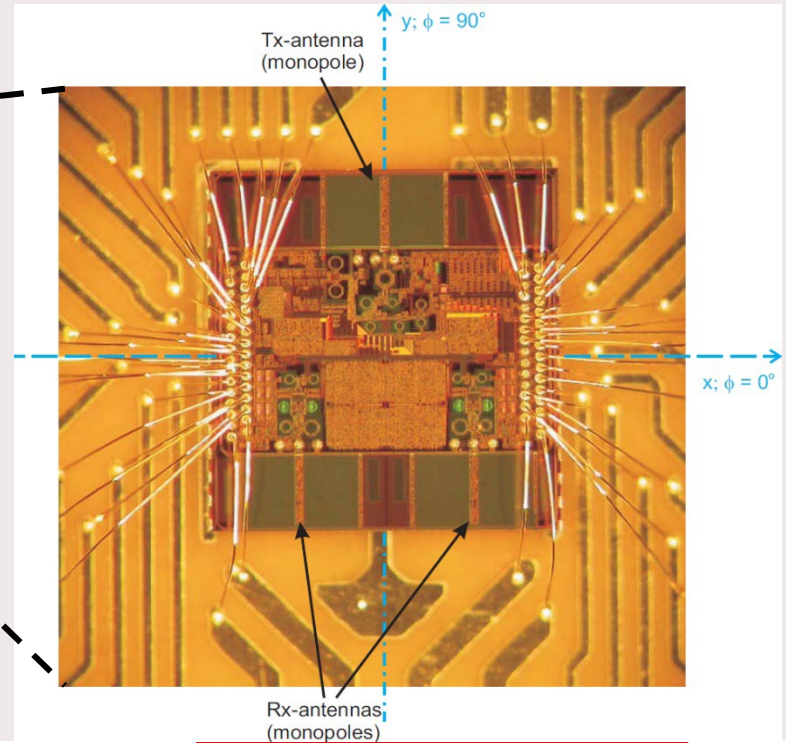
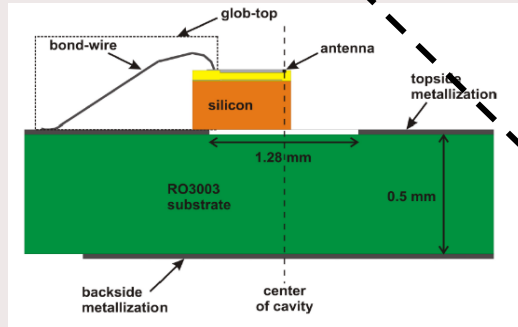
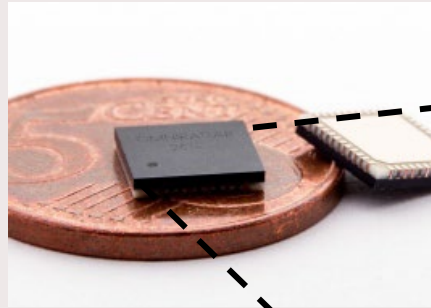
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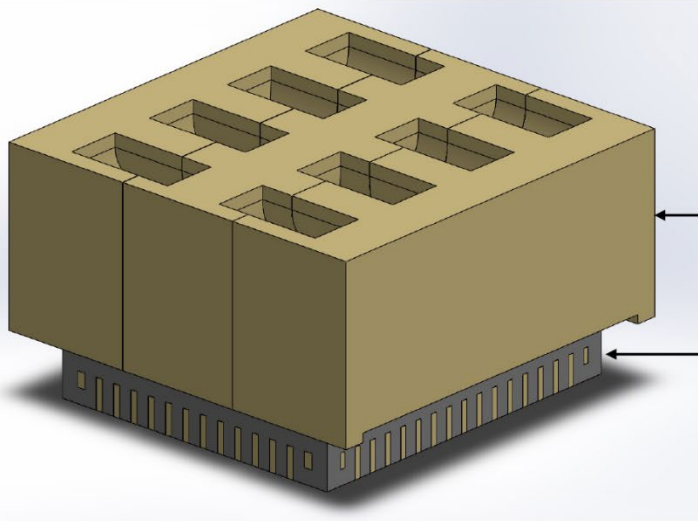
# Ka-Band Target Tracking Radar Using 5G beamforming Chips



