



MEMS based Sensor solution & Application

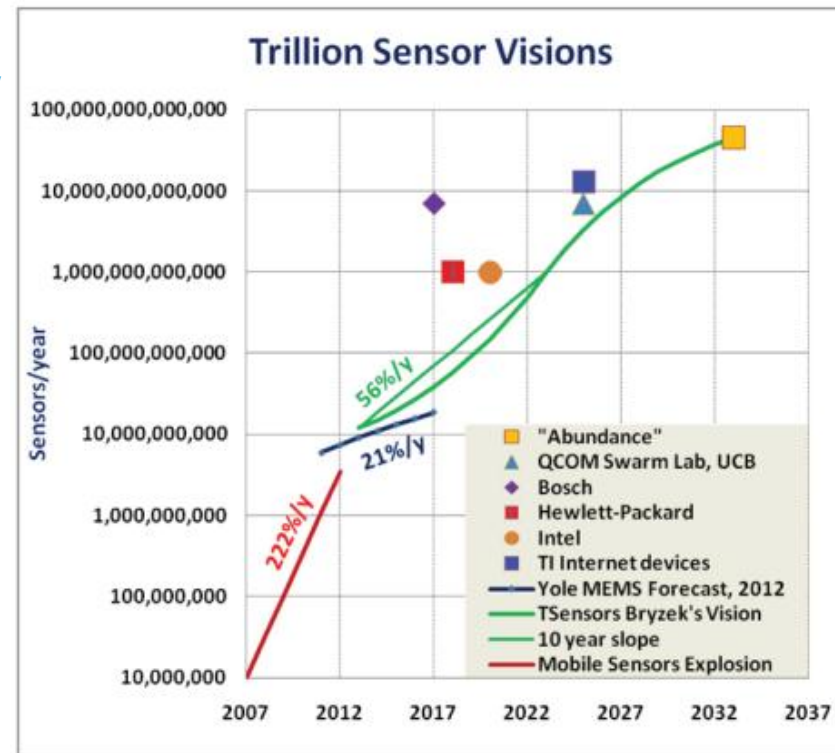
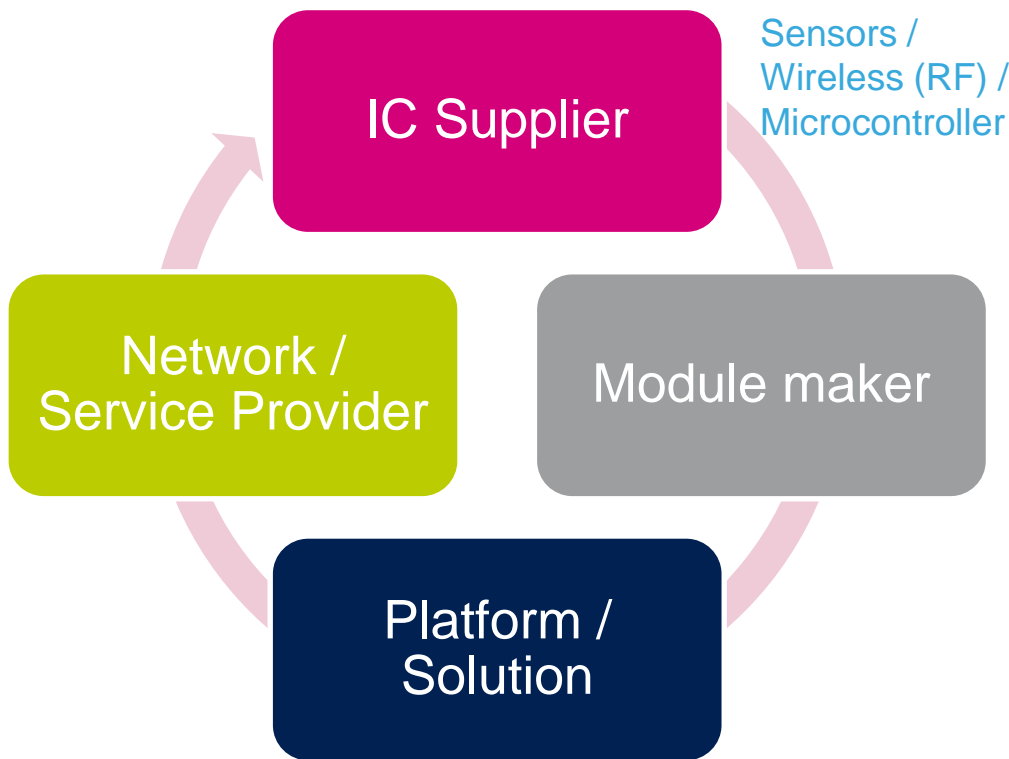
STMicroelectronics

20th Feb Y2014

- Sensors in the IOT (internet of thing) & MEMS Sensor Introduction
 - What is the MEMS Technology
 - IOT & MEMS Sensor market projection.
- How to use the sensor in the market now.
 - Mobile / Portable application
 - SMART Home application
 - Wearable Application
 - Weather Forecast application
- What is the next with sensors.
 - Next application solution
 - Evolution of Sensors

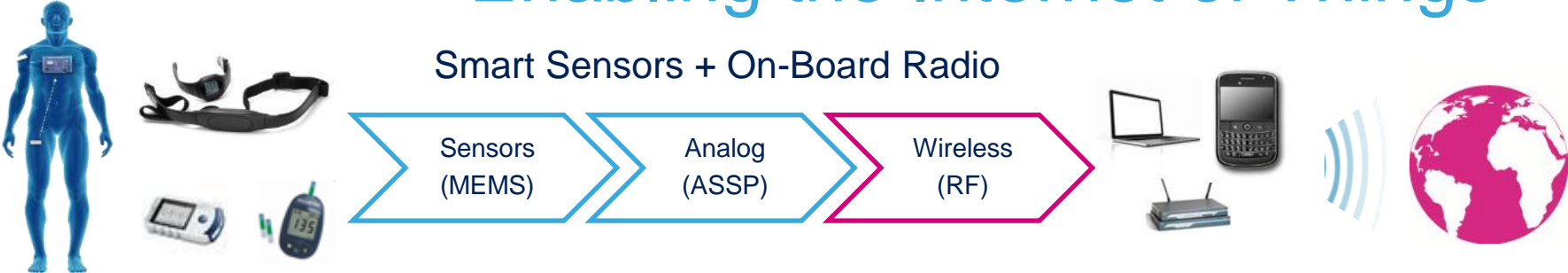
❖ Track B : 15:20 ~ 16:00

Sensors in the IOT market



Source : Tsensor summit, Janusz Bryzek

Enabling the Internet of Things



Sensors

Sensors & Radio in Smart System

RF



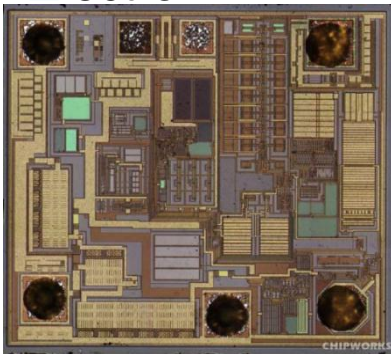
What is the MEMS.....

- MEMS stands for **Micro Electro Mechanics System**
- In MEMS, there are mechanical parts for physical quantity and electrical parts for digital processing.

