Le innovazioni del prossimo futuro: Tecnologie Prioritarie per l' Industria

SETTORE 2: Microelettronica e Semiconduttori

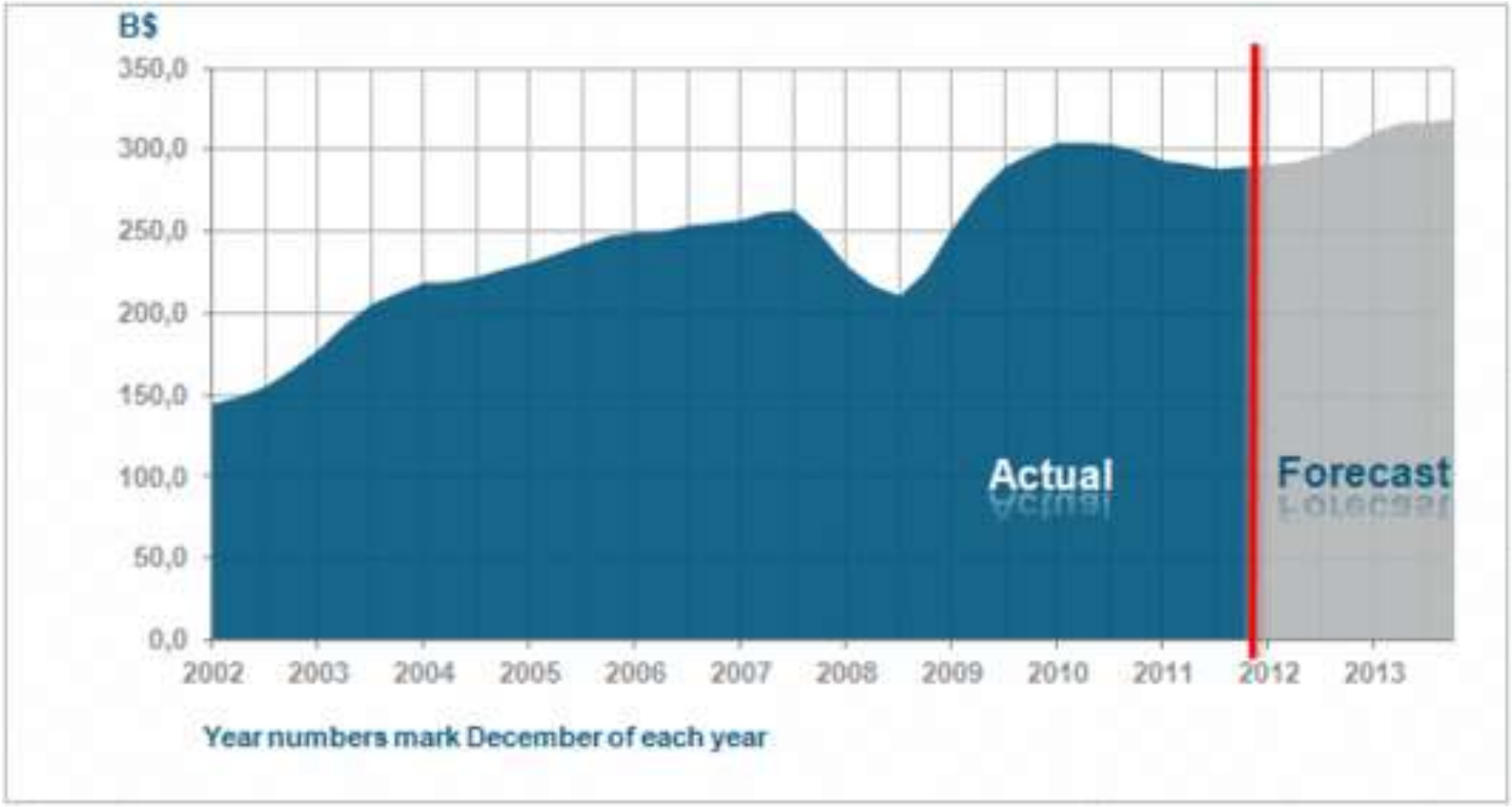
RELATORE: Paolo CARMINA
AZIENDA: STMicroelectronics srl

Bergamo, 17 Giugno 2013, Kilometro Rosso

Settore 2: Microelettronica e Semiconduttori

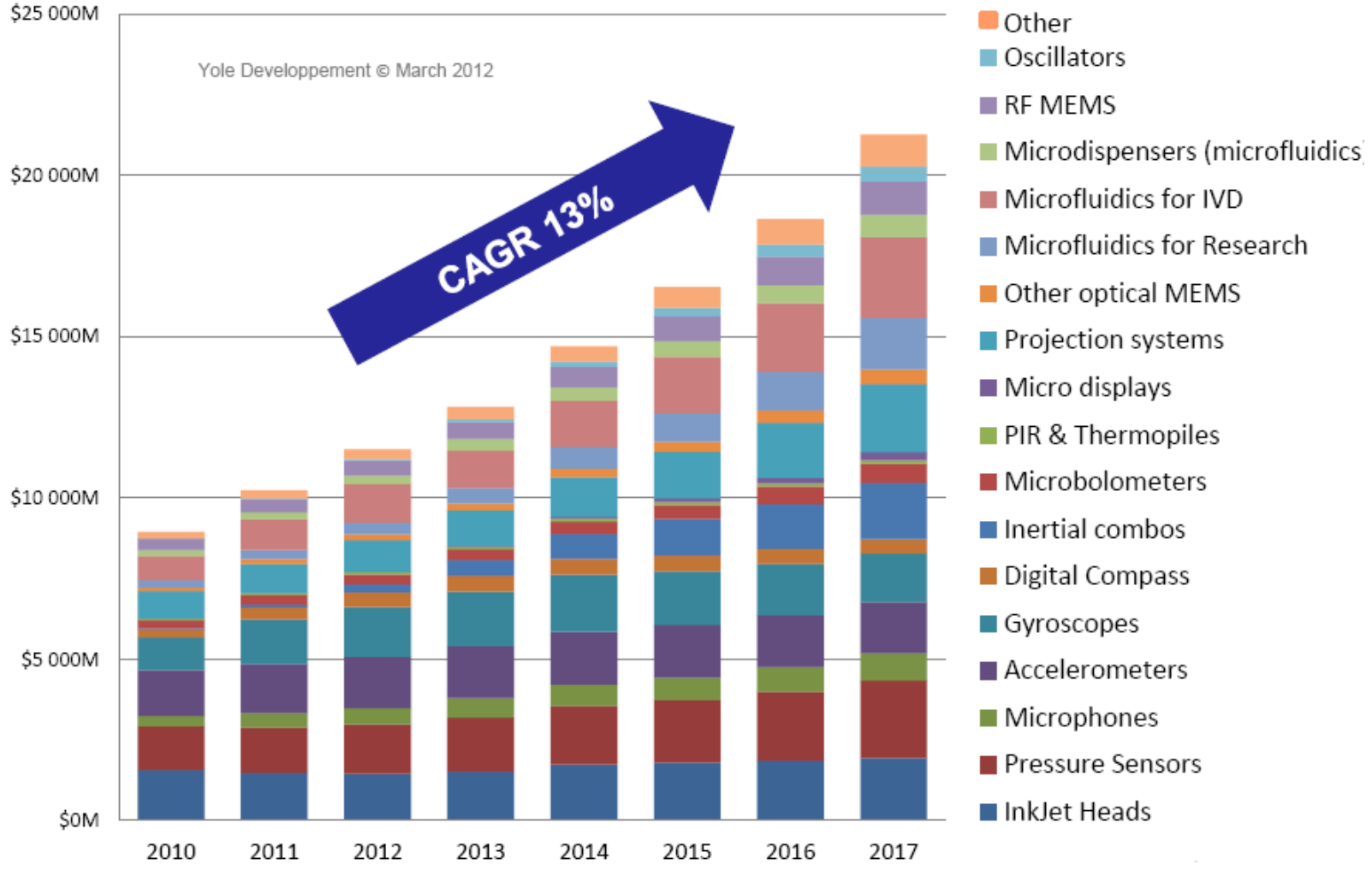
- ***Componenti del Gruppo di lavoro***
  - ***STMicroelectronics (coordinatore)***
  - ***MICRON***
  - ***CENTRO RICERCHE FIAT***
  - ***ERICSSON***
  - ***SELEX ES***
  - ***VENETONANOTECH***

