

Single-Photon Image Sensors in CMOS: Introduction to **SPADnet**

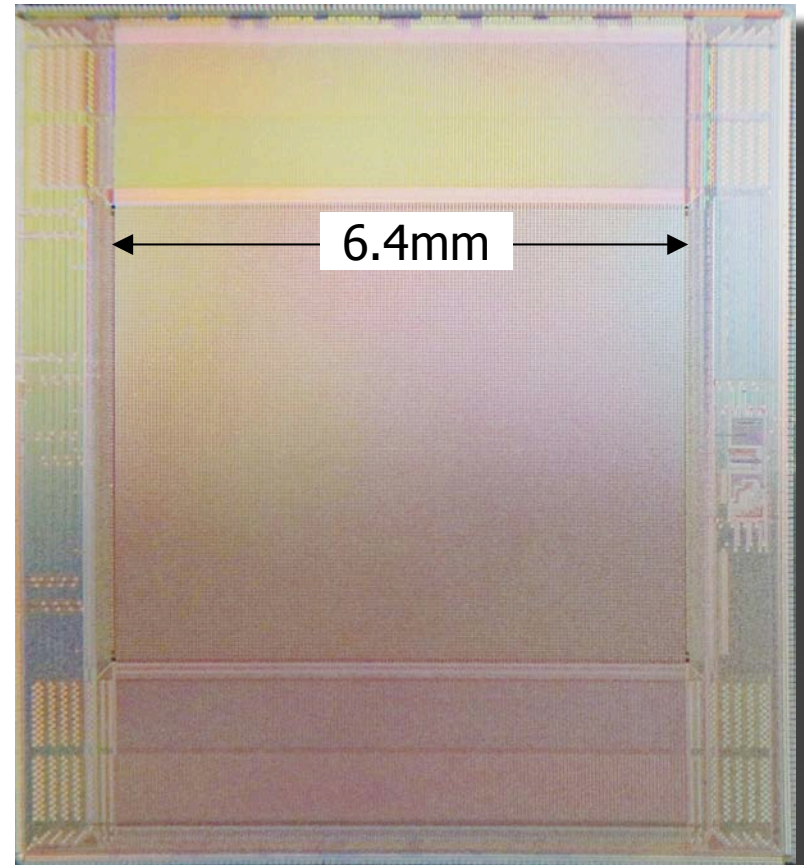
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FP6 FET Open: MEGAFRAME

2006-2010

- 160x128 single-photon pixels
 - 55ps resolution
 - 140ps IRF
 - 50Hz DCR
 - 250kfps
 - Standard CMOS
- Demonstrated in
 - FLIM, FRET, FCS



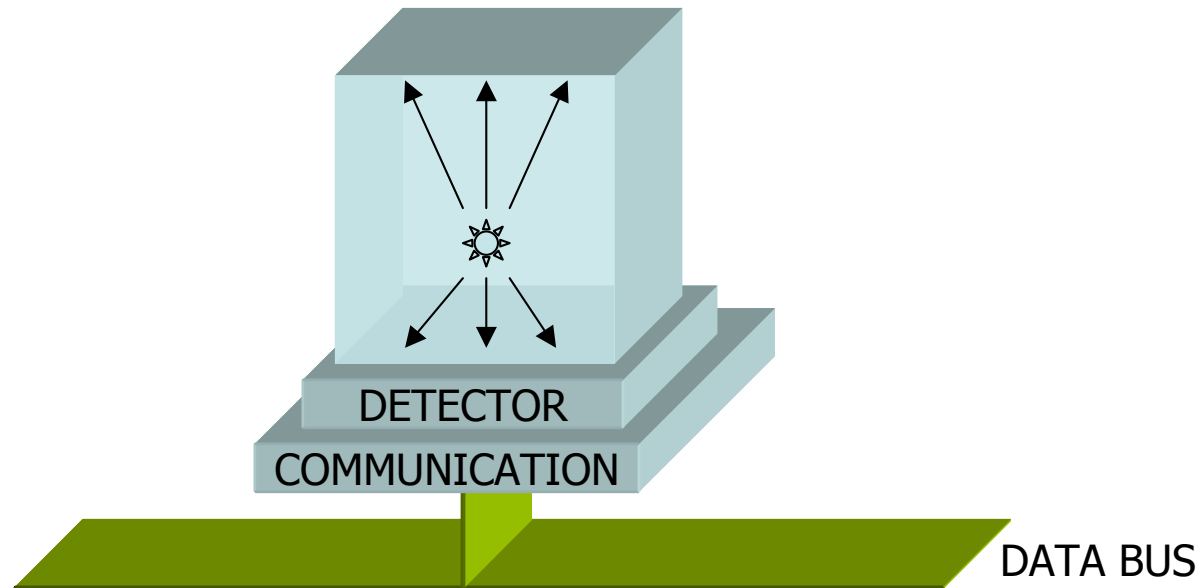
Veerappan *et al.*, to appear, International Solid-state Circuits Conference 2011

