



Reconfigurable Architectures for Wireless Sensors Networks

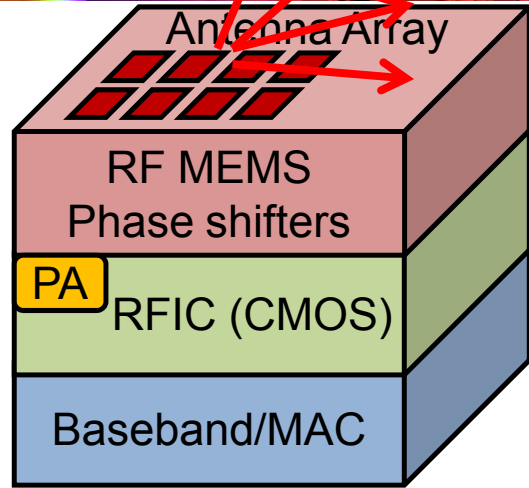
PHY layer (band base and RF) and MAC layer

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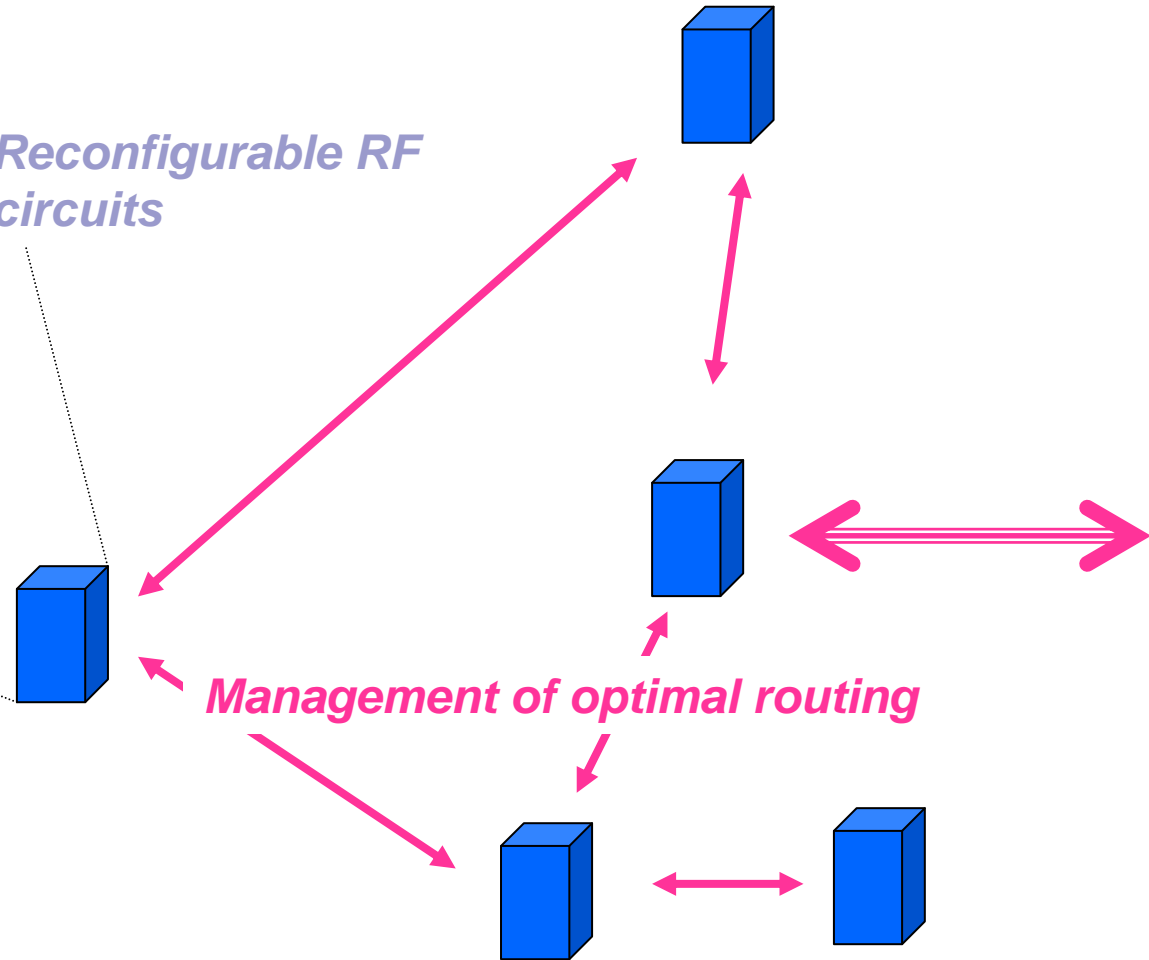
**Micro and NanoSystems for Wireless Communications Group
LAAS-CNRS, University of Toulouse
France**

