EMBEDDED SYSTEMS AND MOBILE SYSTEMS

Embedded systems

• Sensors, actuators, devices

8-bit uC, sensors, actuators

Mobile systems:

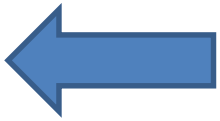
PC open source
64bit, WiFi, BLE,
Ubuntu Mate
Windows 10 IoT

• Portable PC

(powerfull, WiFi connected, heavy, cumbersome, about 4h of battery life)

• Tablets

(quite powerful, WiFi or 4G connected, light, about 8h of battery life, few sensors)



Many embedded sensors
HW –e.g. accelerometer-
and SW –e.g. fingerprint, voice-

• Smartphone

(quite powerful, WiFi or 4G connected, light, about 24h of battery life)

INTERNET OF THINGS (1999)

Things (e.g. sensors, actuators, devices) with internet connectivity,

- easy, thanks to low-cost connectivity (WiFi, BT plus Smartphone -gateway-)

Things with a database in "cloud"

- quite easy, thanks to low-cost open cloud technologies (google drive, dropbox)

Things communicating each other (M2M, machine to machine communications)

- quite difficult. Two approaches: standard protocols, Application in cloud (new)

Adding a new "thing" in a transparent way (without programming)

- Difficult, especially in a multi-vendor, multi-devices, multi-standard scenario

• An example: Camera with Eye-Fi

- Enable WiFi connection or gateway (e.g. Smartphone)
- Photos are directly sent in cloud
- Possibility of instantaneous photo exchange between two cameras
- Suitable applications allow to publish photo in Instagram or Facebook

THE SMARTPHONE AS THE PERSONAL TUTOR

WEARABLE SENSORS OR THE SENSORS EMBEDDED IN THE SMARTPHONE CAN BE COMMUNICATED FOR SAFETY AND SECURITY

GPS, timestamp
Accelerometers,
audio, images

3G, WiFi

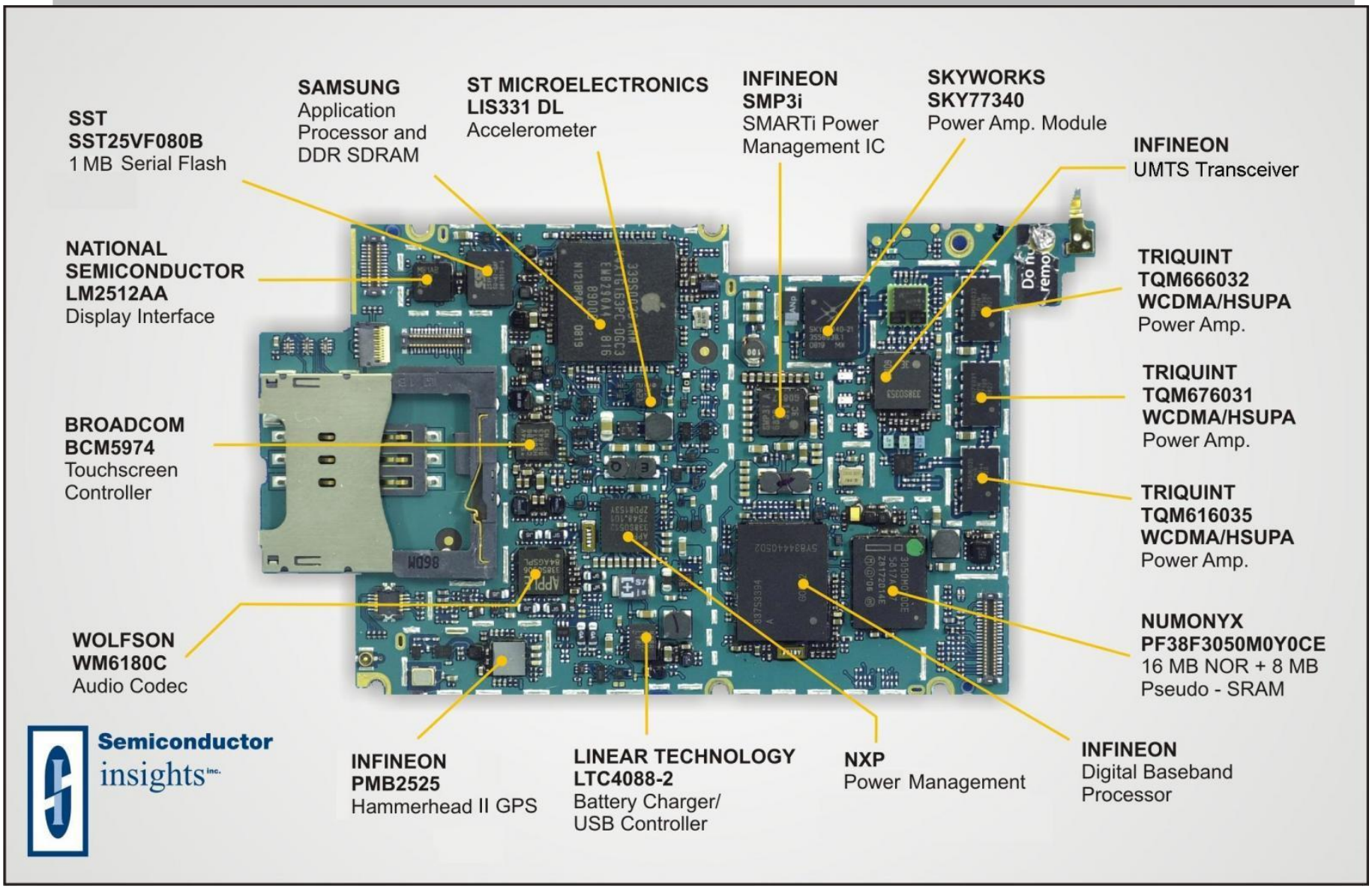
Telemedicine

Security

Relatives, friends, …

The Smartphone is the gateway between sensors and Web services

SMARTPHONE: INTERNAL STRUCTURE (simplified)



