Asset Tracking
a Complete Solution from ST
Introduction

In global manufacturing and commerce, raw materials, components and final goods travel long distances before arriving at the final destination. More than often, the value – direct or indirect – of any particular item warrants the cost associated with monitoring its condition – like detecting shocks or recording temperatures in a cold-chain for food storage and transportation – and track it all along the logistics chain.

Tracking relies mostly GNSS location technologies or wireless communications triangulation positioning, while the continuous monitoring of storage conditions is based on an array of sensors depending on the physical variables involved.

APPLICATIONS AND SEGMENTATION

Outdoor Real-Time Monitoring
- Containers
- Livestock monitoring
- e-bike
- Fleet management
- Pet tracking

Industrial Logistic
- Pallets
- Racks
- Luggage
- Smart parcels

Good Guarantee
- Cold chain
- Food
- Medical

Disposable
- Letters
- Packages
- Parcels

ST 360° PORTFOLIO DELIVERS 100% FLEXIBILITY

- Sensing & Actuating: Accelerometers, Temperature & Humidity, Pressure, Ranging sensor, Vibration Orientation, Free Fall detection, Objects presence detection and counting
- Signal Conditioning & Protection: Analog, Including Signal Conditioning, Protections, ...
- Processing: STM32, Computation by STM32 Family
- Connectivity: BLE, Bluetooth Low Energy Connectivity to gateway/tablet, Sub-1GHz, Long Range Connectivity to base stations/gateway Sigfox/Lora, NFC, Short Connectivity to handheld devices, GNSS, Localization
- Power & Energy Management: DC/DC, LDO, Power Management
ST offering a wide extensive range of environmental sensors (temperature, humidity and pressure), inertial sensors (accelerometers, gyroscopes and magnetometers), proximity sensors. Besides ST provides a huge product portfolio for low-power wireless connectivity such as Bluetooth Low Energy and NFC as short range solution, UHF Reader, and for Low Power Wide Area Network (LPWAN) as LoRa and Sigfox, and easy to use solution for GNSS positioning receiver, that in addition to a wide range of motion, environmental and proximity sensors, low-power microcontrollers, EEPROM memories and high efficiency power management ICs, allow easily to build ultra low-power tracking solutions for pallets and containers.

**TYPICAL ASSET TRACKING APPLICATION DIAGRAM**

<table>
<thead>
<tr>
<th>MEMS Mic</th>
<th>Signal Conditioning</th>
<th>BLE/Sub-1GHz/ Wi-Fi/Cellular</th>
<th>Balun</th>
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<tbody>
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**MEMS & sensors**

<table>
<thead>
<tr>
<th>GNSS</th>
<th>DC/DC LDO</th>
<th>Protections</th>
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**PALLETS AND CONTAINER TRACKING END-NODE - APPLICATION EXAMPLES**

**Tracking Bluetooth Low energy and SigFox**

- **Signal Conditioning**: TSU112, TSU101, TS882
- **BLE SoC**: BlueNRG-2
- **MEMS & sensors**: LIS2DW12, HTS221, STTST22H
- **Balun**: BALF-NRG-02D3
- **Sub-1GHz**: S2-LP STM32WL (SoC)
- **Protection**: EMI06-MSD02N16 ESDA7P120-1U1M
- **DC/DC, LDO**: ST1P01, STL020, LDLN030, LD59030

**Tracking LTE**

- **Signal Conditioning**: TSU112, TSU101, TS882
- **GNSS**: Teseo-LIV3F
- **Balun**: BALF-NRG-02D3
- **BLE SoC**: BlueNRG-2
- **MEMS & sensors**: LIS2DW12, HTS221, STTST22H
- **MCU**: STM32L496
- **Protection**: EMI06-MSD02N16 ESDA7P120-1U1M
- **DC/DC, LDO**: ST1P01, STL020, LDLN030, LD59030
- **Wi-Fi/LTE**: ST1P01, STL020, LDLN030, LD59030
- **Protection**: EMI06-MSD02N16 ESDA7P120-1U1M
- **Balun**: BALF-NRG-02D3
- **MLPF-WB55-0xE3**: Matched harmonic filter

**Note:** * Also parts not available in ST portfolio

**BLE** = Bluetooth Low Energy
Key Products

SENSORS
To support the design of ultra-low-power tracking and monitoring solutions, ST offers an extensive range of temperature, humidity and pressure sensors, inertial measurement units (accelerometers, gyroscopes and magnetometers), proximity sensors.