Reconfigurable antenna using MEMS RF



Reconfigurable RF circuits

Hardwave/Software Reconfigurable telecommunication



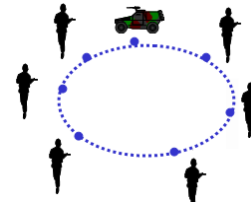
Management of optimal routing

How to use the reconfigurable antenna to obtain optimal routing and optimal power consumption ? French – Japanese Workshop 2009

Research fields

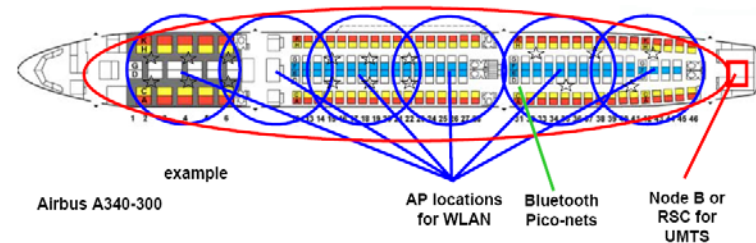
- ❖ UWB transmission

- * IR-UWB
- * OFDM / SC-FDMA
- * 60 GHz
- * MAC layer



- ❖ Circuit design

- * Baseband and MAC
- * CMOS 60 GHz RF IC design

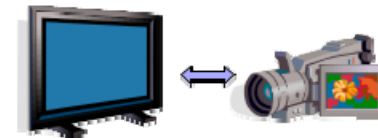


- ❖ Smart antenna

- * Beam-forming using phase shifter

- ❖ Simulator for WSN

- * Network architecture
- * MAC layer



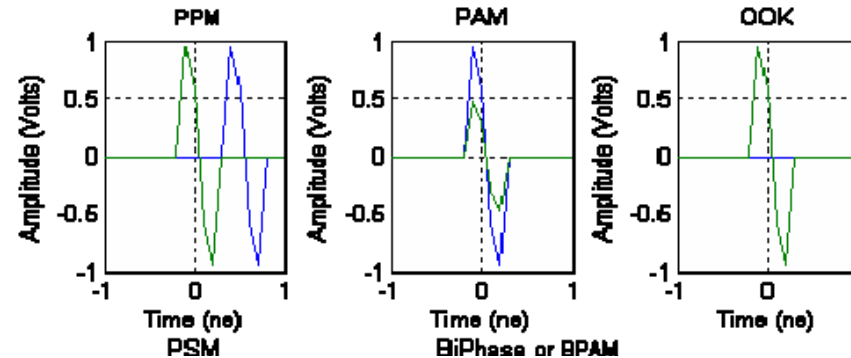
- ❖ Flexible substrate integration

- ❖ Applications : aerospace, military, high data rate WPAN, structure health monitoring

- ❖ **Perspectives** : instrument the hospitals, **health field – body monitoring**

IR-UWB

❖ IR-UWB



* Emitter – receiver architecture

- * Mixed architecture : digital – analog RF front end → 60GHz
- * Mostly Digital architecture → high reconfigurability

