The MARISE Project

➔ **Project title: Materials for Avalanche Receiver for ultImate SEnsitivity**

FP7-ICT-2007-call n0.2-224142, 3-year project, starting May 1st, 2008

➔ **Cost: 3 235 k€ Funding: 2 100 k€**

➔ **Manpower: 206 person x months**

➔ **40 Deliverables**

➔ **http://www.ict-marise.eu**

➔ **Contacts:**

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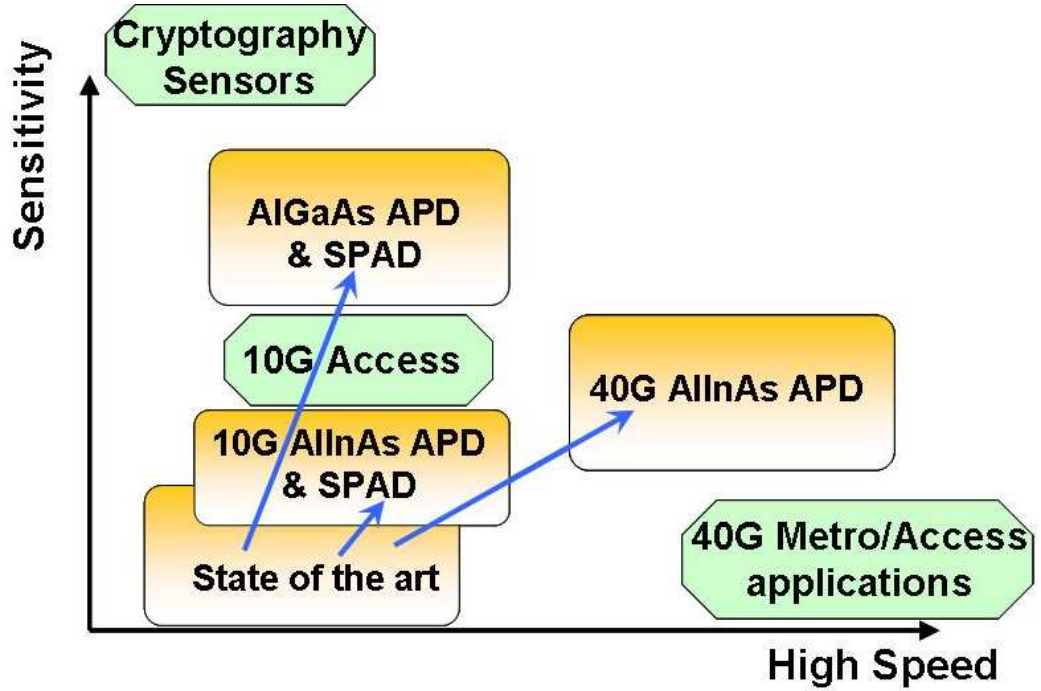
MARISE Objectives

➔ Objectives:

