**Low power RF**
Vital-sign wireless monitoring

LifeSignals: technology background

About LifeSignals

LifeSignals Group Inc, is a venture and private-equity backed company which is led by its co-Founder and CEO, Surendar Magar, Ph.D., who started LifeSignals in 2008 to develop a purpose-built semiconductor platform that would enable high reliability, disposable, low cost, clinical-grade wireless biosensors that would transform healthcare by bringing clinical-grade monitoring and diagnostics out of expensive hospitals, and into homes and remote villages globally.
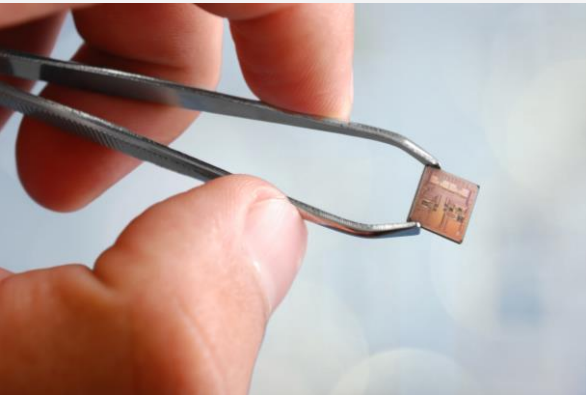
Technology Foundation

LifeSignals has developed world's first and only single-chip Life Signal Processor (LSP) silicon chip platform solely to enable high volume biosensor patches that are clinical grade, wireless, fully disposable, lightweight, comfortable and showerproof which accurately and reliably capture, record and stream vital signs to the cloud.

LifeSignals intellectual property on multiple fronts is covered by over 20 patents.

About LifeSignals LSP Platform

More than 10,000 people have worn the LifeSignals patch for multiple days for remote and ambulatory cardiac monitoring. Patch based on LifeSignals LSP platform that continuously monitors multi-channel ECG and is cleared by FDA, CE (EU) and HSA (Singapore).

These patches save lives and enable 7x24 health monitoring while avoiding undue hospitalizations.[2]

ST has been working with LifeSignals to **develop** and **industrialize** their innovative multi-radio architecture and to **bring it to the market** in **high volumes** while meeting **clinical-grade** requirements

