

Phase IV's Breakthrough Wireless Sensor System: *Leap Sensors™* Designed to Meet Specific Needs of Industrial IoT & Scientific Environments



With over 25 years of wireless sensor expertise through our contract engineering work, Phase IV has designed groundbreaking sensors for clients like NASA, Crane Aerospace, the US Army, as well as many Fortune 500 clients. Our innovative designs won us “Sensor Engineering Team of the Year” in 2015 and “RFID Sensor Product of the Year” in 2016.



We've taken what we've learned on these cutting-edge projects to create the Leap Sensors system: a platform specifically for industrial and scientific users - *at a low-barrier cost.*

It is a major *leap forward* in wireless sensing.

Trusted, Standard Protocol for High Data Security

The Leap Sensor System is designed to leverage internet security methods that people already trust - the same methods that banks send huge financial transactions to the international banking system. In addition, the user interface is website based – so any device with a web browser can connect to the password-protected Leap system. In this way, data is protected as it travels over the air to the final database, and that data can be protected behind a company's own firewall.

- **Interoperability with 6LoPan - internet and network ready:** Each Leap Sensor device has its own IP address and easily integrates into a network. This Internet Protocol (IP) based system - IPV6LoWPAN leverages public key cryptography and secure wireless communication and supports end-to-end encryption from the sensor device all the way to the server. Technically speaking, the system uses AES-128 encryption, starting with a Password Authenticated Key Exchange (PAKE), and internet security with DTLS.
- **Thread-based user interface:** Leap sensors use the established Thread protocol that provides a standard user interface that can support repeaters, mesh networks, and other valuable options.
- **User Interface options to fit a client's needs:** The Leap Sensors User Interface (UI) is a web site with a log-in that has a back-end database. This UI and database can reside on a company server (behind their firewall). (It can also be on a cloud service such as Amazon web services.) Even more powerful, though, is that the UI and database can reside on a single-board computer inside the gateway that can store more than 1M readings. The gateway (with on-board UI) can

simply be plugged into the company LAN (behind their firewall) and the secure system can be up and running in less than 5 minutes and be accessible to anyone with a password on that local network.

Designed from the Ground Up for Industrial Environments

With Phase IV's deep experience in industrial sensor design, Leap Sensors were engineered from the ground up to address the most common needs, including the need for high operating temperature, industrial enclosures, transmission in an industrial environment, and more.

- **Electronics operating range of -40F to +250F (-40C to +120C)** - which can be extended with special enclosures - the **ONLY** wireless sensor with this wide range.
 - With the on-board thermocouple sensor input, temperature extremes from -500F to +3600F (-300C to +2000C) can be measured with off-the-shelf thermocouples.
- **Rugged standard enclosure**, with options for intrinsically safe (ATEX) certified, or miniature sensors if needed.
 - Our miniature Leap sensor option package is *one square inch* – including an on-board antenna *capable of transmitting over 1500 S*.
- **Optimized radio protocols and transmission methods** for industrial environments.
 - DSSS modulation allows the sensor system to operate at the international 2.4 GHz band – but make it highly immune to interference. The DSSS modulation also facilitates a highly sensitive receiver that extends the read range and reliability.
 - Leap sensors have on-board radio power and antenna matching diagnostics to assure maximum radio communication reliability.
 - Leap sensors also act as data loggers when an acknowledgement from the gateway is not received by writing time-stamped data to memory that will be re-transmitted later.
 - To get the reliability of multi-path transmission of a mesh network without the unmanageable complexity of a mesh network, the Leap system allows sensors to “roam” from one gateway to another and still maintain 2-way communication (unlike other wireless sensor systems that require the sensor be assigned to one gateway). Sensor radios can transmit to multiple powered gateways that are deployed in an area of a plant.



- “Infinite Range” – *Sensor Anywhere* options available with the latest Cat-M1 cellular connectivity. We offer cellular gateways and sensor-direct-to-cellular options. Iridium satellite connections are also available customizations.
- **Highly adaptable gateway to deliver data “any way you want it”:** The gateway utilizes an advanced on-board web server – allowing users to interface the Leap network with a web browser and a password from any type of computer. The same web user interface, which supports a variety of operating systems, can be moved to a local server (to keep the data in-house) or to a cloud server.



