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Application-Specific Integrated Circuits Pave The Way To New
Innovative Electro-Therapies For Cardiology And Neurology



About Today's Talk

1. Active Implantable Medical Devices

1. Market size
2. Market trends

2. Use cases

1. Emerging use cases for cardiovascular and neurostimulator implants
2. ASIC as enabler of disruptive innovation

3. Top ASIC technologies that bring innovative implants to life

1. Sensor interfacing
2. Communication
3. Energy harvesting
4. Cyber security

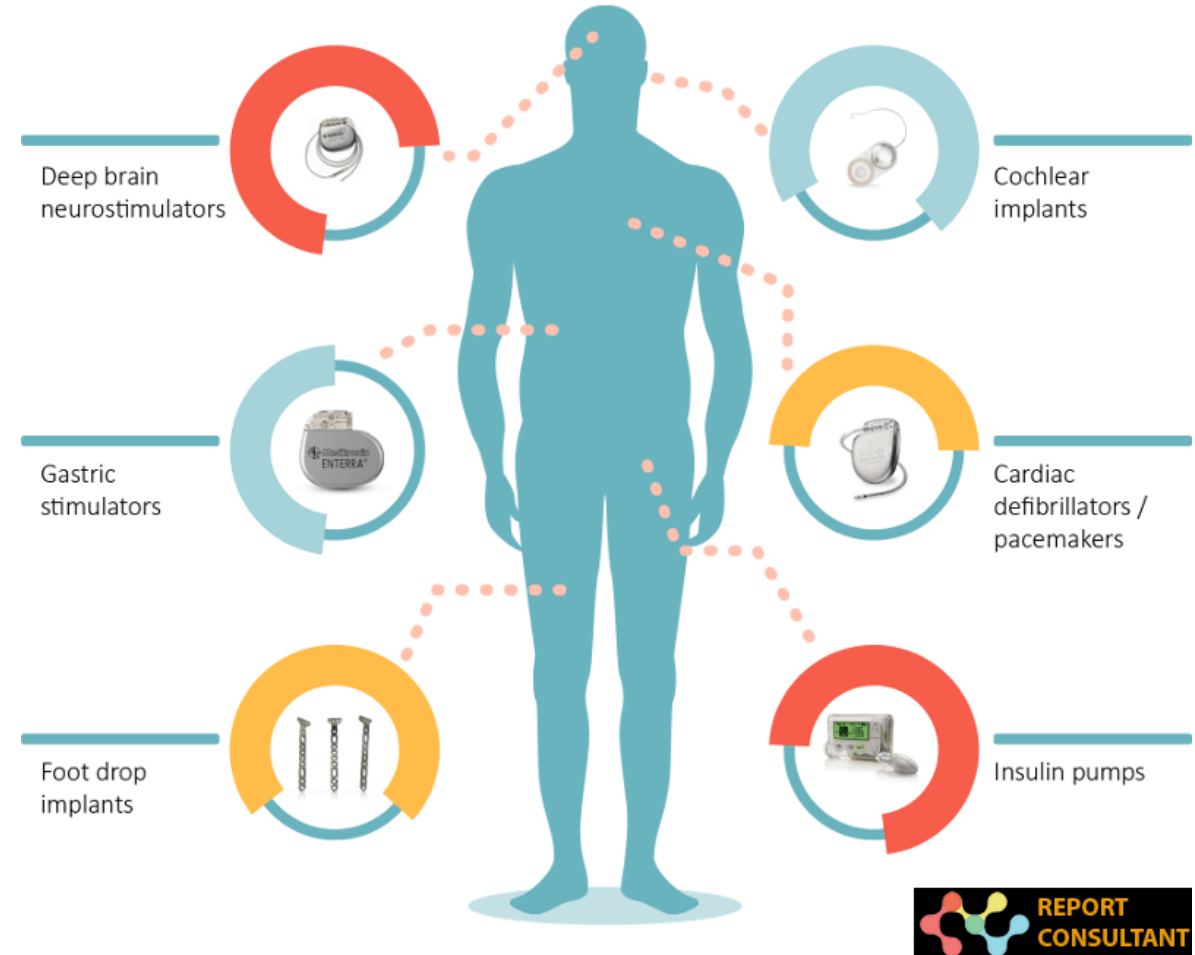
4. About IC'Alps

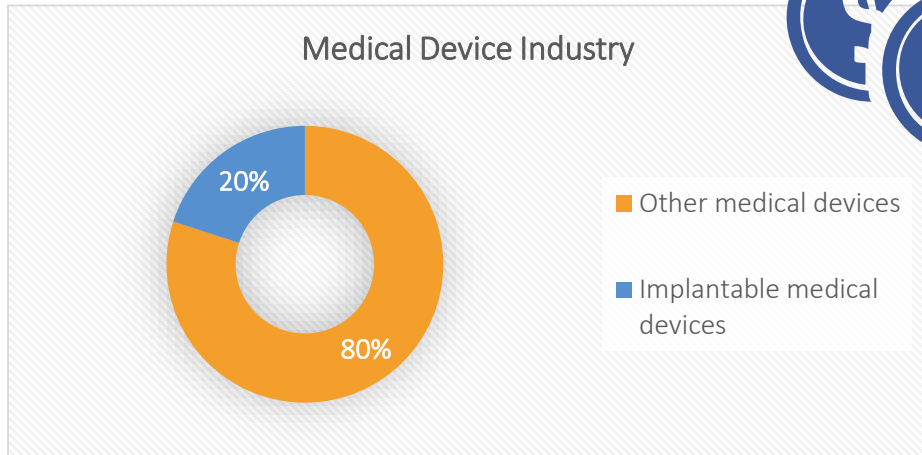
1. The company
2. Why partnering with us



