How to design IoT for the completely connected control room

Challenging industrial IoT applications demand custom-engineered solutions due to their unique problems and specifically challenging environments. Usually, that consists of robust ingress protection, such as IP67 and others, temperature resistance, vibration resistance, carefully designed wireless performance, and more. Industrial IoT requires a higher degree of resiliency to factors that degrade performance in other products, or even disrupt connectivity entirely

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Just as important as all of these is to provide a wireless ecosystem that guarantees design flexibility, extensibility, and the potential to expand and grow with your application's needs. **Laird Connectivity**'s Sentrius BT610 is highly flexible, with out-of-the-box support for temperature, pressure, ultrasonic, AC current applications, and more. It's designed to grow with your application, serving in various subcomponents of an overall design.

This case study looks at just one of many examples where an application is ideally served by multiple sensors gathering data from several separate components of the application. For this example, we explore control hut monitoring – equipment buildings placed adjacent to outdoor installations such as antenna towers, railway tracks and industrial facilities. The overall health of the application is best determined by gathering more data: antenna current, ambient temperature, HVAC compressor current, indoor temperature, and more.

These data points create a comprehensive picture of the real-time status of the overall installation: how environmental conditions impact performance, the equipment inside, and the hardware outside. The more data points that can be quantified on-site, the better operators can be at anticipating and detecting system failure, ensuring more reliable uptime, and avoiding expensive equipment failure and replacement. ▶

The Sentrius BT610 – precisely engineered for demanding IoT designs

A reliable IoT sensor platform must be precisely engineered to resist common industrial environmental problems like vibration, dust, moisture and extreme temperature. This can also include vulnerable external components such as antennas, which introduce weak or failure points in the system.

The Sentrius BT610 is specially engineered to produce the most resilient, reliable, long-performing IoT sensor that addresses our customers' specific needs in the field. Our expertise is built into the DNA of the BT610 in several key product features:

- **Unique, custom-engineered industrial enclosure** resists intrusion from water and dust, including ports that individually seal with IP67 cable glands or caps. An IP67 pressure vent equalises pressure and temperature without exposing internals. A magnetic contact switch triggers connection via a mobile app without exposing the interior. An internal antenna provides reliable communication and connects via an IPEX locking connector for superior vibration protection.
- **Long-range Bluetooth 5 connectivity** powered by the robust BL654 (**Nordic Semiconductor** nRF52840) wireless module, the BT610 enjoys top-of-the-line Bluetooth feature support such as LE Coded Long-Range features, which gives a 4x range boost over last-gen Bluetooth 4.
- **Long/stable battery life via lithium thionyl chloride battery in an AA package** battery chemistry allows full performance across the battery's charge, reliable to the end. Clever power management schemes and configurable parameters (coded PHY, 1M PHY, advertisement and measurement intervals, and transmit power) means your sensors can last more than five years in the field before requiring a new battery (see the BT610 battery calculator online for details).
- **Utilise pre-canned configurations with cable assemblies or bring your own sensors** through IP67-rated cable gland connectors and an internal screw terminal block, connect external sensors to I/O or generic serial interfaces. Laird Connectivity provides temperature thermistor, AC current, ultrasonic and pressure sensors, or connect your own. The BT610 GPIO supports 4x 4-20 mA or 0-10V DC analogue inputs, 2x dry contact digital inputs, 2x digital outputs, 1x 3.3V or 5V power output (to which users can wire in a maximum of two sensors), and the serial peripheral supports SPI/I2C bus + UART interface.

These design considerations form a highly resilient, flexible, high-performing, custom-engineered IoT powerhouse, reliable and flexible for smart industrial applications. This includes current monitoring in, for example, three-phase induction motor applications, fluid and gas tank monitoring with ultrasonic and pressure levels, and a wide range of temperature monitoring, for equipment like coolers, freezers, and HVAC units.

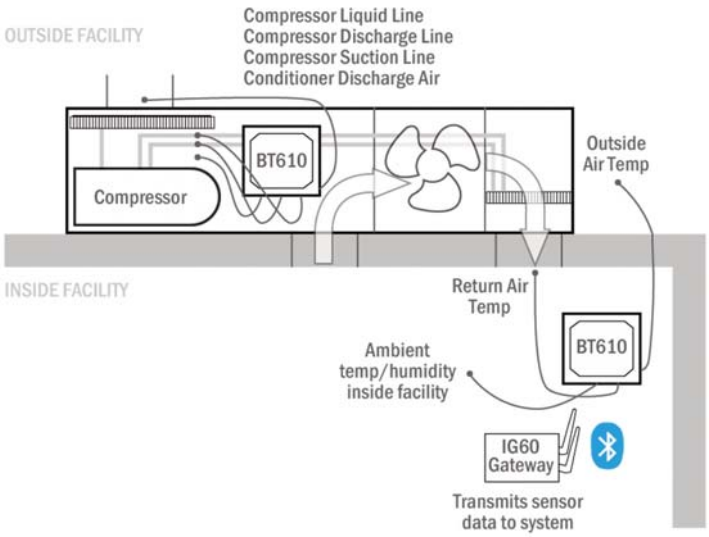
The Sentrius BT610 is designed to cover some of the most common industrial IoT scenarios