<table>
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<tr>
<th>Accelerometers</th>
<th>Pressure Sensors</th>
<th>MEMS Microphones</th>
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<td>H3LIS331DL High-g shock accelerometer</td>
<td>LPS22HH Precision pressure sensor</td>
<td>MP34DT05-A Digital microphone</td>
</tr>
<tr>
<td>IIS3DHHC IIS2ICLX Inclinometer</td>
<td>LPS27HHW Waterproof pressure sensor</td>
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<tr>
<td>IIS2DH Ultra-low power</td>
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<tr>
<td>LIS2DW12 With embedded temperature sensor</td>
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</table>

MEMS Microphones

<table>
<thead>
<tr>
<th>Temperature &amp; Humidity Sensors</th>
<th>FlightSense™ Ranging sensor</th>
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<tbody>
<tr>
<td>HTS221 Humidity &amp; temperature sensor</td>
<td>VL6180X Proximity sensor and ALS</td>
</tr>
<tr>
<td>STTS751 STTS22H Digital temperature sensor</td>
<td>VLS3L0X Ranging sensor</td>
</tr>
<tr>
<td>LM235 STLM20 Analog temperature sensor</td>
<td>VLS3L1X Long distance ranging sensor</td>
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iNEMO®

Inertial Module

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Note: * Coming soon

MICROCONTROLLERS & MICROPROCESSORS

The STM32 family of 32-bit microcontrollers based on the Arm® Cortex®-M processor is designed to offer new degrees of freedom to MCU users. It offers products combining very high performance, real-time capabilities, digital signal processing, low-power and low-voltage operation, as well as wireless connectivity, while maintaining full integration and ease of development.

The wide range of STM32 microcontrollers are based on an industry-standard core and come with a large choice of tools and software, making this product family ideal for both small projects or entire system platforms.

<table>
<thead>
<tr>
<th>MPUs:</th>
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<tr>
<td>High performance MCUs:</td>
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<td>Mainstream MCUs:</td>
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<td>Ultra-low power MCUs:</td>
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<td>Wireless MCUs:</td>
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MCU series for asset tracking applications

- Cortex®-M0/M0+
- Cortex®-M3
- Cortex®-M33
- Cortex®-M4
- Cortex®-M7
- Dual Cortex®-M7 & Cortex®-M4
- Dual Cortex®-A7 & Cortex®-M4

With Cortex®-M0+ radio co-processor
## Wireless Connectivity Solutions

ST’s portfolio includes a variety of transceivers, network processors ICs and fully certified modules that support major technologies currently available for wireless connectivity including sub-1GHz long-range networks (6LowPan, WMBUS, SigFox and LoRaWAN), Bluetooth-Smart®, 802.15.4 ZigBee and OpenThread.

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<tr>
<th>NFC &amp; RFID</th>
<th>Sub-1 GHz</th>
<th>Positioning</th>
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<td><strong>NFC/RFID</strong></td>
<td><strong>Sub-1 GHz</strong></td>
<td><strong>Positioning</strong></td>
</tr>
<tr>
<td>ST25TV</td>
<td>S2-LP</td>
<td>TESEO-LIV3</td>
</tr>
<tr>
<td>ST25DV</td>
<td>BALF-SP2-01D3</td>
<td>GNSS Module</td>
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<tr>
<td>ST25R</td>
<td>BALF-SP2-02D3</td>
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<tr>
<td>ST25RU3993</td>
<td>STM32WL</td>
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<tr>
<th>Bluetooth Low Energy</th>
<th>WPAN</th>
<th>Cellular</th>
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<tr>
<td>BlueNRG-2</td>
<td>STM32WB</td>
<td>Cellular connectivity</td>
</tr>
<tr>
<td>BALF-NRG-0203</td>
<td></td>
<td>In collaboration with several partners</td>
</tr>
<tr>
<td>BlueNRG-M2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32WB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MLPF-WB55-0xE3</td>
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</tr>
</tbody>
</table>

### NFC/RFID tags
- ST25TV
- ST25DV
- ST25R
- ST25RU3993

### Dynamic NFC/RFID tags
- BALF-SP2-01D3
- BALF-SP2-02D3

### NFC Readers
- S2-LP
- STM32WL

### NFC Readers for UHF
- BlueNRG-2

### Sub-1 GHz Transceiver
- S2-LP

### Sigfox compatibility
- BALF-SP2-01D3

### Multi-protocol
- BlueNRG-2
- STM32WB

### Bluetooth 5.0 Wireless SoC
- BlueNRG-2

### Balun for S2-LP

### STM32 Sub-GHz SoC
- STM32WL

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- STM32WL
POWER MANAGEMENT

ST is a leading supplier in power management and mixed-signal ICs for mobile applications, offering a wide range of products from simple power management ICs up to highly-integrated devices that mix power management blocks with advanced analog and digital functionalities.