# Radar Activities: From Single-Chip Integration...

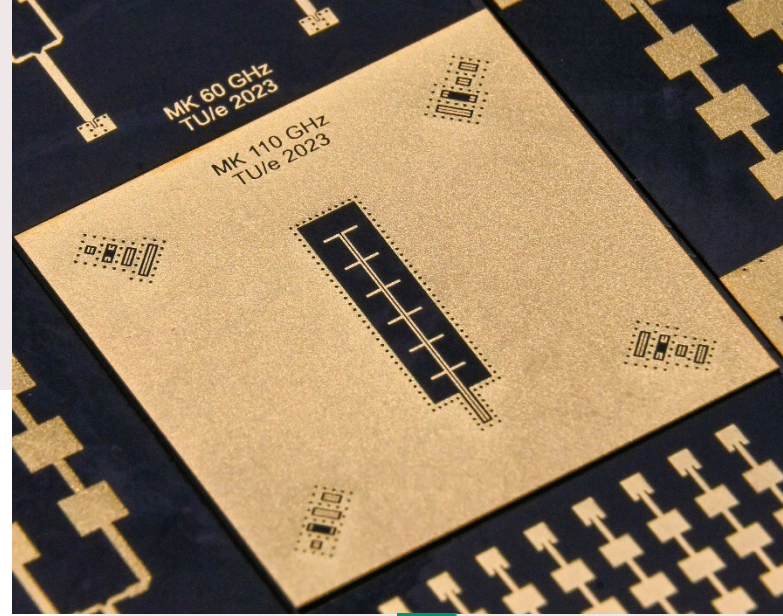



# ...to Advanced Packaging and Heterogeneous Integration...



Low-loss waveguide radiators

Plastic package with RFIC using 3D interconnect



 **Fraunhofer**  
IZM

**TU/e**

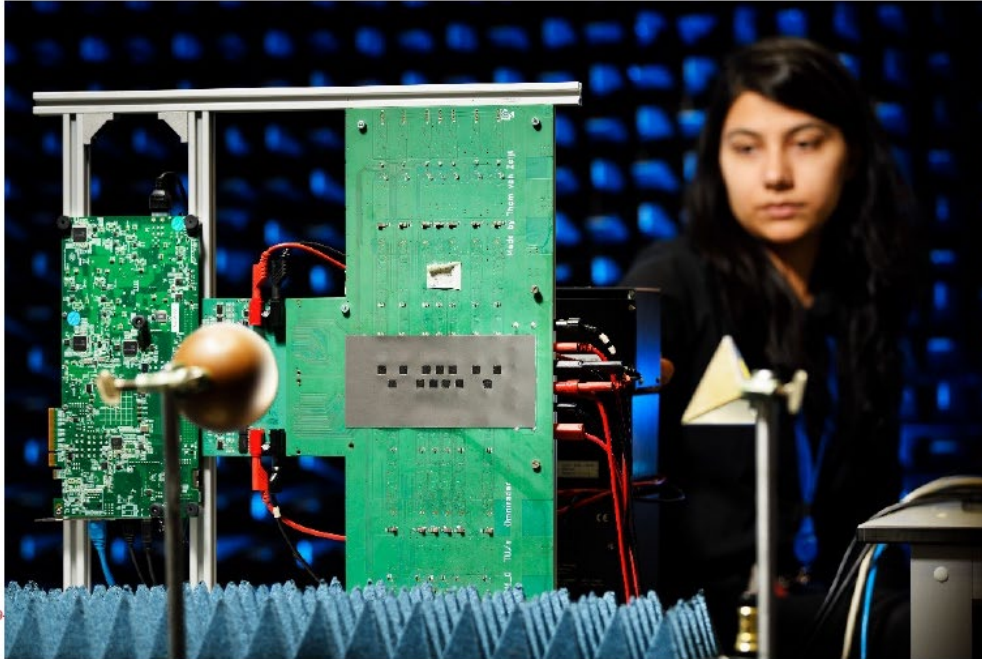
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**CENTER FOR WIRELESS  
TECHNOLOGY  
EINDHOVEN**