The Live Signal Processor (LSP) is the perfect example of the benefits delivered by the complex combination of ultra-low-power **wireless connectivity**, highly **accurate sensor interfaces**, advanced **analog features**, and an ultra-efficient **processing** platform
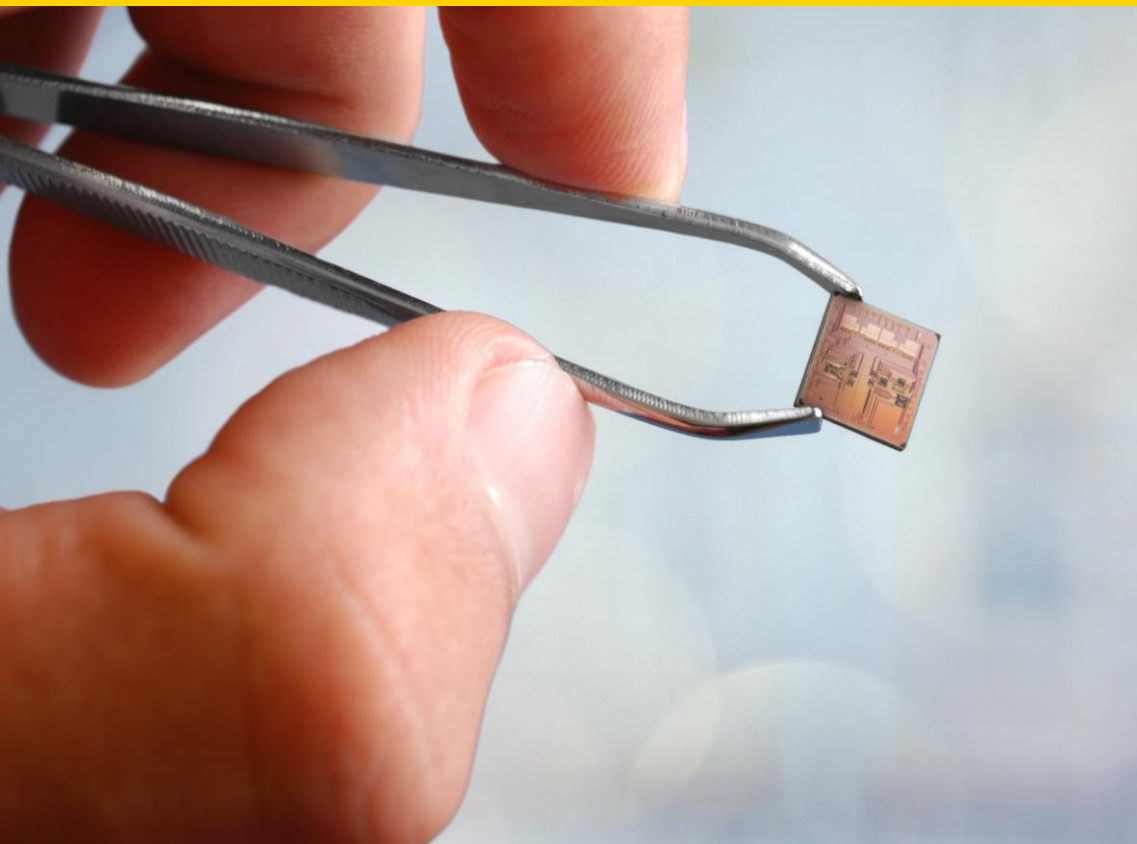
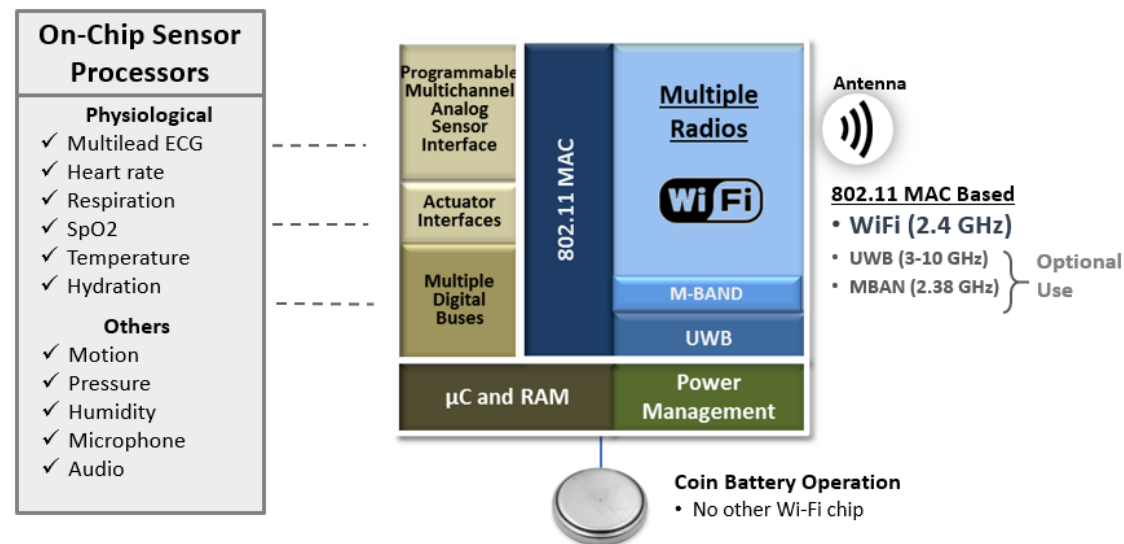**LC1100 Chip**
Life Signal Processor