- [The Leap Gateway](#) is designed to be highly flexible in how it delivers the data to client’s application. The gateway “back end” is programmable and supports just about every physical layer including Ethernet, cellular modem, USB, RS232, Modbus, Iridium satellite modem, and many others. This greatly simplifies the integration of the Leap Sensor System to a client’s existing IT infrastructure.
- Unlike most wireless sensor companies, the Leap Sensor system is available without a required data plan – no SaaS and no recurring monthly fees.
- Leap Sensors Cloud Server is an available option if a client does need a cloud interface.
- **Ultra-long battery life:** Phase IV has leveraged their experience with energy-harvesting battery-free RFID sensors to design ultra-low-power circuits that result in long battery life – between 3 and 10 years, depending on other factors in the sensor design. This makes Leap Sensors *practically battery-free™*.
- **Lower Cost and Increased ROI with Multiple Sensors per Transmitter**
 - Most wireless sensors are one sensor per radio transmitter. With the Leap Sensors’ hardware and firmware modularity, many sensors can be fed to one transmitter.
 - Examples include the [3-sensor motor monitor](#) and the [9 temperature sensors for silicon wafers](#). When the cost of the electronics and enclosures gets divided by many sensors, the cost per sensor plummets and the ROI dramatically increases.
- **Modular hardware and firmware design**
 - Phase IV can easily “tweak” a sensor system to meet a client’s specific needs.
 - The Leap firmware design is structured to be maintainable for a long product life cycle. This platform supports multiple protocols, transmitters, and sensors, which can be easily changed as technology evolves. It is positioned to stay on the leading edge for a long time.

Fast, Cost-effective Proof-of-Concept

Phase IV has a [“demo” multi-sensor transmitter system](#) that supports a huge range of sensors, making it easy to quickly design something that is really close to what a client needs. Once the requirements are field-proven, it is much easier to justify a full system that is tailored for their specific parameters.



Actually Up and Running in 5 Minutes – No Field Configuration or Set-Up – No Software to Install

Even the most technically sophisticated plant engineers and technicians don't want to invest hours in figuring out how to get a wireless system up and running. They want to take it out of the box, turn it on, and have it operating reliably. For this reason, the Leap Sensor system hardware and firmware is 100% factory configured so that the system is ready to run out of the box. *Most sensors can be up and running, transmitting data within 5-10 minutes.* (See our [video demonstration](#) of installing a system in less than 5 minutes.)

- **Web-based User Interface** means no software to install and never a problem with software incompatibility with a computer or operating system. Just use any web browser and type-in the URL of the gateway to get to the log-in page. Any web connected device (phone, tablet, PC) can interact with the Leap system with a password and access to the network where it is installed – with no software to install.
- **Magnetic-mount option:** To further enhance rapid installations, Leap offers a magnetically mounted enclosures and magnetically mounted sensors - such as thermocouples and vibration sensors – that install in just a few seconds.

Actionable Data – Not “Big Data”

The reality is that “Big Data” can really mean “Big Headache”. Often small-to-medium manufacturers don't have the time, or need, to slice and dice a lot of data. They just want to know when a critical reading is out of spec. In addition, storing a lot of data costs money.

- **Practical edge computing data processing:** The Leap Sensor system leverages a powerful on-board microprocessor for very practical edge computing processing of data. Many Leap sensors offer high sampling (up to 5 KHz), then use on-board FFT to “boil down” the data before it is transmitted.
 - Clients can leverage this capability to configure sensor readings based on insights from plant personnel to understand what critical things need to be monitored and what sensor readings should generate an alert. The Leap Sensors regularly take sensor readings (in a low-power battery-saving mode), but only transmit alerts when problem conditions arise. This streamlined but actionable data leads to high-ROI and high plant acceptance of new wireless sensor systems.
- **High data efficiency for longer battery life:** Sensors can be configured to process data at the sensor and send wireless messages only when an alert is justified. This minimizes low-value data and reduces transmissions that affect the battery life

Modular, Configurable Design



Because of Leap sensors’ modular firmware design, we can easily develop custom designs with multiple, various sensors. For example, a motor monitoring sensor may have a temperature, vibration, and amp clamp connected to one transmitter. Plus, no need to have a separate transmitter for each individual sensor *keeps the per-sensor cost low*.

- **Support for all sensor types:** temperature, humidity, pressure, strain, vibration, etc.
- **On-board high-precision four-wire bridge for strain sensing and other low-signal sensors,** such as pressure sensors. Ideal for structural health monitoring and predictive maintenance.
- **A CAN bus option allows multiple sensors of different types on a single long cable.** The industrial CAN bus design assures reliable sensor readings in RF-noisy factories.



For More Information, Contact:

Scott Dagleish

Phase IV Engineering

2820 Wilderness Place, Unit C

Boulder, CO 80301

sdagleish@phaseivengr.com

303-443-6611x114 Toll-free: 1-866-608-6168 (North America Only)

www.phaseivengr.com