**TU/e**

# ... to system design...

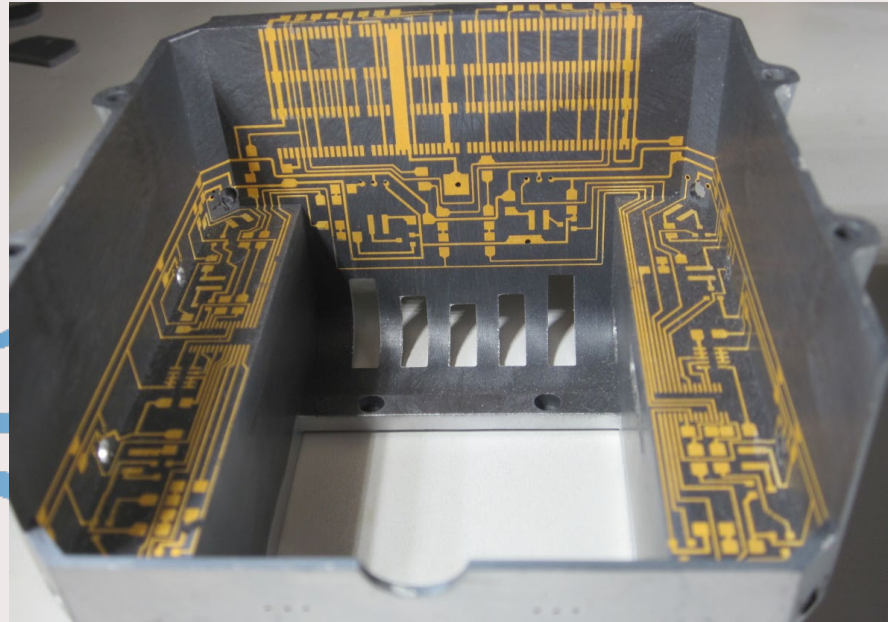
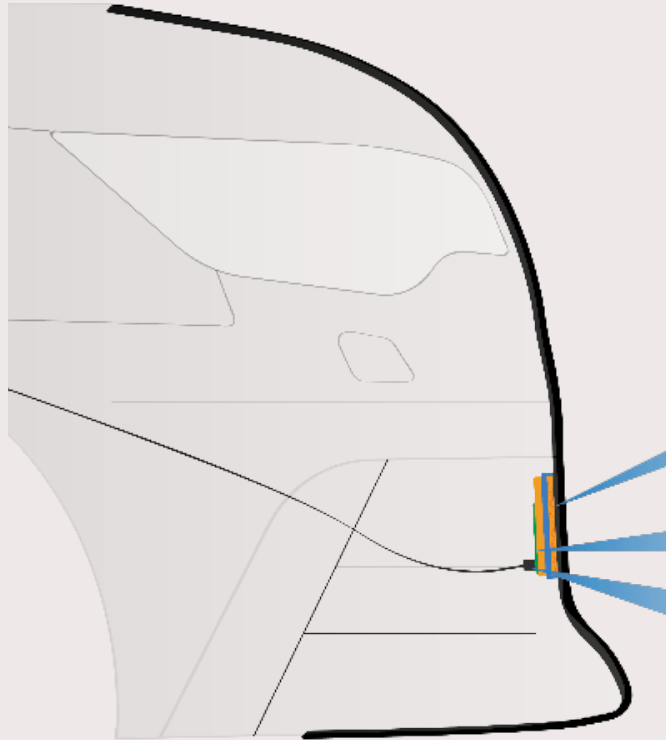
FMCW MIMO radar with 13 TX and 26 RX nodes @ 60 GHz