Life Signal Processor silicon platform

LC1100: Single-Chip Solution with AFE + Processing + Radio link

Developed for medical grade – Key patented IP

The world's first battery operated, ultra-high reliable, disposable wireless System-on-Chip (SoC) solution

On-Chip Sensor Processors

Physiological
- ✓ Multilead ECG
- ✓ Heart rate
- ✓ Respiration
- ✓ SpO2
- ✓ Temperature
- ✓ Hydration

Others
- ✓ Motion
- ✓ Pressure
- ✓ Humidity
- ✓ Microphone
- ✓ Audio

Programmable Multichannel Analog Sensor Interface

Actuator Interfaces

Multiple Digital Buses

802.11 MAC

Multiple Radios

Wi Fi

M-BAND

UWB

µC and RAM

Power Management

Antenna

802.11 MAC Based
- **WiFi (2.4 GHz)**
  - UWB (3-10 GHz)
  - MBAN (2.38 GHz) } Optional Use

Coin Battery Operation
- No other Wi-Fi chip

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Purposely built for mission critical vital-sign wireless monitoring

Life Signal Processor – LC1100

- Dual 32-bit Cortex-M0 Processor
    - 128KB RAM (Radio)
    - 192KB RAM (Application)
- 2Kbit OTP memory
- QSPI, SPI, I2C, I2S, PDM
- EMMC and JTAG

MCU

LC1100 Chip
Life Signal Processor
(LSP)

MBAN

- IEEE 802.11b, 11d, 11e, 11i and 11r compliant
- 1 - 11Mbps data rates with long and short preambles
- IEEE 802.11e compliant QoS support
    - WMM, WMM-PS and WMM-AC standards
- IEEE 802.11i compliant security
    - WPA2 standards
    - HW AES encryption

WLAN

- 2.36-2.4 GHz Medical Band
- 5 MHz channel spacing
- 0.25 - 2.75Mbps data rates
- FCC-approved

- ECG
- SpO2
- TTI based respiration
- RDL amplifier
- Lead off detection
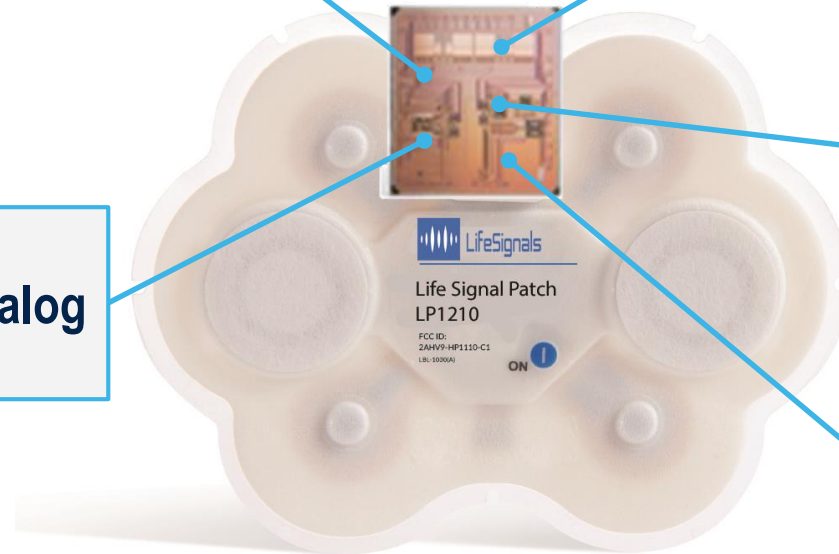- Digital pacemaker pulse detection
- Low battery indication

Analog

LifeSignals

Life Signal Patch
LP1210
FCC ID:
2AHV9-HP1110-C1
LBL-1000(A)   ON

UWB

- IEEE 802.15.6 compliant transmitter
- On-Off modulation with 0.3948 - 12.636Mbps data rates