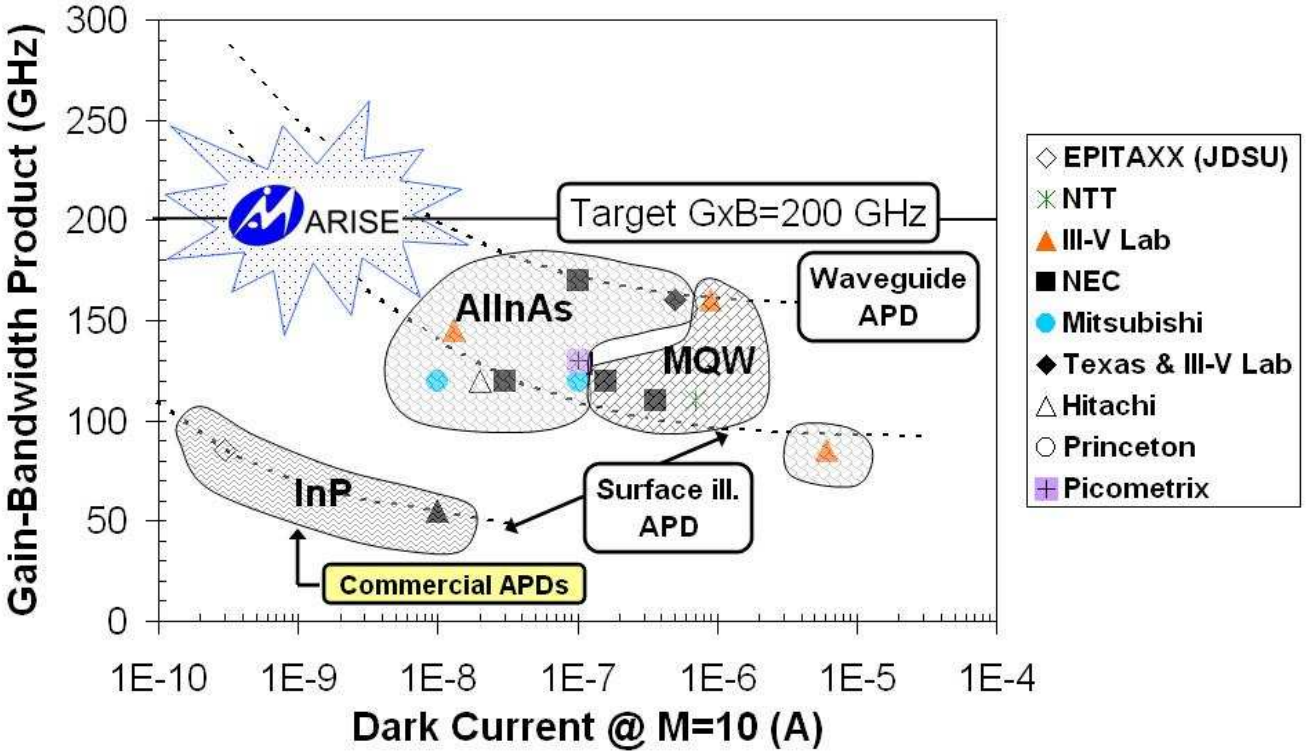
- Innovative APDs using two large bandgap III-V materials of interest: AlGaAs and AlInAs
- Use recent breakthroughs in the impact ionisation characteristics in final APD devices
- Exploit low noise properties of very thin avalanche layers to achieve high sensitivity
- Several applications will be investigated: 10G access, core network avalanche receivers at 40G using waveguide structures and single photon operation for sensing



MARISE progress beyond state of the art

➔ Three major objectives:

- **Improved material:** 1.3-1.55 µm **AlInAs** APD with GxB=160 GHz and Id<10nA at M=10
- **New structure:** 1.55 µm AlInAs **waveguide APD** with GxB=200 GHz and f_{3dB}>30 GHz
- **New material:** 1.3 µm **AlGaAs/InGaAsN** APD with targeted GxB>200 GHz



➔ **Towards lower dark current and higher gain-bandwidth product**

MARISE Impact

➔ Three expected impacts:

- Improved sensitivity at 40 Gb/s (Competitive market):
  - Simplified architecture
  - Longer span

  ➔ Lower cost

- Broadband access networks at 10 Gb/s (Large volume market):
  - Avoid using optical amplifiers (truly passive optical networks)
  - Increase of the physical reach
  - Burst mode operation …

  ➔ Larger splitting factor

- Sensing (Emerging market):
  - Low intensity sensing and cryptography
  - Improved dark count rate (Noise)

MARISE Consortium

➔ **Partners covering all major fields:**

- Concepts and materials: University of Sheffield
- Design and processing: Alcatel Thales III-V Lab
- Characterisations and assessment: AdvEOtec
- Applications: IMEC/INTEC, Id Quantique