### DC/DC converters

- **ST1PS01/02**
  - Synchronous converter,
  - Output voltage flexibility,
  - 400 mA output current,
  - Nano-quiet current (500 nA) for extended sensors battery life

### Voltage regulators

- **STL020**
  - 200 mA ultra-low quiescent current LDO
- **LDLN030**
  - Low Iq, ultra low noise 300 mA LDO with power good
- **LDLN025**
  - Low Iq, ultra low noise 250 mA LDO
- **LD59030**
  - Low Iq, ultra low drop 300 mA LDO

SIGNAL CONDITIONING

STMicroelectronics offers a wide analog portfolio including high-performance amplifiers and comparators dedicated to the challenging industrial, automotive and consumer markets. The main features of our growing portfolio are low power, high precision and tiny packages. The range of products allows easy and fast integration of analog products. For more information visit www.st.com/opamps

<table>
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<tr>
<th>Protection</th>
<th>Description</th>
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<tbody>
<tr>
<td>EMI06-MSD02N16</td>
<td>SD card protection</td>
</tr>
<tr>
<td>ECMF02-4CMX8</td>
<td>USB DATALINE</td>
</tr>
<tr>
<td>ESAT7P120-1U1M</td>
<td>DC-DC protection</td>
</tr>
<tr>
<td>DSILC6-4P6</td>
<td>ESD protection for NFC Tag</td>
</tr>
<tr>
<td>EMI03-SIMO2M8</td>
<td>SIM card ESD protection and filter</td>
</tr>
</tbody>
</table>

**ST Op Amps**

- **TSZ12 Series**
  - Zero Drift
  - CMOS Amplifier
  - Very low offset 5 µV max
  - Very low drift in Temperature 30 nV/°C

- **TSZ18 Series**
  - Zero Drift & Speed Amplifier
  - Very low offset 25 µV max
  - Very low drift in Temperature 0.1 µV/°C
  - Excellent Speed/power ratio 3 MHz/1 mA

- **TSU11 Series**
  - Nano-power Amplifiers
  - Zero Drift
  - 900 nA current Consumption
  - Only 150 µV max input offset Voltage
  - Operating from 1.5 V

- **TSU10 Series**
  - Nano-power Amplifiers
  - 580 nA current consumption
  - Operating from 1.5 V

- **TS88 Series**
  - Nano-power Comparator
  - 200 nA current Consumption
  - Operating from 0.9 V
  - Push Pull & Open Drain

PROTECTION

ST’s large portfolio of protection devices and ICs have passed all certifications, meeting or exceeding international protection standards for electrical hazards on electronics boards found in the demanding, industrial market. Standard and advanced innovative packages (flow-through µDFN, WLCSP and PowerQFN) keep board space to a minimum, helping improve layout options. For more info refer to https://www.st.com/en/protection-devices.html
ST provides different hardware and software solutions to help designers in their job. Starting from the Product Evaluation Boards, that can be used to perform a comprehensive evaluation of ST’s products, arriving to the Solution Evaluation Boards tailored to exploit one or more features of the application. Between these two families of evaluation boards, ST offers a fast and modular prototyping system, namely STM32 Open Development Environment (ODE), which permits to combine STM32 microcontroller with a broad range of expandable boards to reproduce the desired set of functions for sensing, connectivity, power, audio, motor control and more.

The ST Software Development Tools complement the ST hardware ecosystem adding programming tools, firmware libraries, middleware and stacks to reduce the design complexity.

**KEY PLATFORMS**

**NFC & RFID**

Solution Board
STEVAL-SMARTAG1

Firmware Packs
FP-SNS-SMARTAG1
ST NFC Sensor mobile app

**STM32 ODE Approach**

NUCLEO-L053R8
X-NUCLEO-NFC04A1
X-NUCLEO-IKS01A2

**Target Applications**

**Bluetooth Low Energy**

Solution Board
STEVAL-BCN002V1B

Firmware Packs
STSW-BLUETILE-DK
STBLESensor

**Target Applications**

SensorTile.box wireless multi sensor ready-to-go IoT Node
**Sigfox™ Tracker**

- **Firmware Packs**: FR-ATR-SIGFOX1

**IoT LoRa® Tracker**

- **Solution Board**: STEVAL-STRKT01
- **Firmware Packs**: FP-ATR-LORA1

**TOMTOM™ Tracker**

- **Firmware Packs**: FP-ATR-TOMTOM

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**STM32 ODE Approach**

- NUCLEO-L053R8/L476RG
- X-NUCLEO-S2868A2/915A1
- X-NUCLEO-IKS01A2/3

**Target Applications**

- 

**STM32 ODE Approach**

- B-L072Z-LRWAN1
- X-NUCLEO-GNSS1A1
- X-NUCLEO-IKS01A2

**Target Applications**

- 

**STM32 ODE Approach**

- NUCLEO-F401RE
- P-L496G-CELL01 2G/3G
- P-L496G-CELL02 LTE

**Target Applications**

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Order code: BRASSTRACK0120

For more information on ST products and solutions, visit www.st.com