

ULTRAWAVE

Ultra capacity wireless layer beyond 100 GHz based on millimeter wave Traveling Wave Tubes

ULTRAWAVE

Technology for D-band Point to multiPoint distribution

Horizon 2020

ICT-09-2017: Networking research beyond 5G



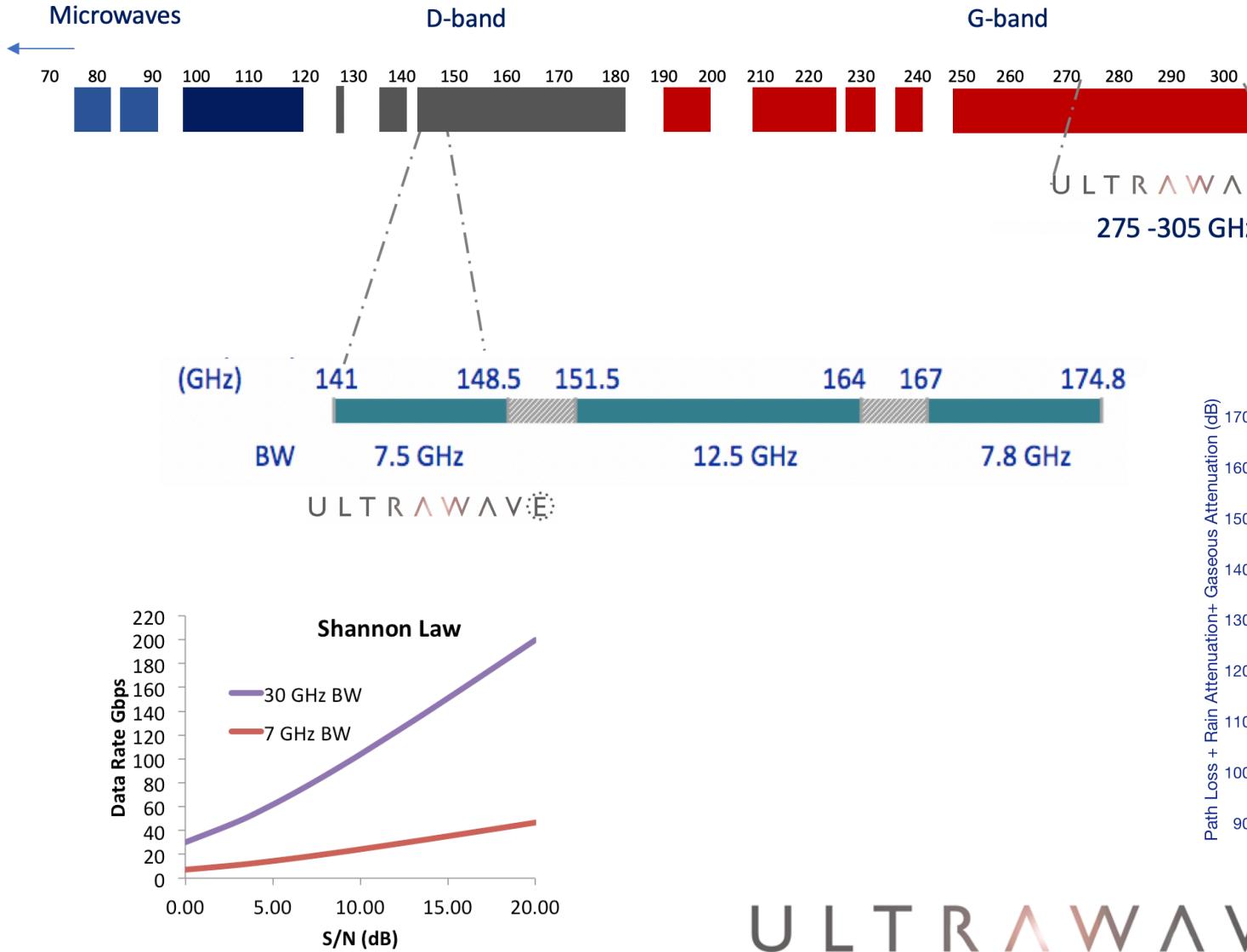
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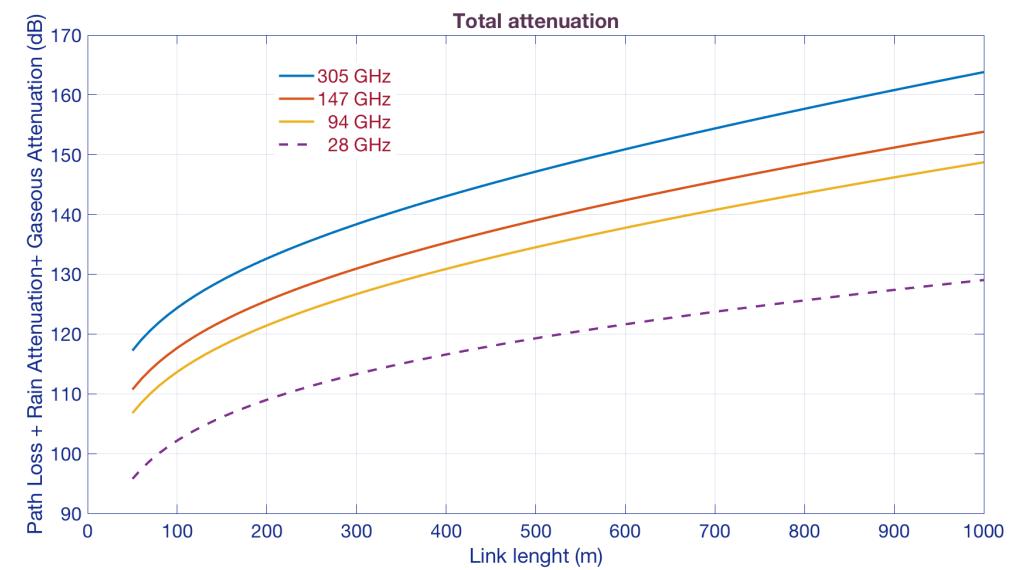
Claudio Paoloni
ULTRAWAVE Coordinator
Lancaster University
UK