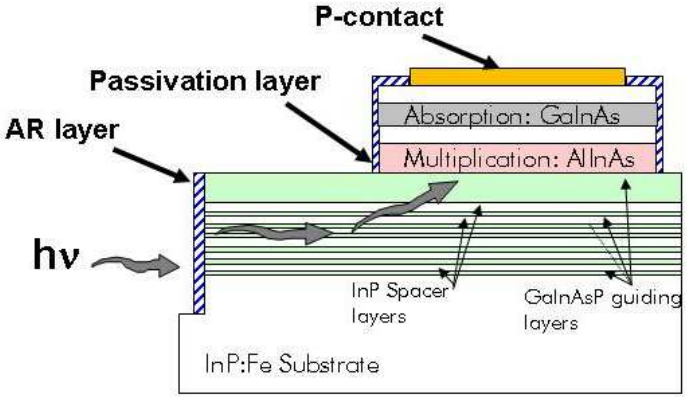
MARISE Work-Packages (1)

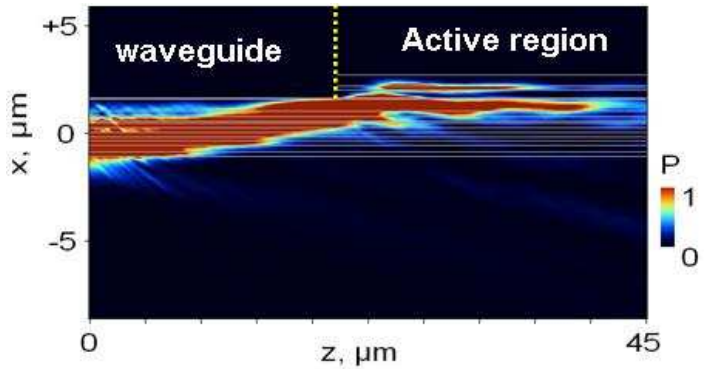
➔ WP1: Concepts & Materials

- AlInAs/GaInAs:
  - Control of critical charge doping layer and optimisation of thin graded regions
- AlGaAs/GaInAsN:
  - $Al_xGa_{1-x}As$ composition for large ionisation and GaInAsN for 1.3 µm detection

➔ WP2: Design & Processing

- Test structures:
  - Mesa type for Avalanche effectiveness assessment
- Planar junction APDs (10G & SPAD):
  - High performance, low leakage current back-side illuminated APDs
- Waveguide-illuminated APDs (40G):
  - High bandwidth and gain-bandwidth structures with efficient passivation of active stripe





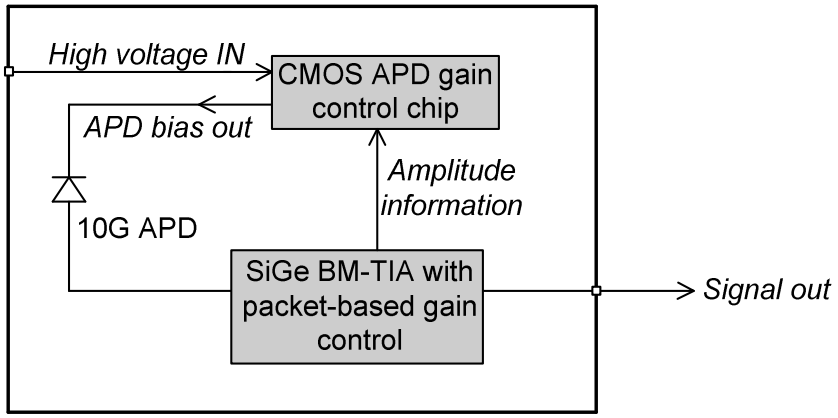
MARISE Work-Packages (2)

➔ WP3: Characterisations & Assessment

- Provide sound data base for comparison and optimisation of APD structures
- Reliability assessment (long term ageing):
  - Assessment of device stability (passivation layers, charge doping profile,…)

➔ WP4: Applications

- 10Gb/s burst mode receivers for next generation PONs:
  - large dynamic range and improved sensitivity (larger splitting factor)
- 40Gb/s APD photoreceivers for metro/access networks
  - Very high gain-bandwidth product (>200 GHz) and improved sensitivity
- Single photon photoreceivers for cryptography and OTDR
  - Very low dark current, no carrier trapping and minimum excess noise



MARISE Work-Plan