



# Imaging, BiCMOS ASIC & Silicon Photonics

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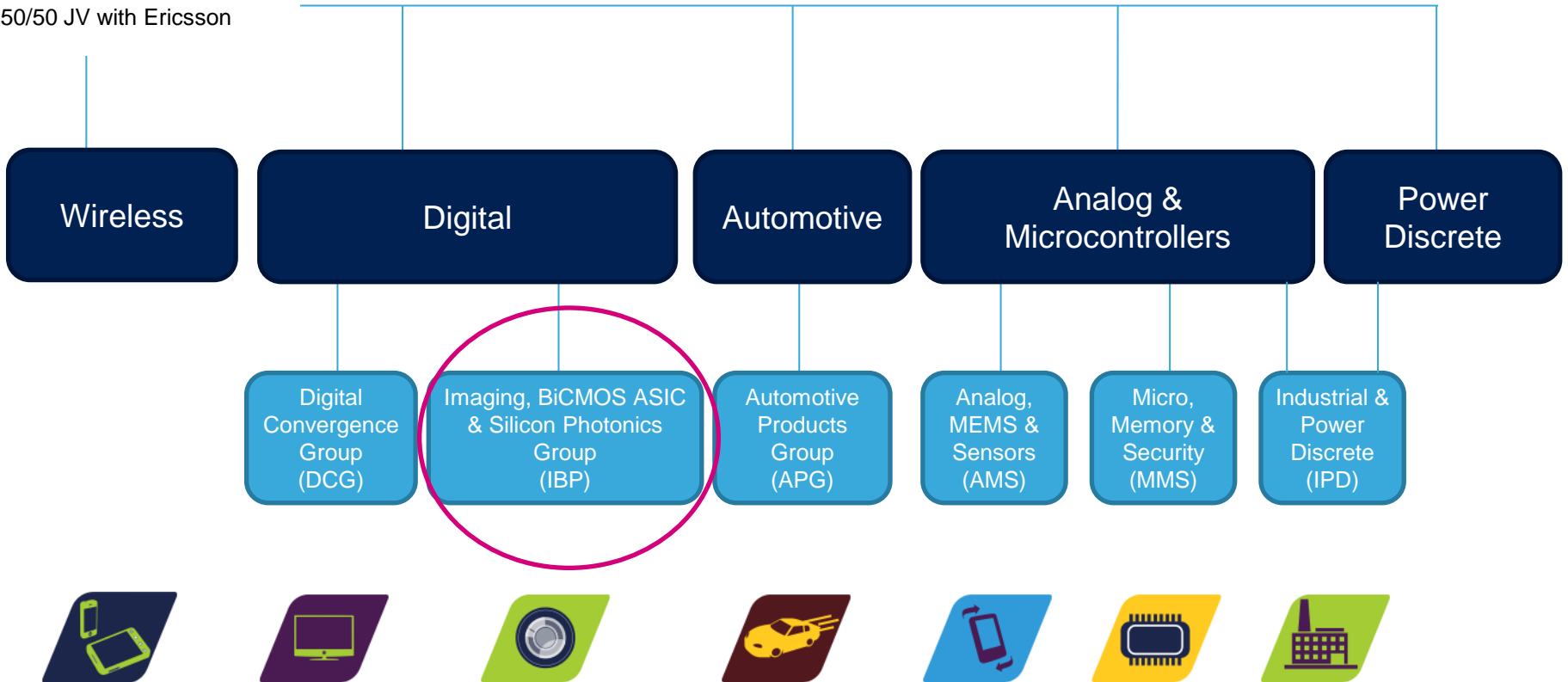
# Focused Product Segments