World Wide global semiconductors sales

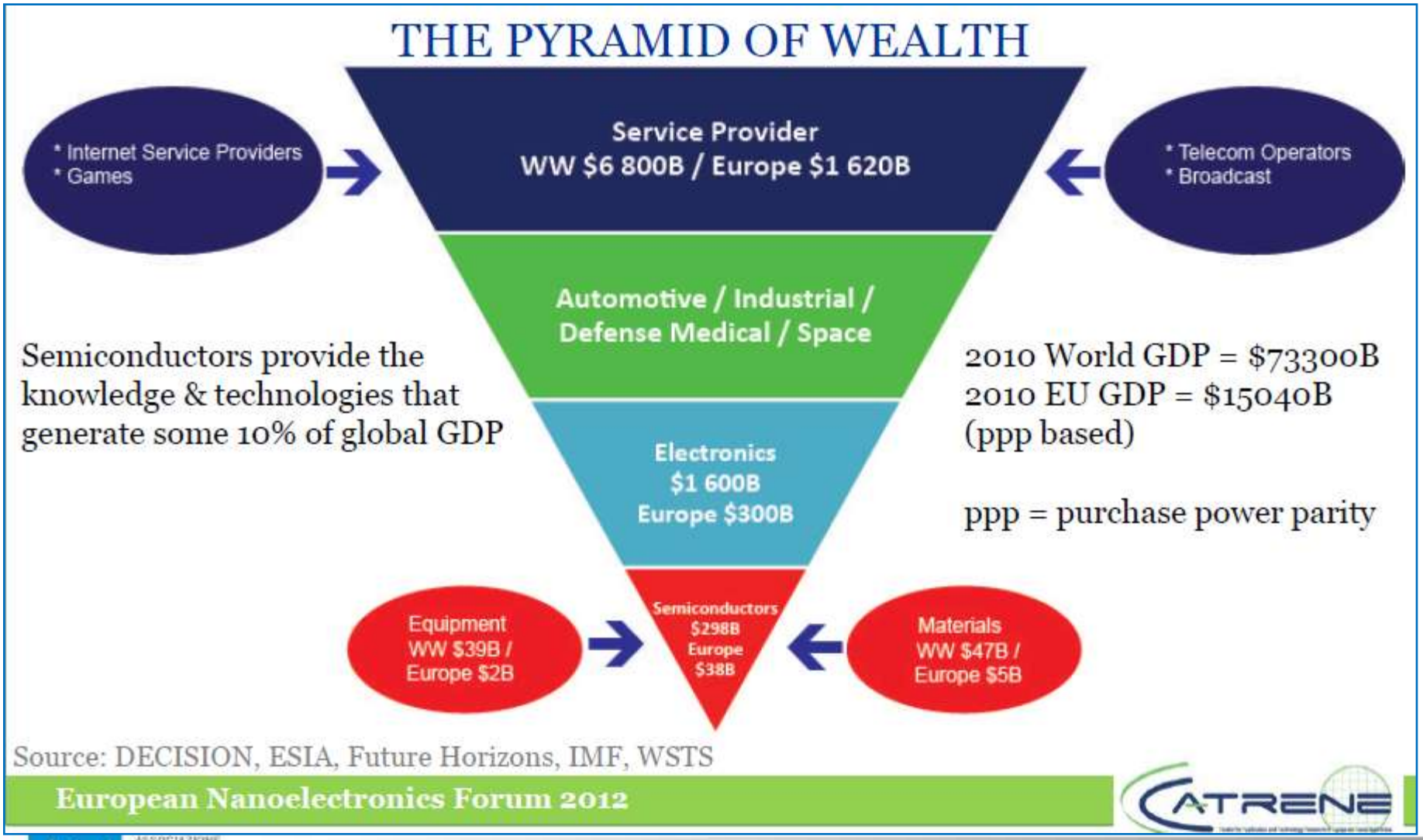


Source: WSTS

Global MEMS sales



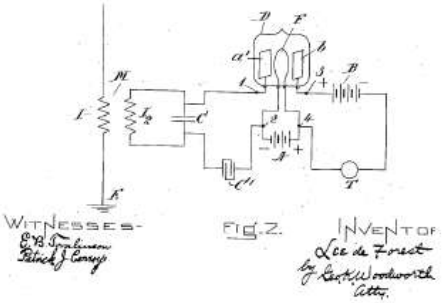
La microelettronica nella piramide dei valori

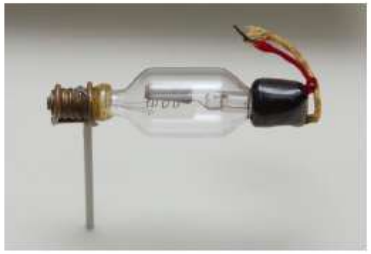


Da dove veniamo?