Second THz Communications workshop – Brussels – 7th March 2019

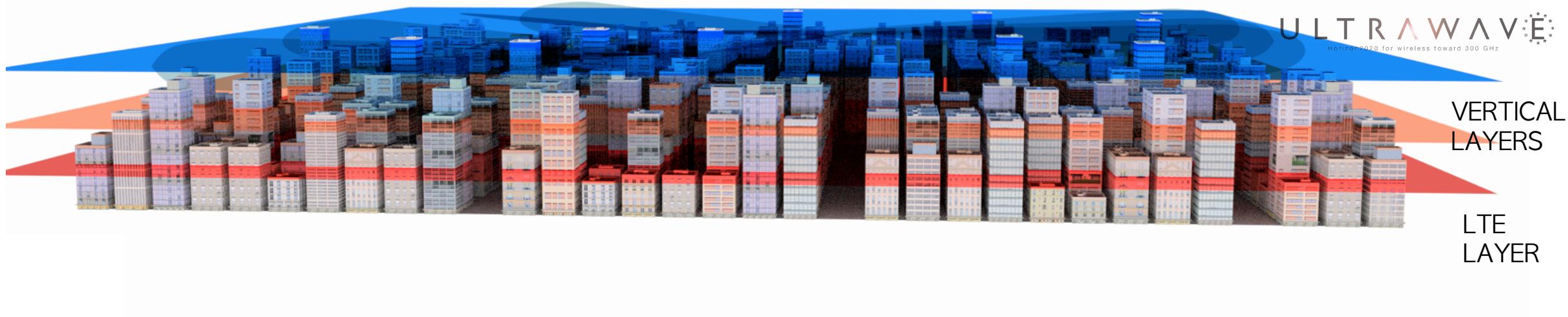
The opportunity: millimeter waves

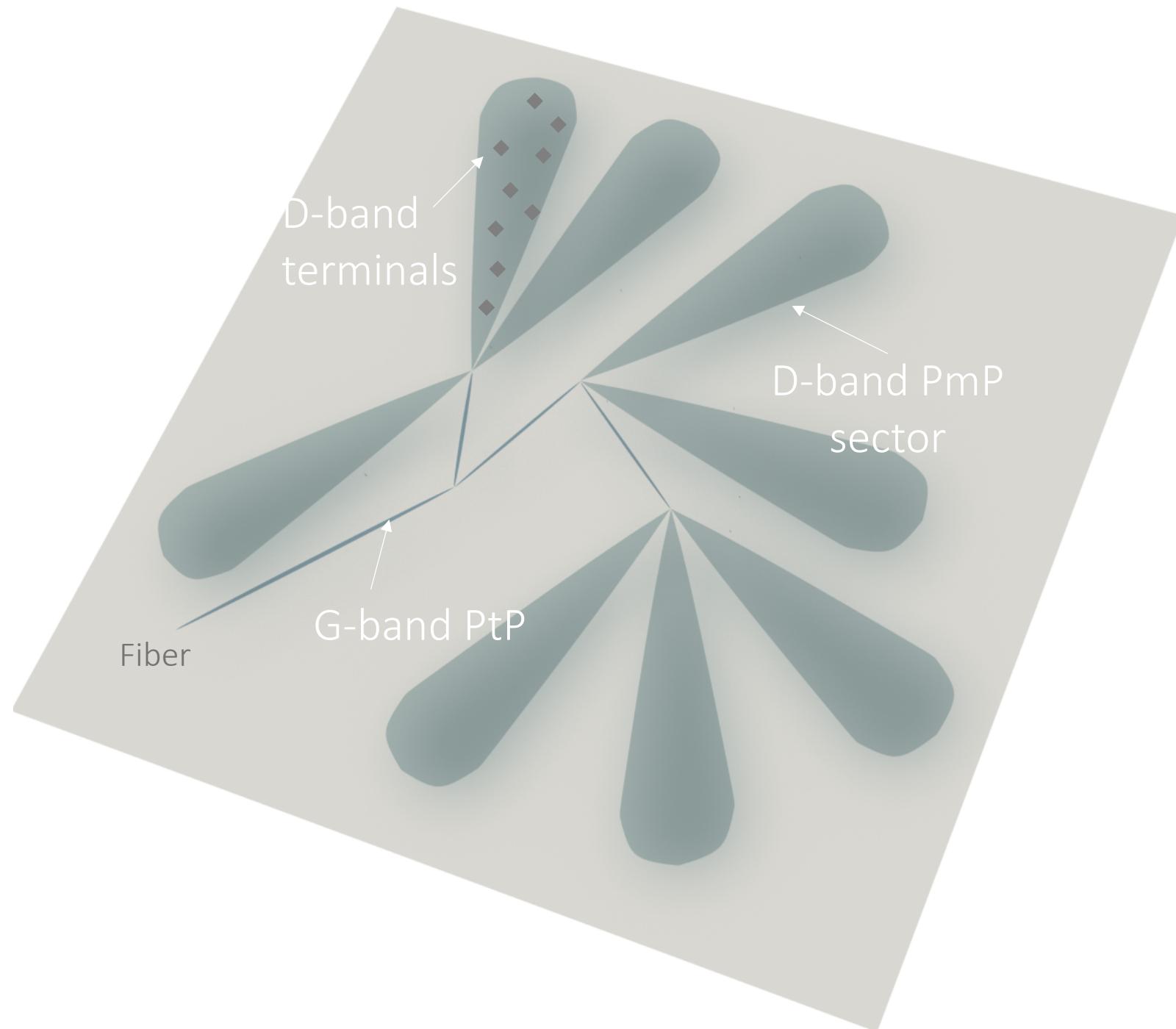


ULTRA WAVE
Ultra capacity wireless layer beyond 100 GHz based on
millimeter wave Traveling Wave Tubes



The concept for ultracapacity layer





ULTRAWAVE
High hierarchy layer

D-band Point to Multipoint
(141 – 148.5 GHz)
high area capacity sectors

connected by
G-band Point to Point
(275 – 305 GHz) links

D-band terminals to distribute
capacity to sub-networks

- Point to multipoint uses one transmission hub for multiple terminals
- Low TCO, about 30% less than Point to Point
 - PtP is difficult to deploy for high density cell architectures.
- Half of the equipment need (1 TH + N Terminals vs. 2N front ends in PtP)
- Dynamic allocation of capacity
- Easier to install
- No frequency planning
- The shortest latency from RAN to EDGE
- Low footprint

Cons

- Higher power amplifier to support a low gain antennas

No enabling power amplifiers are available above 100 GHz

ULTRAWAVE Consortium

Sebastian Boppel



THz MMIC

Marc Marilier



MMIC up to 300 GHz

Ralph Zimmerman
Trung Le



Mm-wave and THz

HF Systems Engineering

Claudio Paoloni
Rosa Letizia



Project Coordinator
Millimeter wave TWTs

Budget €2.9 M
1st September 2017

U L T R A W A V E 
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Antonio Ramirez