Disposable Wireless Patch
for remote vital-sign monitoring

Wi-Fi®

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5

Diagnostics technologies

PRE-diagnosis: Screening

Patch-S

LifeSignals provides disposable wireless patch to allow more accurate screening

POST-diagnosis: Monitoring

Patch-M

LifeSignals has ground-breaking technology that allows remote monitoring of all key vital signs currently monitored in hospitals

LifeSignals technology can assist government officials and the medical community to respond to the Coronavirus outbreak at two critical steps

LifeSignals **wireless patches**

- Transmission to cloud
- Disposable afterward
- 5 days of continuous operation

Real-time critical vital sign monitoring, alerting and reporting @ scale

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LSP-based personal symptom monitoring
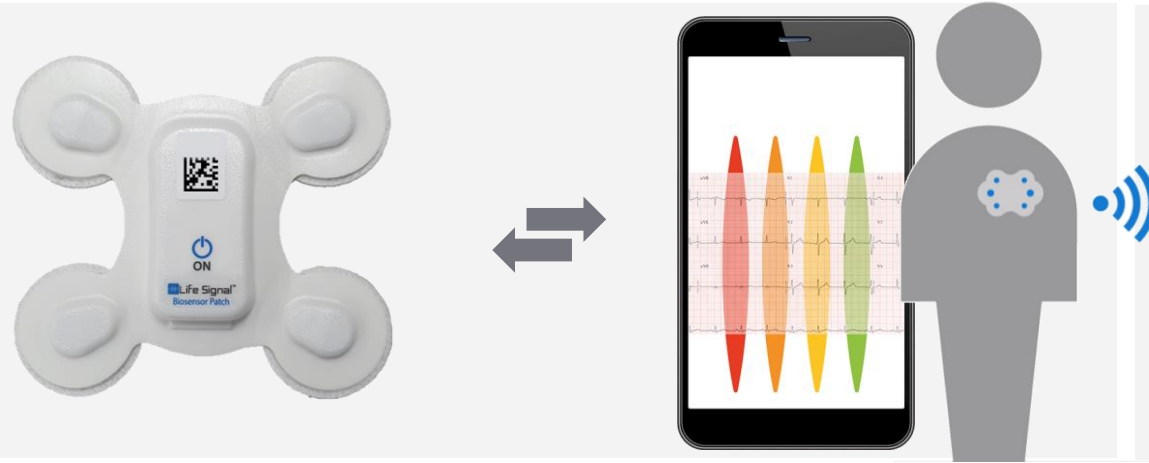
Patch-S – Symptomatic monitoring