AIMD
Industry

Medical device embedding
electronic to measure or
interact with the human body
functioning on a source of
electrical energy



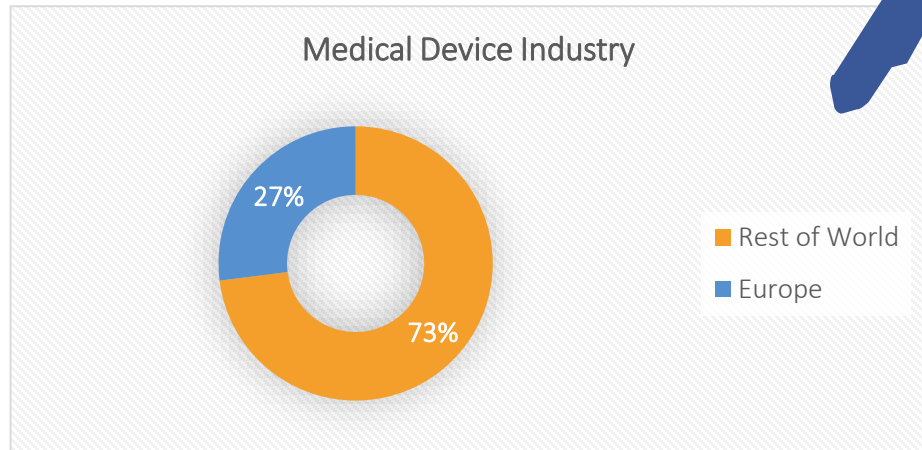


Valued at **USD 24,89 Billion in 2021**

Projected to reach **USD 36.17 Billion by 2026**

Growing at a **7.76% CAGR** from 2021 to 2026

[Source](#): Market Data Forecast



Increasing number of cardiovascular and neurological cases

Increasing elderly population who need these devices

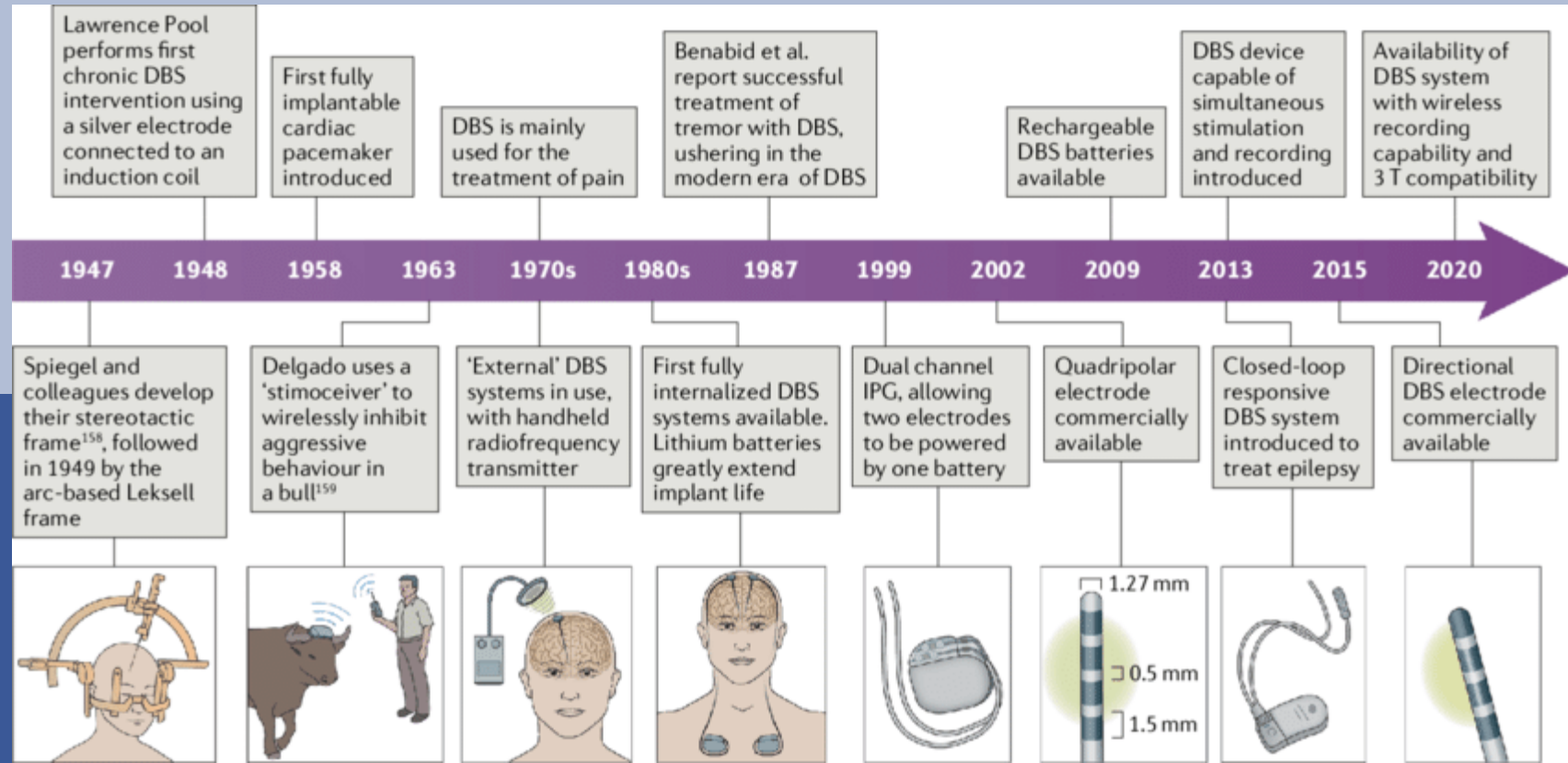
New developments in procedures, and increasing applications of implantable devices in neurological diseases, chronic pain diseases