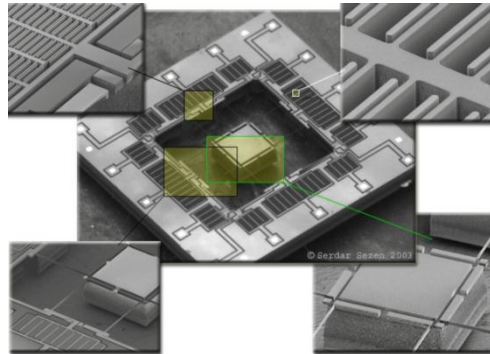
Micro



Electro



Mechanics

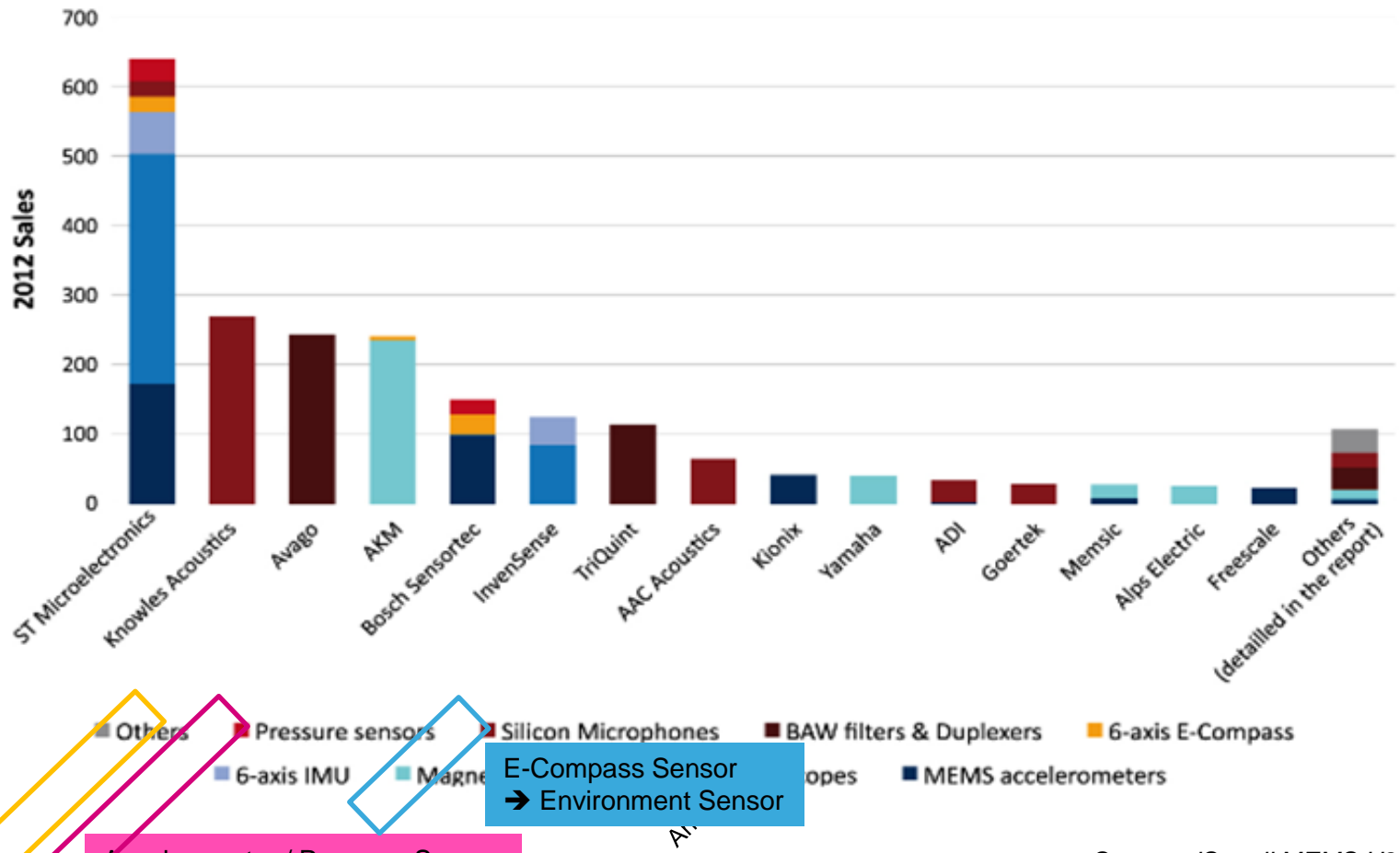


System

MEMS Top ranking suppliers

Top MEMS suppliers in the mobile phone and tablet market (in \$M)

- 2012 revenue (\$M) - Breakdown by product type -



Others Pressure sensors Silicon Microphones BAW filters & Duplexers 6-axis E-Compass
6-axis IMU Magneto-impedance E-Compass Sensor Microphones MEMS accelerometers