Photonics devices and subsystems

Viktor Krozer



THz technologies

Ernesto Limiti



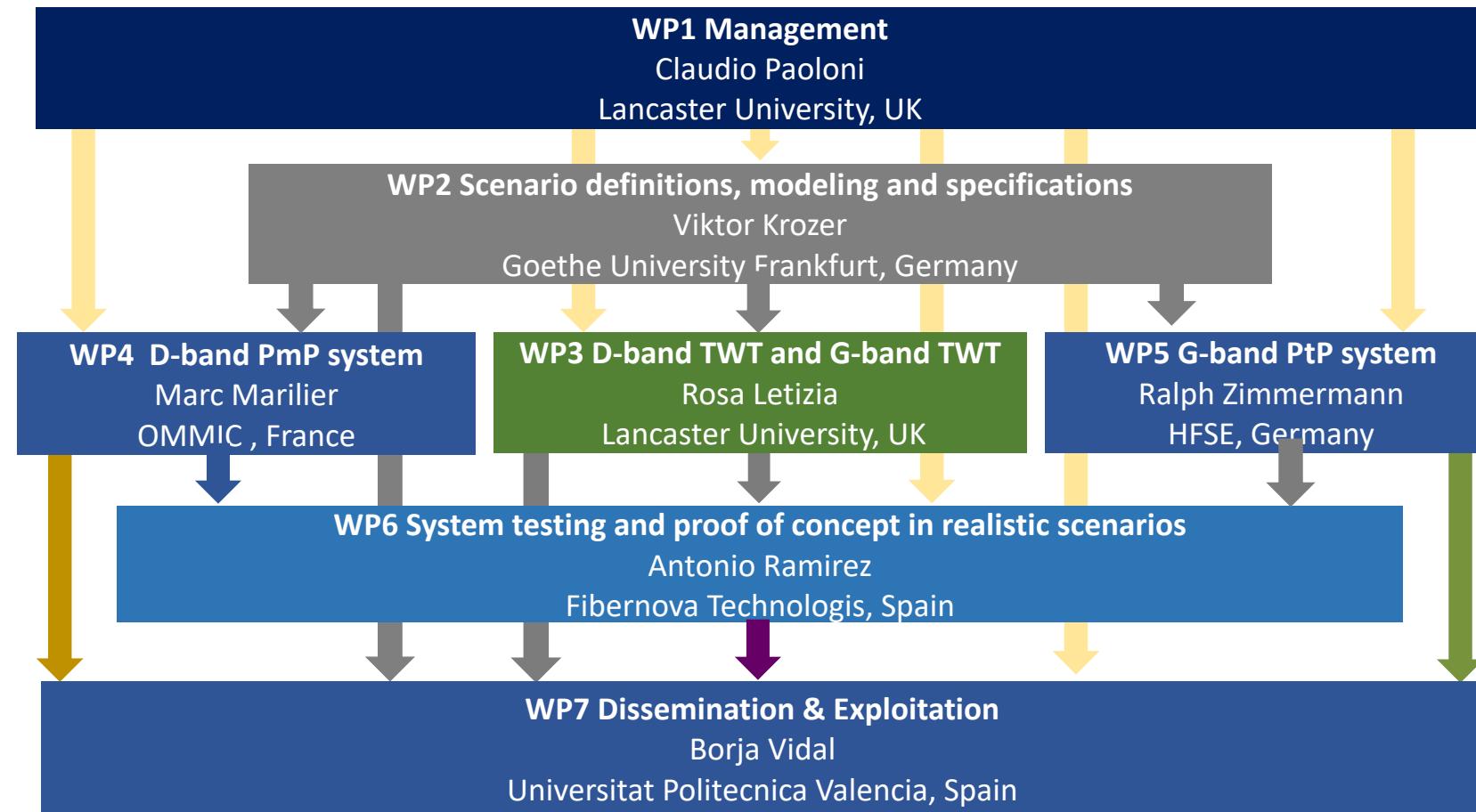
MMIC design and test

François Magne



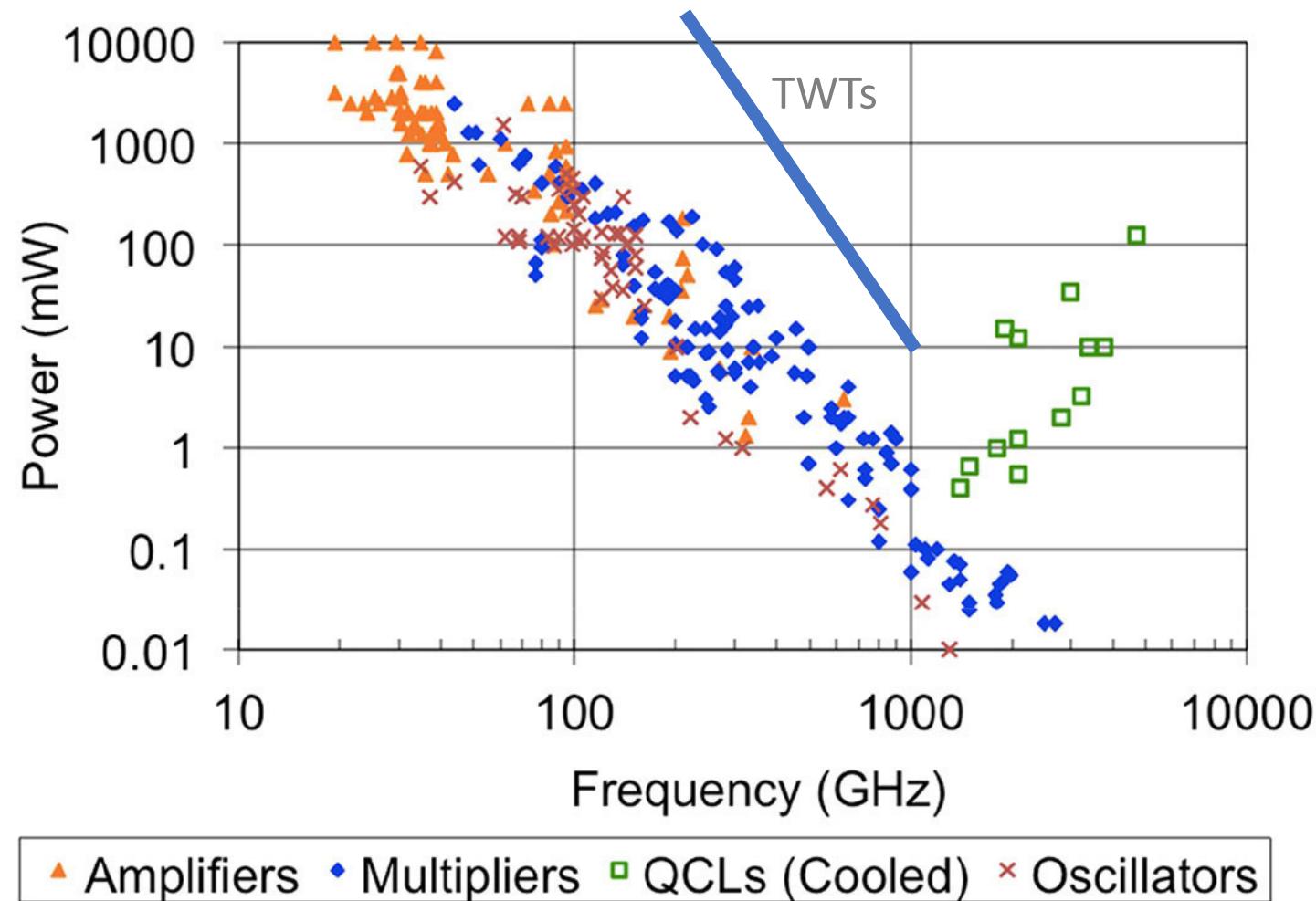
Network architecture

ULTRAWAVE Workplan

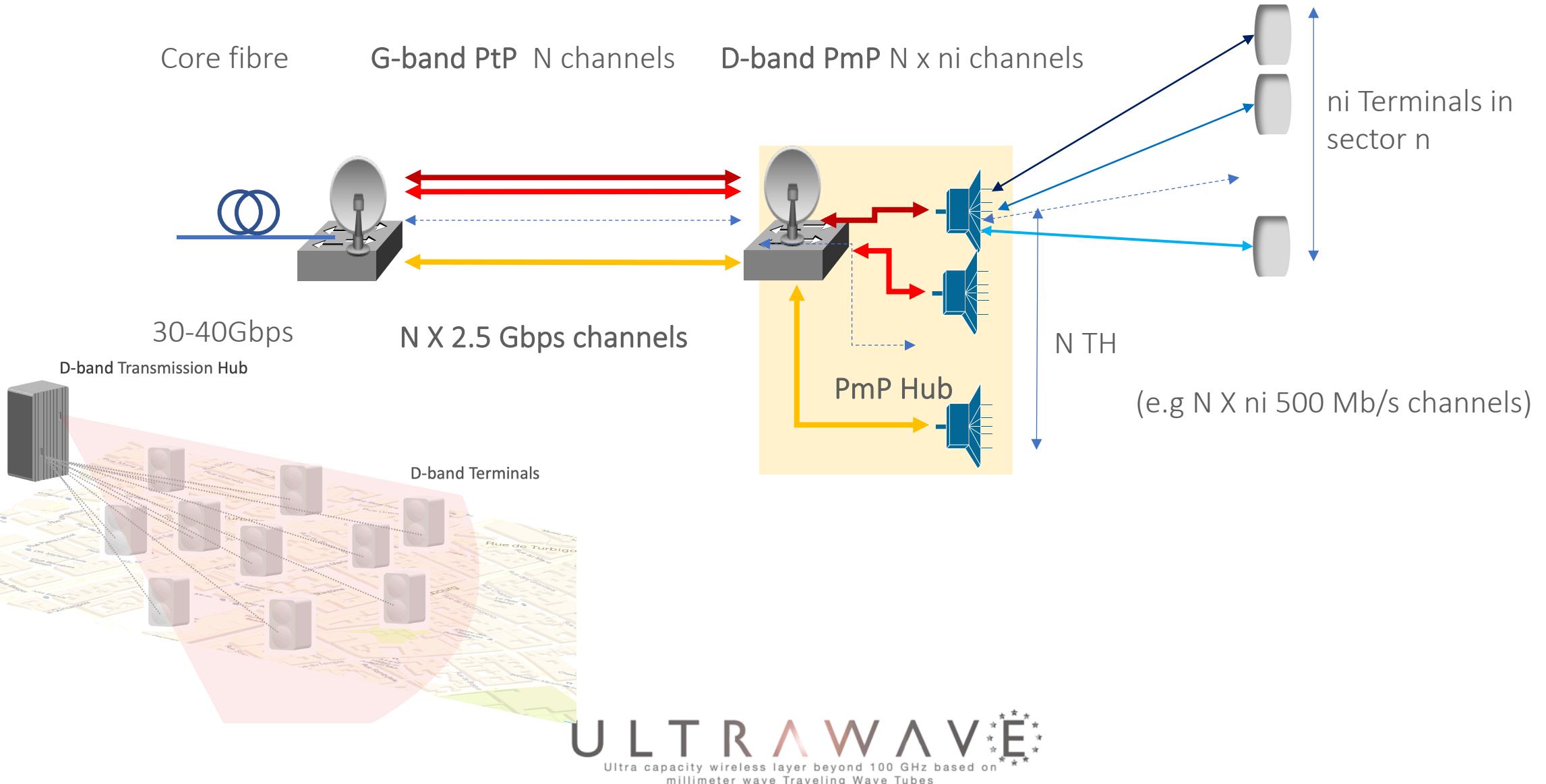