2-channel ECG, heart rate, respiration rate, skin Temperature, cough frequency
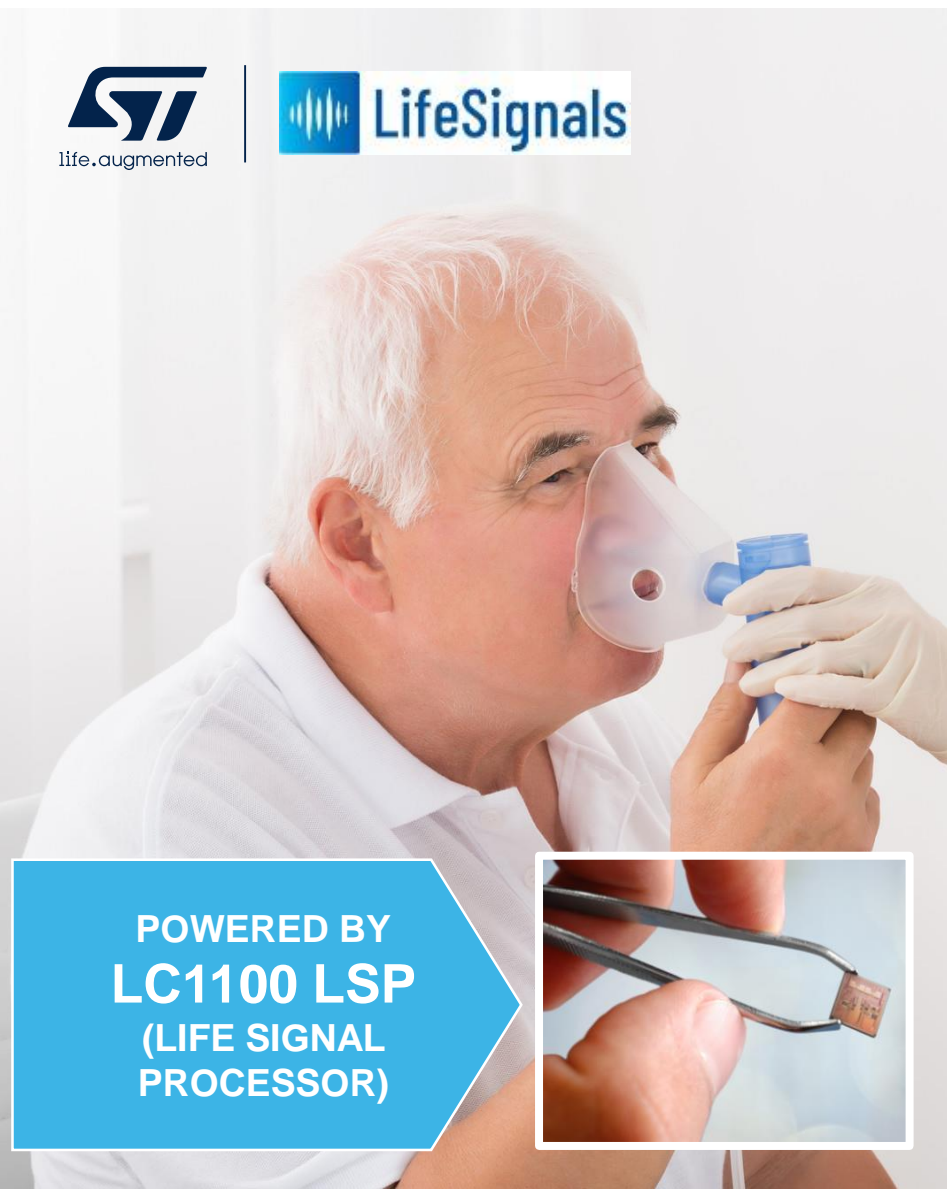
Patch-M – Clinical monitoring

SpO2, 2-channel ECG, heart rate, respiration rate, Skin Temperature, cough frequency, heart sound, Bluetooth Low Energy

Example of COVID-19 monitoring

For the many people who are currently self-isolating at home, continuous monitoring of COVID-19 symptoms is not possible. With the Patch-S and Symptom Tracking App, key COVID-19 symptoms can be continually monitored, providing individuals with detailed health trends and alerts.

There is currently a shortage of Intensive Care Unit (ICU) and high dependency beds in hospitals. Recovering patients can return to the comfort of their own homes or low dependence setting while still being monitored remotely, releasing scarce bed space in the hospital.

Life Signal Processor – Wireless wearable patches

POWERED BY
LC1100 LSP
(LIFE SIGNAL PROCESSOR)

LSP1210: LIFESIGNALS BIOSENSOR 1A
Multi-Parameter Disposable Patch

2-channel ECG, Heart rate,
FDA/CE approved on FEBRUARY 2020
In production

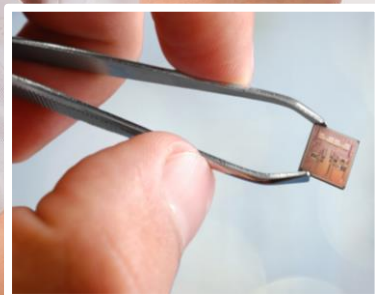**LSP1250: LIFESIGNALS BIOSENSOR 1AX**
Patch-S: symptomatic monitoring