Accelerometer / Pressure Sensor
 → Gyro Sensor market

Gyro / 6 axis Combo
 → 9 axis Combo

E-Compass Sensor
 → Environment Sensor

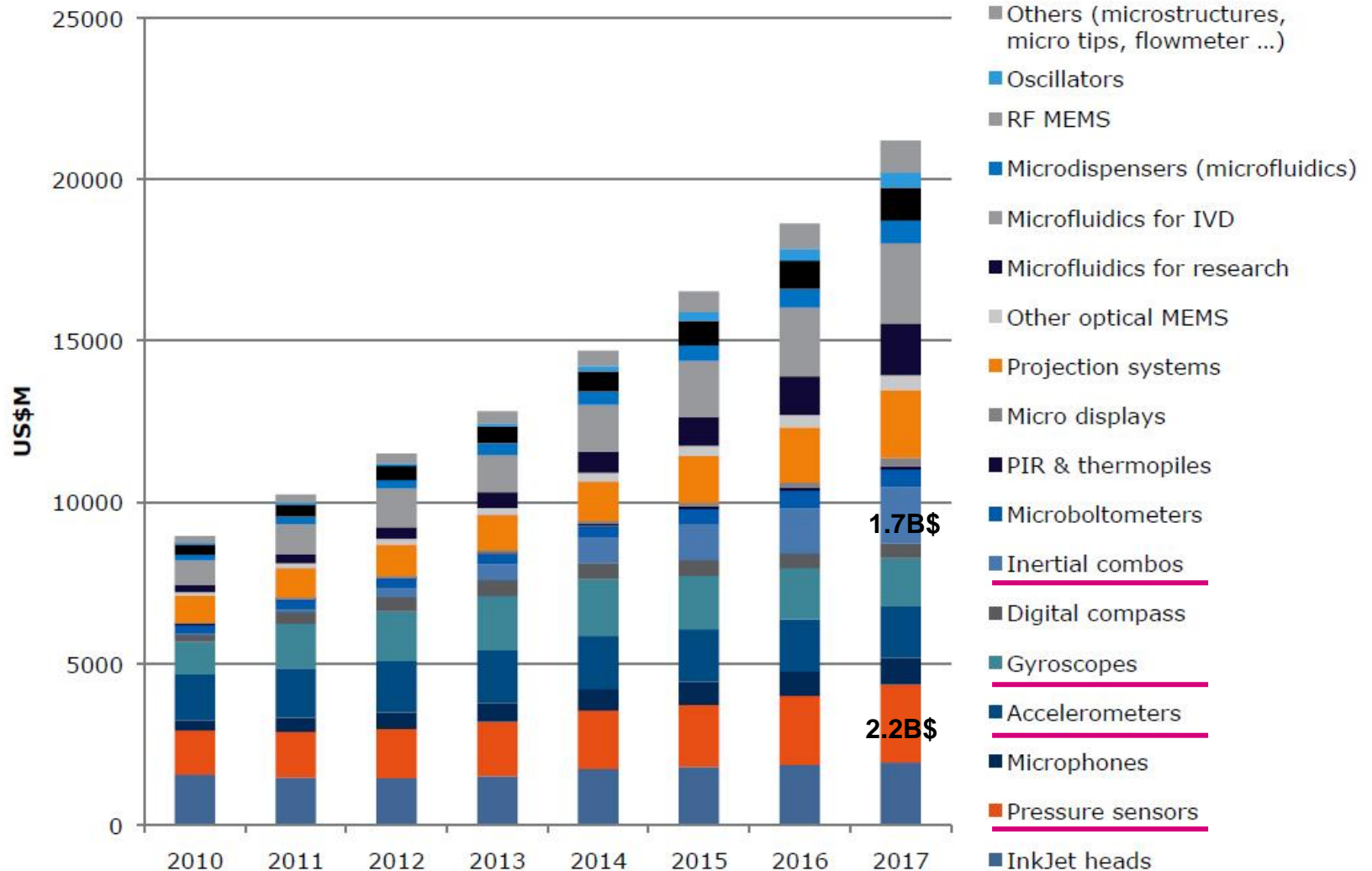
Source : iSuppli MEMS H2 2012

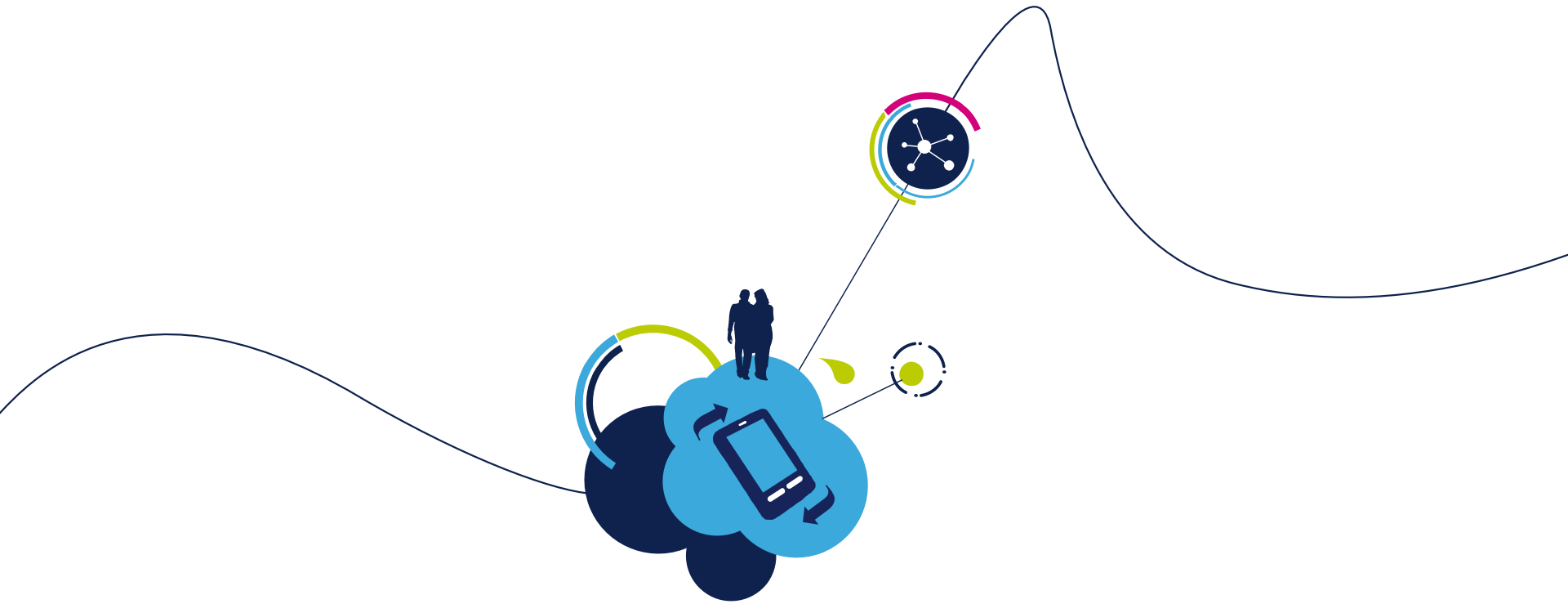
Source : Yole development

MEMS Market Forecast by product

MEMS market forecast 2010 - 2017 (US\$M)

(Source: Status of the MEMS industry report, to be released mid 2012, Yole Développement, March 2012)

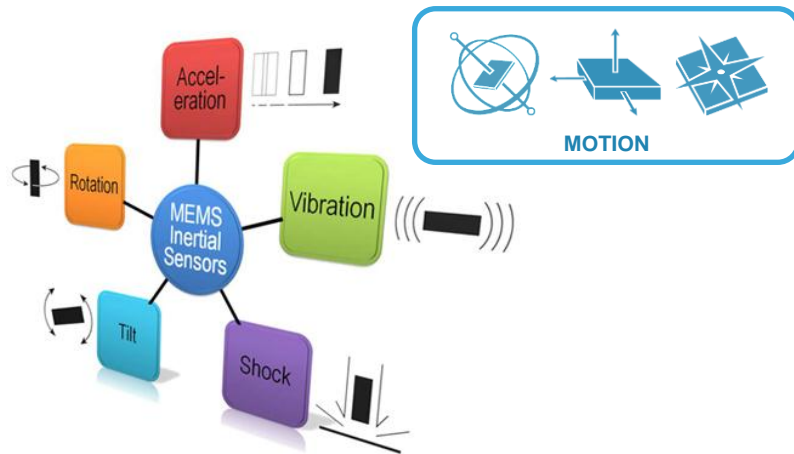




Sensor in the Application

Sensors.... In the market

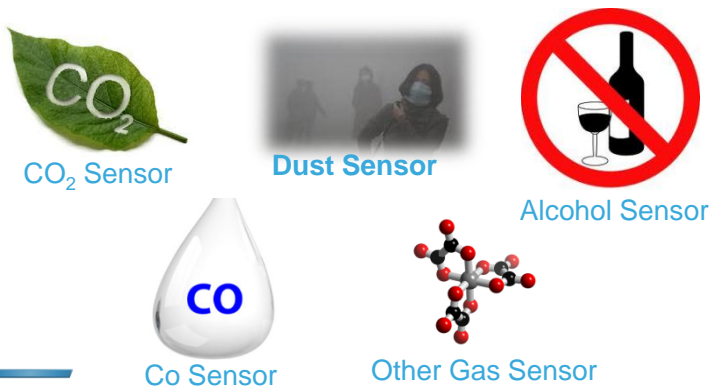
Inertial Sensor (Motion MEMS)



