



# Intro to NOVA MEMS

2007

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**Xavier LAFONTAN**

General manager

# Corporate intro

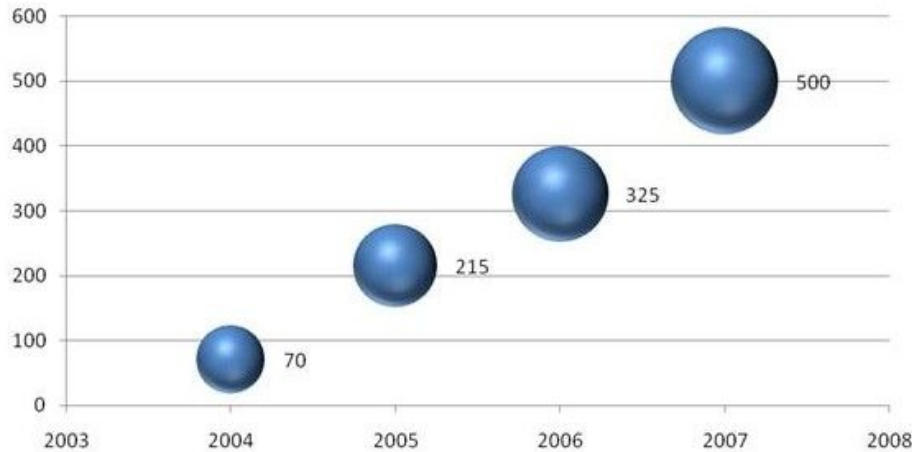


- Created in november 2003
- Based on a technological spin-off with CNES and LAAS
  - In the field of failure analysis of micro and nano technologies (no fabrication)
  - Share of know-how and equipments
  - Self funded growth
- Engineering company in Micro and Nano Technologies
  - Advanced research and expertise in multiphysic integrated technologies
  - Design of embedded systems for MEMS Manufacturers and End-users
  - Integration of wireless network and MEMS sensors
- Staff : 11 people

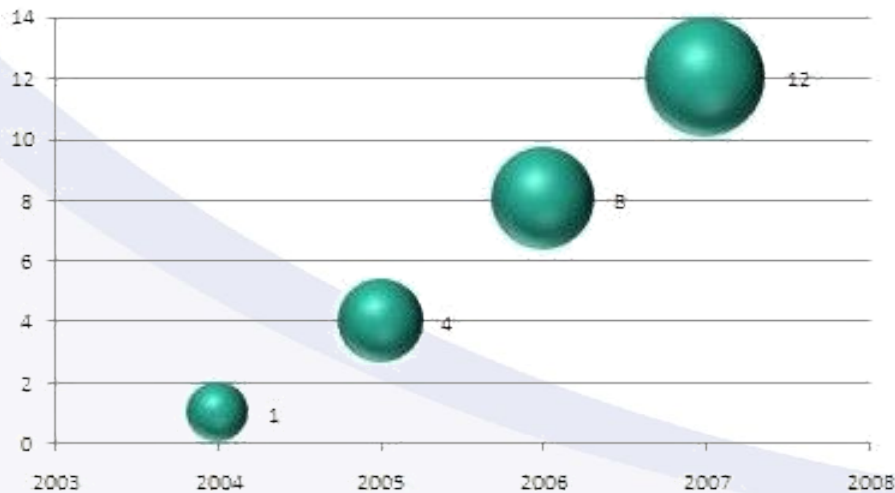


# Key figures

INCOMES (k€)