KEY MARKET TRENDS



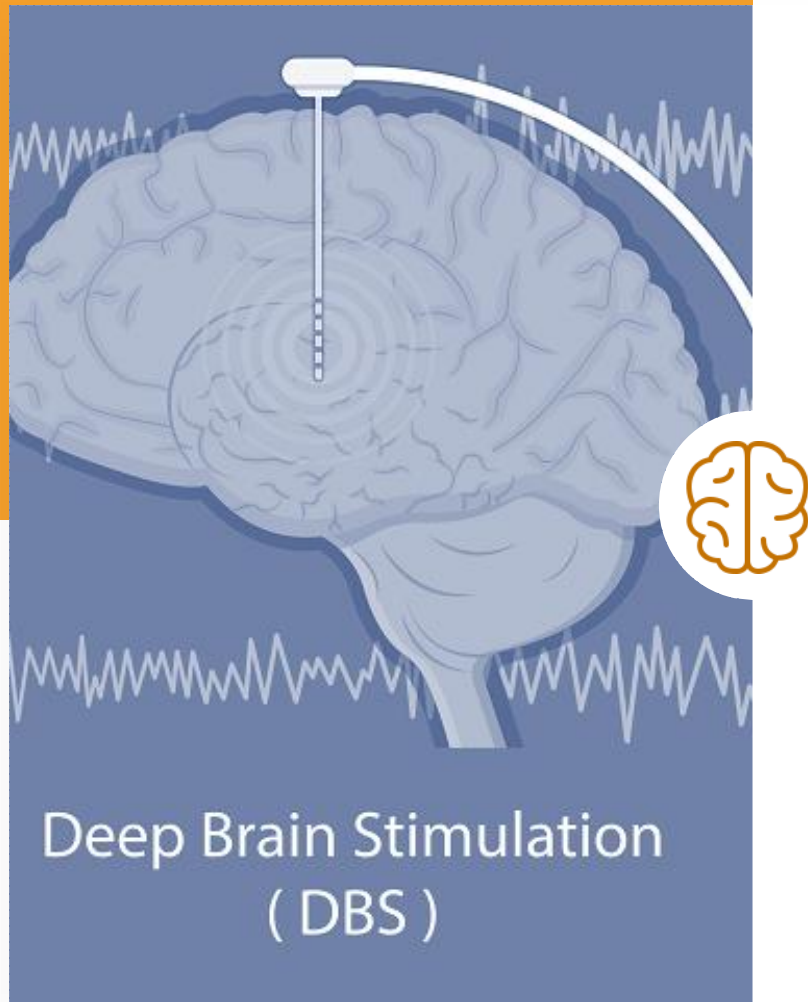
- + Enhancing longevity of implant
- + Improving implant efficacy
- + Enabling IoMT
- + Addressing new use cases