TU/e



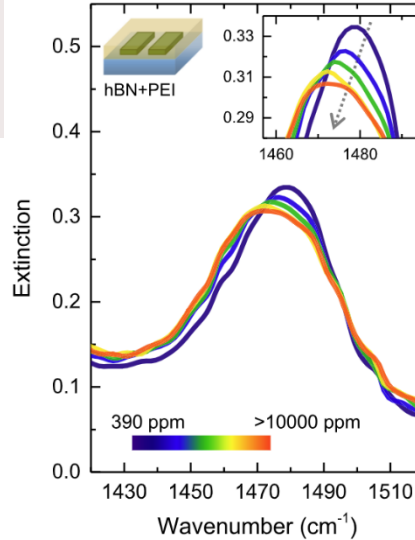
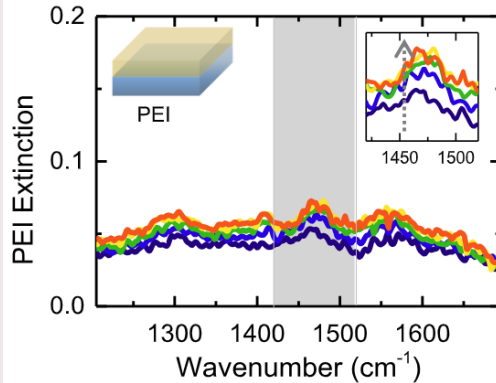
# ... to Platform Integration!



# Advanced remote sensing using metastructures

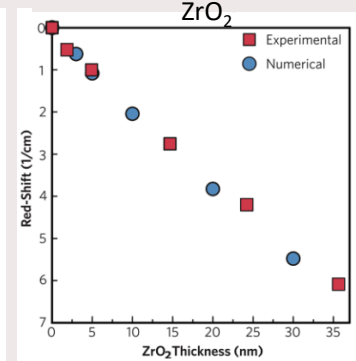
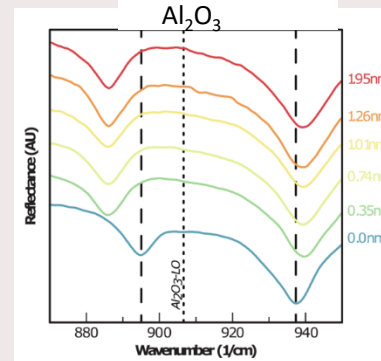
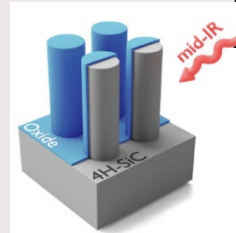
Phonon polaritons (PhPs) are sensitive to refractive index of surrounding medium

- Sensing CO<sub>2</sub> with greatly enhanced sensitivity
- Use of PhPs in hBN gratings with a functionalized layer (polyethyleneimine – PEI)



ACS Photonics 2022, 9, 1, 34–42

- Sensing atomically thin oxide films
- SiC pillars support surface PhPs
- Reflectance depends on oxide layer thickness



ACS Photonics 2018, 5, 7, 2807–2815

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# Ambient Temperature Reflector Feeds

- Ambient Temperature LNAs with  $<10\text{K}$  Noise Figure Reported:

S. Weinreb and J. Shi, "Low Noise Amplifier With 7-K Noise at 1.4 GHz and 25 °C," in *IEEE Transactions on Microwave Theory and Techniques*, vol. 69, no. 4, pp. 2345-2351, April 2021, doi: 10.1109/TMTT.2021.3061459.