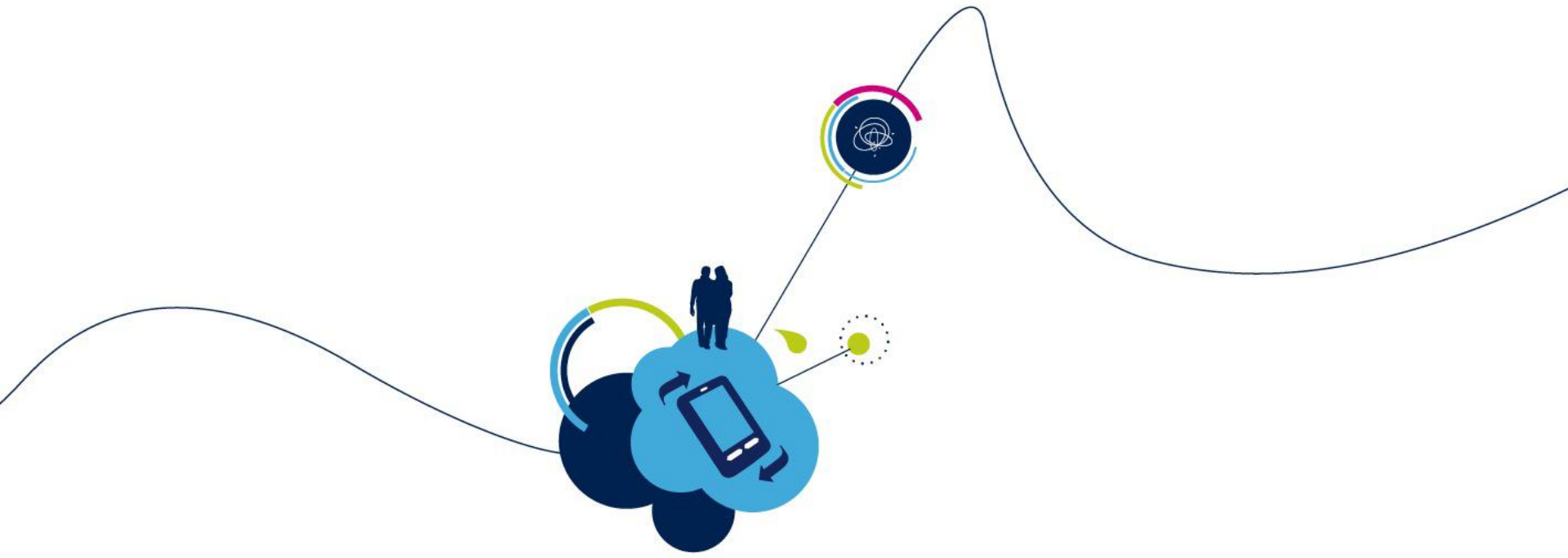


50/50 JV with Ericsson



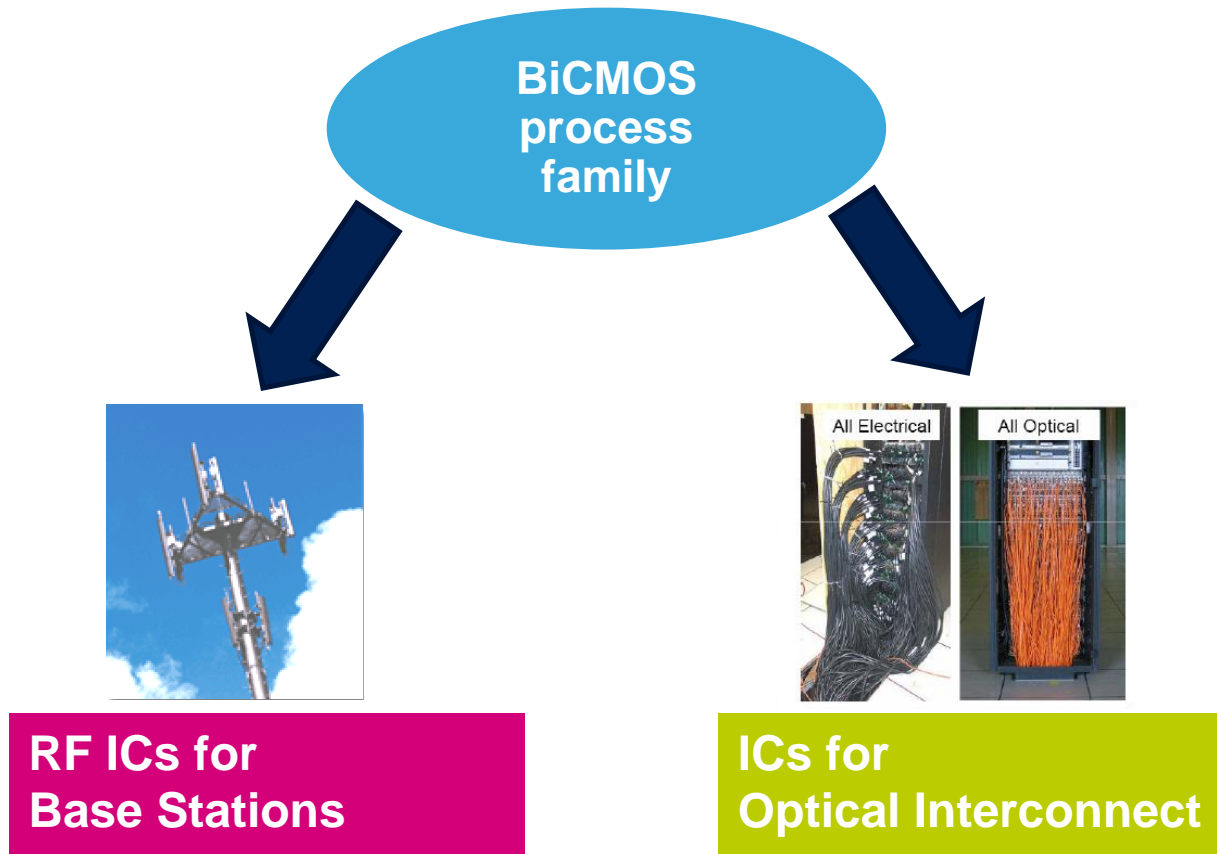
life.augmented





# BiCMOS ASIC & Silicon Photonics

# BiCMOS in Communication Infrastructure

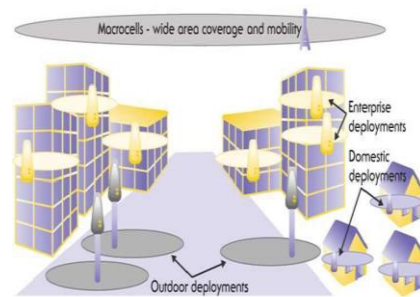


- Internet traffic growth drives fiber optics pervasiveness
- Mobile data traffic push Wireless Network evolution from Macro Base Station to Heterogeneous Network based on Small Cells (Micro/Pico / Femto BS) driving RF market demand increase
- BiCMOS demand is driven by higher frequency and integration
- Miniaturization, growth in speed and strong demand for reduced power consumption will be driving factors for Silicon Photonics

US\$M	2011	2016	CAGR Y16/11
<b>Optical Modules ICs (include Photonics)</b>	325	570	11%
<b>Infrastructure RF</b>	160	360	16%
<b>Mixed Processes Div TAM</b>	485	930	13%



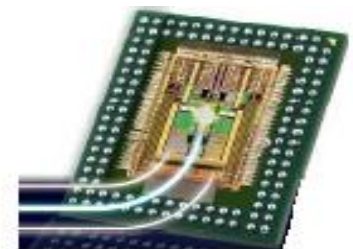
Internet traffic



Mobile network



Parallel optics



SI-photonics

2012

RF

## ICs for Wireless Base Station Infrastructure

Technology : BiCMOS7RF  
Packages QFP etc.