[Source](#): Nature Reviews Neurology



Use Cases

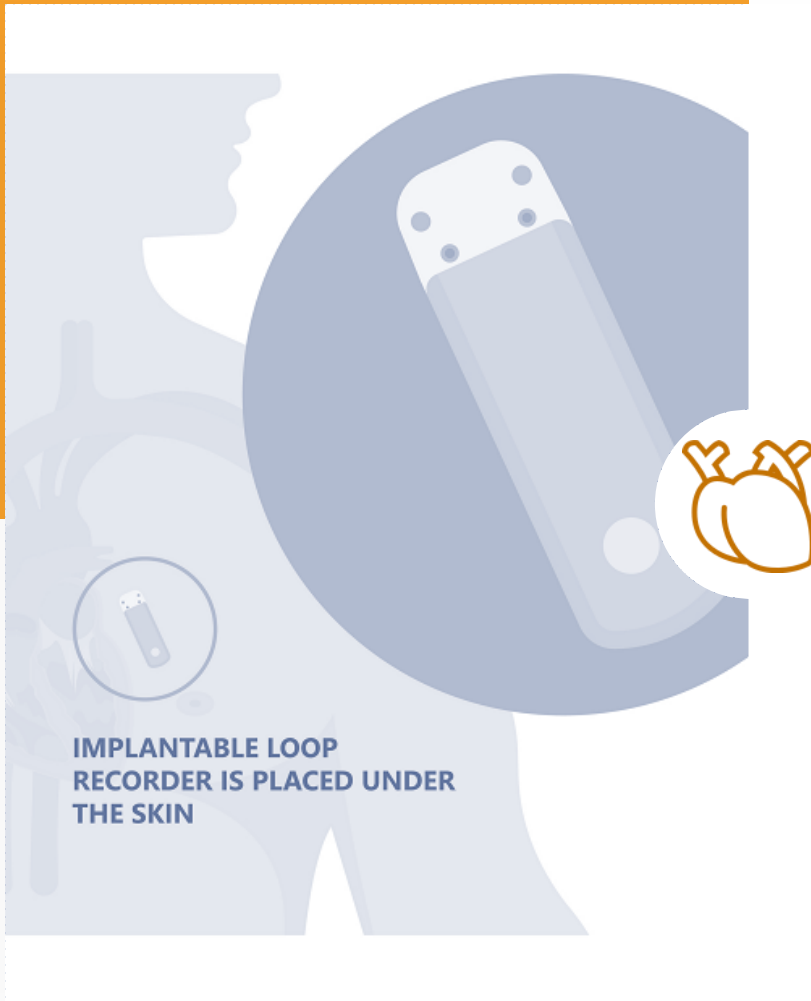


New Use Cases In Neurology

- + Adaptive / on-demand stimulation
- + Connected care
- + Sensing technologies
- + Closed-loop stimulation

New Use Cases In Cardiology

- + Connected cardiac implants
- + Less invasive cardiac implants
- + Operating all the time
- + Rechargeable

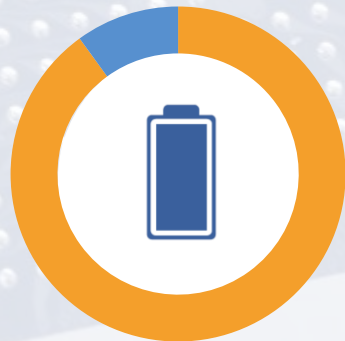


ASIC As Enabler

Of Disruptive Innovations & Market Differentiation



SMALLER



AUTONOMY



FASTER



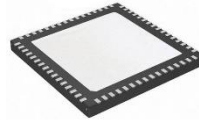
MORE
FUNCTIONALITY



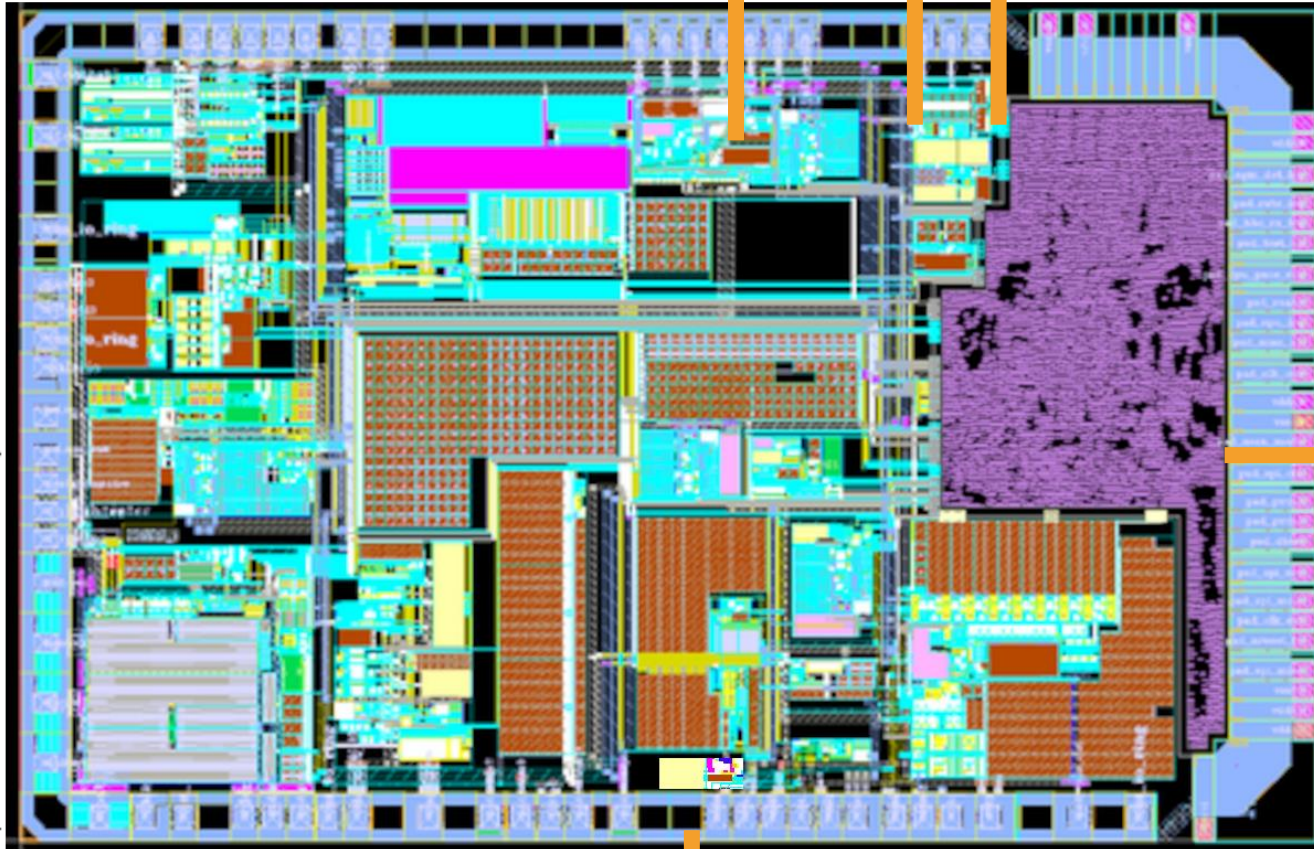
ASIC Technologies
That
Bring Innovative
Implants to Life