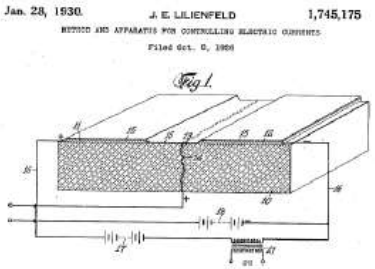
Switch with Gain

Triode, 1906

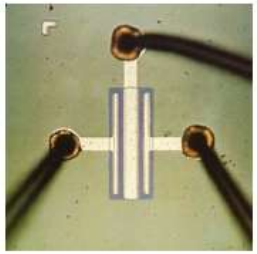




FET, 1928

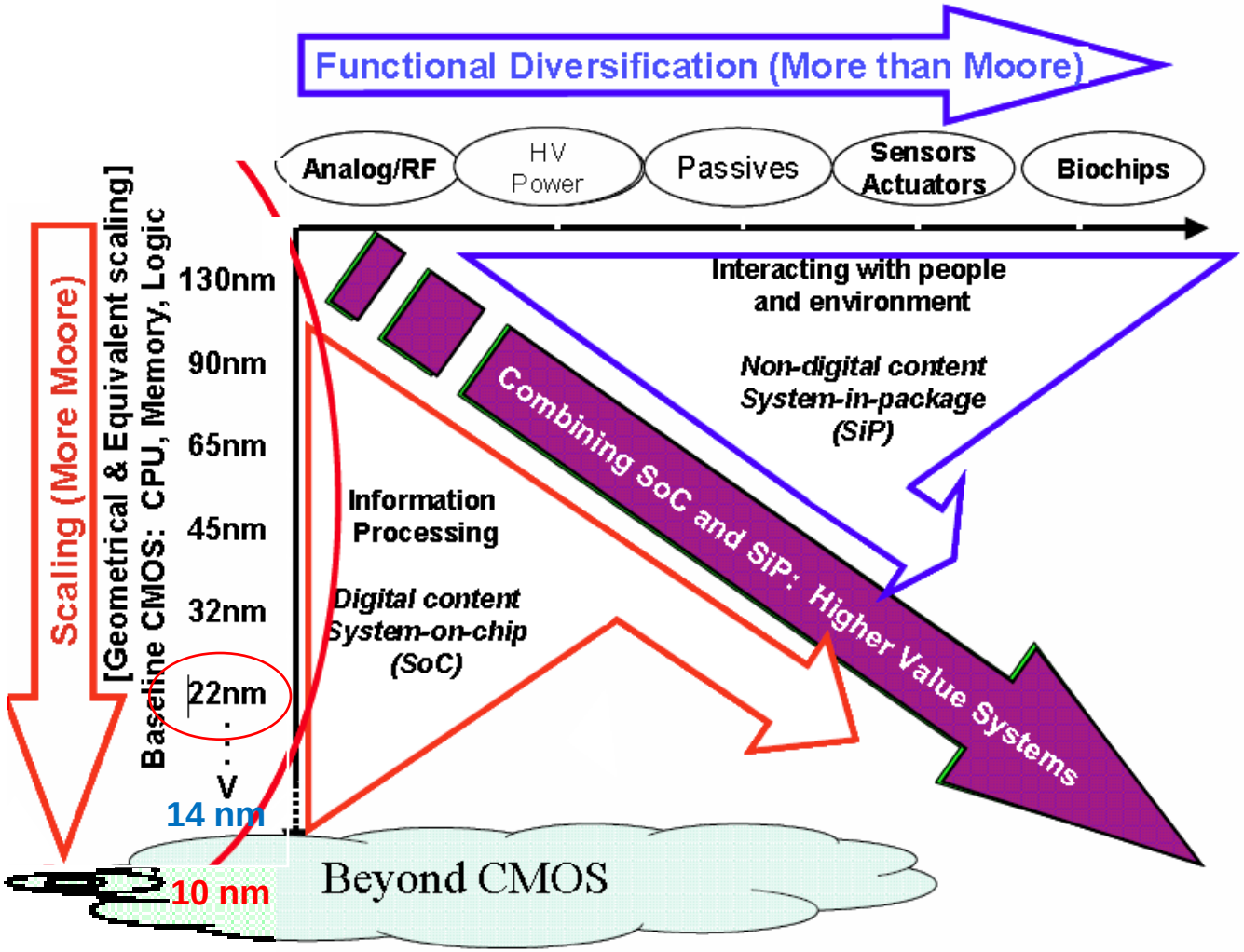


MOS first built: 1959

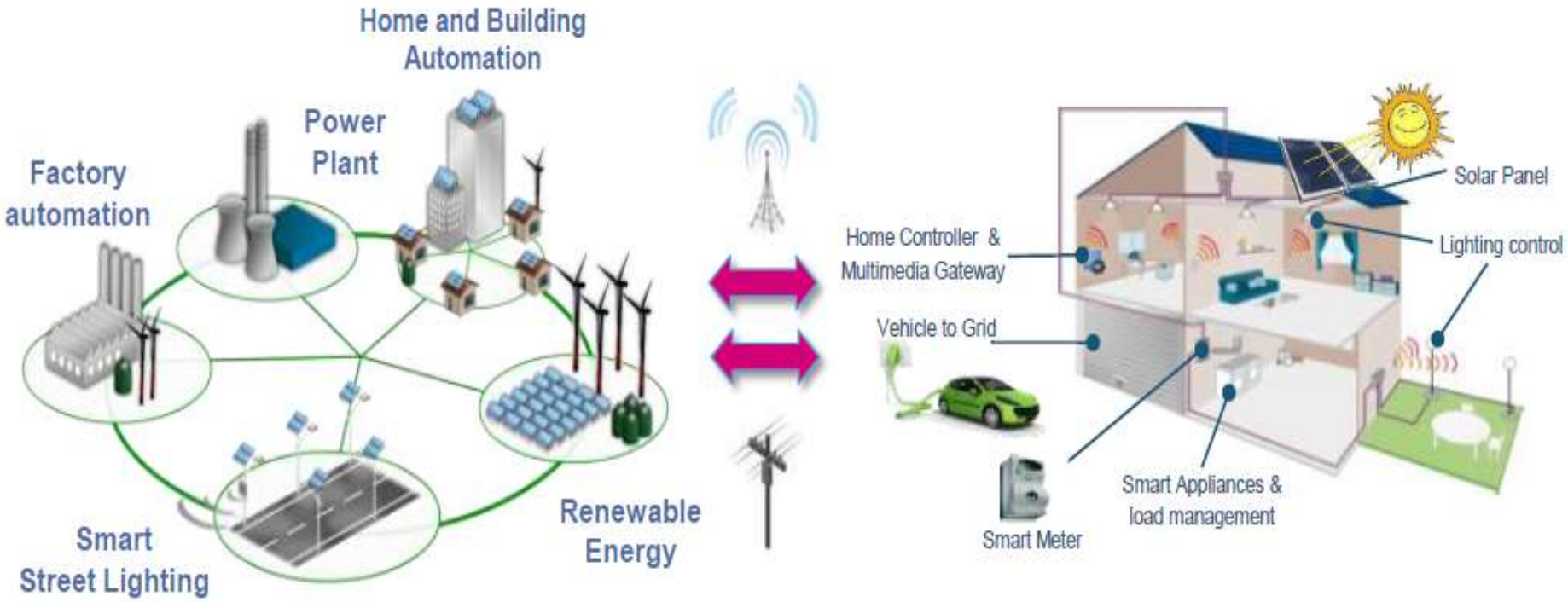


Transistor, 1947

Le strategie: Moore's Law and More



Fra i prossimi temi: Smart Grid, Smart Home, Smart City



Fra i prossimi temi: protezione della salute

Healthcare Market segment

Typical Application

Medical imaging
- Ultrasound
- Magnetic resonance imaging (MRI)
- Positron emission tomography (PET)
- Endoscopes

Clinical, diagnostic and therapy
- Patient monitoring
- Respirators
- Infusion pumps
- AED
- ECG

Portable
- Blood pressure meters
- Temperature meters
- Glucose meters
- Blood oximeters
- Hearing aids
- Portable ECG

Wellness, fitness, assisted living
Motion control/sensing
- Pedometers
- Heart rate monitors
- Fall detect
- Wheelchairs, Hospital beds
- Drug dispensers

Source : Semicast

Fra i prossimi temi: internet delle cose

Source: Sensor ID

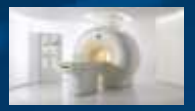
Le Tecnologie Prioritarie

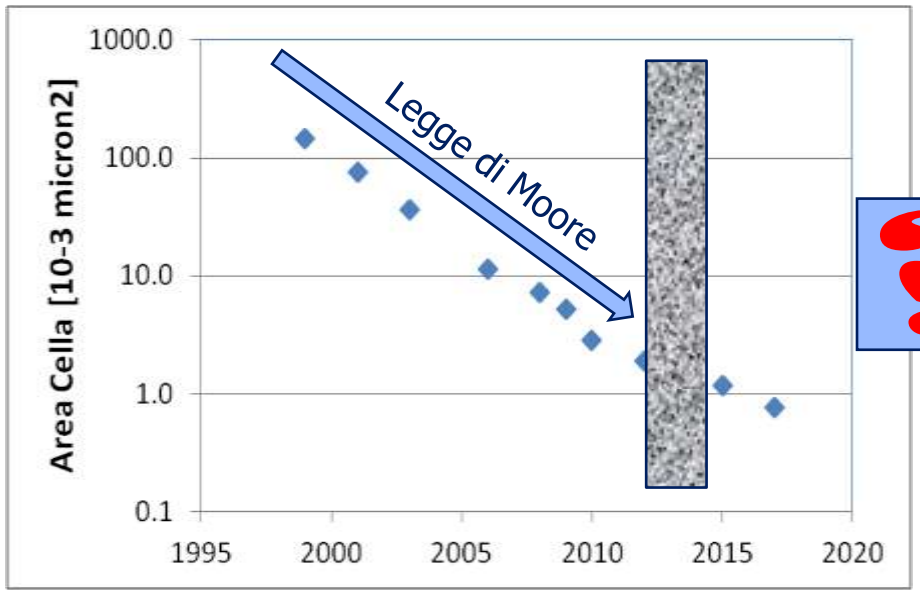
- **Tecnologia Prioritaria 1**
  - **Integrazione di sistemi elettronici su silicio**
- **Tecnologia Prioritaria 2**
  - **Tecnologie per applicazioni fotovoltaiche**
- **Tecnologia Prioritaria 3**
  - **Tecnologie per materiali alternativi al silicio**
- **Tecnologia Prioritaria 4**
  - **Tecnologie di Integrazione eterogenea**
- **Tecnologia Prioritaria 5**
  - **Tecnologie per sensori**
- **Tecnologia Prioritaria 6**
  - **Silicon Photonics**

