Technology trends for connected health
Medical equipment fully dependent on advanced semiconductor technologies and components

Diagnostic equipment  Medical Imaging  Therapy equipment
Example of electronics inside medical equipment: portable ultrasound echography device

- **Hardware Security Feature**
- **Remove artifacts**
- **High Voltage Complex Operations**

**Low-power operation**

**Commands & display**

- **Process complex data**
- **Complex operations**
- **Low-power operation**

**Electronics components**
- **Probe Authentication**
- **Transducer**
- **LNA**
- **TSC**
- **LP**
- **ADC**
- **FPGA**
- **MCU**
- **Display Protection**
- **GPIO Protection**
- **Audio Amplifier**
- **User Interface**
- **Ethernet Connectivity**
- **Ethernet Protection**
- **SD/MMC Mass Storage**
- **Display Protection**
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- **Remote operations**
- **Ethernet**
- **Ethernet Protection**
- **SD/MMC Mass Storage**

- **Main AC 110/230V**
- **Isolated Power Supply**
- **Overvoltage protection**
- **AC/DC (Powerhouse Inverter Control)**
- **12V/12A**
- **LDO**
- **Digital Power Supply**
- **Analog Power (V/1.5/3.3V)**
- **Digital Power (1.5/3.3V)**
Main drivers for connected e-health

Technology can help achieve more efficiency and cost reduction

- Increasing health costs
- Population aging
- Increasing chronic and long-term illness
- Regulatory reforms
- Consumer demand for health information and self-care
- Insufficient medical resources (hospitals, doctors, …)
Technology innovation: multiple benefits in medical healthcare applications

Technology innovation can drive market change

- Medical market
- Consumer market

Time

- Improving performance
- Reducing costs
- New healthcare devices
- In traditional medical equipment
- In consumer devices

Life augmented
Microelectronics: an enabler for medical & healthcare

- **Remote monitoring**
  creating new services for eHealth

- **Compact Devices for diagnostic measurement**
  Lowering cost barriers

- **Increased processing power & A.I.**
  Providing new Diagnostic support tools

- **Privacy & integrity of patient data**
  for transmission and storage of medical records
Challenges for technology

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Statement</th>
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<tbody>
<tr>
<td>30%</td>
<td>Personal connected health devices may help to make diagnostics decisions and help improve patient health</td>
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<tr>
<td>42%</td>
<td>Moderately agree to include patient generated data in the EMR (+)</td>
</tr>
<tr>
<td>40%</td>
<td>Agree that remote monitoring of chronic conditions can reduce unnecessary visits</td>
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<tr>
<td>60%</td>
<td>Are concerned about how patient data is handled and secured</td>
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What doctors say (*)

Their expectations from Technology

- Develop technology for **new diagnostic tools** and **improve precision** of existing devices
- Make diagnostic tools **more pervasive**
- Use of **Artificial Intelligence** as a support for decision making
- **Improve security** at every stage
- Promote **EMR standardization** to encourage use of electronic data

(*) Source: pchalliance.org, Ipsos, May 2017
(+ EMR = Electronic Medical Records)
ST offer in healthcare
ST product offering for healthcare

ST is a trusted provider of high-quality technical solutions enabling the development of breakthrough medical systems

Targeting a broad range of applications

- Medical Imaging
- Focused Ultrasound
- Energy Harvesting and Neurostimulators
- Non-Destructive testing
- Electrocardiography (ECG)
- Photoplethysmography (PPG)
- Galvanic Skin Resistance (GSR)
- Bio Impedance functionalities
- Oxygen saturation
- Respiratory Rate
- Skin Temperature

Acquiring data
- Sensors for Imaging
- MEMS & measurement ICs
- Electronic interfacing

Processing data
- Powerful microcontrollers
- Artificial Intelligence at the edge
- Specially developed devices

Security
- Secure element for medical data integrity
- M2M-SIM for authentication and confidentiality
- Enabling Blockchain transactions

Connectivity
- Short-range low-power BLE, NFC
- Long range IoT (Sigfox, LoRa)
- Cellular Broadband, narrowband

MEMS = Micro-Electro-Mechanical Systems fabricated at Silicon level
Sensor solutions for healthcare applications

Benefits of MEMS-based sensor solutions:
- Accuracy of Sensors
- Low power
- Non-Invasive Technique
- Machine learning core allowing data pattern recognition

Products:
- Medical grade accelerometer
- Temperature sensors
- Ultrasound microphone
- Reference system solution embedding motion sensors, pressure sensors and microphone
Imaging for health care: Spectrometer, ranging, light sensing & 3D scan imager