Key Functions In AIMD ASIC

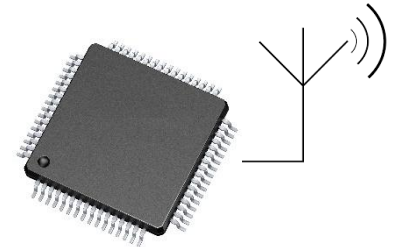
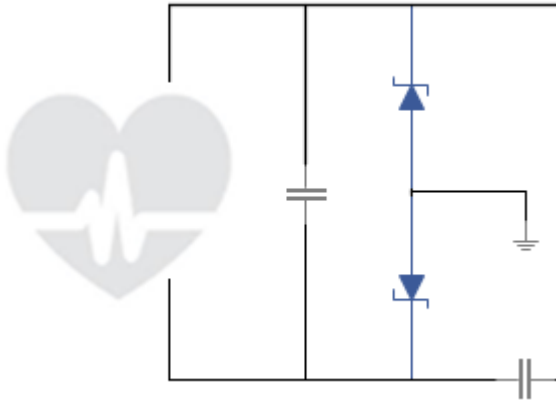
MEMS Accelerometer



Quartz oscillator



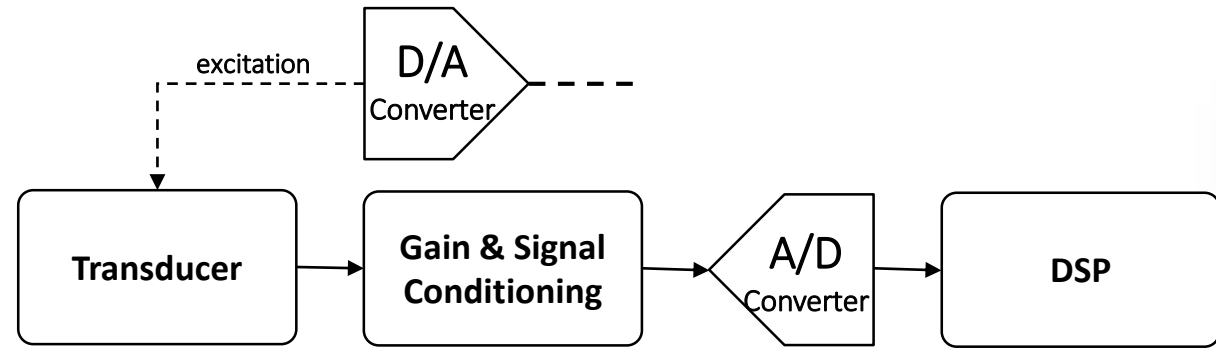
Cardiac Interface with protections



CPU with BLE



Battery



To capture a sensor output signal and to convert it into corresponding electric signal

Analog filter

To clean-up the useful signal in the appropriate bandwidth and suppress unwanted noise and artifacts

Signal amplifier

Sensors outputs are often weak and must be amplified to be useful

Signal conditioning

Voltage, current, frequency, etc.