TP1: Memorie Non Volatili

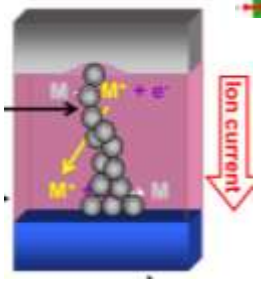


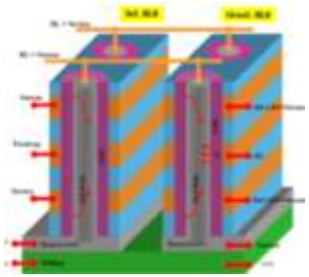






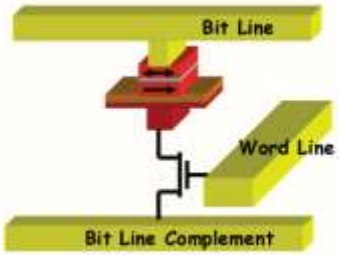
Memorie resistive





Memorie verticali

Memorie magnetiche



- **Aumento di capacità e riduzione costi sono stati ottenuti sinora riducendo le dimensioni delle celle di memoria.**
- **Limiti fisici e tecnologici rendono difficile continuare su questa strada. Radicali innovazioni sono necessarie.**
- **Unica alternativa in produzione: la memoria a cambiamento di fase, sviluppata in Italia.**

Memorie a cambiamento di fase

News & Analysis

Micron claims first high-volume production of 45-nm PCM

Dylan McGrath

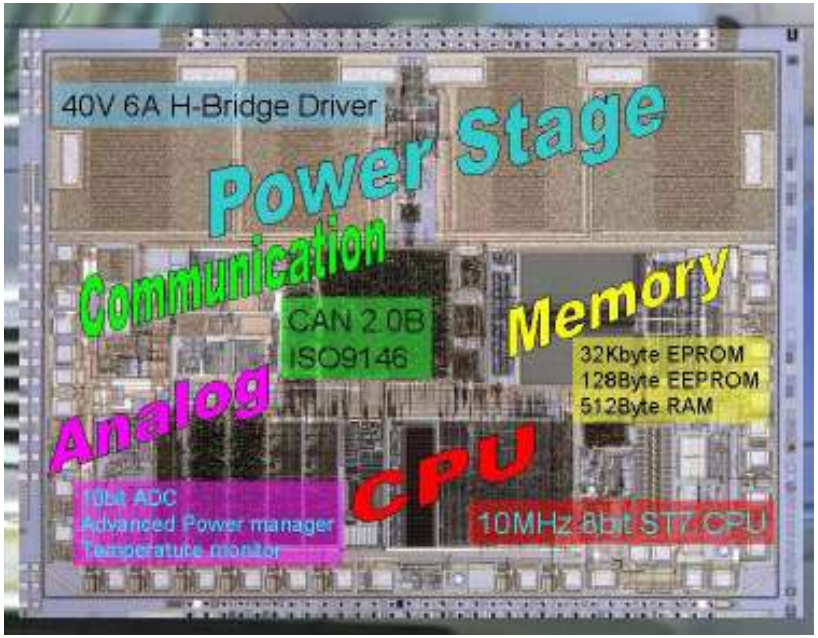
7/17/2012 8:27 PM EDT

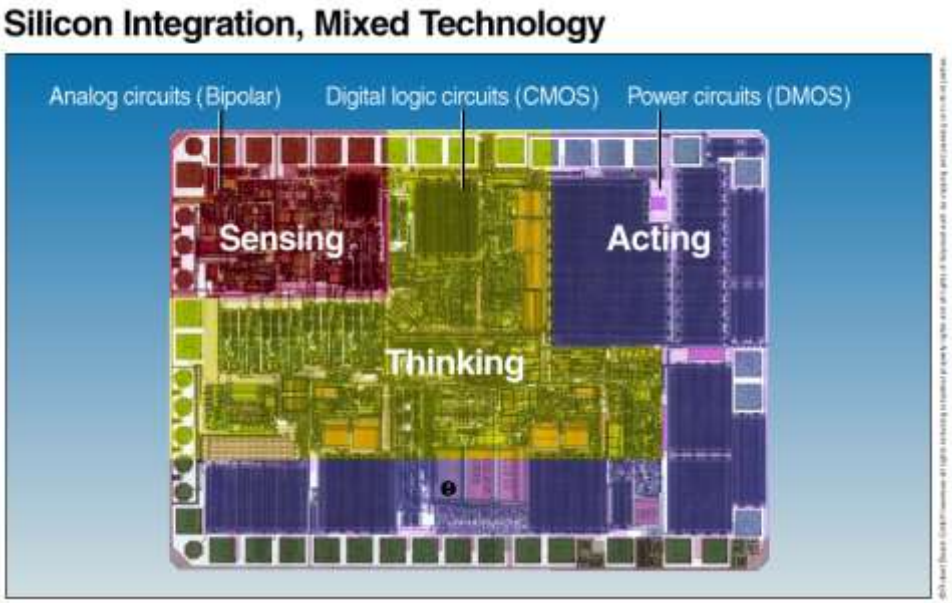
Micron

Airi ASSOCIAZIONE ITALIANA PER LA RICERCA INDUSTRIALE

TP1: Piattaforme multifunzionali BCD

BCD ➔ ***B****ipolare (analogica) +* ***C****MOS (logica)+* ***D****MOS (potenza)*
Nodo litografico: oggi 110 nm ➔ domani 90 nm
Tensione di alimentazione: fino a 800V ➔ domani 1200 V

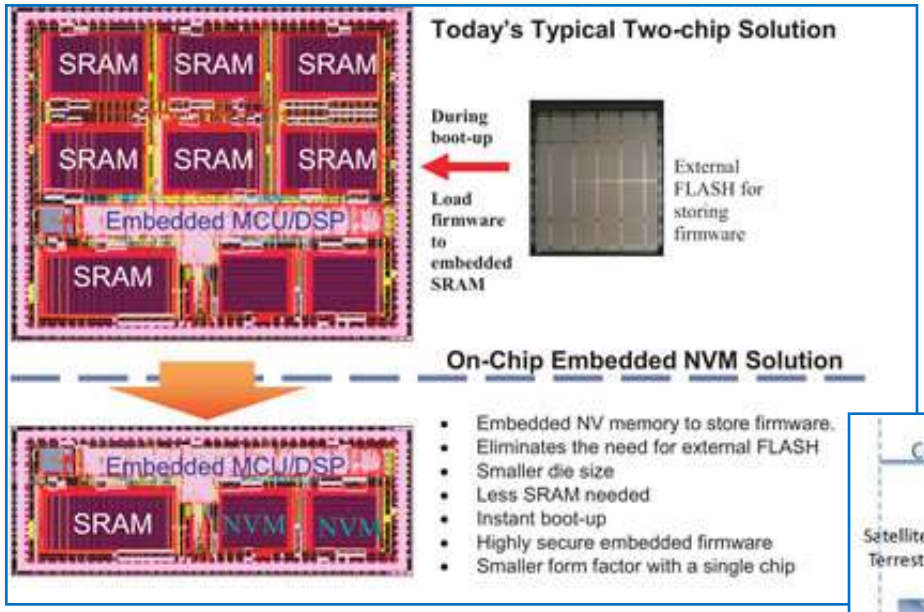




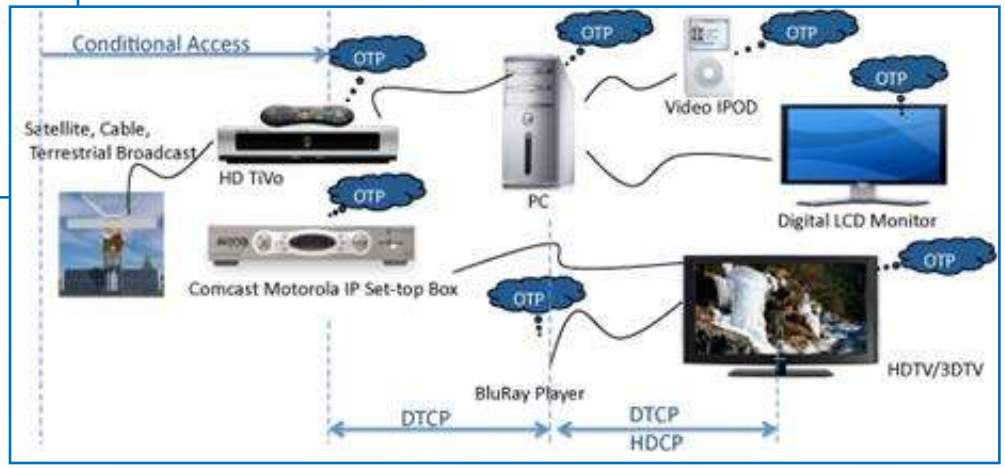
Source: Bosch

TP1: Piattaforma multifunzionale CMOS con NVM

Nodo litografico: oggi 65 nm ➔ domani 45 nm
Tensione di alimentazione: 3,3/5/30 V