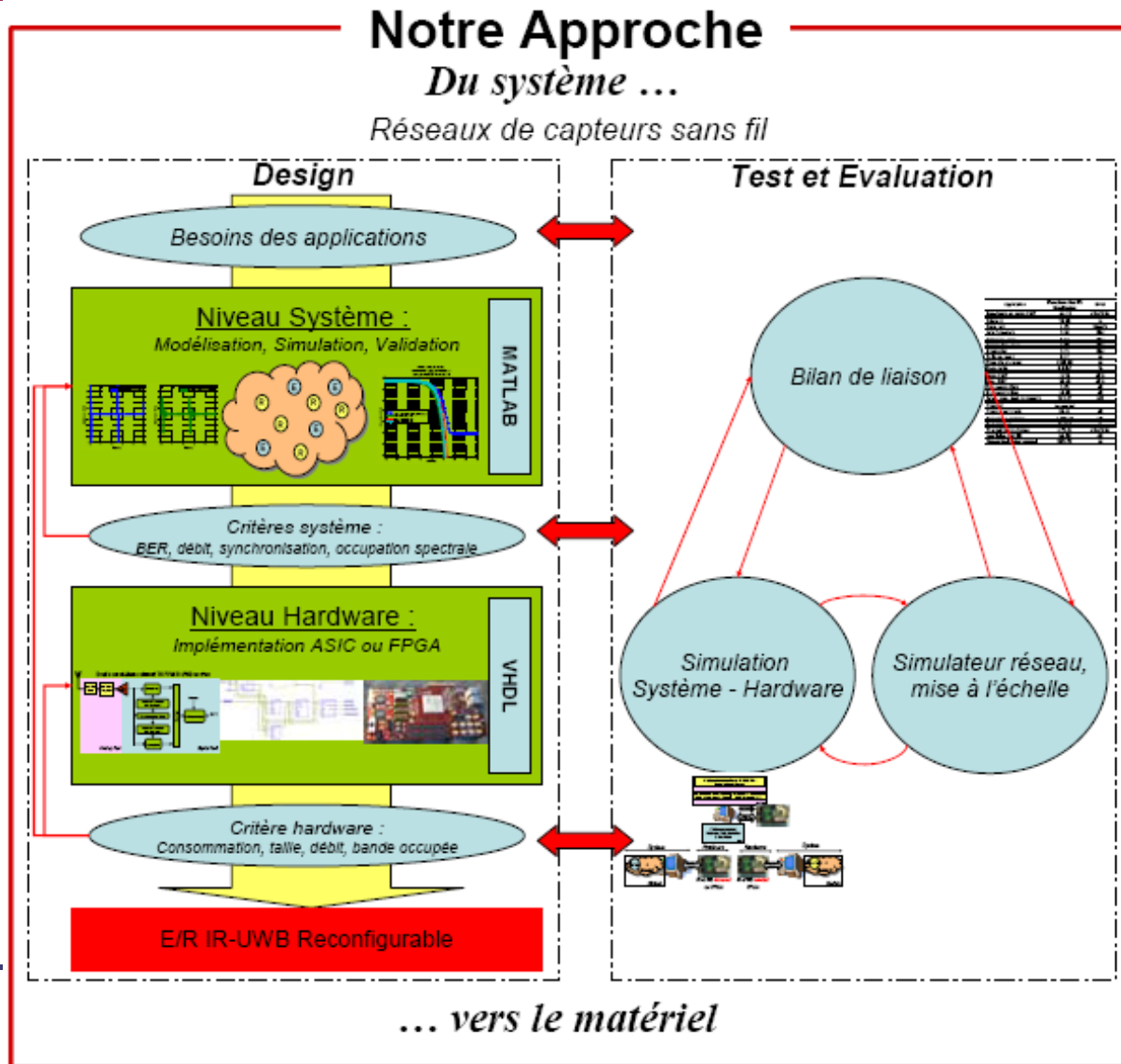
* High data rate →

- * channel capacity → directive antenna and 60GHz
- * transceiver architecture

* BER