More than 25 Researchers 44 Tasks 347 Person/months 48000 hours

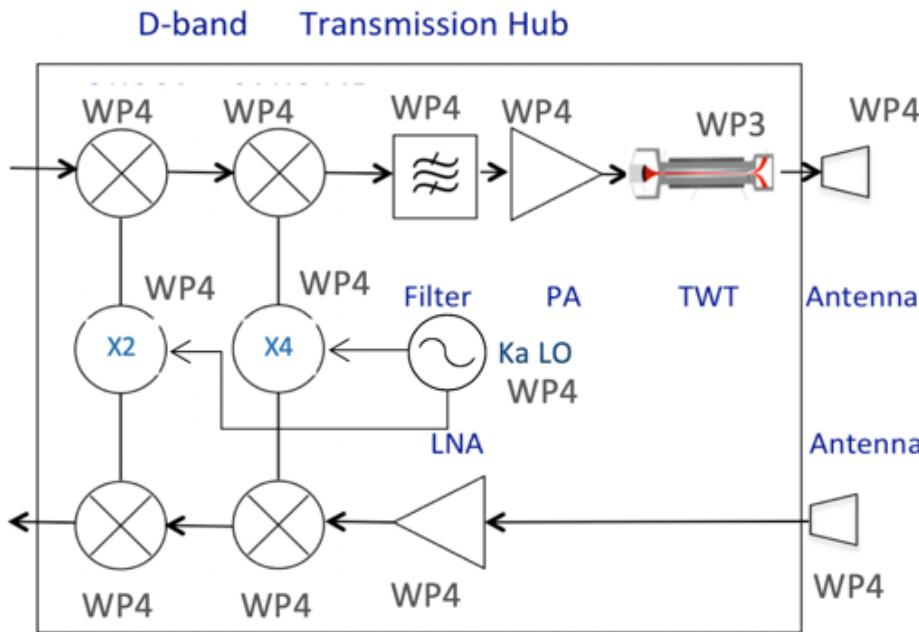
mm-wave solid state power vs. TWTs



Network architecture



D-band Transmission Hub

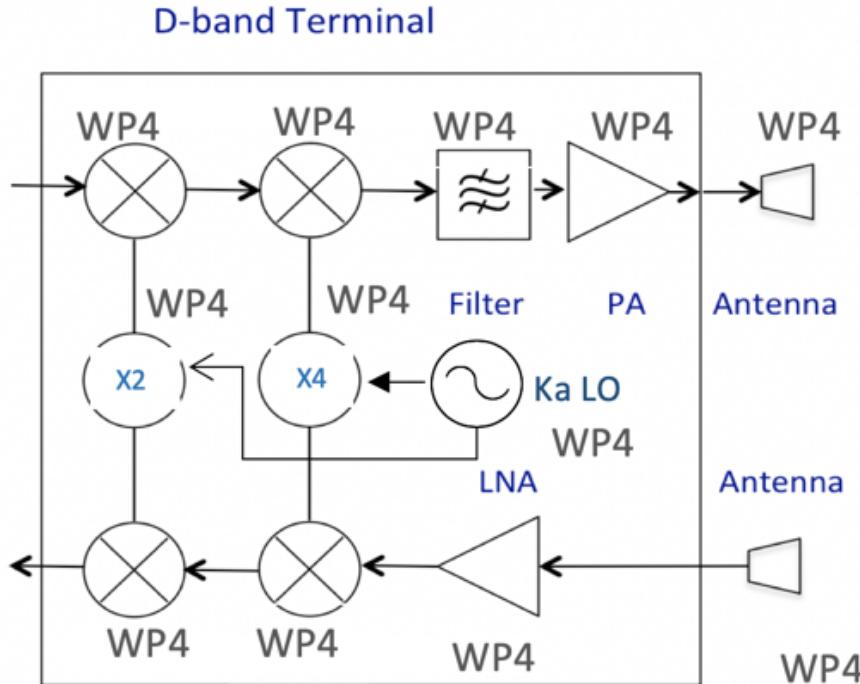


Channel Bandwidth 250 MHz
Modulation 16 / 64QAM
Data rate up to 1 Gbps