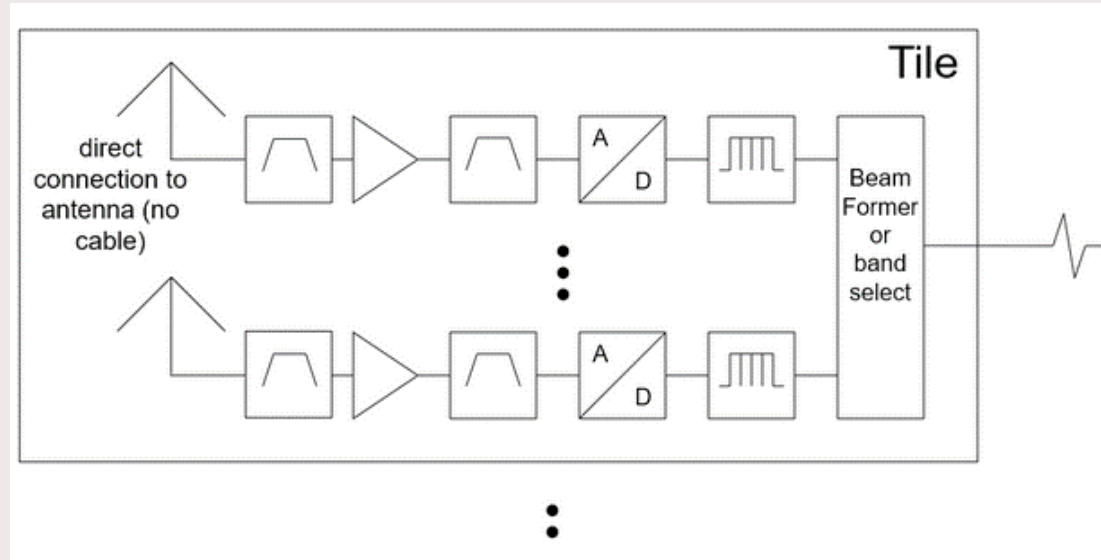
J. Shi and S. Weinreb, "Room-Temperature Low-Noise Amplifier With 11-K Average Noise From 0.6 to 2 GHz," in *IEEE Microwave and Wireless Technology Letters*, doi: 10.1109/LMWT.2023.3315269.