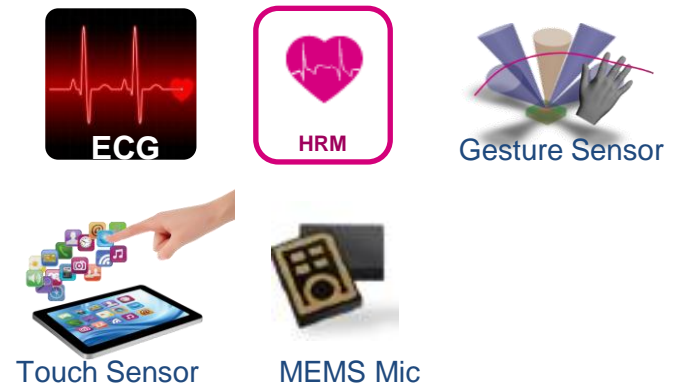
Environment Sensor



GAS Sensor



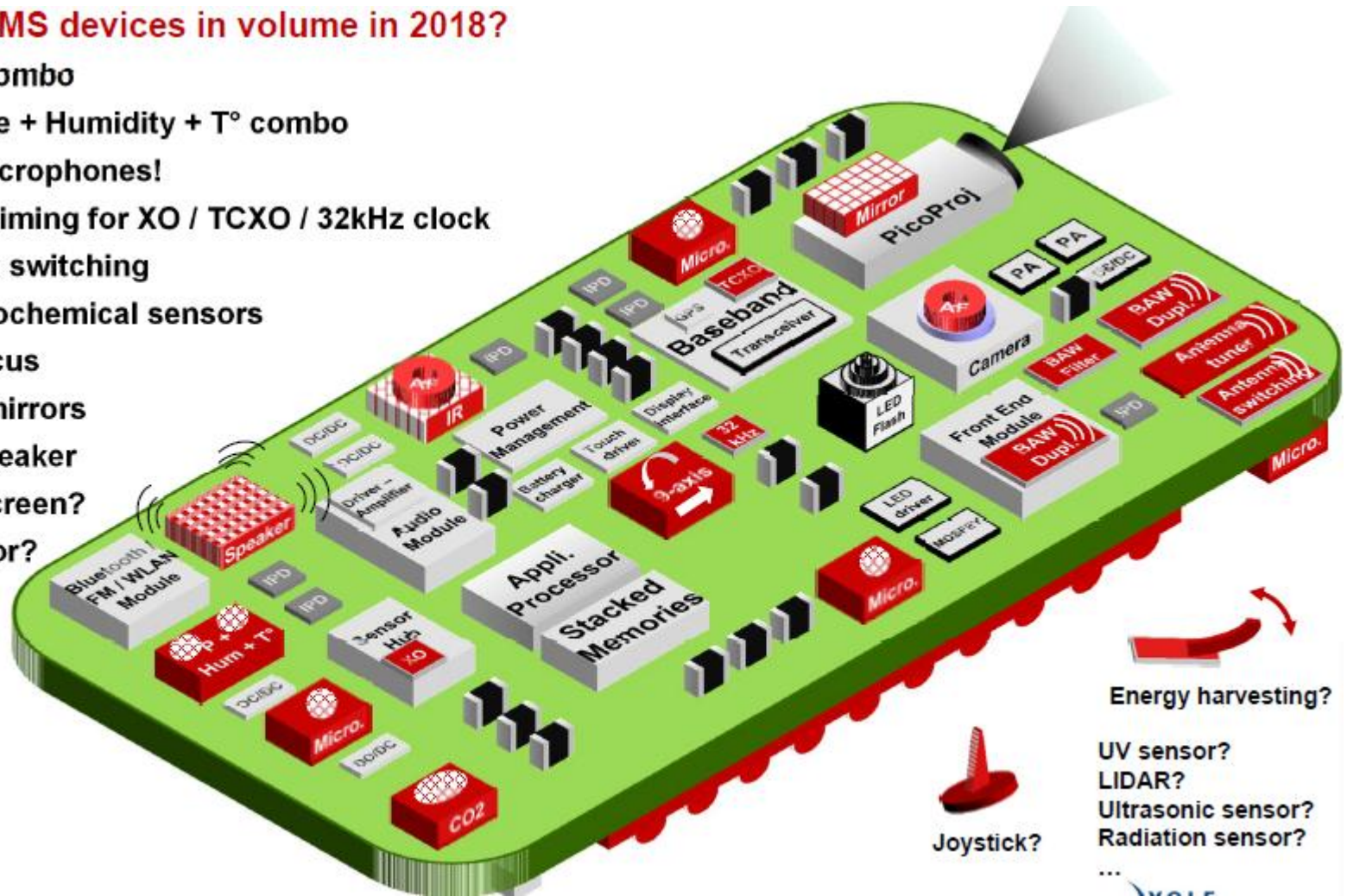
Medical & Other sensors.



Sensors in the SMART Phone

New MEMS devices in volume in 2018?

- 9-axis combo
- Pressure + Humidity + T° combo
- More microphones!
- Silicon timing for XO / TCXO / 32kHz clock
- Antenna switching
- Gas / biochemical sensors
- Auto-focus
- MEMS mirrors
- Microspeaker
- Touchscreen?
- IR sensor?



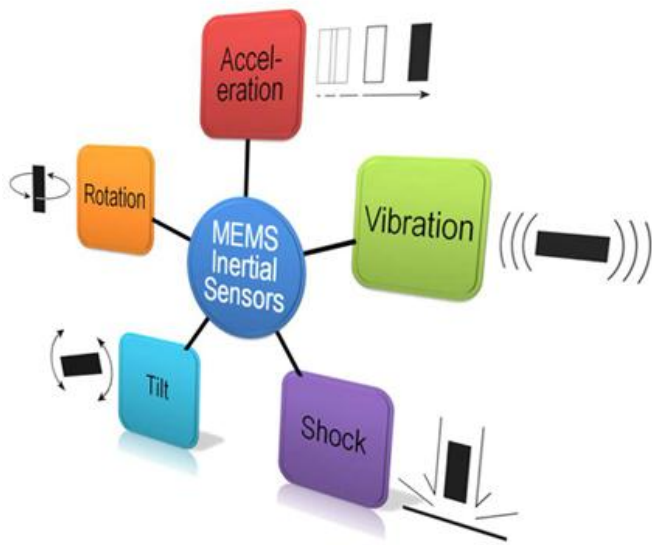
- Energy harvesting?
- UV sensor?
- LIDAR?
- Ultrasonic sensor?
- Radiation sensor?
- ...

Joystick?