2-channel ECG, heart rate, respiration rate,
skin temperature, cough frequency
Sampling NOW

LSP1250: LIFESIGNALS BIOSENSOR 2A
Patch-M: clinical monitoring

SpO2, 2-channel ECG, heart rate, respiration rate, skin
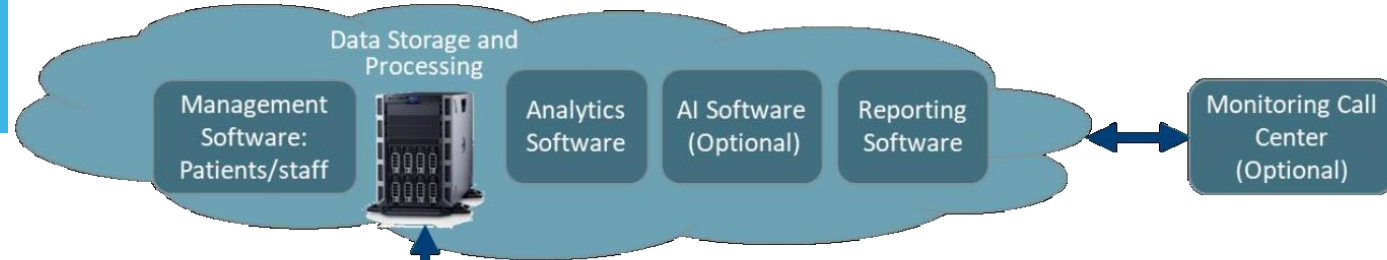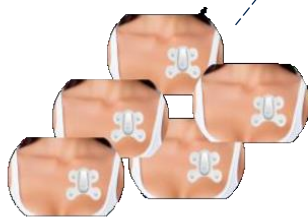temperature, cough frequency, heart sound, Bluetooth LE
Sampling e/o APRIL 2020

Scalable remote monitoring solution

Ready to build E2E ecosystem with LifeSignals patches

Patches easily worn and changed by Patients

Infrastructure to monitor Millions and Millions

Data Storage and Processing

Management Software: Patients/staff
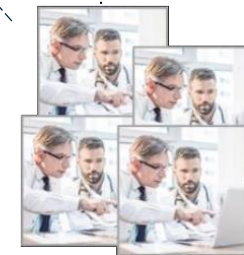
Analytics Software

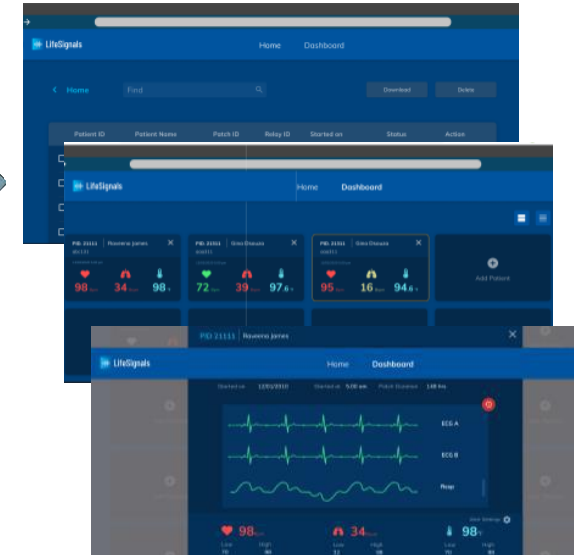AI Software (Optional)

Reporting Software

Monitoring Call Center (Optional)

Clinical-Grade Reliable Internet Data Transfer

Examples

1. Holter
2. In-Patient Monitoring
3. Remote Monitoring
4. Disease Management

LifeSignals

Thank you

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