SPADnet Consortium

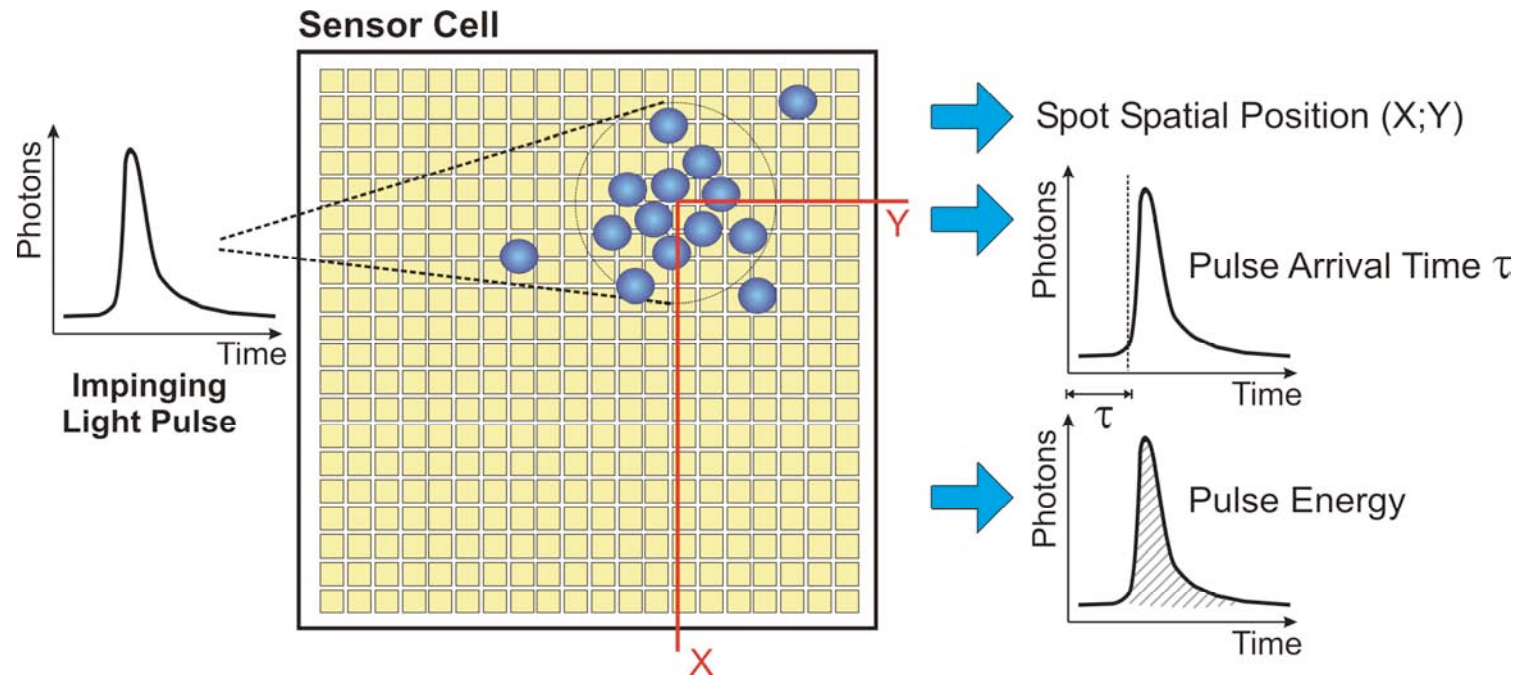
- **EPFL, Lausanne, Switzerland**
- **TU DELFT, Delft, Netherlands**
- **Univ. of Edinburgh, Edinburgh, Scotland**
- **Fondazione Bruno Kessler, Trento, Italy**
- **STMicroelectronics, Edinburgh, Scotland**
- **STMicroelectronics, Crolles, France**
- **MEDISO Ltd., Budapest, Hungary**
- **LETI, Grenoble, France**
- **Budapesti Muszaki es Gazdasagtudomanyi Egyetem (BUTE), Budapest, Hungary**