Products : Synthesizer,  
Mixers. Down-Converter

Optical Module

## ICs for Telecom & Datacom Optical Transceivers

Technology : BiCMOS9/MW  
Packages QFP etc.

Products : Trans-Impedance  
Amplifiers, Clock Data  
Recovery, Photo Detector

Coming

Silicon Photonics

## Components for Optical Connections (Transceivers etc.)

Technologies :  
PIC25 Photonic,  
Advanced Copper Pillar,  
Optical Packaging

Products :  
Integrated Transceivers,  
HS Data Link

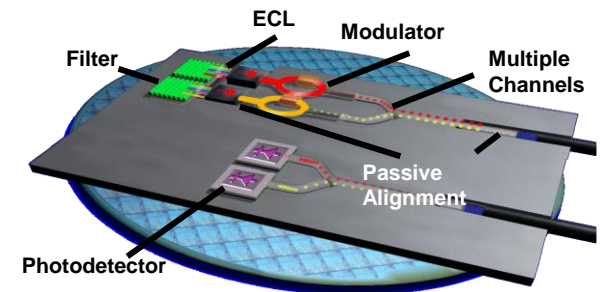
ASSP/COT

# Silicon Photonics and Luxtera Licensing

- ST and Luxtera, a world leader in Silicon Photonics, signed a partnership contract in December 2011
- ST has acquired Luxtera technology license, and is setting up the process in ST CMOS 65nm 12" Crolles line (PIC25G)
- Solutions will be based on Hybrid integration with CMOS die through copper pillar technology
- ST will design, manufacture and sell products based on PIC25G.
  - PIC25G process will be available in Q1 2014.

Silicon Photonics is a technology that allows to process and manipulate light signals on silicon and that can be produced using existing semiconductor fabrication techniques.

Silicon Photonics allows dramatic increase in processing speed and outstanding power consumption reduction.



# Silicon Photonics Application Areas

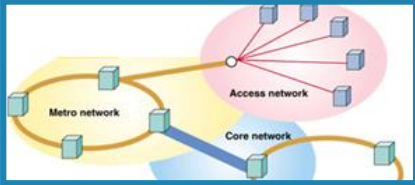
**WAN**

**Enterprise**  
Rack to Rack  
Board to Board  
Chip to chip

**On Chip**


## MARKET SEGMENTS

Transport  
Metro  
Access



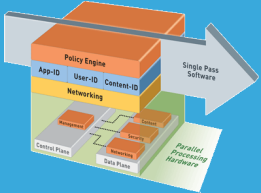
A network diagram showing three interconnected regions: 'Metro network' (yellow), 'Core network' (blue), and 'Access network' (pink). Nodes are represented by small server icons connected by lines.

LAN  
Data Center  
Routers  
Switches  
HPC



Two photographs: the top one shows a server rack with multiple units, and the bottom one shows a large data center with rows of server racks.

Parallel processing  
Multicore  
interconnection



A 3D block diagram of a network chip architecture. It shows layers: 'Policy Engine' (orange), 'App-ID' (orange), 'User-ID' (orange), 'Content-ID' (orange), and 'Networking' (yellow). Below these are 'Control Plane' and 'Data Plane' blocks. A large arrow labeled 'Single Pass Software' points from the top layers to the bottom. A separate block labeled 'Parallel Processing Hardware' is shown at the bottom right.


## PRODUCTS

Transceivers



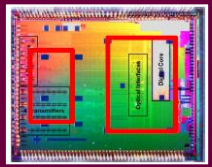
Three types of optical transceivers are shown: a small 10G SFP+, a larger 10G XFP, and a multi-lane 10G X2/XENPAK.

Active optical cable



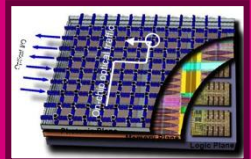
A photograph of an orange active optical cable with connectors at both ends.

