

Challenges and research priorities:

•Reconfigurable cross layer communication architecture to obtain energy aware wireless sensor network → **Function co-location**

•New design paradigm : **energy aware system** (hardware-software) design

•Develop new nanometric reconfigurable very low power wireless communication architectures robust to electromagnetic interferences and multi path. **IR-UWB communication is a very good candidate** → **Dark Silicon**

•Propose very low power and reconfigurable MAC layer architectures adapted for Wireless Sensor Network, including measurements synchronization protocol

•Today energy nJ/bit → tomorrow pJ/bit → after tomorrow : zero power energy when including harvesting energy. **IR-UWB communication is a very good candidate.**

•**Flexible substrate integration:** Develop new smart antenna on flexible substrate to allow energy efficient routing

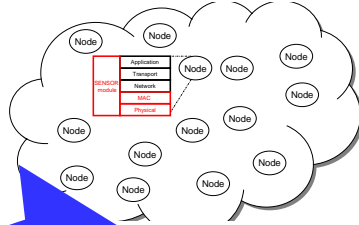
•Put together passive wireless sensor network and active wireless sensor network

•Set up an advanced **predictive** Wireless Sensor Network simulation platform

Road-map

Toward Energy efficient wireless sensor network

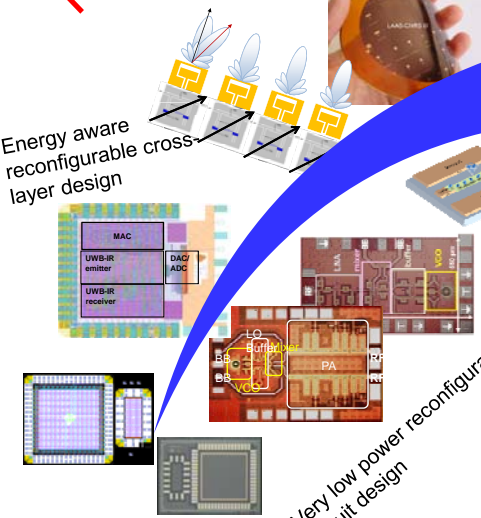
Smart antenna on flexible substrate for energy efficient routing



Flexible substrate integration

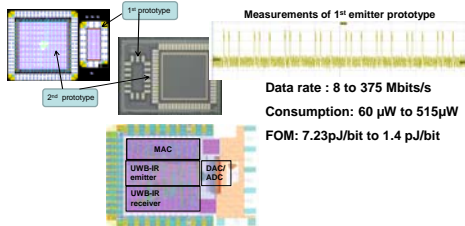
To investigate Carbon-based technology

Very low power reconfigurable circuit design



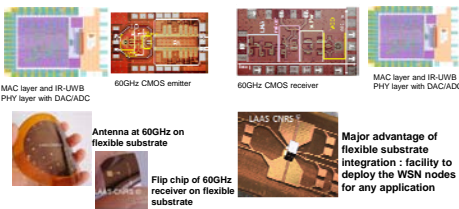
Very low power reconfigurable digital IR-UWB Phy layer

- IR-UWB emitter – CMOS nanometric technology .Low complexity digital design : fast and reliable
- 1st emitter prototype : without DAC, 1 bit output, OOK modulation
- 2nd emitter prototype: energy efficient reconfigurability in data rate, distance, modulation, impulse form, impulse duration;
- Toward a cross-layer prototype with adaptive and reconfigurable MAC layer included



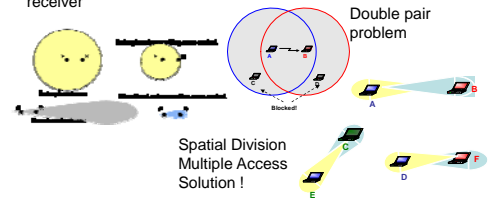
Toward very low power wireless energy efficient communication architectures and flexible substrate integration

- Very low power, reconfigurable IR-UWB CMOS circuits
- In home clock synchronization protocol WiDeCs and MAC layer for networking
- New 3D packaging : complete communicating node integration on flexible substrate
- Advantages of 60GHz : Low interferences → very interesting for high number nodes WSN



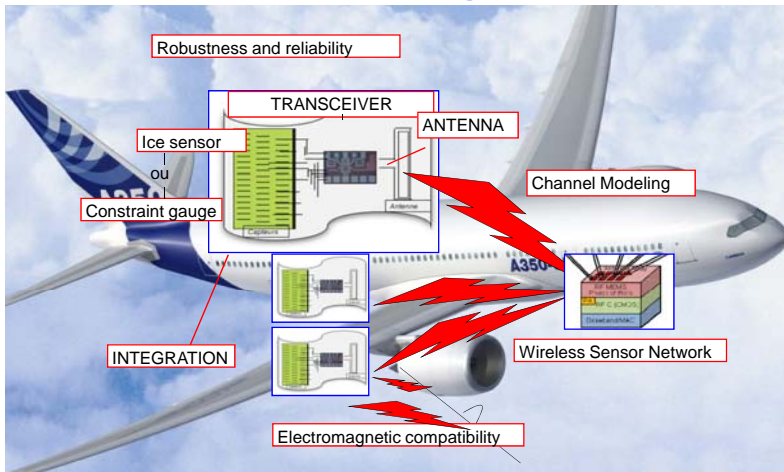
Benefits of smart antennas on routing protocols → energy efficiency

- Smart antenna :
 - **Beam Direction** : Focus on the receiver, avoid interferences
 - **Power Control** : Power consumption and autonomy
 - **Better ratio** : energy transmitted / energy for reaching the receiver



Rethink Network, MAC and PHY Layer !

Aeronautic applications : toward greener, safer aircrafts



Ambient Intelligence LAAS-CNRS Platform ADREAM

- real world test of energy efficient WSN