Up to 20 Channels
Area Capacity >150 Gbps/km²

D-band Transmission Hub (141 – 148.5 GHz)

- D-band TWT
 - 10 - 13 W output power, 40 dB gain
- Chipset GaAs
 - Driver amplifier 17 - 20 dBm
 - Low noise amplifier 5 dB NF
 - X2 and X4 multipliers
- Horn Antennas 25 dBi (30 degrees)
- Range PmP 600 – 700 m

D-band Terminal



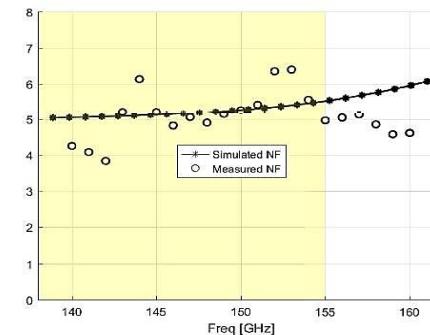
D-band terminal (141 – 148.5 GHz)

- Same chipset improves the cost
- Chipset GaAs
 - Power amplifier 17 – 20 dBm
 - Low noise amplifier 5 dB NF
 - X2 and X4 multipliers
- Lens Antenna 39 dBi (2.5 degrees)
- Range PtP 600 – 700 m