Source: Kilopass Technology



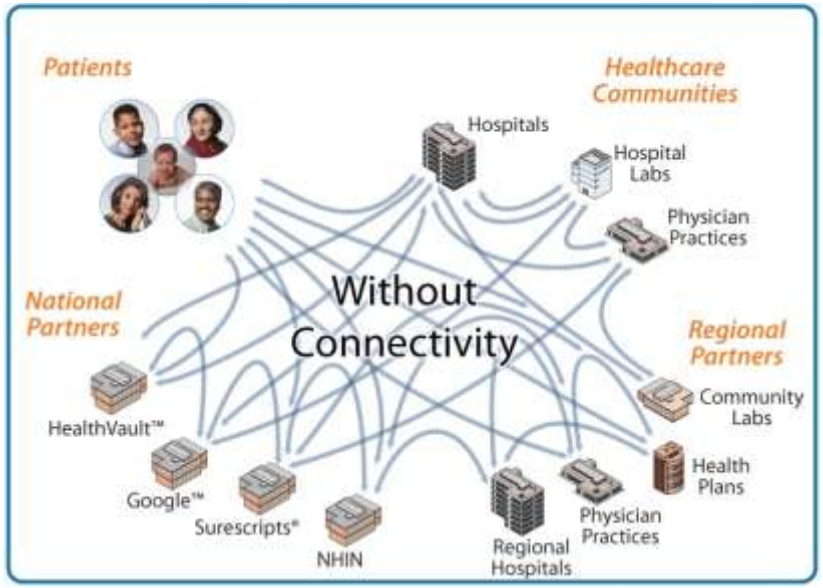
TP1: Soluzioni CMOS ad alta efficienza

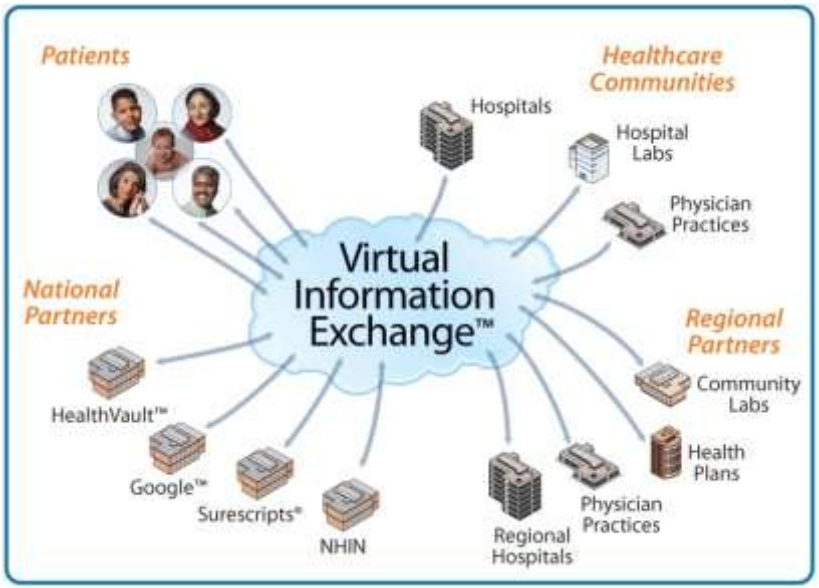
ERICSSON

Connessione uomo-macchina
Connessione macchina-macchina

Virtual presence
Virtual education
Virtual healthcare

esplosione della richiesta di connettività ➔necessità di capacità di banda delle reti
➔basso consumo, velocità, integrazione…



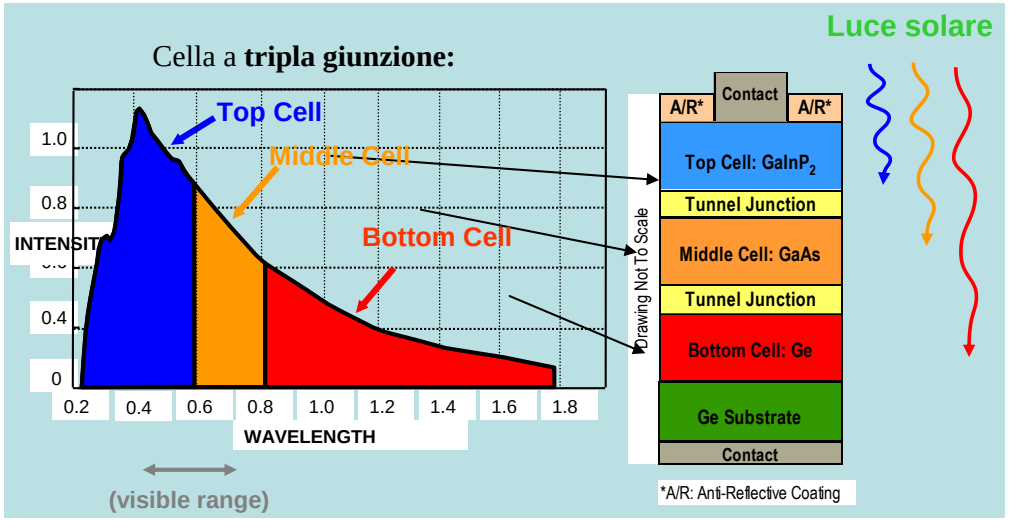


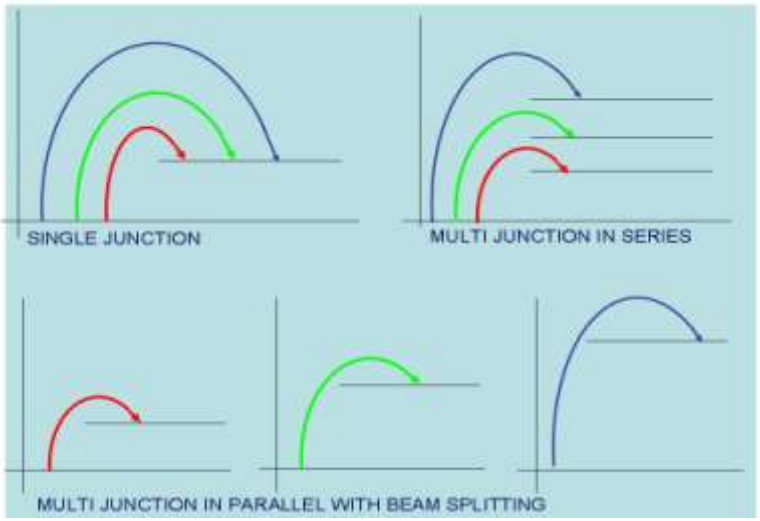
Source: EHM

TP2: Applicazioni fotovoltaiche

Sistemi a concentrazione solare su selezione spettrale

Giunzione ottimizzata per le tre bande spettrali: efficienza → >35%
Prossimo traguardo: → >50%