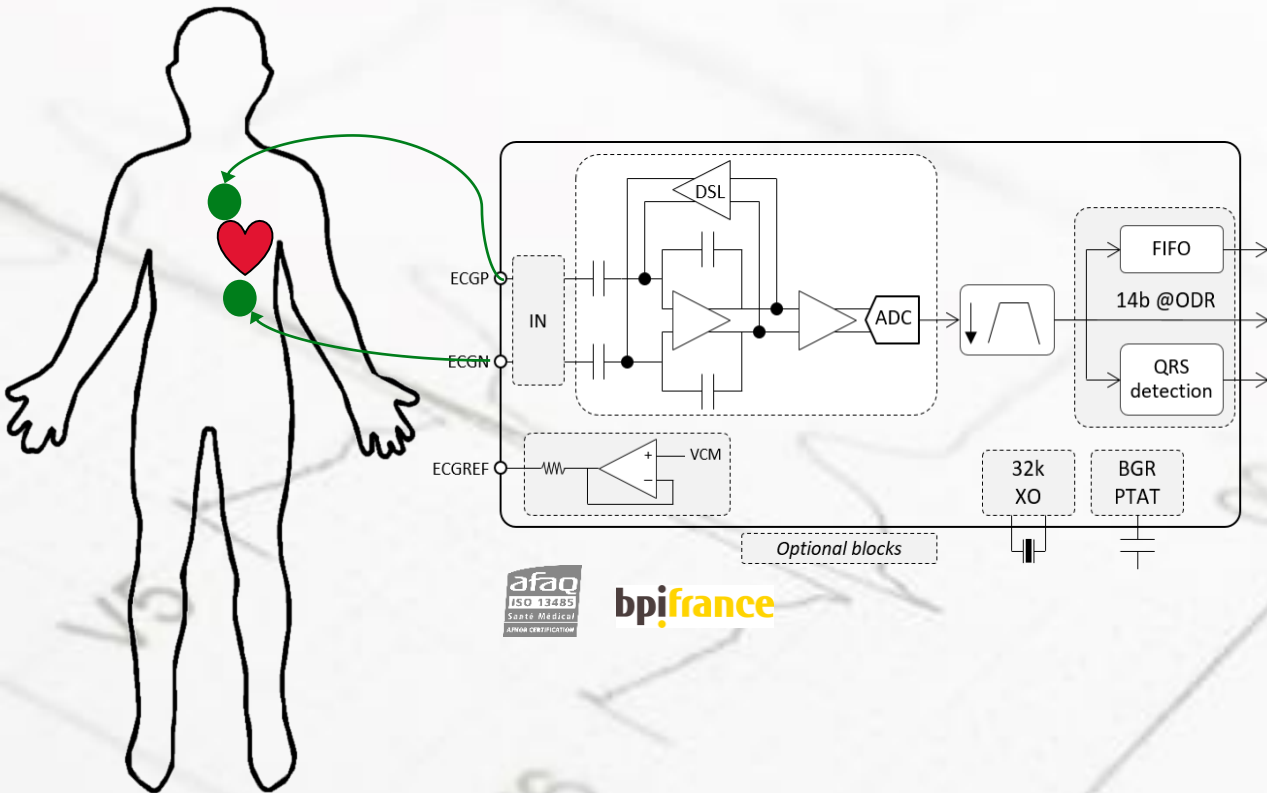
References

Voltage, current, frequency, etc.

Analog to Digital conversion

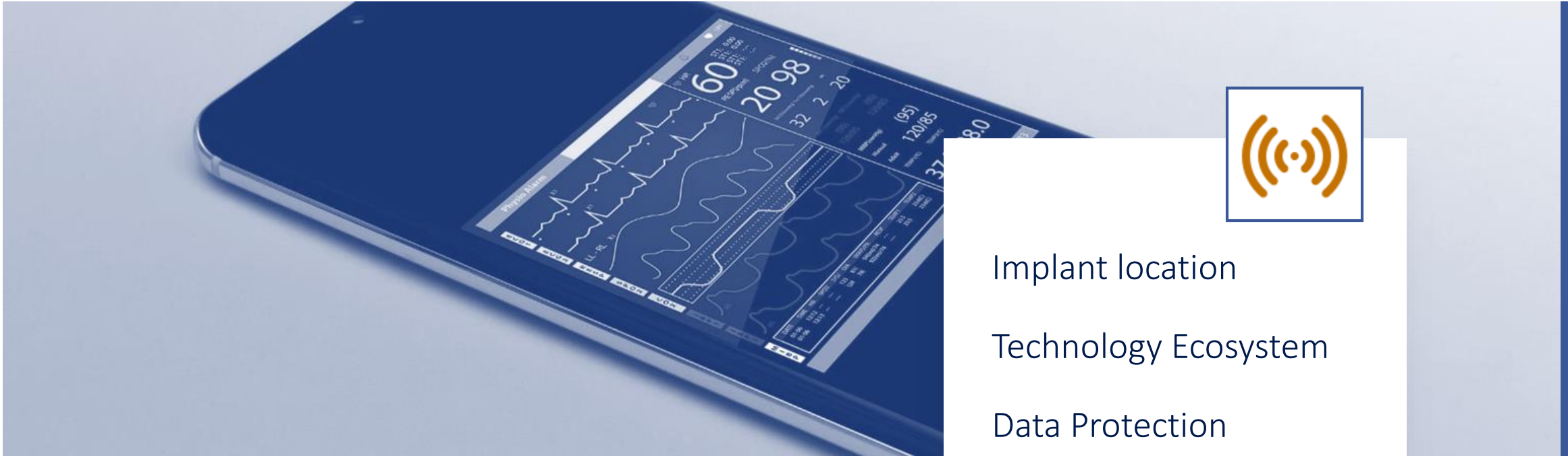
For microcontroller processing, DSP, algorithm

Continuous and real-time ECG monitoring and QRS detection



AFE Readout Circuit	180 nm architecture
ENOB	10
Input noise on [5-100] Hz bandwidth	< 6 μ Vrms
Consumption	50 nW
Consumption - Shutdown mode	< 1 nW
Size	< 1 mm ²

AFE Readout Circuit	55 nm architecture
ENOB	10-12
Input noise on [5-150] Hz bandwidth	< 2 μ Vrms
Consumption @ 4 kHz - Nanopower settings	150 nW
Consumption @ 32 kHz - High-SNR settings	400 nW
Consumption - Shutdown mode	< 2 nW
Size	< 1 mm ²