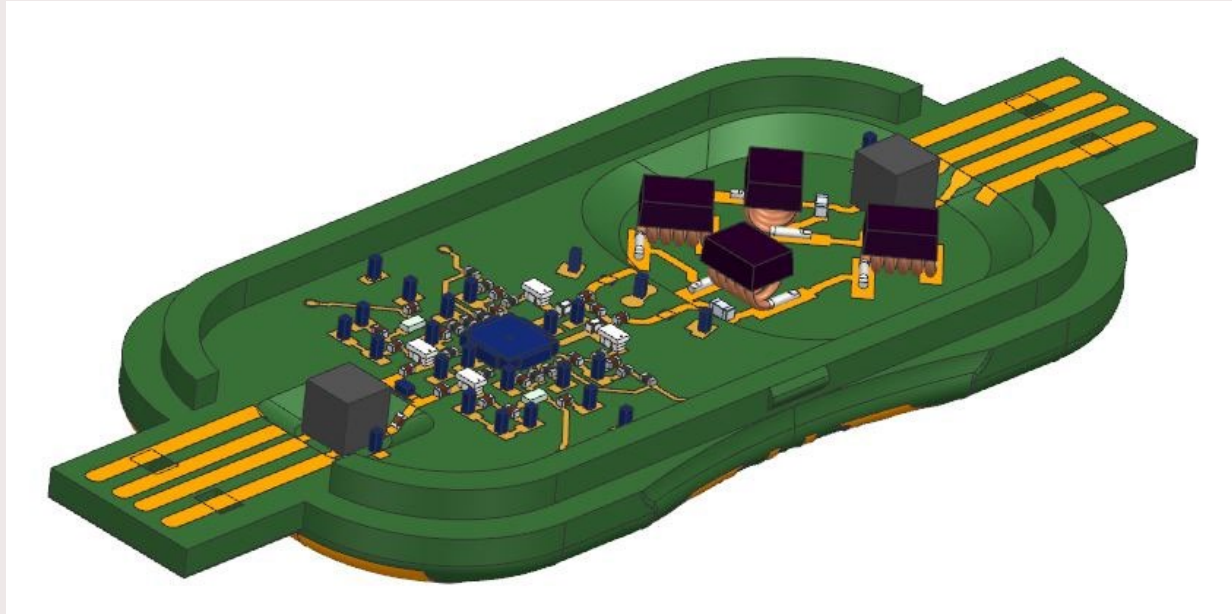
# Low Frequency Array (LOFAR) Telescope



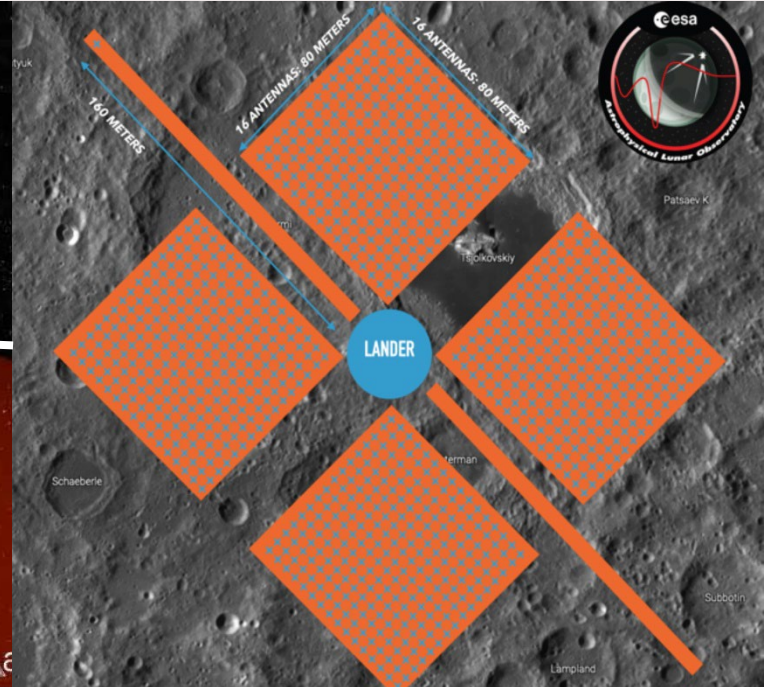
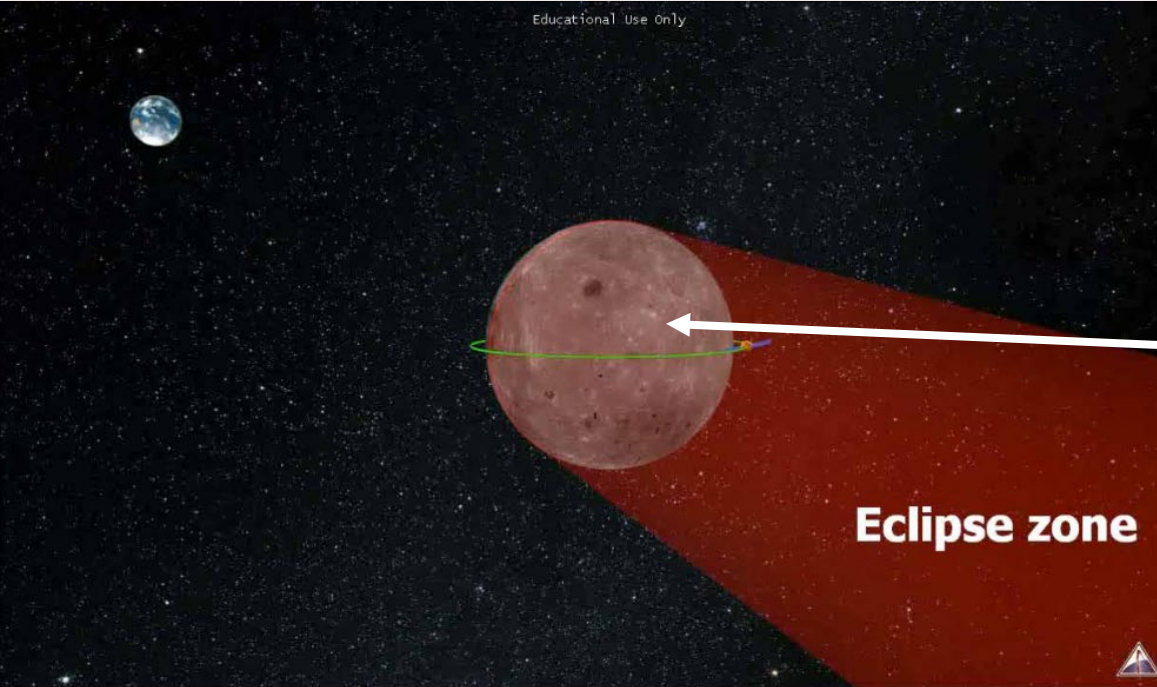
# Integrated Digital Front-End for LOFAR



