T3 Towards TeraHertz Transmissions

BEAMS
SCEE

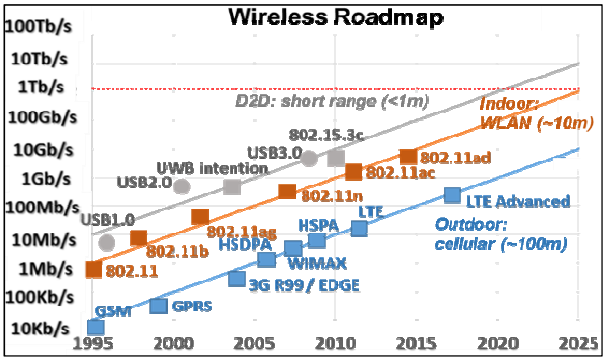
Context of T3 project

Wireless data traffic is growing by a factor of 100 every 10 years

It is estimated that the demand for data rate in wireless networks increases by 40% up to 70% year upon year

⇒ the wireless networks will need to deliver as much as several hundreds of times the capacity as compared to the current levels

To attain data rates of the order of 1 Tbps* (or even some good fraction of it), *a very broad bandwidth of several tens of GHz will be required.



Wireless standards roadmap, from the ITRS (International Technology Roadmap for Semiconductors http://www.itrs2.net/)

Technical challenges for THz transmisions

- **Electromagnetics: highly efficient & high-gain flat antennas**
  - Compensating the huge path loss (102 dB at 300 GHz for a typical indoor distance of 10 m) by using very efficient and high-gain antennas
  - innovative flat antenna architectures must be invented
- **Signal processing and digital communications**
  - choice of the waveform (multi-carrier, single carrier, constant envelope)
  - the associated receivers (synchronization, channel estimation, equalization, etc.) and analog to digital design are considered as major bottlenecks
- **Advanced materials, and fabrication / packaging technologies for THz systems**
  - Due to the so-called THz gap, the standard fabrication streams and packaging techniques currently used at microwave frequencies (PCB, waveguides) and in optics (semi-conductors, thin film processes) are not suitable – or must evolve drastically
  - low-loss materials suitable for circuit and antenna design must be identified and characterized

Work done in T3 project

Antenna design (IETR/BEAMS with UC3M – Madrid)

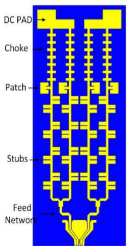
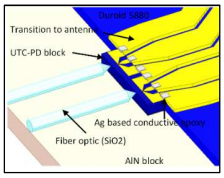
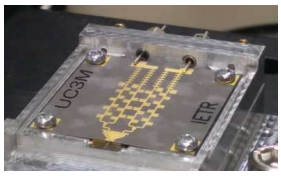


Photo-diode excited antennas



Thickness : 127 µm

ε_r = 2.2 ; tanδ=0.003

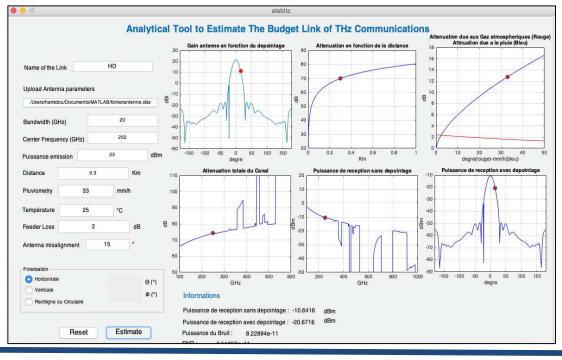


Optical power: 45 mW.
Error-free data transmission:
- **Bit rate: 2.15 Gbit/s (OOK)**
- **Distance: 25 cm**

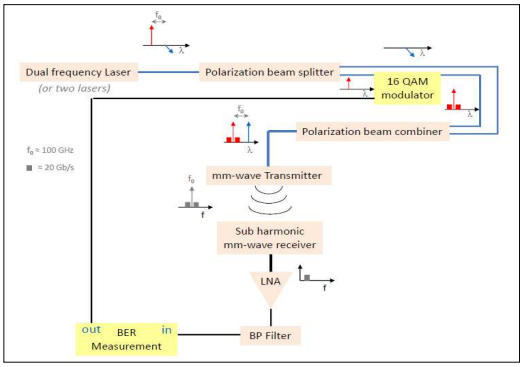
Dissemination :
- One seminar held at IETR (Sept. 2019) : 30 attendees.
- 3 publications (2 at IRMMW-THZ 2019, 1 at Journées du Club Optique micro-ondes).

Link Budget in THz communications (IETR/SCEE)

Tool developed taking into account : path loss, humidity, pluviometry, Feeders losses, antenna misalignment, transmit power, carrier frequency



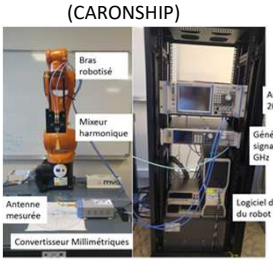
THz pre-testbed with optical carrier generation (FOTON)



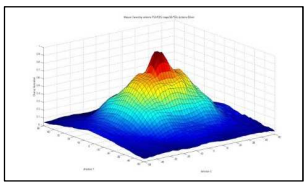
Use of Persyst testbed (Lannion) to establish the performance

THz metrology (Lab-STICC)

Characterization device (CARONSHIP)



Far-field antenna measurement



Fresnel lens characterization :