Implant location

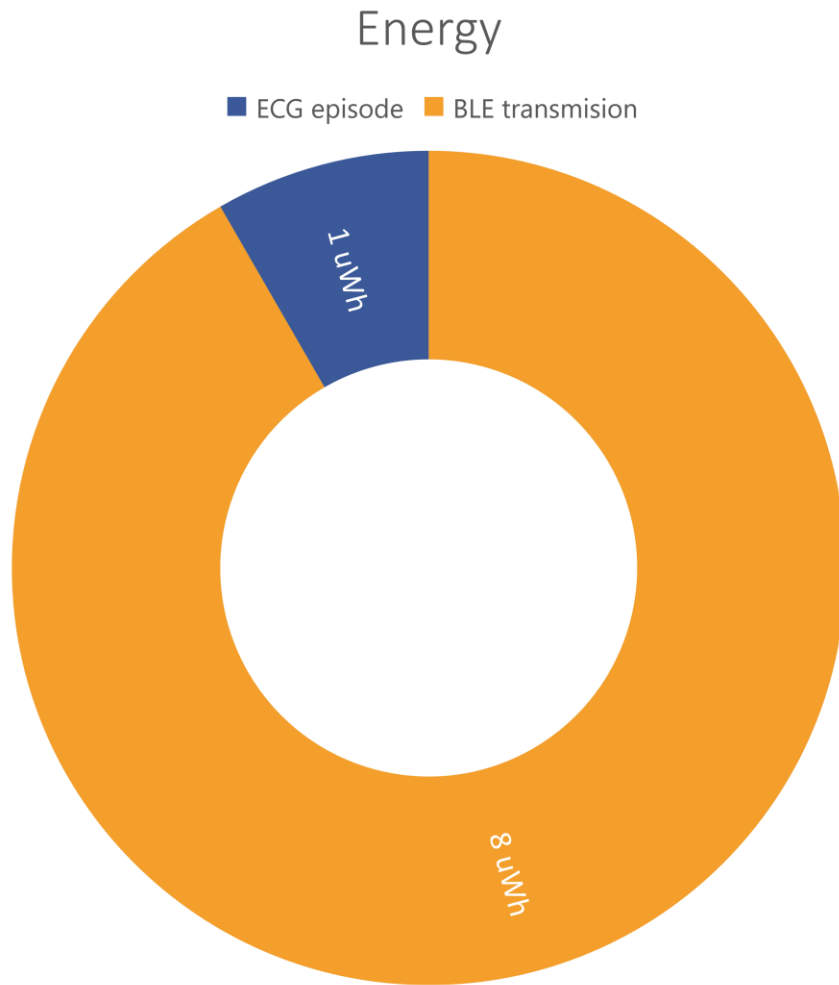
Technology Ecosystem

Data Protection

Power Efficiency

Data Processing Strategy

Factors to consider before adding
connectivity capabilities to an implant



BLE data transmission requires

8 times

as energy as ECG trace acquisition

Combined data from ECG + 3 axis
accelerometer requires

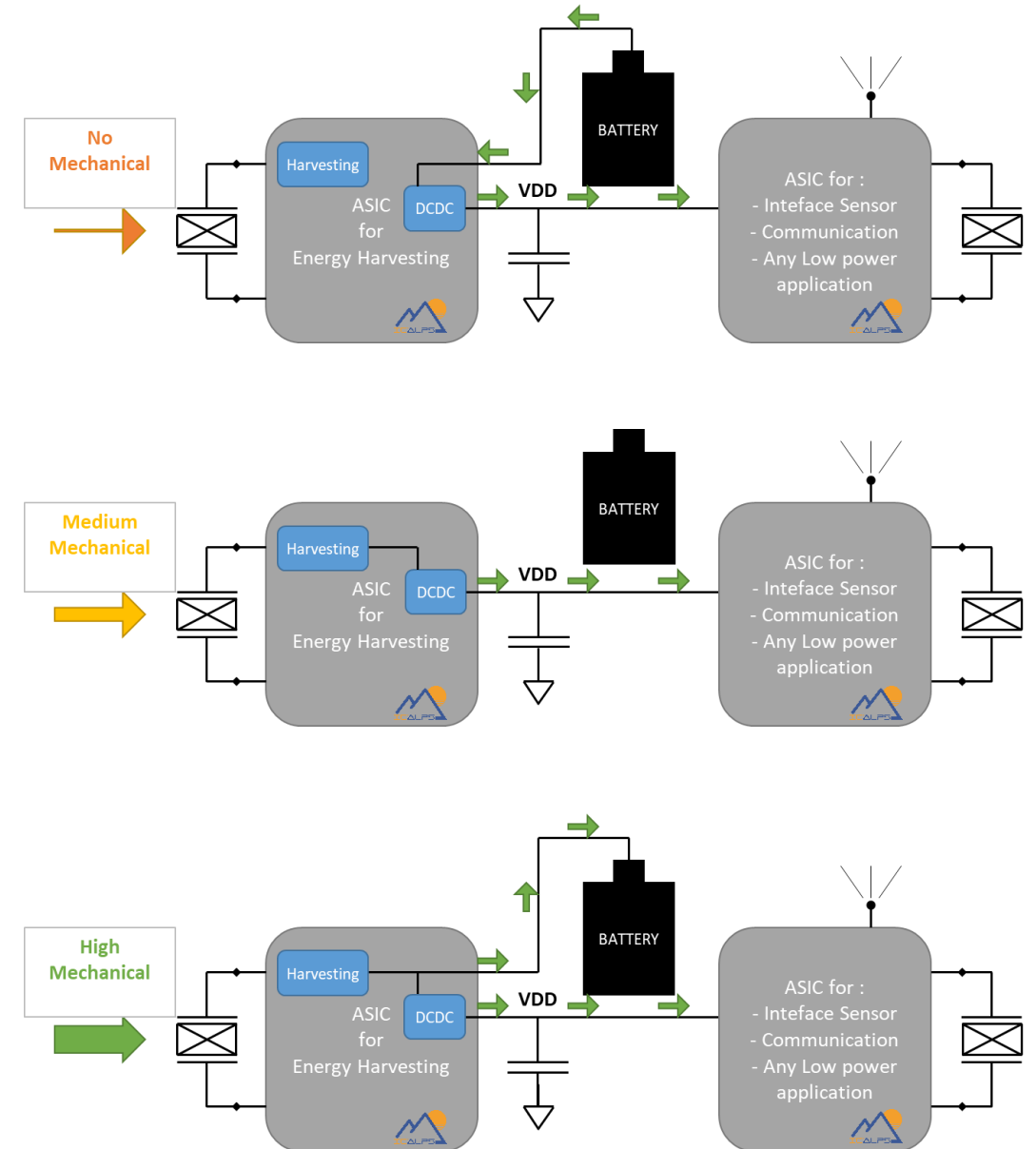
1 min

of BLE transmission time and

256 uWh

3 scenarios combining a piezo sensor with an ASIC for energy harvesting

- › ASIC chip used as interface
- › ASIC chip used as energy supplier
- › ASIC chip used as energy supplier and battery charger





4 fundamental principles

- » Availability
- » Authenticity
- » Integrity
- » Confidentiality

Data encryption

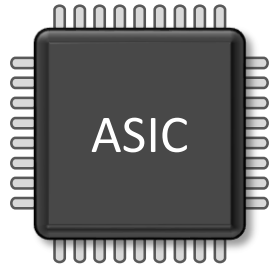
PUF

Secure boot