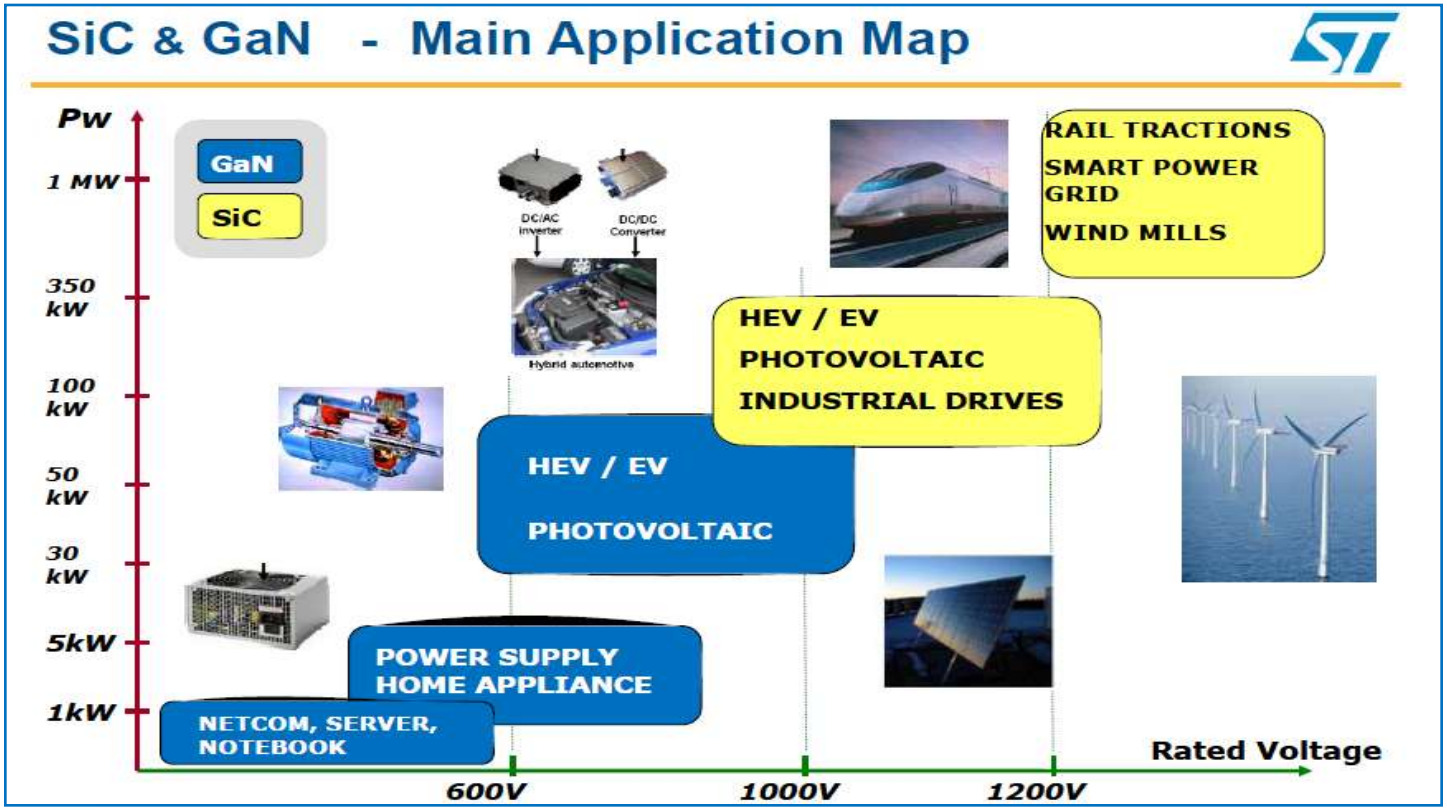


Rosso: Ge; Verde: GaAs; Blu:InGaP

TP3: Materiali alternativi al silicio

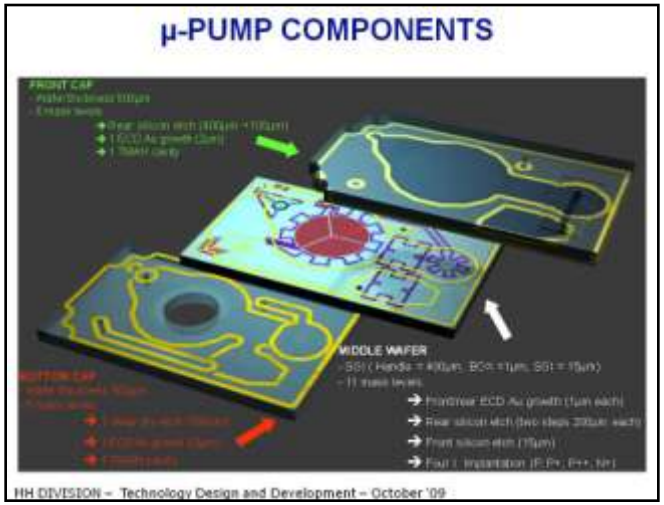
Tecnologie per SiC e GaN

Alto gap, tenuta in tensione, conducibilità, stabilità termica, capacità in frequenza (microonde, radar…)

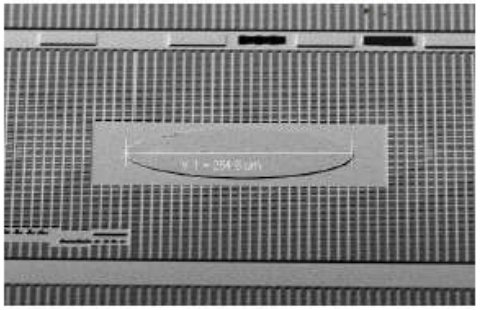


TP4: Integrazione eterogenea

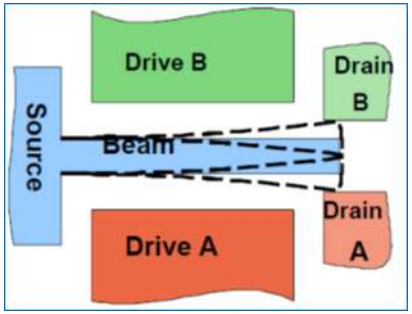
Integrazione 3D di componenti passivi, elettromeccanici, di sistema



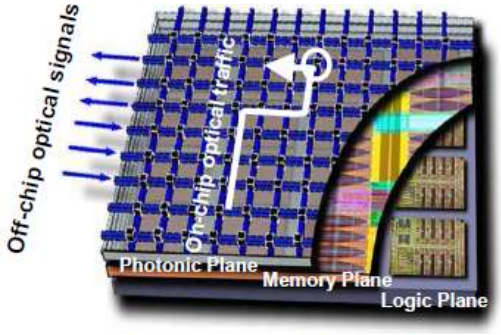
Hall with Integrated Magnetic Concentrator (HIMC)/up to 30A



Source: ST



NEM: Nano Electro-Mech. Switch
Source: Sematech



3D Stack, combining logic, memory and optical functions

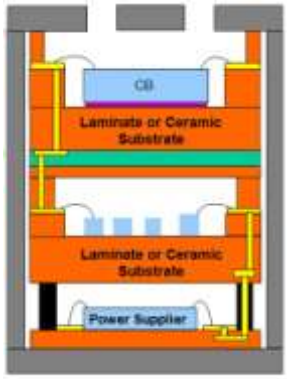
Source: IBM

TP4: Integrazione eterogenea

Co-packaging componentistica

Advanced Packaging for High Power Devices (composite materials, heat-pipes, active cooling systems, …)

3D Packaging (new materials and integration processes, microwave design, photonics)



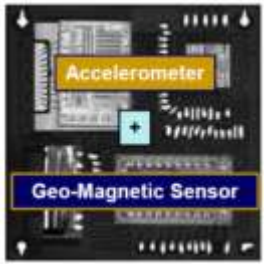
3D Packaging

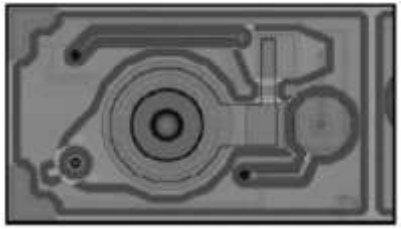
Selex ES
A Finmeccanica Company

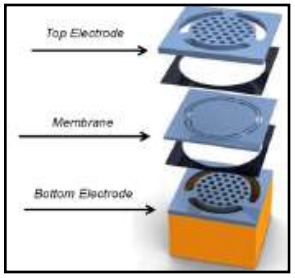
TP5: Sensori

Sensori: interfacciano l'ambiente

- ***Sensori di movimento (MEMS inerziali) e posizione***: ACC, GYR. MAG, PS
- ***Sensori ambientali***: pressione, umidità, temperatura
- ***Microfoni microlavorati***
- ***Microattuatori***: µpompe, µmirrors (picoproiettori integrati)
- ***Sensori ottici***: usi militari (esplosivi), sorveglianza, 3D-imaging
- ***Sensori bio***: analisi DNA, proteiche, virali…