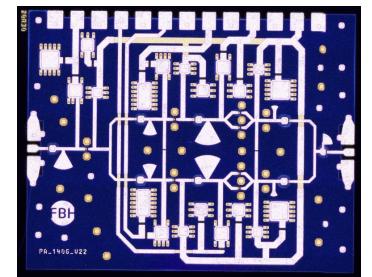
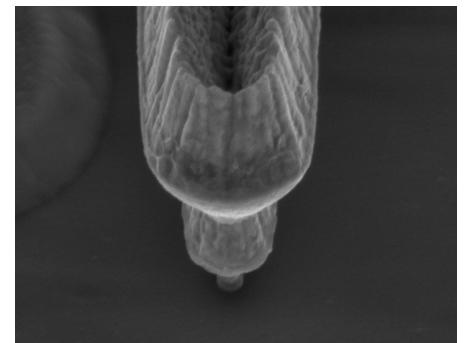
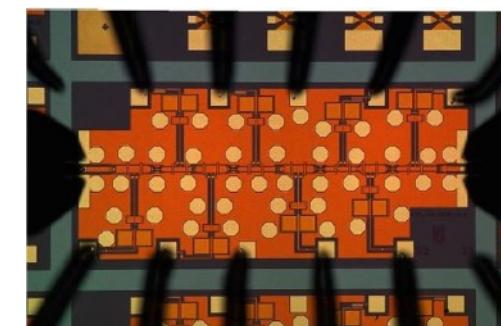
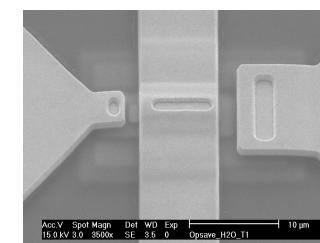
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D-band Chipset - Amplifiers

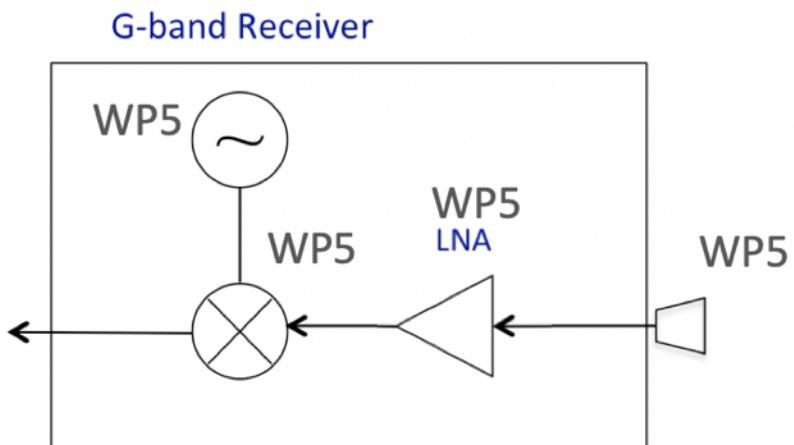
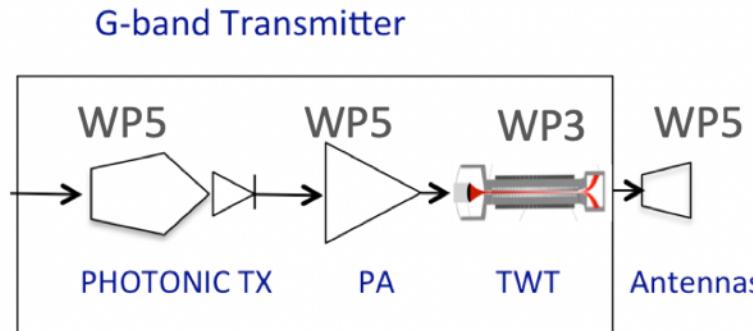
- D-Band Low Noise Amplifier
- OMMIC 40 nm metamorphic process
- Band = 141-151GHz; Gain = 20dB; NF = 5dB



- D-Band Power Amplifier
 - FBH InP DHBT Process fmax=450/530 GHz
 - 800 nm / 500 nm HBTs
 - Medium power 10 dBm
 - High power 19 dBm