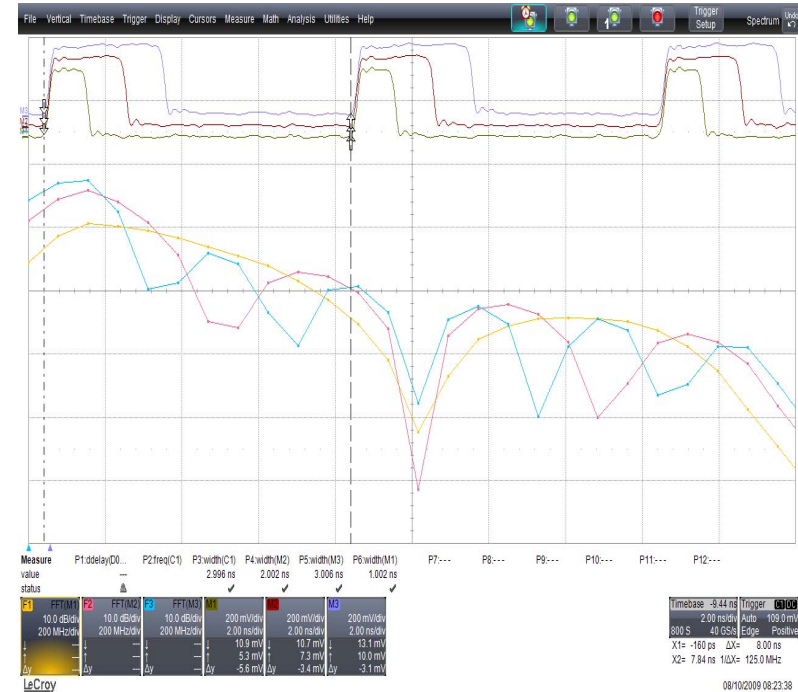
* MAC layer for IR-UWB

From system down to hardware

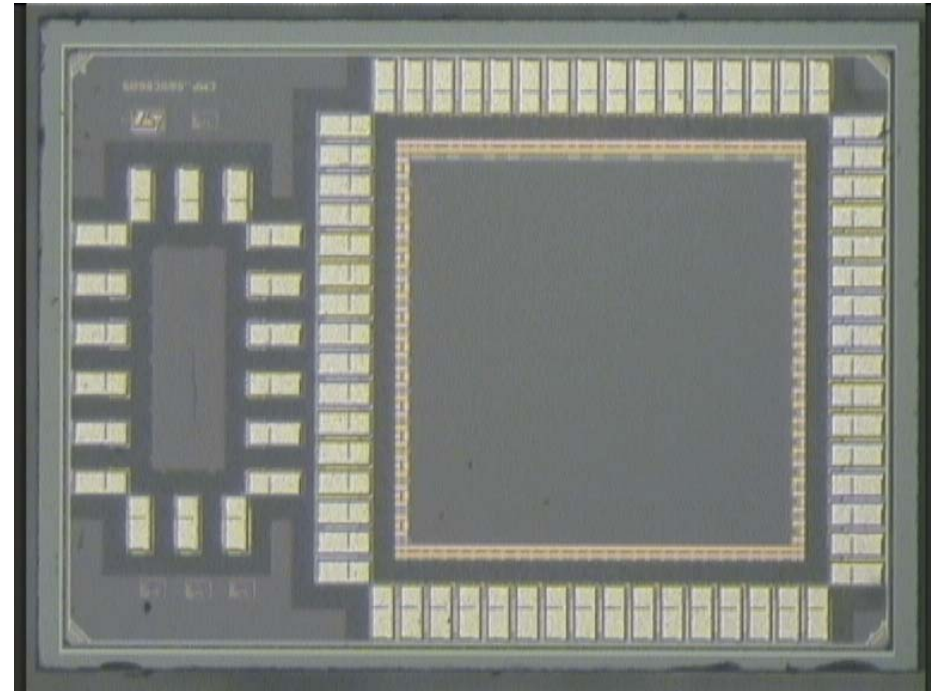
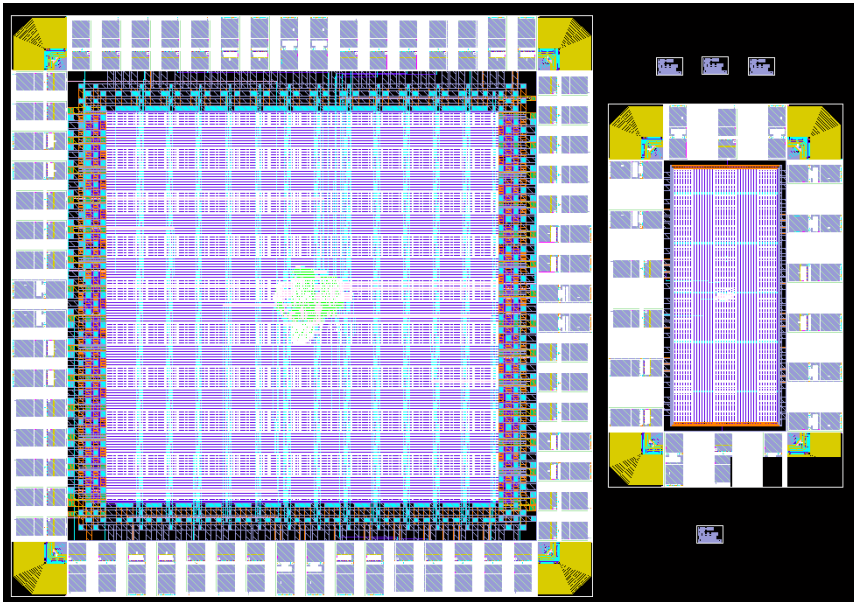