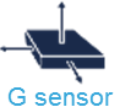
Source : Yole Development



Sensors in the traditional SMART Phone



High Power consumption



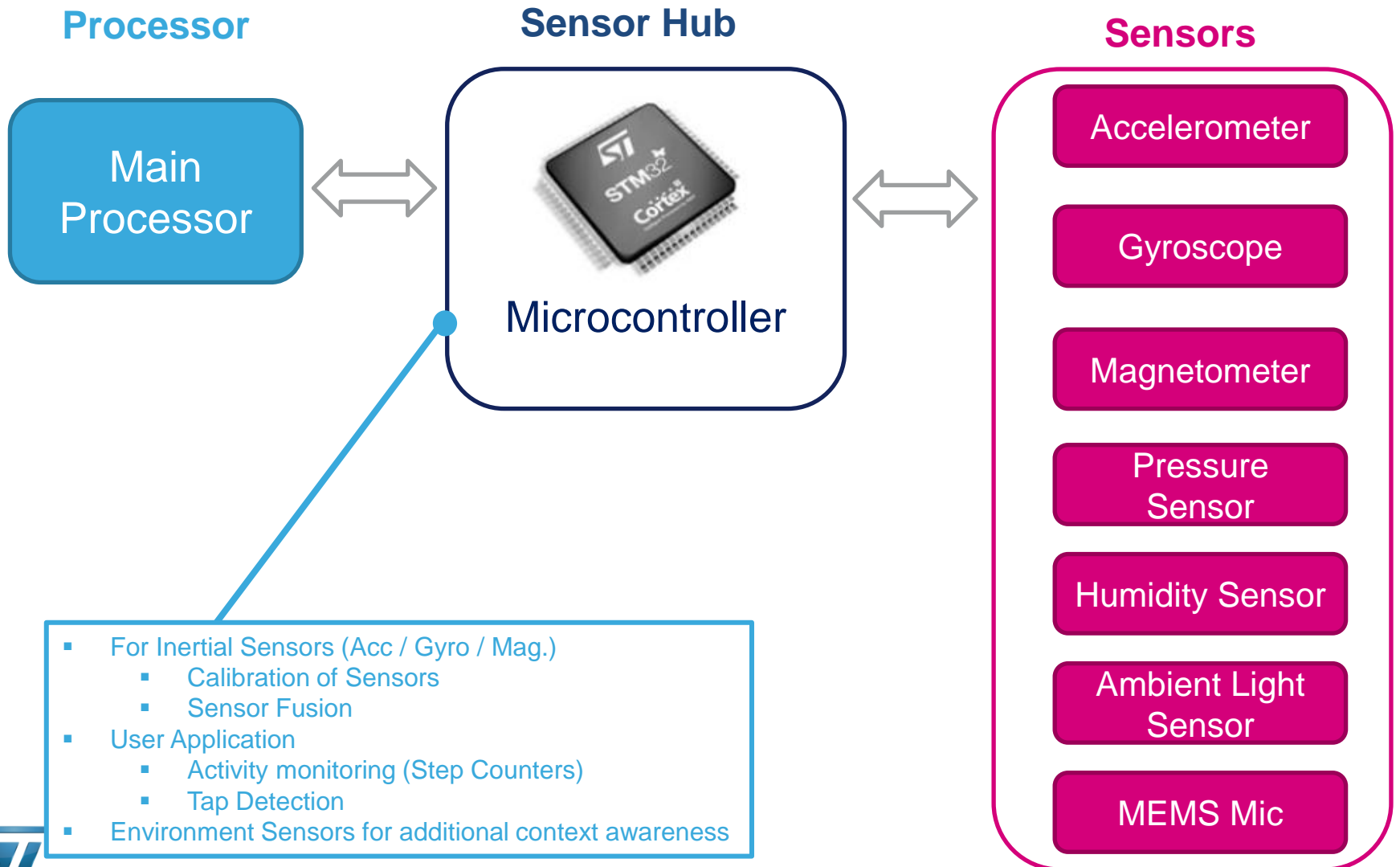
Accelerometer



Gyroscope



Sensor Hub Overview in SMART Phone



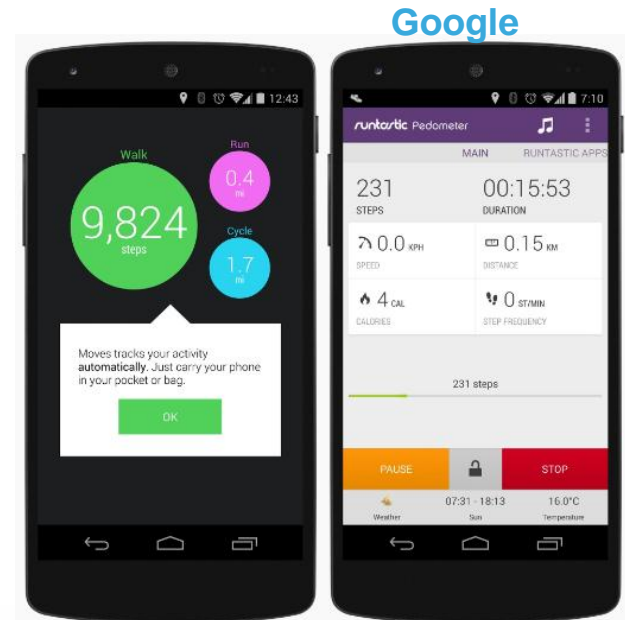
Why Sensor Hub in SMART Phone

Maximized Battery life time!



- Always ON Sensors...
- **Pedometer**
- **Activities Recognition**

How use Sensors in SMART Phone NOW



Moves and Runtastic Pedometer are using the hardware step-detector to offer long

<http://developer.android.com/about/versions/kitkat.html>



<http://www.samsung.com/sec/consumer/mobile-phone/mobile-phone/kt/SHV-E300KDS3KC-features>

Sensor in SMART Home

Monitor Weather & Air Quality



Made for iPod iPhone iPad



INDOOR

OUTDOOR



Sensors



Humidity



Temperature



CO₂



MEMS Mic



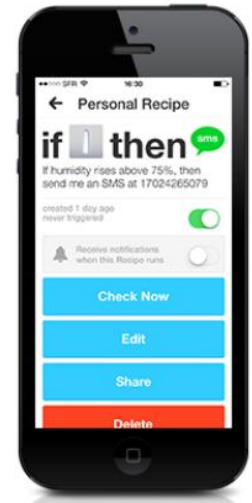
Barometric pressure

<http://www.netatmo.com/en-US/product>

IFTTT

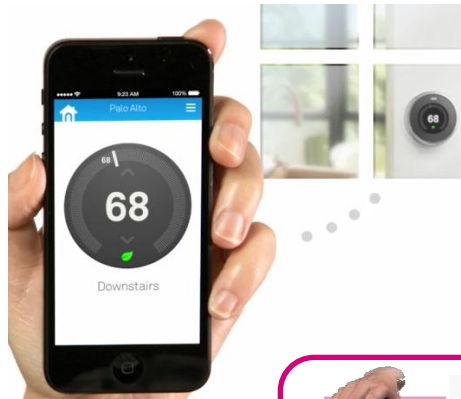
Put the internet to work for you.

IFTTT lets you create powerful connections with one simple statement – if this then that. For example : "Get an SMS when the humidity is over 60%."



Sensors in SMART Home

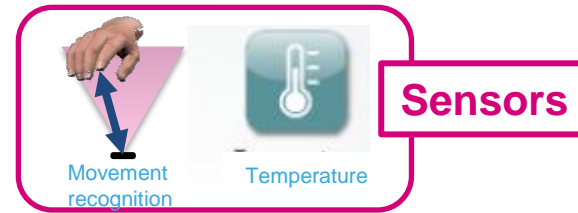
NEST : Thermostat



Save while you're away.

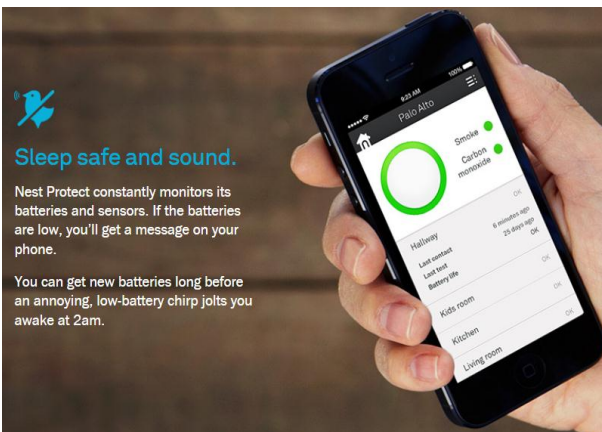
With Auto-Away™, the Nest Thermostat automatically turns to an energy-efficient Away temperature when you're gone.

Auto-Away works in 90% of homes, even if your Nest is in a spot you don't pass on your way out the door.



Source : <https://nest.com/>

NEST Protector : Smoking + CO Alarm

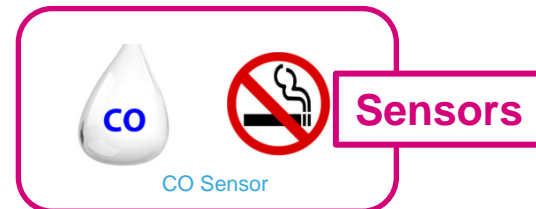


Sleep safe and sound.
Nest Protect constantly monitors its batteries and sensors. If the batteries are low, you'll get a message on your phone.

You can get new batteries long before an annoying, low-battery chirp jolts you awake at 2am.



We made a smoke and CO alarm you'll love, because hating it is dangerous.