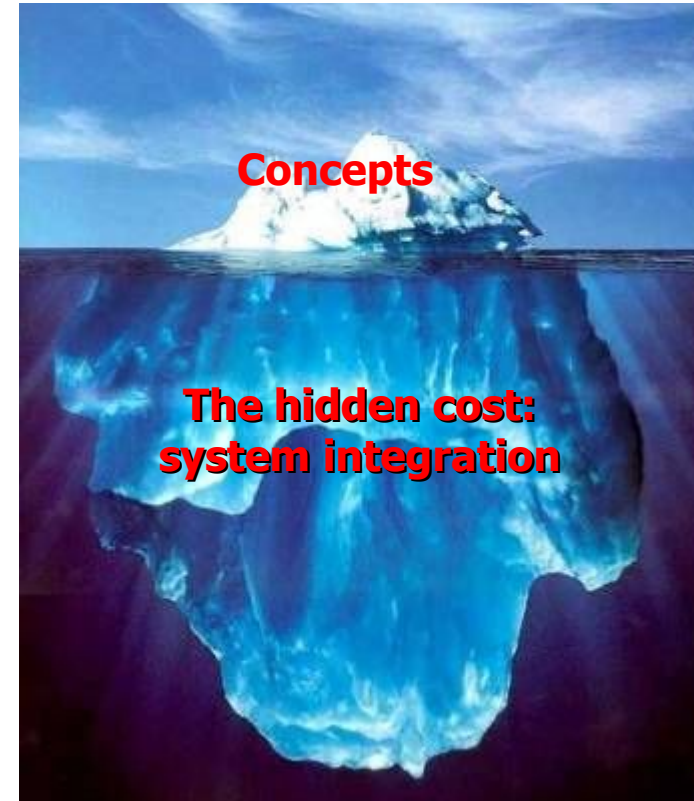
Staff



- Profitable company since its foundation
- Strong growth (4 new employees/year)
- Self financed growth thanks to customer projects and collaborative R&D projects

# Market positioning

- MEMS technologies are complex
  - Low data on reliability issues
  - New failure mechanisms
  - Investigation's difficult due to size
- MEMS developments and integration suffer of high cost due to:
  - Qualification
  - Reliability
  - Selection of the good technology
- NOVA MEMS was born for answering those needs:
  - Highlight affordably reliability issues and reduce time to market
  - Develop new usage of MEMS in high-reliability and security applications



# Activities

- NOVA MEMS develops solutions for MEMS Manufacturers and End-Users
  - The "Quality assurance dpt" provide technical support for MEMS manufacturers and integrator for assessing reliability issues and unlocking technological bolts of their MNT
  - The "Wireless sensors dpt" develops new use of MEMS technologies. We design smart wireless sensing solutions for high reliability and security applications. We develop new usage of COST MEMS and we assume the qualification and integration risks. IP will be soon ready for licensing.



## Quality Assurance

### Activities

Technological analysis  
Failure analysis  
Reliability enhancement  
Qualification of integration technologies

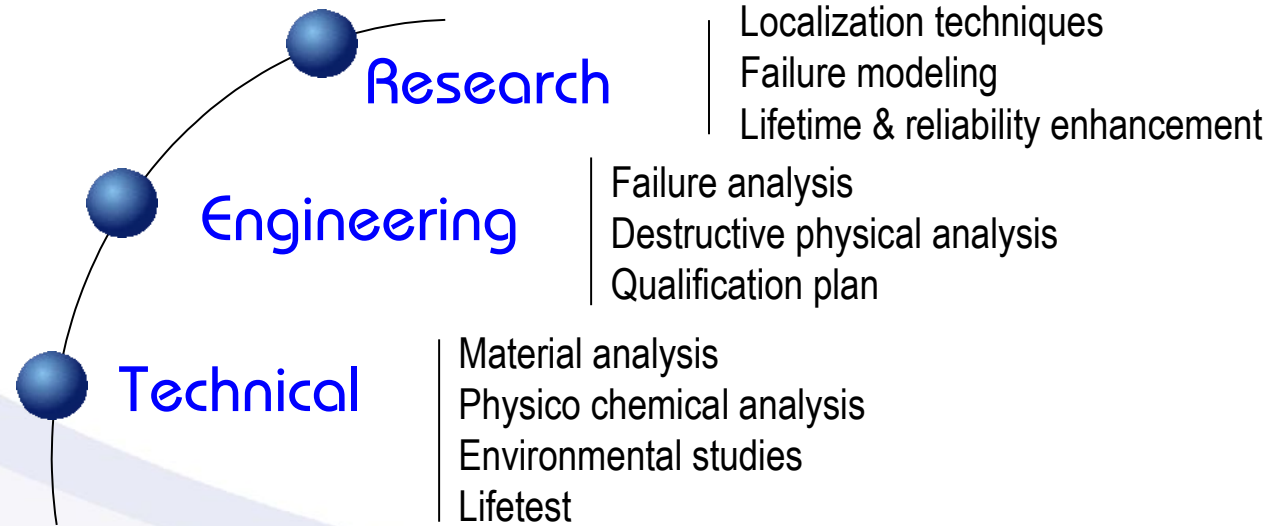
## Wireless sensors

### Activities

MEMS sensors integration for high rel apps  
Wireless sensor networks (WSN)  
Embedded system design