ASICs



A photograph of a silicon ASIC chip with a color gradient overlay, highlighting different functional blocks.

Photonics ICs



A photograph of a silicon photonics IC chip with a blue grid overlay, showing the layout of the photonic components.



- **RF**

- Develop RF ASSP Roadmap
- Address HetNet topology evolution

- **Optical Modules ICs**

- Consolidate leadership with key customers
- Develop Optical ICs for open market

- **Silicon Photonics**

- Set up process in Crolles 12”
- Address key customers
- Master full supply chain



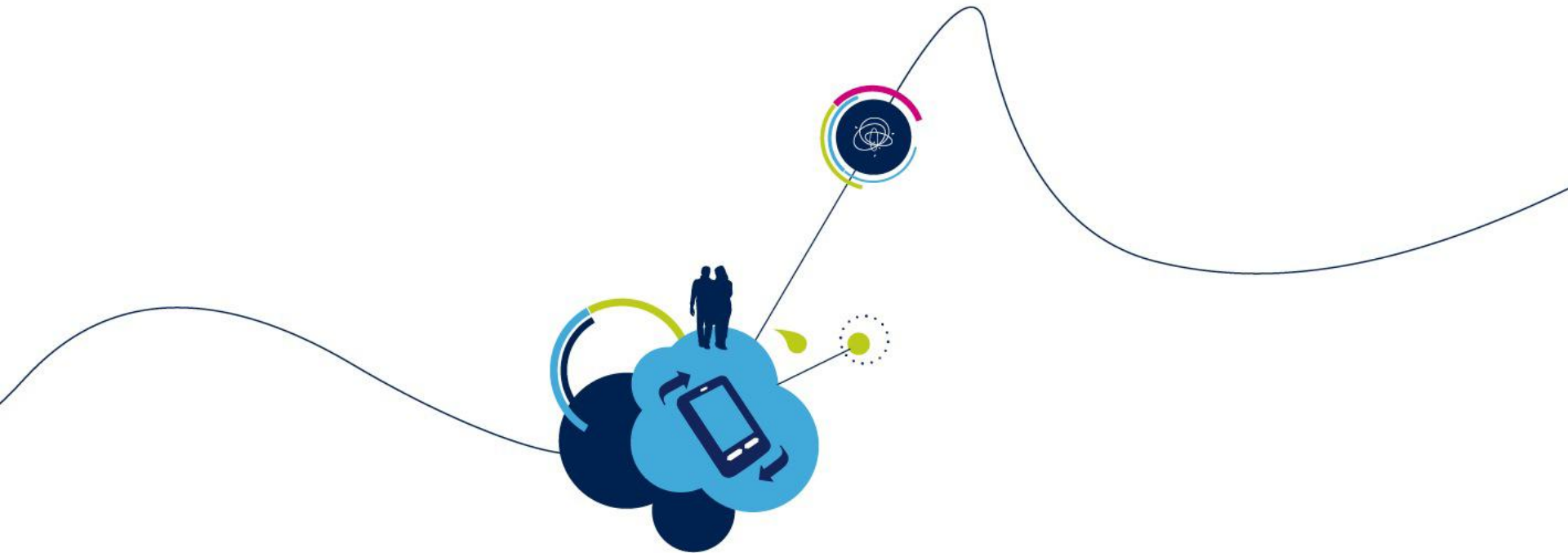
RF



Optical ICs



Silicon Photonics



# Imaging

# Imaging Division at a Glance

## Core technologies

- FSI & BSI CMOS imaging process
- Pixel & sensor design & integration
- Camera module design & automation
- Image improvement algorithms & integration
- Innovative system development & industrialization



More than 20 years experience in CMOS image sensor technology, camera system expertise & mass volume manufacturing.

A Unique Value Chain: From internal manufactured sensors to Cameras and System Processing.