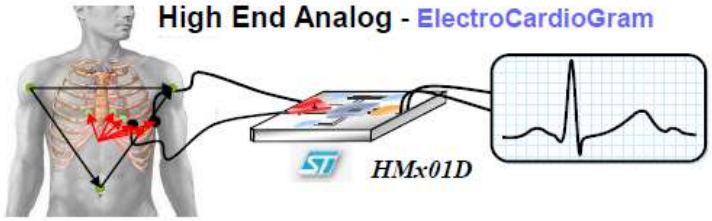
TP5: Sensori

- ***Consumer***: cells, tablets, pc, giochi…
- ***Fitness***: pedometro, performance monitoring…
- ***Home***: shock detection (elettrodomestici, allarmi…)
- ***Auto***: airbag, stabilità, antifurto, tracking (blackbox)….
- ***Medical***: monitoraggio remoto, riabilitazione, diagnostica….
- ***Industrial***: robotica, sismica, edilizia…

TP5: Sensori

Sensors for Vital Sign Detection

High End Analog - ElectroCardioGram



Accelerometer/Gyros
body activity

Strain Gauge + RF
Intraocular pressure

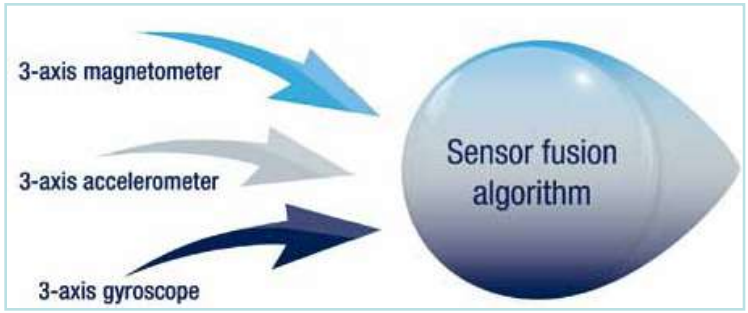
Bio-chip
lactic acid

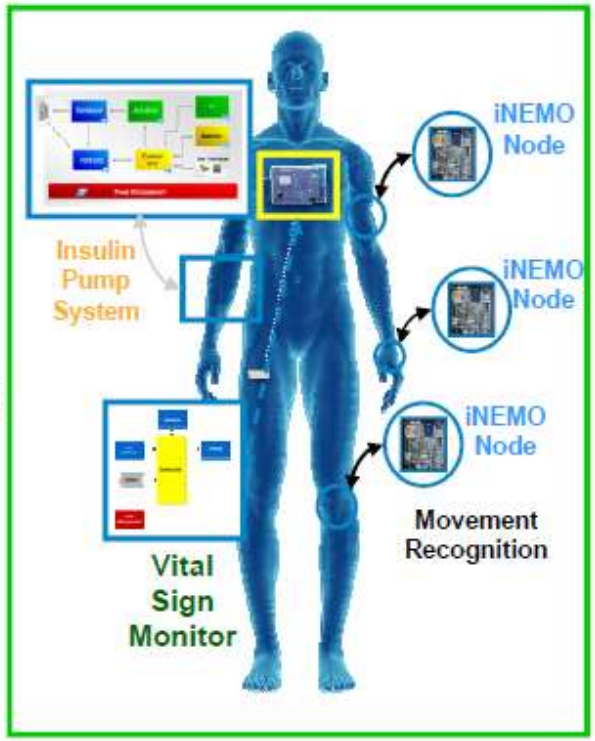
Temperature sensor
Body - temp

Pressure sensor
blood pressure

Microphone or Pressure sensor
Heart beat

TP5: Sensori


3-axis magnetometer
3-axis accelerometer
3-axis gyroscope
Sensor fusion algorithm


iNEMO Node
iNEMO Node
iNEMO Node
Insulin Pump System
Movement Recognition
Vital Sign Monitor


iNEMO®
iNEMO Engine sensor fusion suite
Multi-axis sensors
Augmented reality
Motion gaming
Enhanced pointing
Wellness
Pedestrian navigation
Motion tracking


iNEMO

TP5: Sensori

Selex ES

SENSING TECHNOLOGIES

Contexts

Military

- Warfare chemical agents
- Explosives

Civil

- Homeland protection
- Surveillance (customs, airport…)
- Structural monitoring

TP5: Sensori

Selex ES

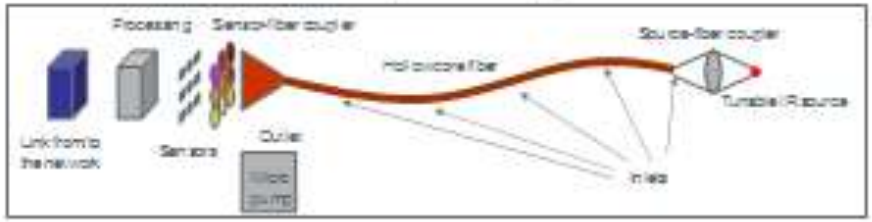
SENSING TECHNOLOGIES

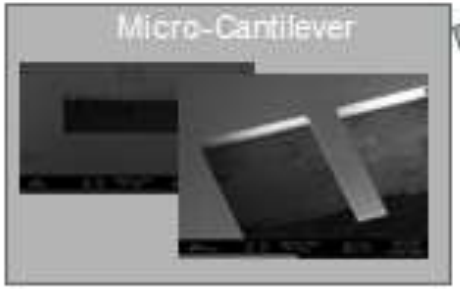
Technologies

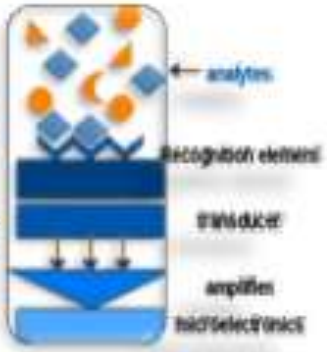
- Optical based sensors
  - IR spectroscopy
  - Fiber optics
  - Integrated optics
- Biochemical recognition
- Body antibody processes
- DNA
- Electrochemical transduction
- Signal processing Algorithms
- Fiber optics