Sensor in Wellness / Wearable

UV Sensor in Bracelet

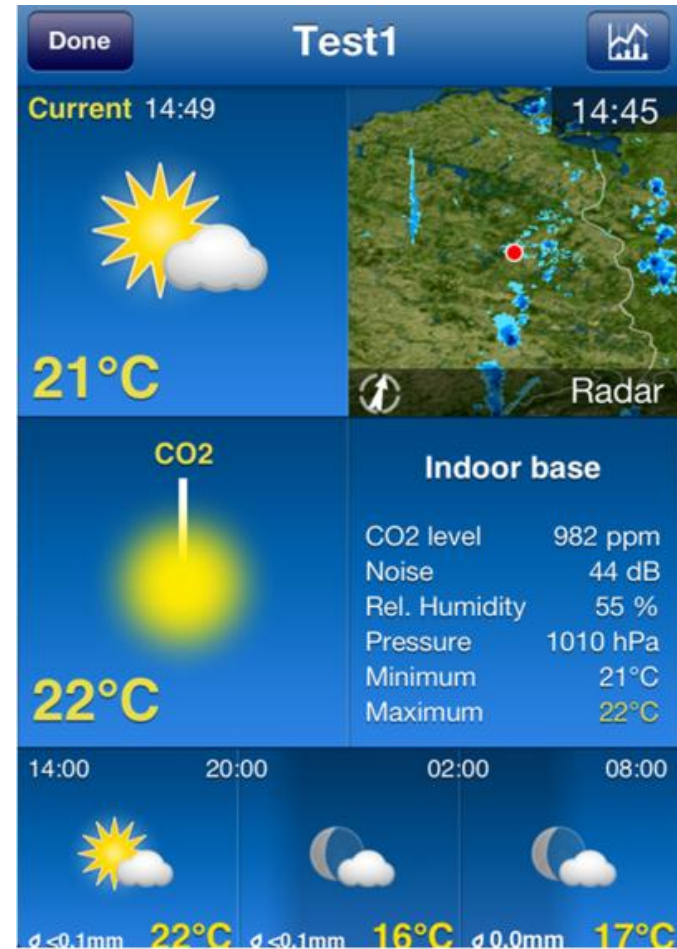
HRM Earphone

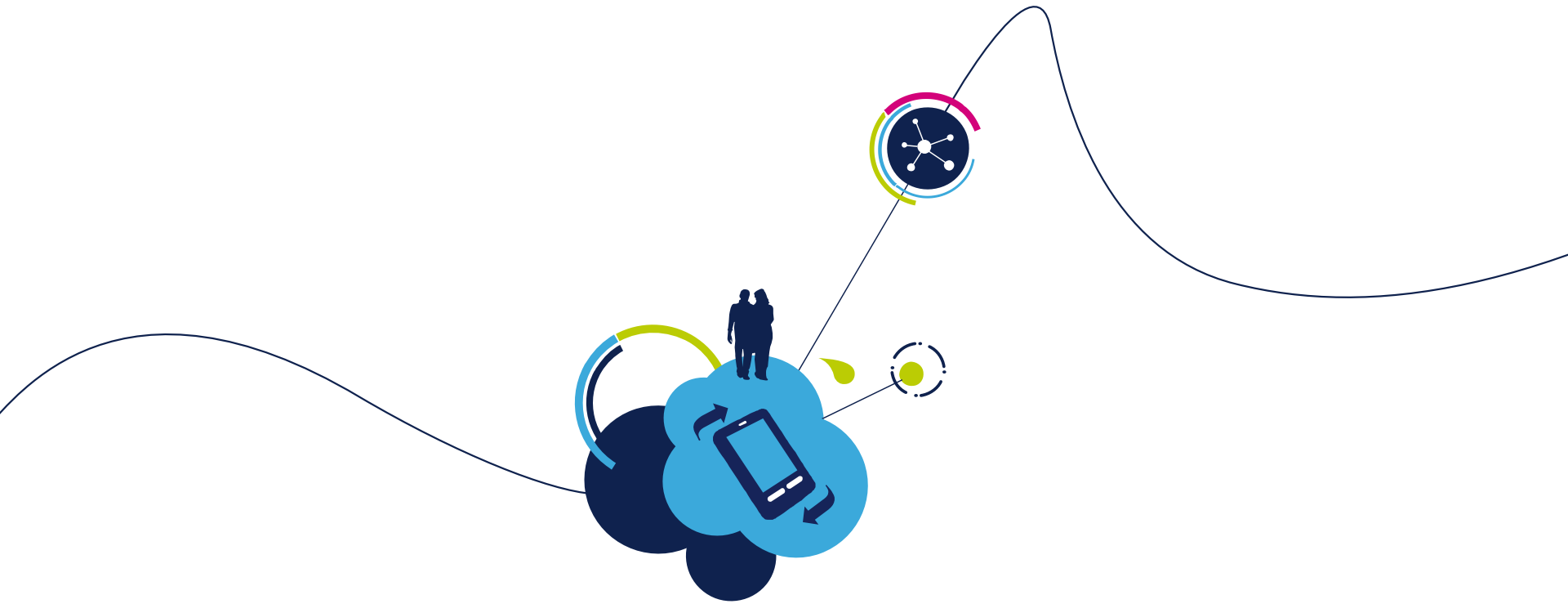


<http://www.netatmo.com/en-US/site>

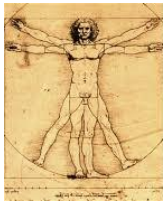


Environment sensors for weather forecast





What is the next?

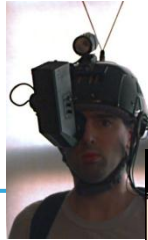


Humanization of technology what is coming

Wearable / Application

Smart connected sensors

Miniaturization

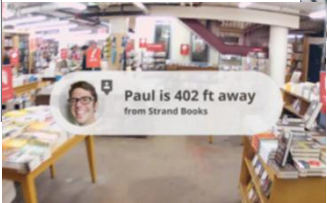
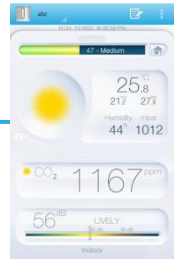


Contextual Awareness Technology

Sensor networks

Sensor Fusion

Situational awareness

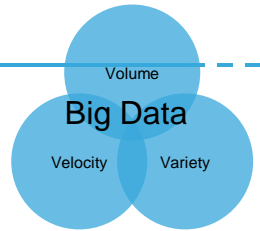


Super Connected Devices

The Cloud

Big Data

Internet of things



Sensor Information

Motion MEMS

- 사용자의 동작을 판단하고, 운동량과 같은 구체적인 동작 정보 제공
- 내장 마이크로폰 등의 기타 센서와 연계하여 사용자 주변의 환경 정보를 판단, 종합적으로 사용자의 운동 상태와 이동 수단, 그리고 동작 정보를 제공

Environment Sensor

- 출근 시 날씨 등의 일상 정보를 제공하여 사용자가 이에 대비하게 함

Bio Sensor

- 사용자의 심박, 긴장도 및 피로도를 항상 모니터링
- 생체 기반 사용자 인증을 가능케 함

Contextual Awareness

Start to work

- 출근 사실을 인지하고, 최신 뉴스, 관심 기사, 어제까지 읽은 도서 제안
- 기상 정보를 보여주고, 어울리는 복장, 우산 여부 등을 제안

In Office

- 자동으로 회의 모드로 전환

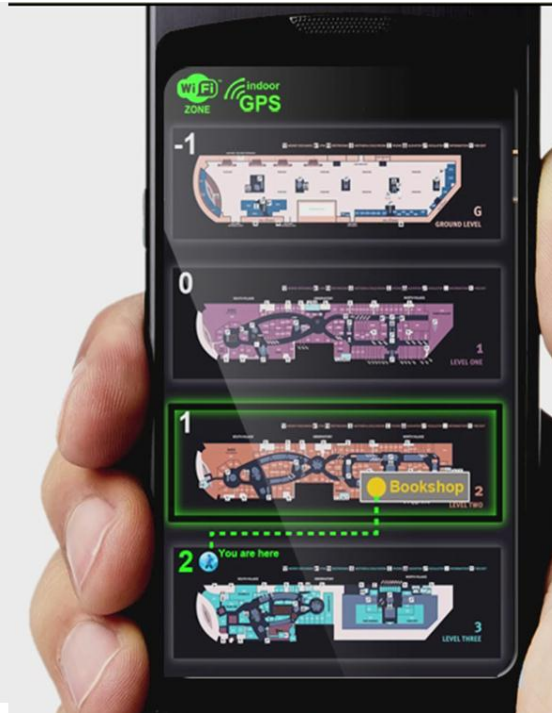
Exercise

- 신체 상태를 판단하여, 적정 수준이 되는 시점에 알람
- 매일매일의 운동량을 자동으로 기록
- 편안한 휴식 및 숙면 유도

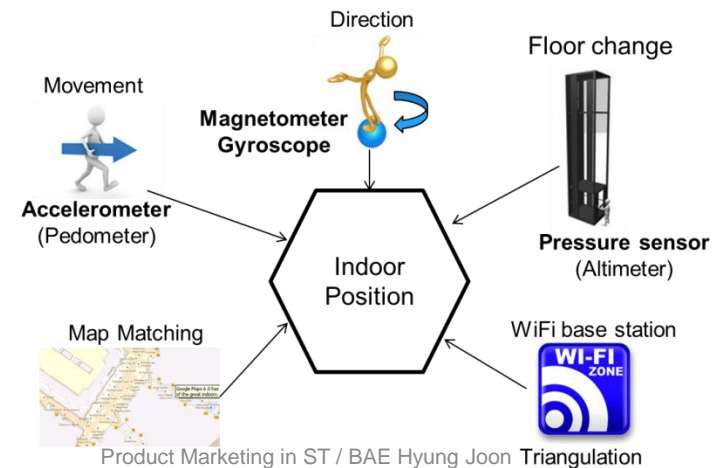


ST In-door navigation Solution

High-performance Indoor Navigation



- 3G/GSM and Wi-Fi providers
- Sensors provider
 - Accelerometer + Gyroscope + Magnetometer + pressure sensor
- Map Provider
 - Google 6.0, Navteq, Point Inside
- Android app developers



Future Application with always on sensor

❖ Advanced Context Awareness

- “Always on” Intelligent Sensors
 - Phone (or Application) context – What is the phone doing
 - User context – What is the user doing
 - Macro context – What is the environment
- Use information to intelligently predict needs and user of the phone (application)