## A long standing commitment

- VLSI Vision, a pioneer of CMOS imaging, acquired by ST in 1999
- 1<sup>st</sup> imaging products started in ST in 1995
- Internal sensor manufacturing since 2000
- >700M sensors & camera modules delivered to mobile phone makers
- >900M sensors delivered to industry players
- >700M ISP delivered to the industry



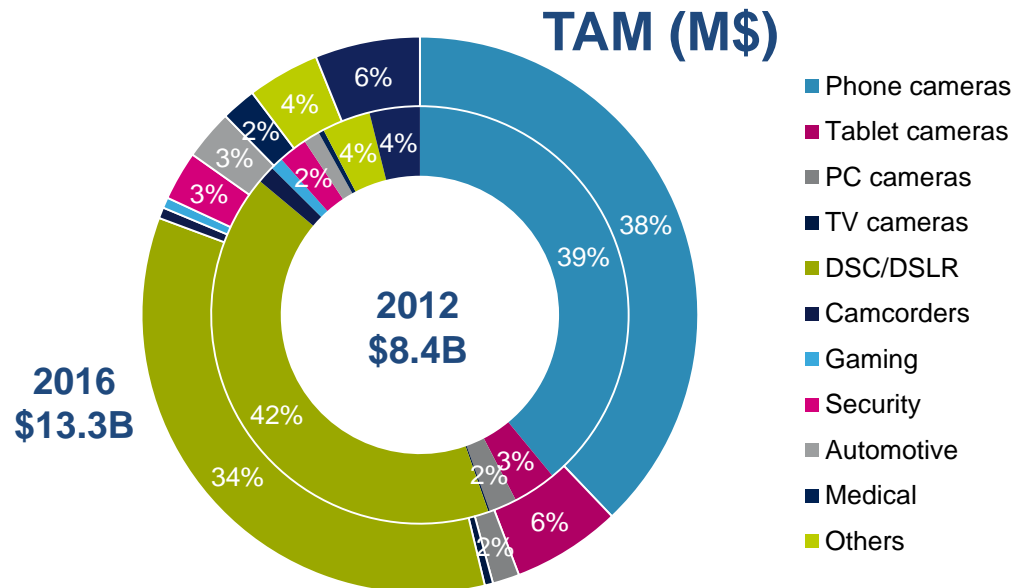
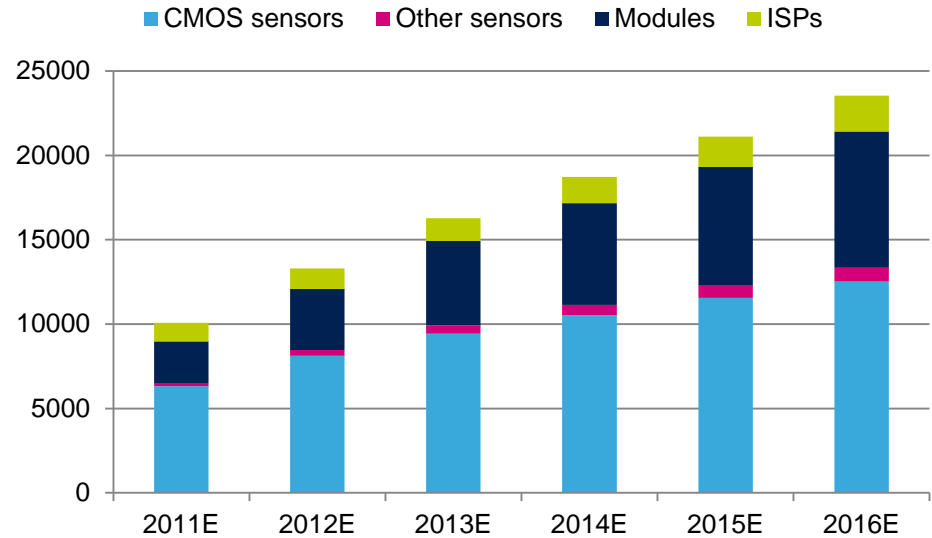
## Imaging teams