SENSORS ON A CHIP

Hollow fiber based IR Spectroscopy



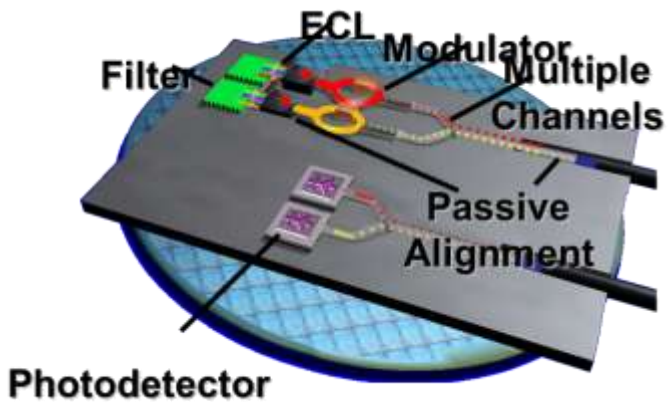


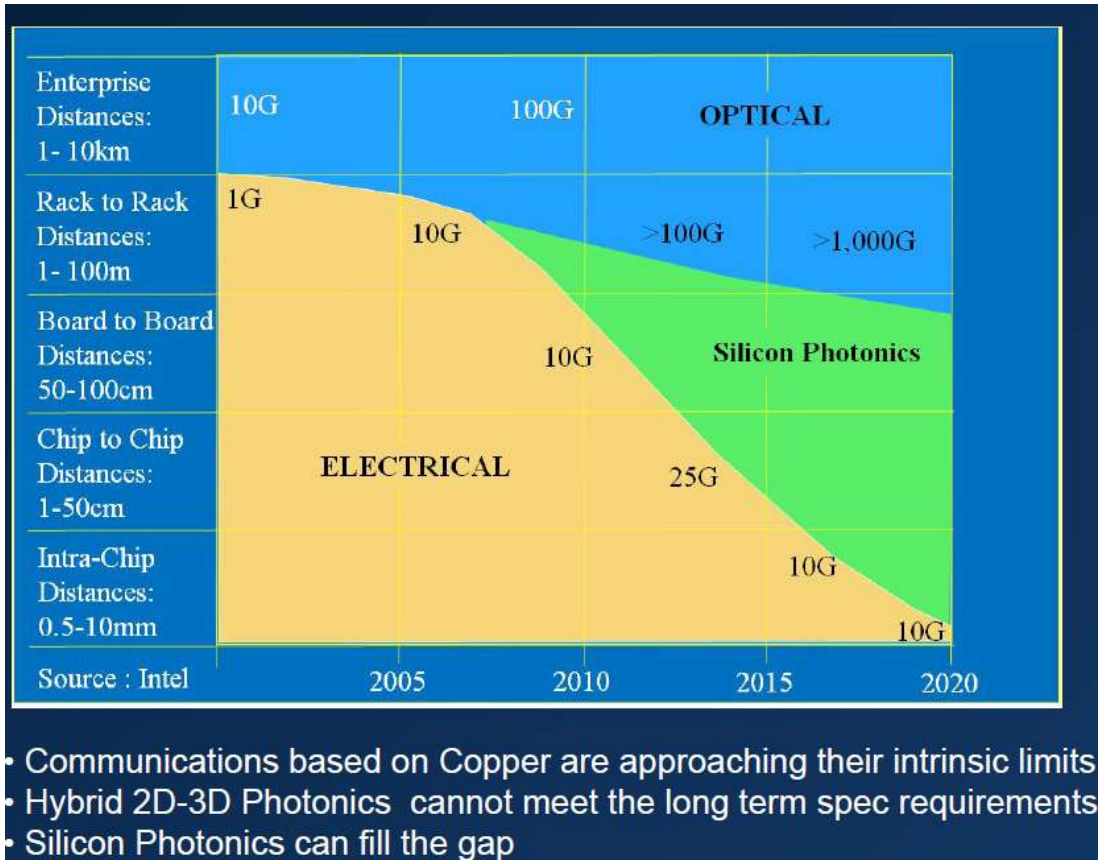


TP6: Silicon Photonics

Integrazione ibrida elettronica/ottica e sottosistemi optoelettronici e fotonici

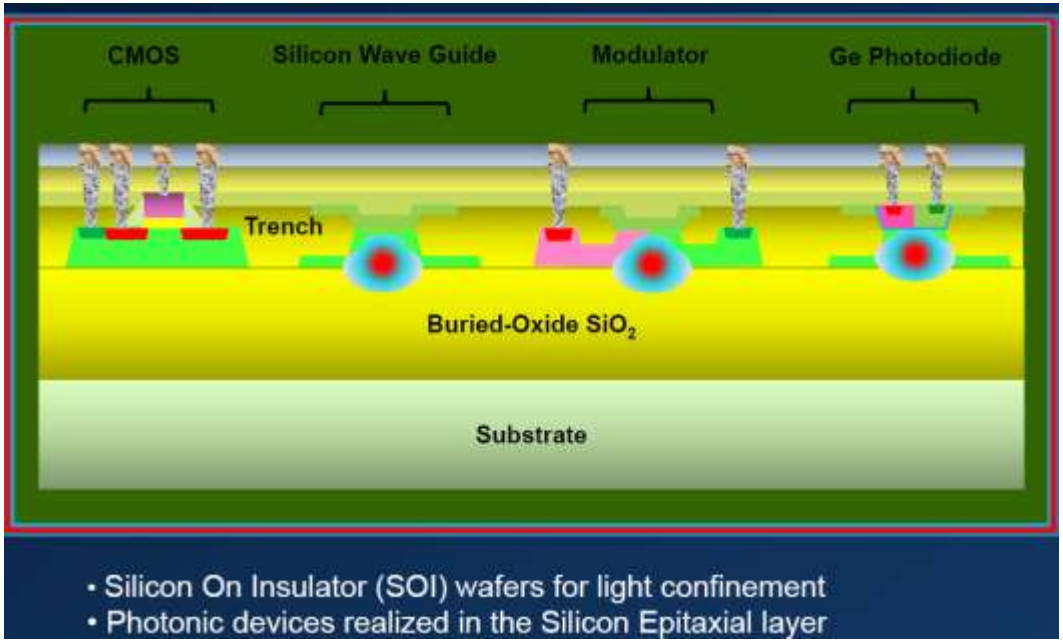
Integrazione di componenti ottici e fotonici con piattaforme CMOS su substrati SOI per superare il limite fisico della trasmissione elettrica su distanze >50 cm con rate >20 Gbs.



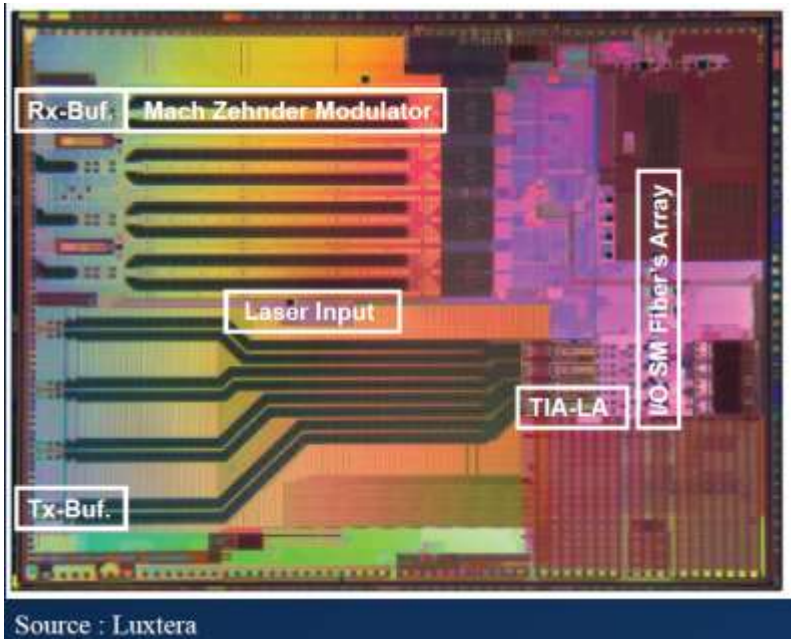


- Communications based on Copper are approaching their intrinsic limits
- Hybrid 2D-3D Photonics cannot meet the long term spec requirements
- Silicon Photonics can fill the gap

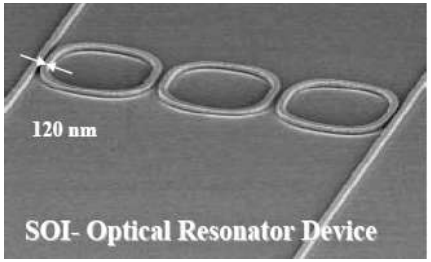
TP6: Silicon Photonics



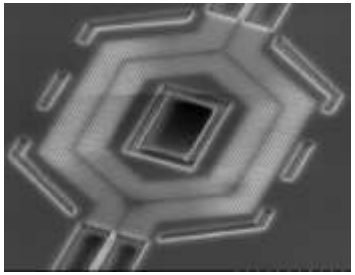
- Silicon On Insulator (SOI) wafers for light confinement
- Photonic devices realized in the Silicon Epitaxial layer



Source : Luxtera



Microring resonators



$LiNbO_3$ Photonic Crystals

Source: Selex ES

Grazie a tutti per l'attenzione e la pazienza