# Quality Assurance Offer

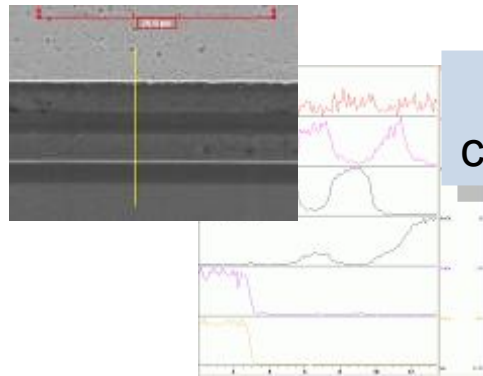
- NOVA MEMS provides three levels of offer:
  - Research services for the localization, modeling and study of MNT failure mechanisms
  - Engineering services for the understanding of issues and definition of adapted qualif plan
  - Technical services for the analytical analysis of a technology



# Research in Failure modeling strategy

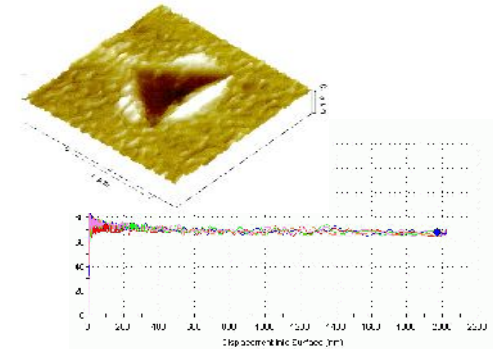
- The Strategy is based on collaborative networks
  - Strategy
    - Partnership with CNES & LAAS
    - Supported R&D : RAMENS & CO2MEMS project, Smartis (Eu project), Polynoe (to be started)
  - Content
    - Material properties (CNES / LAAS / LTPCM)
    - Creep and mechanical aging ( LTPCM / CNES)
    - Thermo mechanical issues (Epsilon engineering / LAAS)
    - Physics of electrical contacts (Ecoles des Mines, XLIM)
    - Dielectric charging and breakdown (LAAS / XLIM)
    - Stiction and activation of surfaces (Recif technologies / LAAS)
    - Packaging (CNES / IXL)
    - Radiation (LAAS / TRAD)
  - Output
    - Failure mechanisms model
    - Aging factors
    - Accelerated life test procedures

# Reliability assessment method



Material  
characterisation

- Mechanical
- Chemical
- Electrical



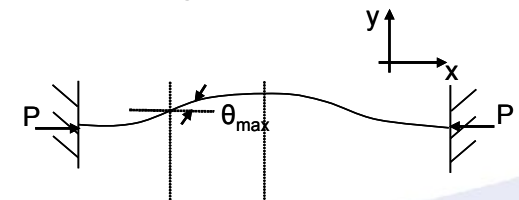
Failure analysis

- Failure localisation
- Environmental failure analysis



Failure Modeling

- Degradations
- Aging
- Fatigue



# Analytical equipments

- **Nano-Microscopic Material characterization**
  - Young modulus / Hardness by nanoindentation
  - Stiffness by micro-flexion
  - Nano-Roughness (surface or sidewall)
  - Stress gradient
  - Intrinsic stress
  - Resonant frequencies by vibrometry
  - Density
- **Macroscopic Material Characterization**
  - Mechanical
    - Traction, Compression, Flexion
  - Thermal analysis
    - Thermal Elongation Coefficient (Dilatometry)
    - Dynamic Mechanical analysis (DMA)
    - Differential Scanning Calorimetry (DSC)
    - Thermogravimetric analysis (TG)
  - Polymer
    - Degree of Polymerisation(DSC)
    - Glass Transition temperature (Tg)
    - Endo or endothermic phases
    - Sorption and Desorption
- **Imaging**
  - Binocular / Optical microscope
  - UV Optical microscopy
  - IR confocal laser microscopy
  - X-ray imaging (with microscopic resolution)
  - Field Emission Scanning Electron Microscope
  - Transmission Electron Microscope
  - Optical profilometry Large surface (up to 100x100mm<sup>2</sup>)
  - Profilometry - High resolution (AFM or interferometry)
  - Environmental profilometry
- **Physico chemical analysis**
  - Energy dispersive x-ray analysis (EDX)
  - SIMS analysis
  - FT-IR