**Time-of-Flight**
Measure true distance/depth
Independent of reflectance

**Spectrometer**
Spectrometer, Ambient Light Sensors, Light flicker detector

**Unique Imager**
High perf. In IR & visible, High Dynamic Range, flicker free.

**Applications**
- Proximity and ranging
- 3D depth sensing
- Fine gesture
- Heart rate monitor (HRM), PPG, SpO2…
- Body vital sensing
- Barcode scan
- Medical imagery
Endoscopy

- Advanced imaging technology enabling small pixel pitch
- Scalable supply chain for low volume

X-Ray

- Optimized technologies for X-Ray
- Radiation hardening expertise
- Stitching for extra-large dies
- Scalable supply chain for low volume

Ultrasound

- Ultrasonic transmitters, receivers
- Ultrasound piezoelectric actuators
- >15 year experience
- Close cooperation with top level players
- 30 patents granted on Ultrasound imaging
Providing end-to-end information security

At home
- Identification of devices using Unique ID in silicon
- SW integrity of devices via a Secure Boot process
- Integrity of Patient Data with Digital Signature
- Confidentiality via Encryption
- Generation of Blockchain transactions

Secure Cloud
- Secure network access
- Verification of allowed devices
- Identification of people
- Preserving data integrity

At the hospital
- Identification of devices using Unique ID in silicon
- SW integrity of devices via a Secure Boot process
- Integrity of Patient Data with Digital Signature
- Confidentiality via Encryption
ST in European projects on medical
A European project led by ST, started June 2017 – 3.5 year program
Addresses the needs of patients remotely followed by professional caregivers by developing advanced smart e-health IoT devices and architecture in Europe

**Outcome:** Development of 3 medical devices addressing 3 medical domains:

**Domain 1: Remote Healthcare**
Moving care services from hospital to home

- First Low-power Medical IoT Module validated with 2 class IIx medical devices

**Domain 2: Early detection**
Of Methicillin-resistant bacteria

- First Low-power Mobile Detector for MRSA i.e. antibiotic resistant bacteria

**Domain 3: Fall Prevention/Detection**

- Fully wireless insole for Fall Detection + Risk Monitor

- Evaluated clinical prototypes
- Multi-centric clinical investigation plans
- IoT system evaluation
SERENE-IoT Use Cases: application scenario within a clinical framework

1. Remote Healthcare
   - Medical Device 1
   - Medical Device 2

2. Early detection for MRSA
   - Low power detector

3. Fall Prevention & Detection
   - Wireless insole

System & Service Interface
- Cloud
- Blockchain

Data Operator / User
- Healthcare Professional
- Patient association
- Pharmacy manufacturer
- Medical device manufacturer
- Medical device manufacturer
- Insurance / Payers
- Healthcare tele-service provider @Home, @Point-of-Care
A European large-scale pilot on smart living environments, started Jan 2017, 4 years program
Objective: To build the first European IoT ecosystem to enable the deployment and operation of Active & Healthy Ageing IoT based solutions and services

Supporting and extending the independent living of older adults in their living environments

Responding to the real needs of caregivers, service providers and public authorities

Reusing and scaling up IoT platforms, technologies and standards, and integrating new interfaces needed to provide interoperability across these heterogeneous platforms

- 4 years project
- 9 Deployment Sites
- Seven European countries
- 50 partners
Examples of end devices powered by ST
The Body Gateway recorder is a wearable, battery operated device, intended for use as a part of a multi-parameter analysis system.

It acquires, stores and periodically transmits to a device connected to a medical service (Heart rate detection, Physical activity estimation, Breathing rate measurement, Body position).

Applications:
- Chronic cardiac disease monitoring
- Elderly people home monitoring
- Event monitoring
- Single lead holter
Intuity® JECT by EVEON

• An all-in-one platform offering fully automated preparation and delivery devices
  • Prepares the treatment by blending the drug and solvent with an accurate dosage
  • Guarantees the homogeneity, without manipulation or contact with the products
  • Injection, data transmission and tracking
• As the process is automated and easy to use, the injection can be operated by the patient themselves at home
• Powered by ST components
  • Ultra-low-power microcontrollers that control and process the drug preparation following parameters identified by the medial staff
  • Motor control to drive the blending
  • Bluetooth low energy module to send the data
Takeaways

- Innovation in **sensor and processing** technologies
  - Improving equipment performance and functions
  - Lowering cost barriers
- **Low-power electronics** and innovation in consumer market
  - An opportunity for e-Health to grow
- **Artificial Intelligence** at the edge is a valid remote diagnostics support tool
- **Security devices** allow secure data collection, transmission and storage, preserving integrity and confidentiality of patient Medical Records
Thank you