FPGA prototypes

- * IR-UWB multi user emitter and receiver
- * IR-UWB receiver with localization function
- * IR-UWB reconfigurable transceiver in modulation, pulse duration, spectral occupation, data rate and user code
- * IR-UWB reconfigurable transceiver at **120Mb/s** – state of art: 50Mb/s presented at ICC 2008

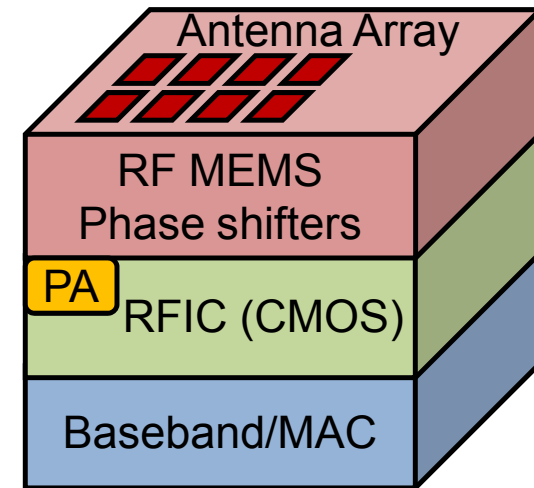
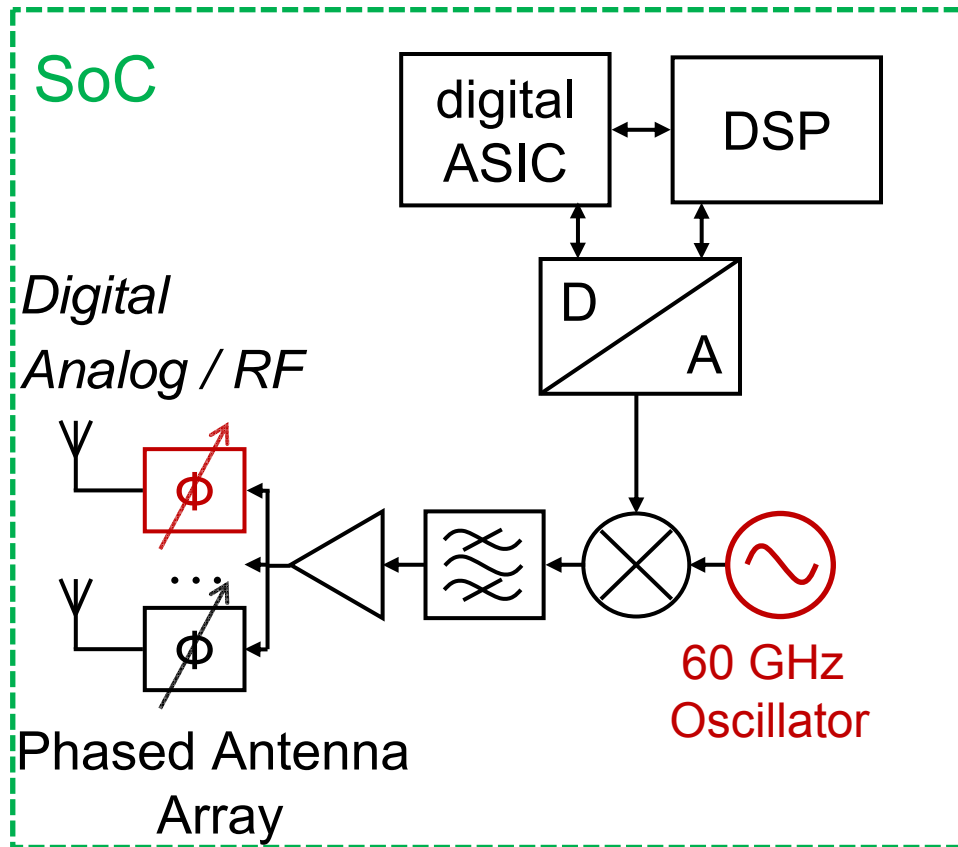