# Analytical equipments

- Electrical characterization
  - Resistivity
  - Permittivity
  - Dopant distribution
  - Thermal laser stimulation (OBIRCH)
- Environmental stress
  - Temperature
    - Storage (cold or hot)
    - Temp. cycling
    - Temp. shock
  - Humidity
    - HAST (Coupled with high temp and pressure)
  - Mechanical
    - Vibration
    - Acceleration
    - Shock
  - Electrical Stress Discharge (ESD)
    - Machine Model
    - Human Body Model
  - Radiations
  - Packaging
- Packaging
  - Mechanical
    - Die shear
    - Ball shear
    - Wirebond pull
  - Hermiticity
    - Gross leak test
    - Fine leak test
  - Particule detection (PIND test)
- Sample preparation / Post process
  - Cross-section
    - Enrobing polishing (conventional)
    - Bare die polishing (nanoscopic quality)
    - FIB
  - Metallization
    - Gold, Platinum, Carbon
  - Die sawing
  - Dry etching
    - Organic, SiO, SiN
  - Wet etching
    - Organic, Metals, Insulators ...

# Activities

- NOVA MEMS develops solutions for MEMS Manufacturers and End-Users
  - The "Quality assurance dpt" provide technical support for MEMS manufacturers and integrator for assessing reliability issues of their MNT
  - The "Wireless sensors dpt" develops new use of MEMS technologies (development of concept through development of vertical applications). We assume the qualification and integration risks.



## Quality Assurance

### Activities

Technological analysis  
Failure analysis  
Reliability enhancement  
Qualification of integration technologies

## Wireless sensors

### Activities

MEMS sensors integration for high rel apps  
Wireless sensor networks (WSN)  
Embedded system design

# Wireless network

## Sensors node

Contains several sensors, CPU, battery and wireless transceiver

Range: 100m, autonomy >5years, SMD integration, flexible installation

## Relay

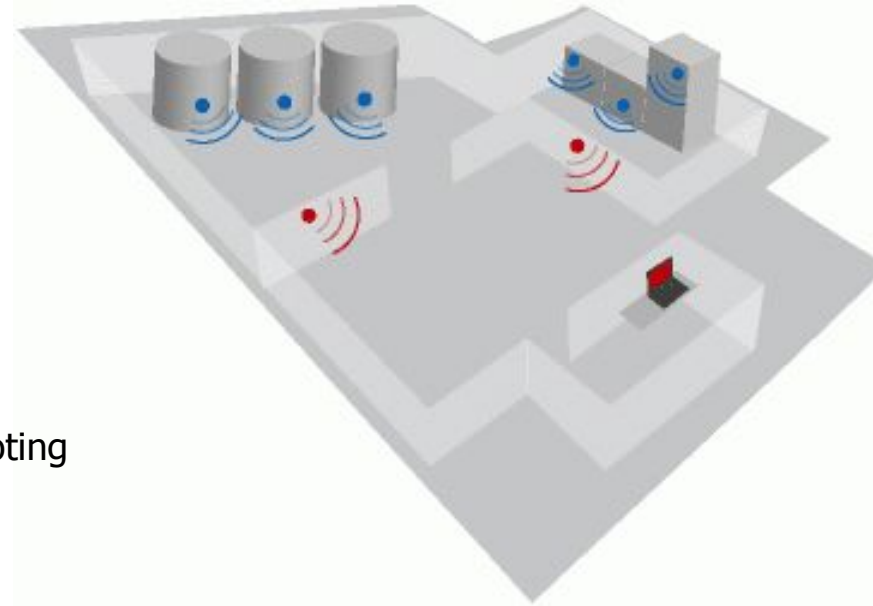
Extends range, power supplied, automatic routing  
Mesh, Tree, Star topologies

## Gateway

Embedded webserver + Datalogging

Network and sensors board config through web pages

Gateway to the Information systems used by the customer



### | MEMS sensors module



Sensors + energy  
Radio transceiver + micro controller

### | Relay



Radio transceivers + micro controller + external power supply

### | Gateway



Radio transceiver



Ethernet link



Driver + Graphic User Interface

# DiWIS project

- Content :
  - Multisensor platform for Health Monitoring of Systems
  - Low power, wireless and high autonomy

**DiWIS: Distributed Wireless Integrated Systems**

## DiWIS module

- Sensors & Actuators
- Local data computing
- Data logging
- Wireless communication
- Power management



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