GPS, Accelerometers and other sensors

Accelerometer within the smartphone can be used to detect

• human activities – walking, running, dancing or posture

• vehicles collisions or vibrations

• The Smartphone includes gyroscopes (orientation –yaw, pitch, roll- and their variation) and magnetometers (the strength of earth's magnetic field)

Proximity sensor, touchscreen

• during a call, if the phone is close (in touch) to the ear, the touchscreen is disabled. The touchscreen can be considered as another sensor

Microphones

• is a sensor for word and/or noise detection and identification, but also a sensor for acoustic pollution measurement, a sensor for traffic measurement, weapon shot detection, and so on

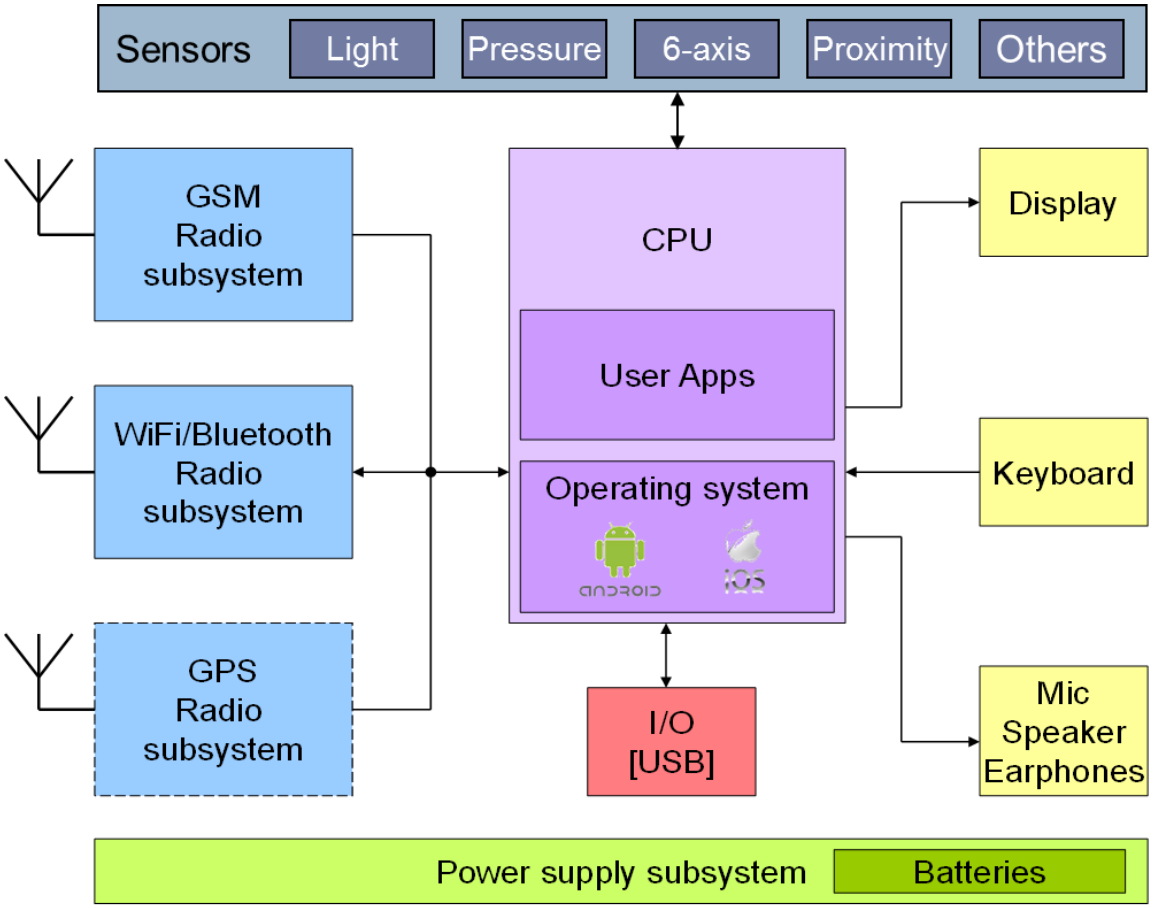
Cameras, luxmeter

• A smartphone includes two cameras with sometimes a luxmeter for automatic flash management. The camera can be used as a heart rate detection. New possible cameras for pulsiossimeter or glucose detection

OPERATIVE SYSTEMS (OS)

Why a Smartphone needs an OS?

- To execute several programs and applications
- To manage memory and communication interfaces
- To manage its HW and its SW



ANDROID, Overview of OS for mobile

Android, open source, based on Linux, Samsung, LG, other
IOS, license, brand, guaranteed, powerful, Apple, iPhone, iPAD

- First mobile phone 1983, camera phones late ‘90, OS late ’90
- Proprietary formats emerged to better take advantage of hardware capabilities:
  - Palm OS (became Garnet OS)
  - RIM Blackberry OS
  - Java Micro Edition
  - Symbian OS (Sony Ericsson, Motorola, Samsung)
  - Windows Phone (Nokia)
  - iPhone iOS
- Major players now:
  - iOS
  - Android
  - Windows Phone