These scenarios have a primary characteristic to measure, such as current or temperature, but are greatly served by capturing diverse data that paints a more complete picture. We'll look at the control hut application and how the BT610 adds valuable intelligence that scales as a more comprehensive snapshot of current conditions is established.

An antenna control hut is a fixture of many transmitting antenna tower installations that exists for multiple reasons to facilitate antenna tuning and protecting workers onsite. It protects equipment and workers from the powerful, hazardous energy at the antenna radiator. It contains radio equipment, sometimes HVAC for sensitive equipment or operator comfort, and connections to various components of the radio antenna tower.

Primary measurable data points might be the ambient temperature inside/outside of the hut, where sensitive equipment may overheat and malfunction. Taking a closer look, there are many other measurables that can indicate not just imminent failure, but emerging problems:

- **Pressure of compressor lines** Variances of pressure around the compressor can indicate emerging failures, such as physical leaks or compressor wear.
- **Changes in current to the compressor or fan system** Unusual electrical activity can precede a complete failure, and can prompt operators to repair or replace equipment before it creates an unexpected problem. ▶



- **Changes in current to the antenna/radiator equipment** Unmeasured electrical problems moving from the hut to the external antenna tower can spell disaster for the application at large. Monitoring internal and external hardware in tandem can help isolate working components of a system from disrupted ones.

- **Open/closed status for doors and windows** Security is critical where expensive equipment is under lock and key. It's also important to keeping the area cooled and functional, and can provide more data to explain HVAC problems, such as overheating due to open windows and doors.

The BT610 has a capacity limit for connected sensors, with some requiring more wired-in connections. Multiple units may be needed to cover a whole installation, but the consistent base platform eliminates the need for multiple single-input, single-use sensor types.

As you can see, expanding on an IoT application yields increasing awareness and intelligence about the conditions and behaviours of its subcomponents. With the addition of more data points, a more comprehensive and actionable picture emerges to sense and prevent disruptive equipment failures. The BT610's flexible configurability, ease of placement and versatile sensor input support make it an excellent choice for facilities and applications with multiple measurables across various conditions and locations.

Develop your way with versatile software options

Just as important as flexibility in hardware and peripherals is flexibility in software design. The BT610 is based on an embedded Cortex M4F processor, with an open software architecture that is designed to give you multiple paths to creating and developing your applications.

Develop with **Zephyr** RTOS or the Nordic nRF Connect SDK. The Nordic SDK provides the familiar tools and features you know and love from Nordic. The Zephyr RTOS route provides an open-source option for your firmware that is widely supported, connectivity focused, and footprint conscious. We provide a boards file and additional documentation on the Zephyr website. This design flexibility helps you integrate the BT610 into your existing platform, using familiar tools to integrate it with other devices.

The BT610 firmware communicates using CBOR encoded commands over the MCU Manager SMP protocol for compact JSON that maximises throughput with simple key-value pairs. Laird Connectivity continues to grow and develop available software and documentation for the BT610 across upcoming future GA releases.

Endless applications

The control hut example demonstrates the range of measurables and locales that the BT610 can serve. But the same can be said of many other use cases where multiple measurables can serve to identify, anticipate, and isolate component failures.

In HVAC, temperatures at various points in the system can provide a holistic view of climate control effectiveness across an entire facility. In food safety/cold chain applications, the status of compressors and refrigerant lines for coolers or prep stations can verify the storage-to-serve pipeline for food safety. An industrial motor's temperature or 3-phase electrical supply can identify possible overheating or dangerous failure conditions.

Laird Connectivity's decades of experience in wireless design and deep collaboration with customers gives us the insight to design IoT products uniquely suited to demands on the ground. The BT610 is carefully designed to address these demands, last for years in the field, and help businesses gather the data they need to achieve better outcomes. ■

For more on our Sentrius BT610 I/O sensor, as well as pre-canned configurations, product specifications, and documentation, see our website:
https://www.lairdconnect.com/bt6x0-series