ASICs - low power emitter UWB-IR

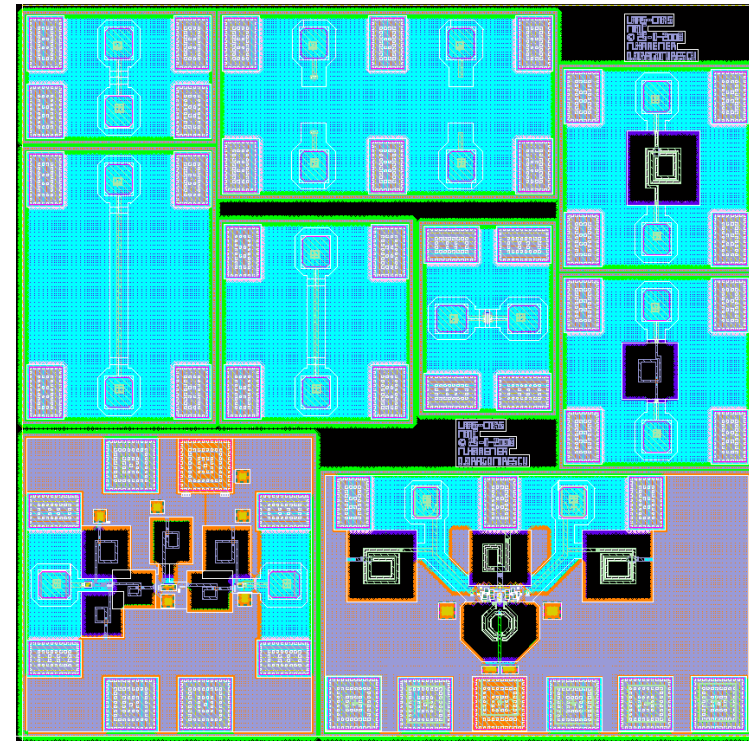
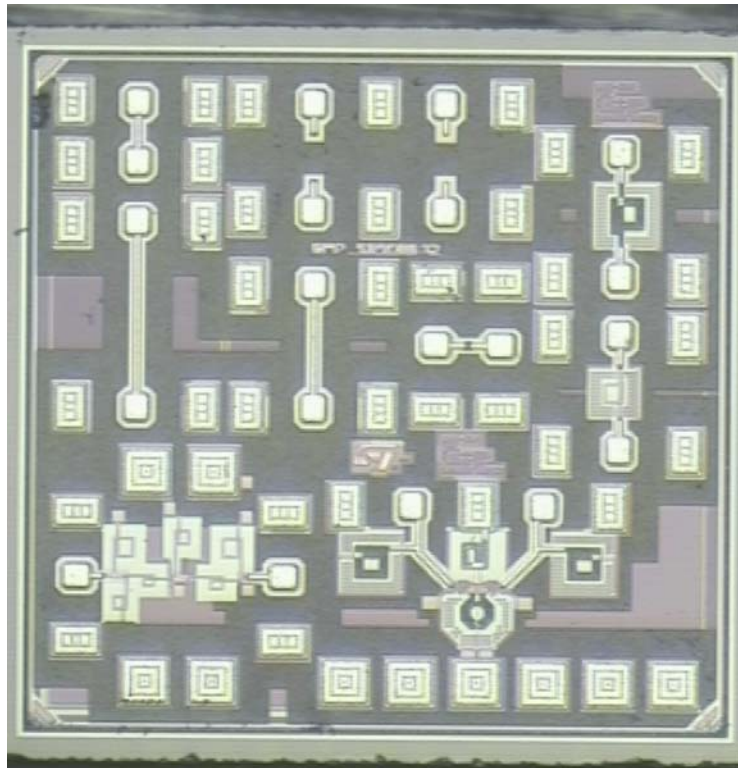