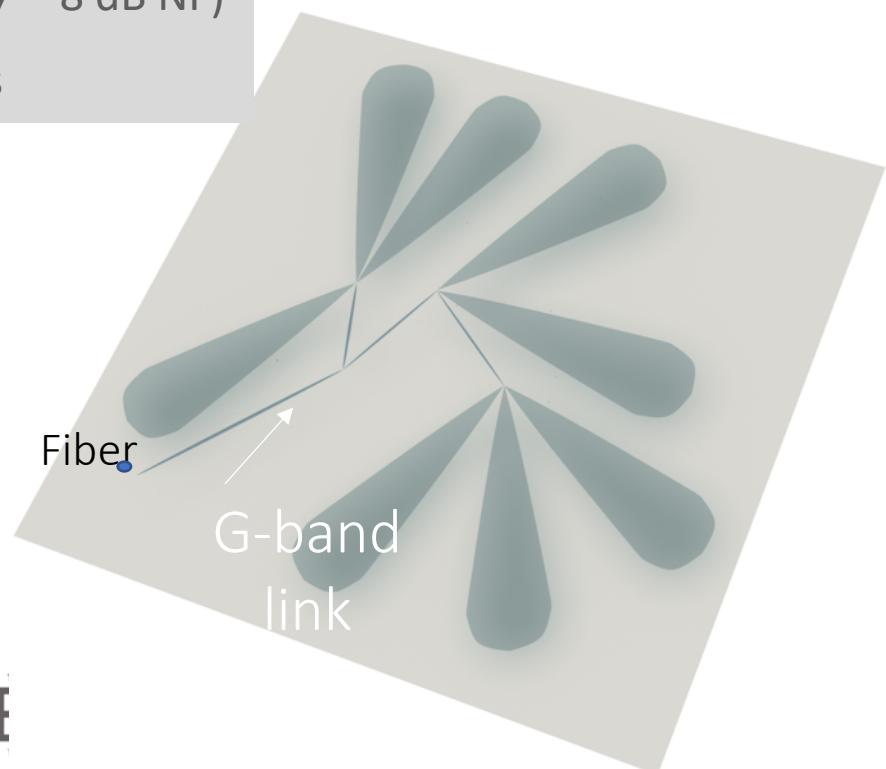
G-band front end for Point to point



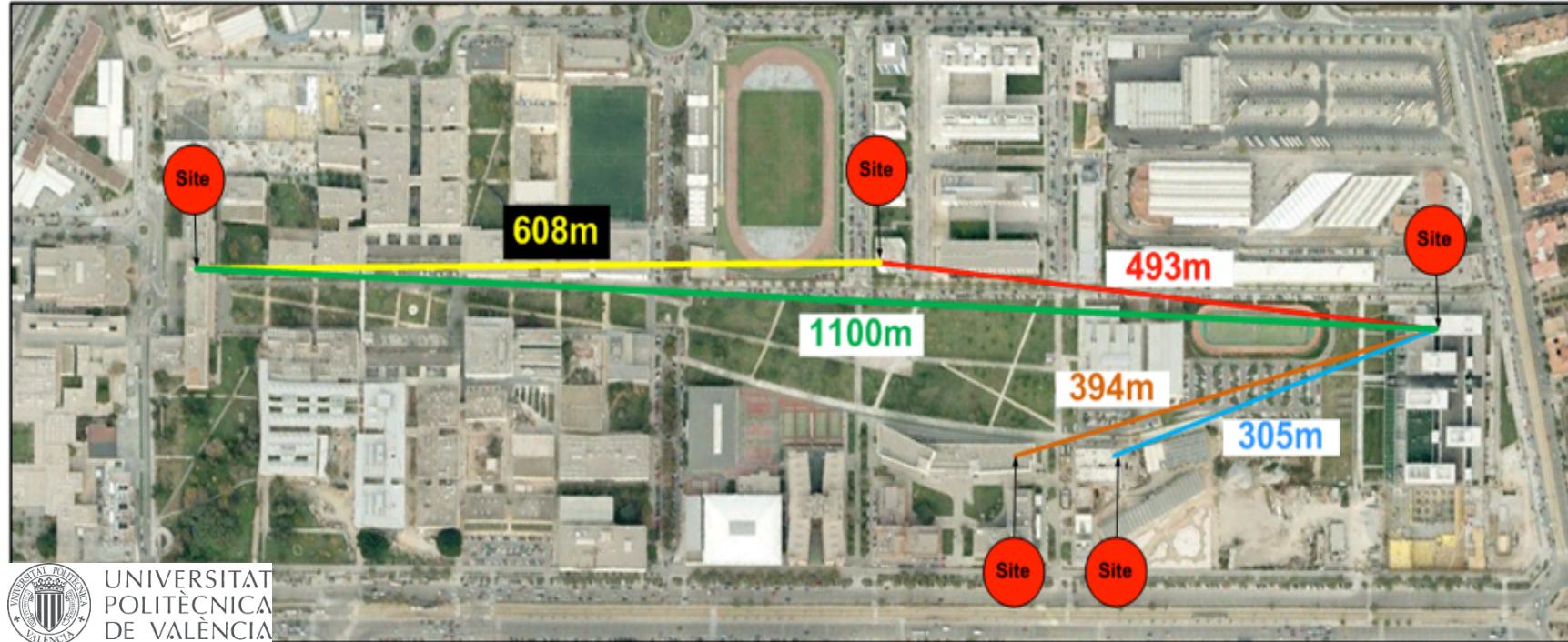
G-band front end (275 – 305 GHz)

- Novel TWT
 - 1-3 W output power, 30dB gain
- MMIC InP DHBT Power amplifier 10 mW
- 300 GHz Low Noise Amplifier (7 – 8 dB NF)
- Optical transmitter for 48 Gbps

Bandwidth 30 GHz
Modulation QPSK
Data rate 40 Gbps
Range PtP 600m



Test and field test





Thank you!

We are developing European technology to make real the ULTRAWAVE concept

The ULTRAWAVE project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement no 762119.

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