



## TECHNOLOGY SOLUTION

### Sensors



# Wearable RFID Sensor Tags Yield Extended Operational Times

Preserves RFID active tag battery to extend operational lifetime

Innovators at NASA Johnson Space Center have developed a method that uses Radio Frequency Identification (RFID) interrogators for use with wearable active RFID sensor tags that can operate on ultra-low power. The technique uses a store-and-forward approach to manage the collection of data from RFID active tags even when they are not in range of an individual interrogator, as they move from the coverage area of one interrogator to the next. This allows the use of RFID active tags to transport sensor data in a highly complex environment where instantaneous access to an RFID interrogator cannot be guaranteed. Using this technique, an RFID active tag battery operational lifetime can be extended.

#### BENEFITS

- Supports multiple RFID tags constantly moving through coverage areas
- Enables years-long operational lifetime for the RFID tags - power is provided by an interrogator (plugged into vehicle) saving sensor battery life
- Eliminates need for battery charging or replacement
- Practical to manufacture and implement using COTS components



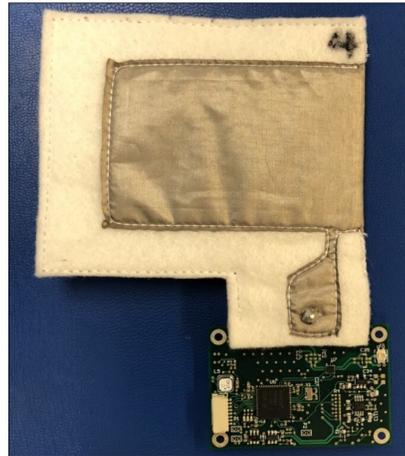
## THE TECHNOLOGY

This technology exploits the inherently passive nature of RFID to approximate the services provided by traditional active Internet of Things (IOT) protocols like ZigBee and Bluetooth. A novel store-and-forward overlay on COTS RFID protocols allows an RFID active tags to transit through an ecosystem of RFID interrogators, exploiting contact opportunities as they arise and quietly transfers sensor readings at nearly no power cost to the RFID active tag. Specific intelligence built into both the interrogator and the tag leverages the RFID tag user memory (UM) as a stand-in IOT interface. The tag operates by sampling data into timestamped “packets” and loads them into tag memory. When an interrogator in the ecosystem realizes that a tag is in view and that there is unrecovered data on the tag, it takes custody of the sensor data packet and offloads the data into a database. A smart scheduler reads from the population of interrogators and schedules data transfers for specific tags when an interrogator can seed the custody transfer process for the data packets. NASA has produced working prototypes of wearables, worn by the crew aboard the International Space Station, that reports humidity, temperature and CO2 readings. In one estimate, the battery life is on pace to last an estimated nine years.

The Low-Power RFID to Collect and Store Data From Many Moving Wearable Sensors is a technology readiness level (TRL) 6 (system/subsystem prototype demonstration in a relevant environment). The innovation is now available for your company to license and develop into a commercial product. Please note that NASA does not manufacture products itself for commercial sale.



Shown: bare RFID/CO2 sensor board uses store-and-forward approach to manage data collection.



Shown: board encased in small flexible sheath and folded back behind antenna to make a wearable sensor “patch.”

## APPLICATIONS

The technology has several potential applications:

- Industry/occupational health: wearable sensors for air quality monitoring
- Hospitals: wearable geo-location and biometric sensors for staff and patients moving throughout facility
- Other healthcare settings: telehealth/medical monitoring of home-bound patients
- Aerospace: monitoring space habitats for astronauts i.e. usage aboard ISS
- Internet of Things: tech introduces new applications for wearable sensors where battery charging or replacement is not practical

## PUBLICATIONS

Patent No: 11,062,099

Wagner, R.S. and R.J. Barton; "Delay Tolerant, Radio Frequency Identification (RFID)-enabled Sensing", IEEE International Conference on Wireless for Space and Extreme Environments (WiSEE), October 2014.

[technology.nasa.gov](http://technology.nasa.gov)

**More Information**

National Aeronautics and Space Administration

**Agency Licensing Concierge**

**Johnson Space Center**

2101 NASA Parkway

Houston, TX 77058

202-358-7432

Agency-Patent-Licensing@mail.nasa.gov

**[www.nasa.gov](http://www.nasa.gov)**

NP-2021-07-2966-HQ

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

MSC-26501-1, MSC-TOPS-93