STRNG

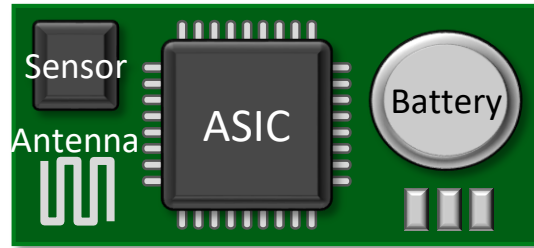
Etc.

Etc.



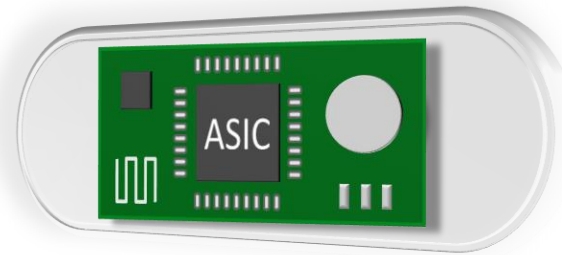
Custom Integrated Circuit

- › Physiological readout
- › Communication
- › Processing
- › Security
- › Sensors/MEMS control



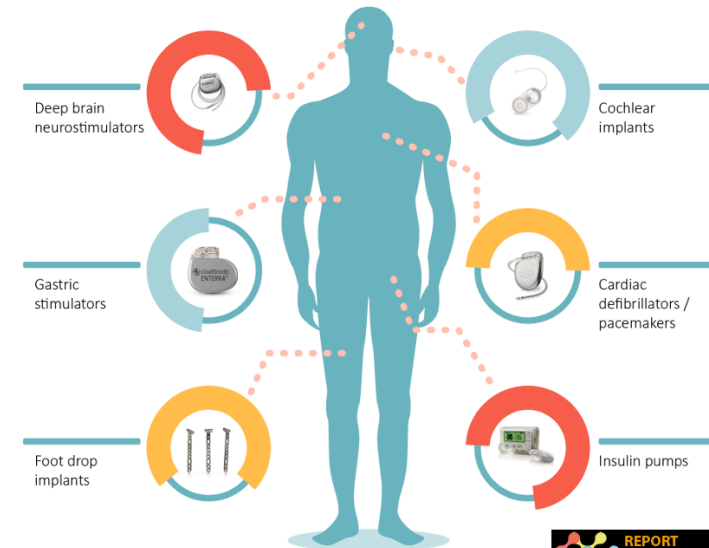
PCB

- › Sensors
- › Battery
- › Antenna
- › Printed Circuit Board
- › Software & Algorithm
- › Power supply



Medical Device

- › Application Platform
- › Physiological sensors
- › Mechanical
- › Pre-clinical / clinical tests





About
IC'Alps

On-Demand ASIC/SoC
Design & Supply

About IC'Alps Profile



Watch video



38+ In-House Experts

Analog | Digital | Mixed-Signal



HQ in France – International Partnerships


Turnkey Projects | ASIC Design & Backend Services




THANK
YOU



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