❖ Indoor Pedestrian Navigation

- Indoor, GPS free dead reckoning
- Use only inertial sensors (motion sensors) to navigate the directions.
- 3 challenges
 - Errors compound
 - Magnetometer instability
 - Integration with other sensors (like pressure sensor)

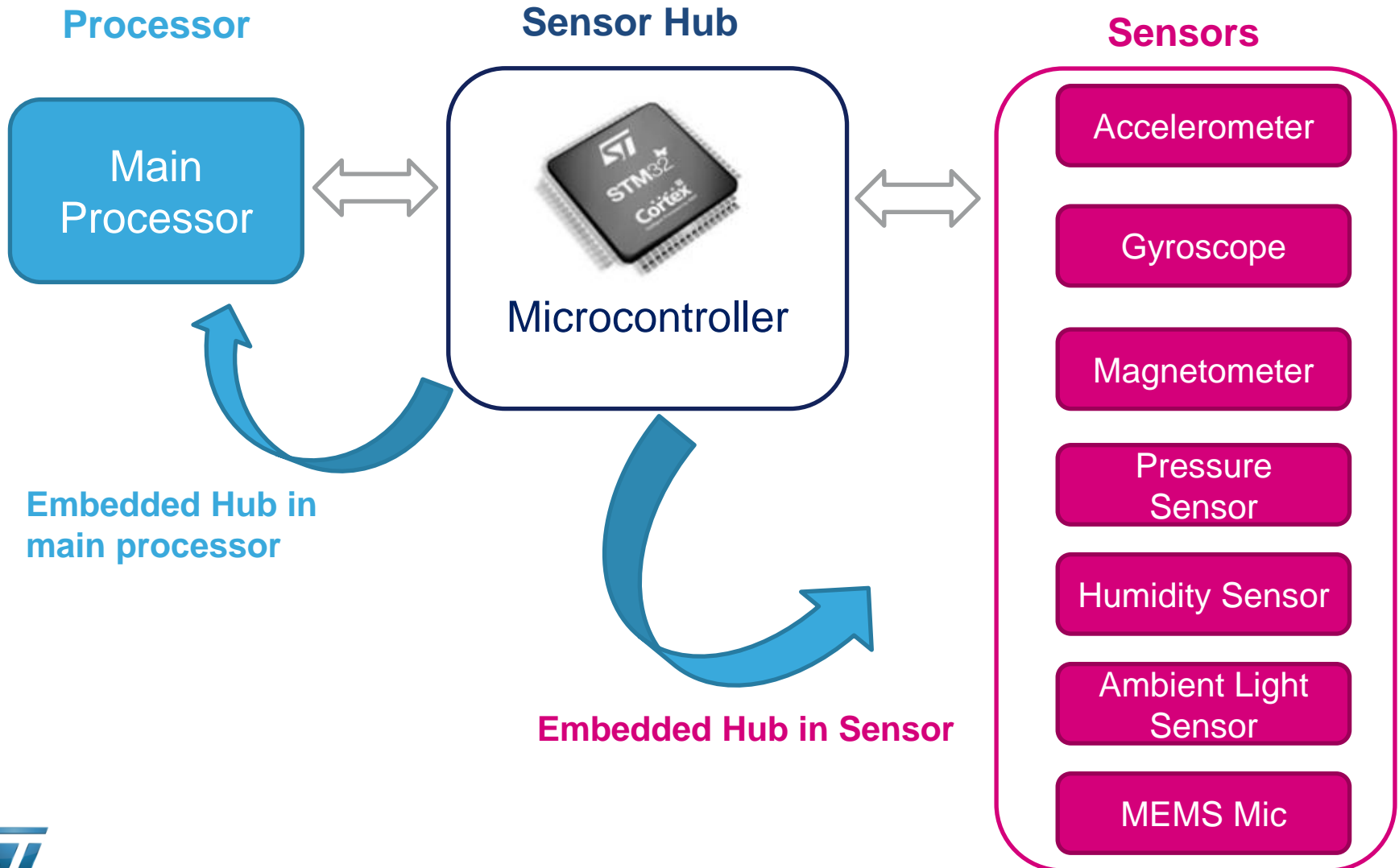
Source : Steve Scheirey (Hillcrest LABs) & Diya Soubra (ARM)

More and More

New coming application with Sensors

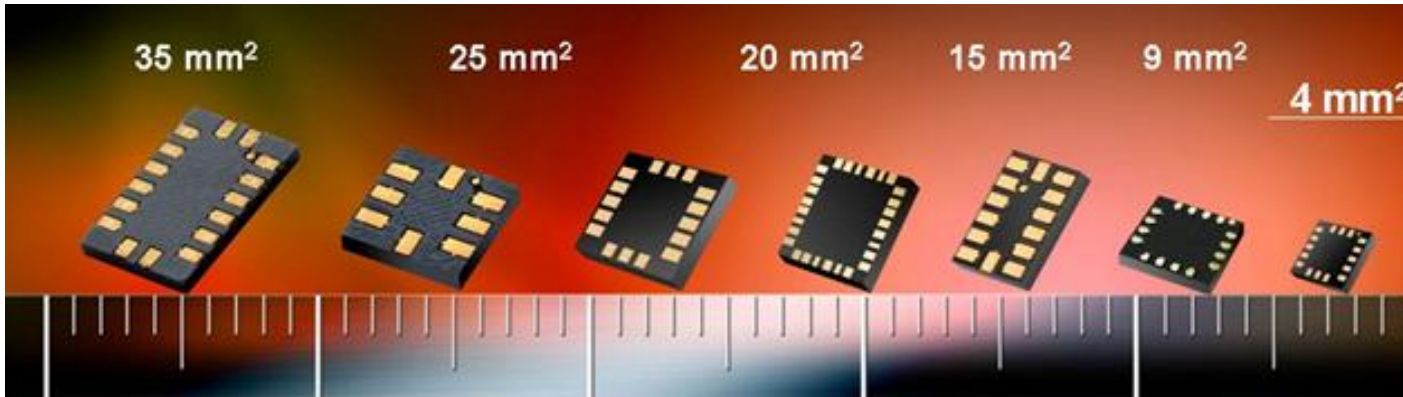
For IoT (Internet of Thing)

Evolution of Sensor Hub Structure



Evolution of Sensors

1. Size evolution of sensor (include Combo)



More smaller!!



CO₂ Sensor
(16mm diameter / 15mm thickness)



CO Sensor
(16mm diameter / 10mm thickness)