Objective

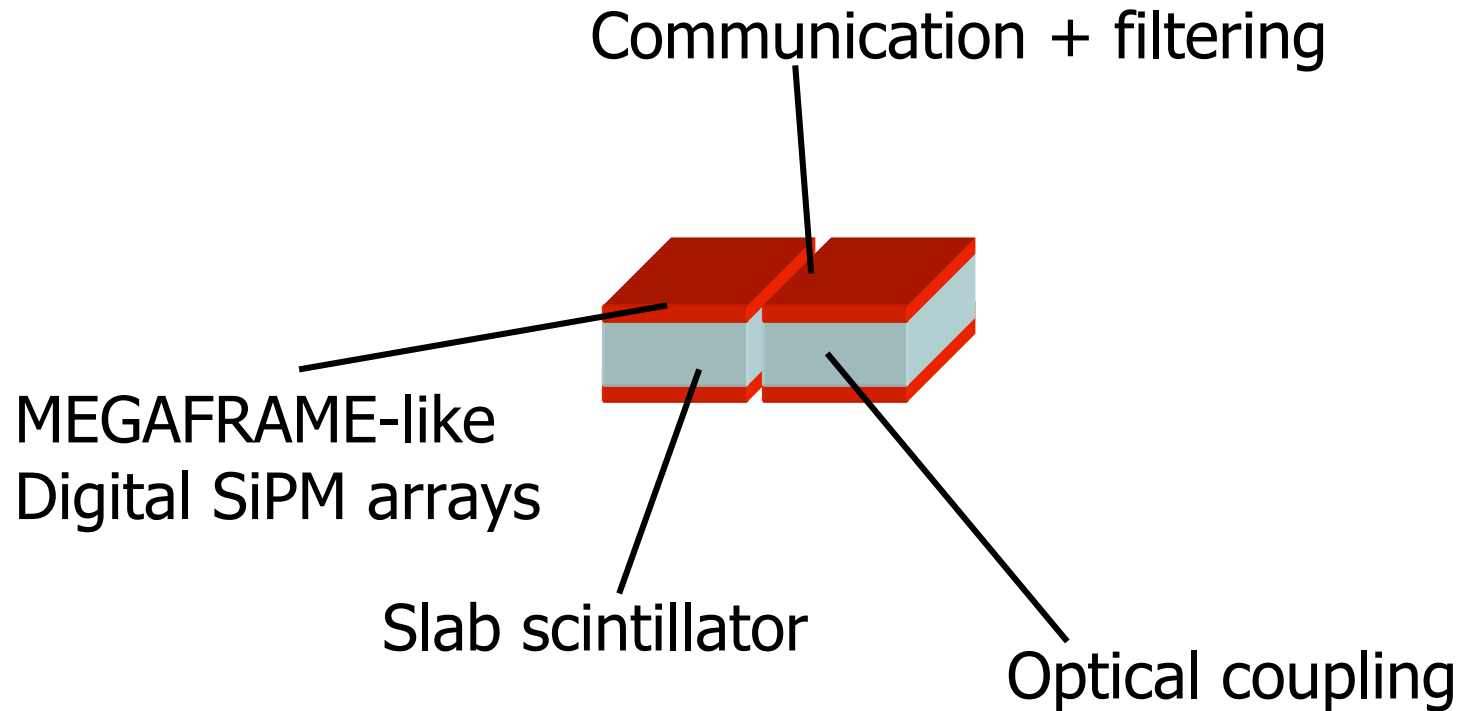
Fully digital, scalable photonic component capable of detecting single and multi-photon bursts, their time-of-arrival and intensity



Sensor Cell Concept



Module Concept



The Big Innovation

- SPAD sensors with massively parallel chip-level time detection
- Large format with through-silicon-via based packaging
- Advanced optical coupling
- Network between sensors with high-speed message-passing
- Digital coincidence by hierarchical message snooping
- Novel image reconstruction exploiting spatial information

Expected Impact

- Cheaper, simpler, scalable, robust PETs
- Higher levels of reliability
- Higher speed and flexibility in data processing for imaging
- Full compatibility with MRI and other imaging techniques
- Use of existing and new radiotracers with low lifetime and high specificity will be feasible

Intended Users and Involvement

- In the short term
 - Hospitals
 - Small animal research centers
 - Pharma industry
- In addition, in the long term
 - Point-of-care centers
 - Small medical centers
 - Medical facilities in developing countries



Why We Will Be Successful

- The Megaframe experience will be an invaluable starting point
- The roles are well defined and complementary with constructive overlaps
- The most advanced expertise for each member and for each WP

<http://www.spadnet.eu>