- R&D in UK, France, Singapore & India
- Operations & manufacturing in France, Singapore & China



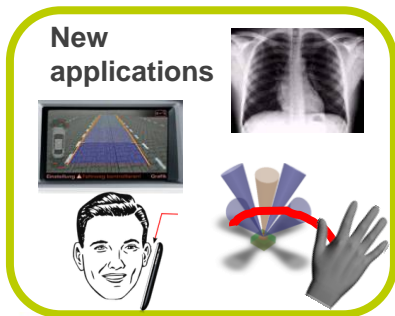
# Imaging Market Trends

- **Continuous & important TAM growth, and a rising everyday use of image capture & sharing**
- Increasing camera attach rate in mobile handsets and tablets
  - Primary & secondary camera (avg. 4.7Mp in 2016)
  - Growing ASP due to resolution evolution & camera module
- CMOS eliminating CCD in Digital Still Camera, migrating from high-end to whole range
- New applications fueling growth:
  - Proximity sensing, user detection, optical HMI
- New market segments growing:
  - Automotive, gaming, medical, security, sports



# Imaging Strategy: Diversification...

- **Deploy products diversification and innovation across various segments and lead new applications**
  - Proximity sensors
  - Man machine interface, gesture recognition
  - Automotive, gaming, medical, security
  - Partnership with leaders in defined segments
- **Support diversified business models**
  - Image sensors, sensors, modules, ISPs, wafers
- **Expand on higher value segments in mobile imaging products**
  - New Products expansion: new moving optics camera / BSI image sensors & modules / Prime camera & video modules / Generic, Customer Driven ISP's
  - Extending Customer Base



# ...keeping the 4 Pillars of ST Imaging

## Imaging Semi-conductor

### Image Sensor

- Production from 1.4um to 5.6um pixel
- 1.1um development
- From VGA to 24Mpix

## Semi-conductor

### Sensor

- User detection
- Proximity module
- Optical navigation
- Man machine interface
- Automotive
- Medical

## Image Signal Processing

### Coprocessor

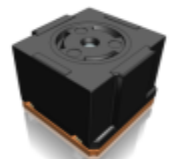
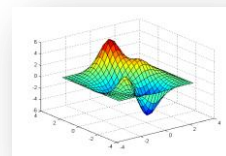
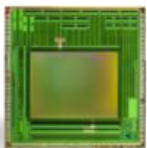
- Stand alone ISP
- Full ST video pipe IP
- Integration of third party IP on demand
- CMOS40nm ST & foundries in production
- Developing IC's in 12" CMOS28nm
- ST internal BGA assembly line

## Packaged Lens & Sensor

### Module

- Fixed focus camera
- Wafer Level reflowable camera
- EDOF camera
- Auto-focus camera
- Innovative optics, assembly & test technologies
- ST manufacturing
- Key optics & supply chain partners

12" manufacturing capabilities both In-House and at Foundries



- **Mobile Phone**

- Design win and production volumes of a new improved low light sensor in some Windows smart-phones. Phones shipping on the market now.
- Design win and production volumes of a new ISP for an Android smart-phone market leader, several phone models shipping on the market now.
- 3<sup>rd</sup> generation of fully integrated (ISP + image sensor), camera module in customer ramp-up. Smart phones available now.
- 4<sup>th</sup> generation of reflowable camera module, with enhanced image quality in customer ramp-up

- **New applications**

- Security: Design win / business award at a leading security camera manufacturer
- Medical: Business award of a new generation of CMOS X-Ray sensors for medical applications with a leader in the industry
- Digital still camera: Design win, business award in samples stage of a high performance large image sensor for a leading brand
- Proximity sensor: Technology hitting the market. Excellent customer feed-back based on proprietary time of flight technology
- Automotive: Won major safety system camera and processor for a key European Tier 1 and OEM