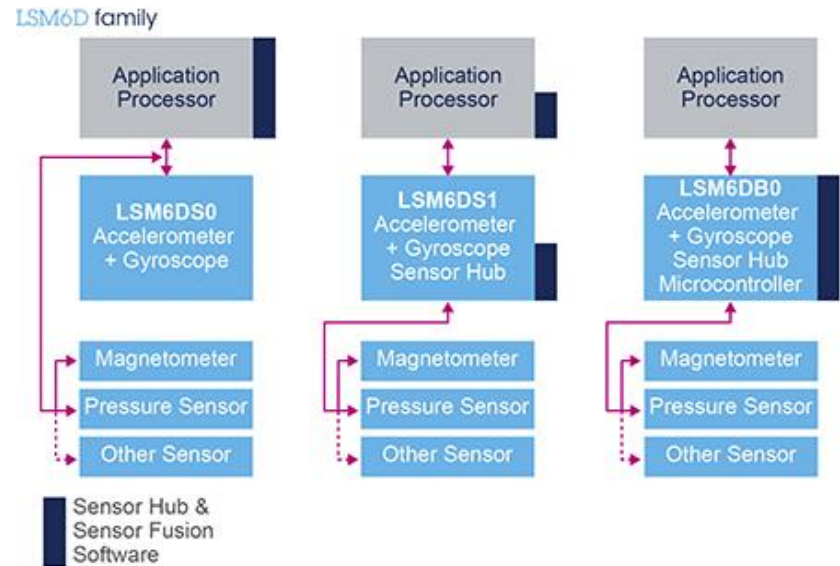
2. SMART Sensors



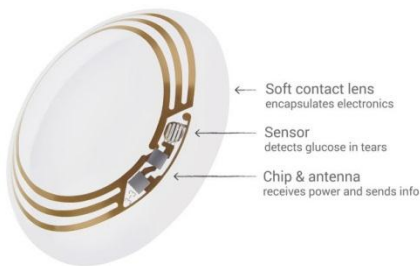
3. Embedded Sensor Hub in Sensors

Always-On

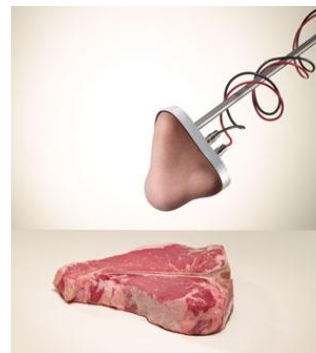
6-Axis Inertial Motion Sensors



4. More various kinds new Sensor and Technology.

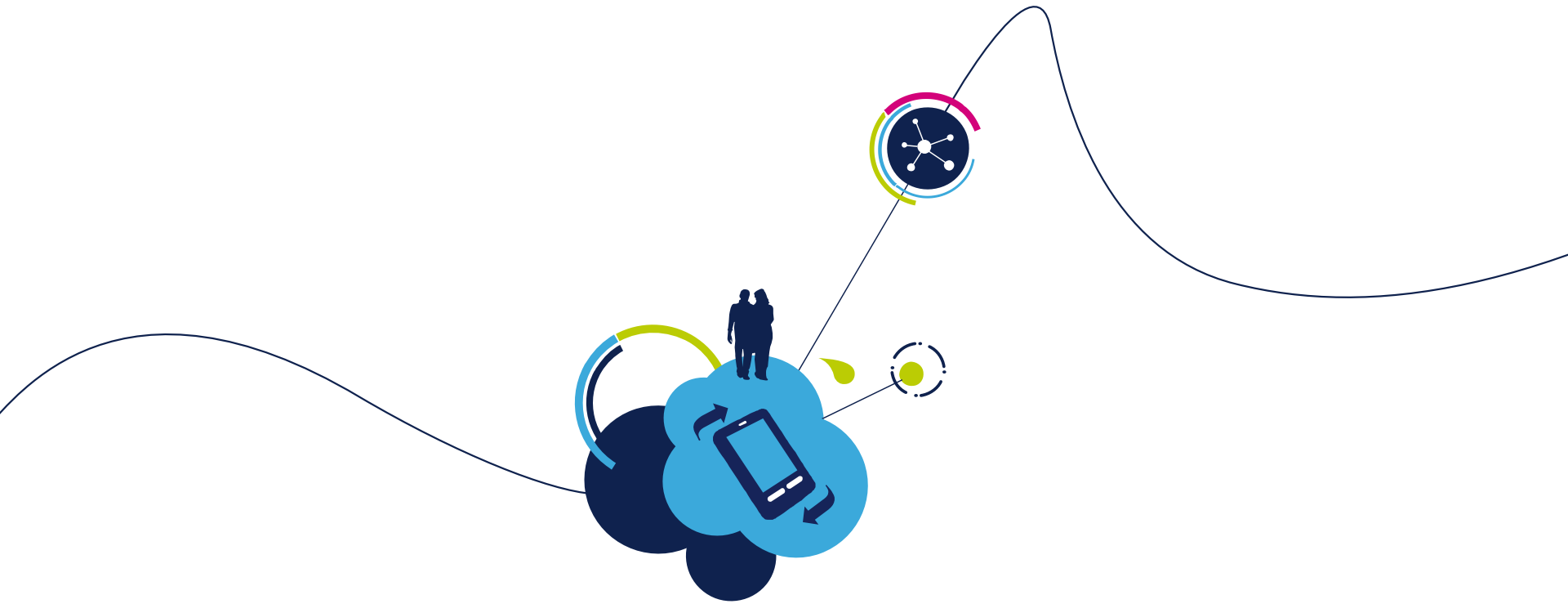


Google SMART contact lens



Electrical Nose

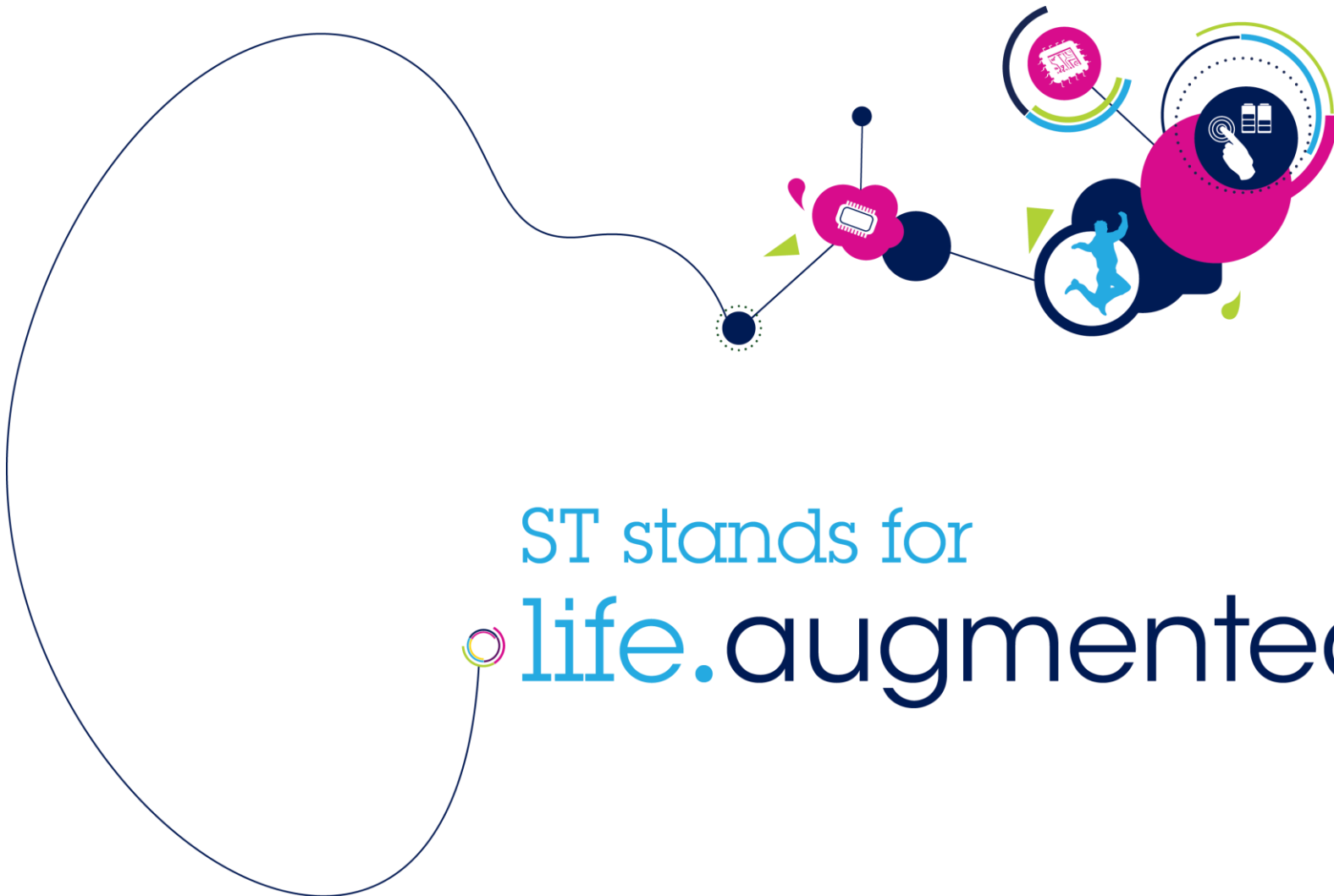
By Josephine B. Chang,
Vivek Subramian Posted
29 Feb 2008



Q&A

Thank You

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ST stands for
life.augmented