Emitter UWB impulsionnel
CMOS 65nm

Architecture for 60GHz implementation



Low power ASICs at 60GHz

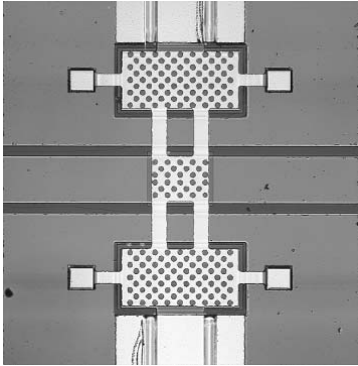


Technology : CMOS 65nm
 Low power LNA ($P=8.5\text{mW}$) and VCO 60GHz
 Inductances 60GHz : 50pH – 300pH

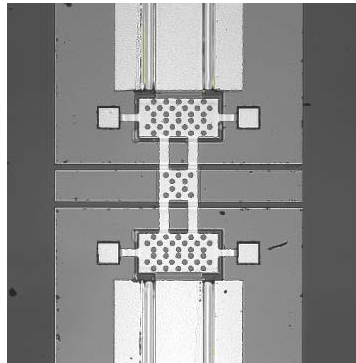


MEMS RF and Phase Shifters @60GHz for smart antenna

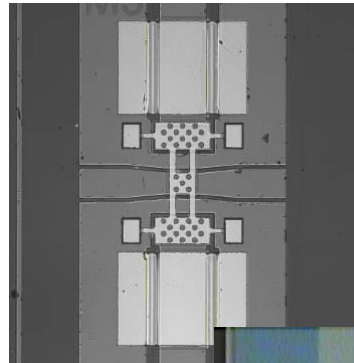
RF MEMS and phase shifters @ 60GHz



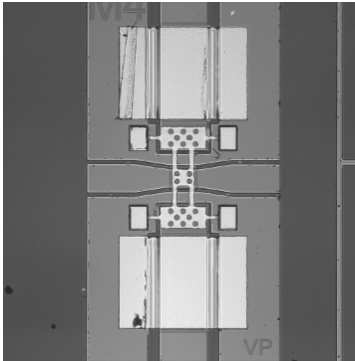
20-GHz MEMS



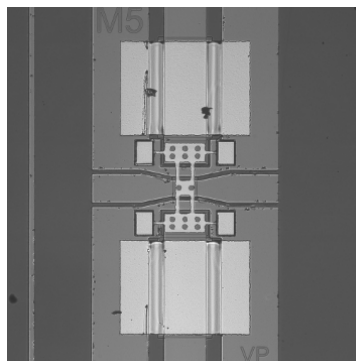
35-GHz MEMS



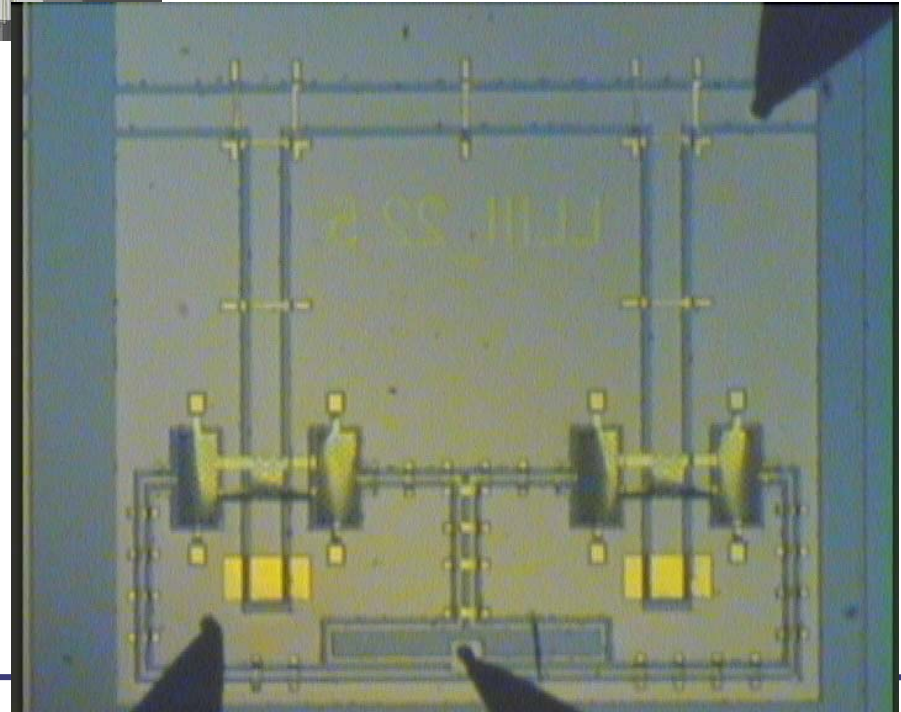
60-GHz



77-GHz MEMS



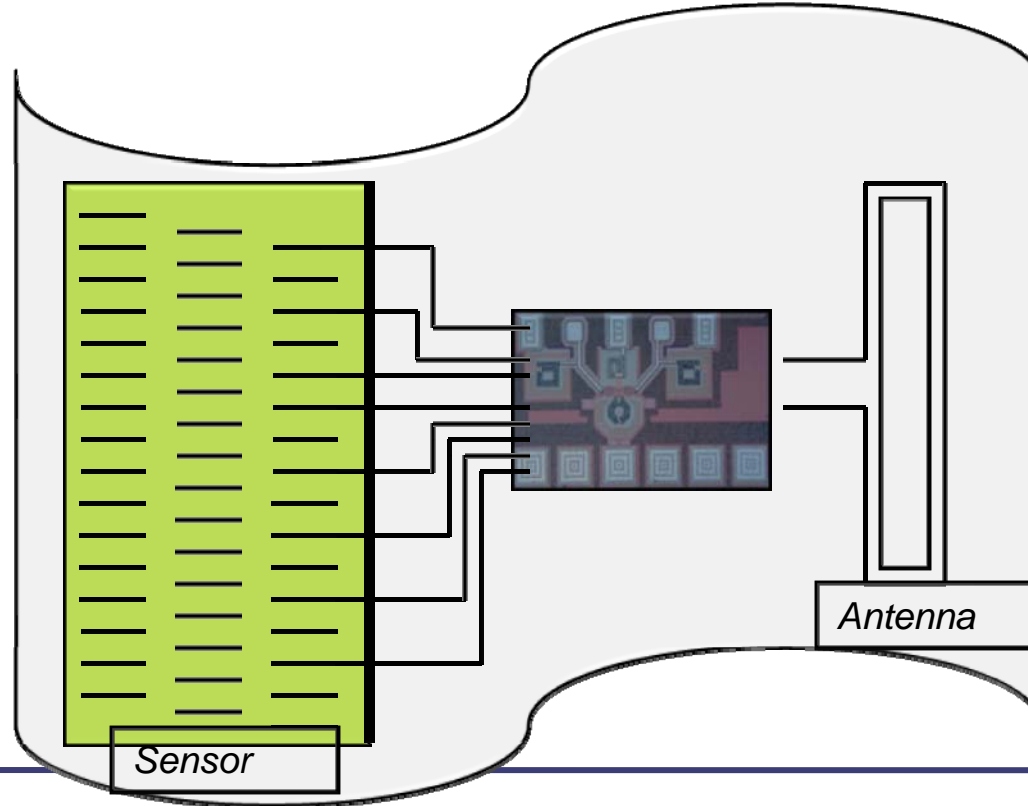
94-GHz MEMS



Flexible substrate integration

❖ Work in progress

- ✳ Low power transceiver integrated on flexible substrate together with the sensor and the antenna



French – Japan possible future collaboration

- ❖ **WSN for human body monitoring**
- ❖ **Challenges**
 - * Developing **bio compatible** new technology on flexible substrate
 - * Developing sensors on flexible substrate
 - * Possible collaboration with LIMMS
 - * Sensor Networking
 - * Developing ultra low power transceiver architectures
 - * LAAS-CNRS



WSN Conclusion

- ❖ UWB impulse radio reconfigurable emitter and receiver developed on FPGA
- ❖ Impulse radio UWB emitter on ASIC developed → very low power (1.3pJ/bit)
- ❖ Very low power 60GHz architectures in progress on ASIC
- ❖ 60GHz MEMS RF designed and fabricated in LAAS-technology
- ❖ Flexible substrate technology for WSN in progress
- ❖ Possible French – Japan collaboration on body monitoring



Autonomous Wireless Sensor Node

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French – Japan collaboration

Autonomous Wireless Sensor Node