# 3D-MID Integrated Digital Front-End for LOFAR



# Astrophysical Lunar Observatory





**Thank You!**

# CWTe Project Highlights



*Antenna Systems Experts for 6G Non-Terrestrial Networks*

[www.anterra-project.eu](http://www.anterra-project.eu)

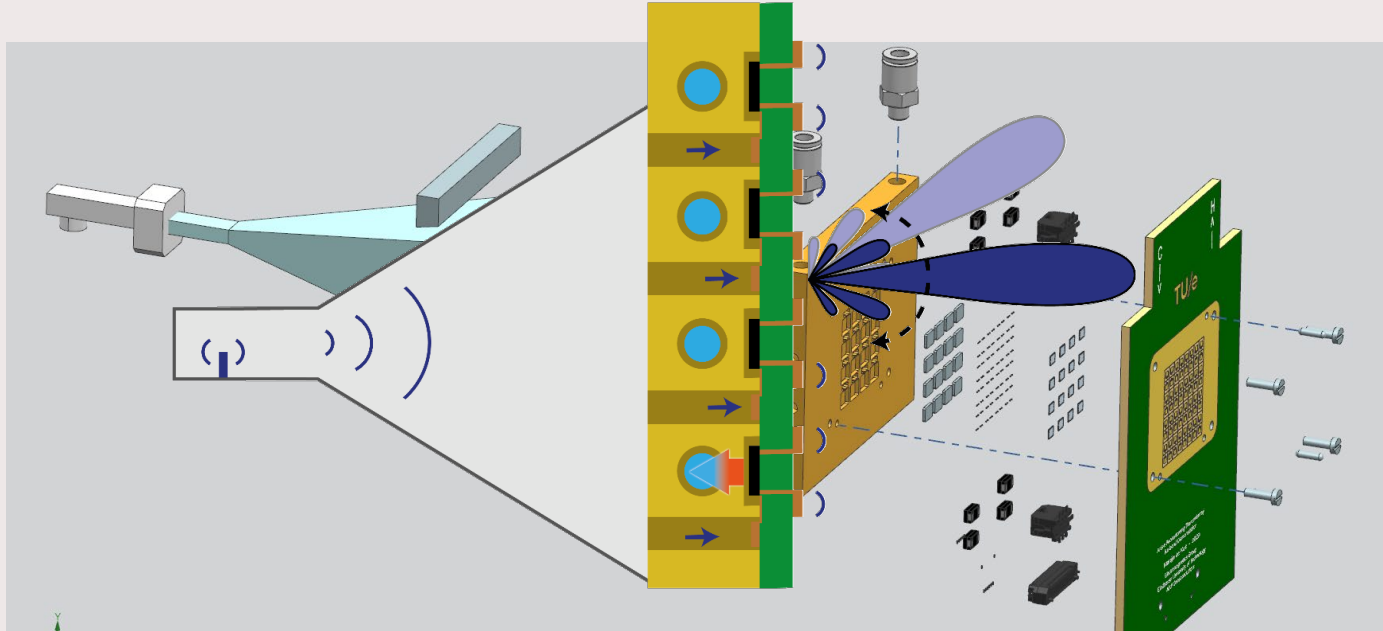


ANTERRA Confidential



**6G FUTURE NETWORK SERVICES**

# Ka-Band Target Tracking Radar Operating Principle



# CWTe Project Highlight

