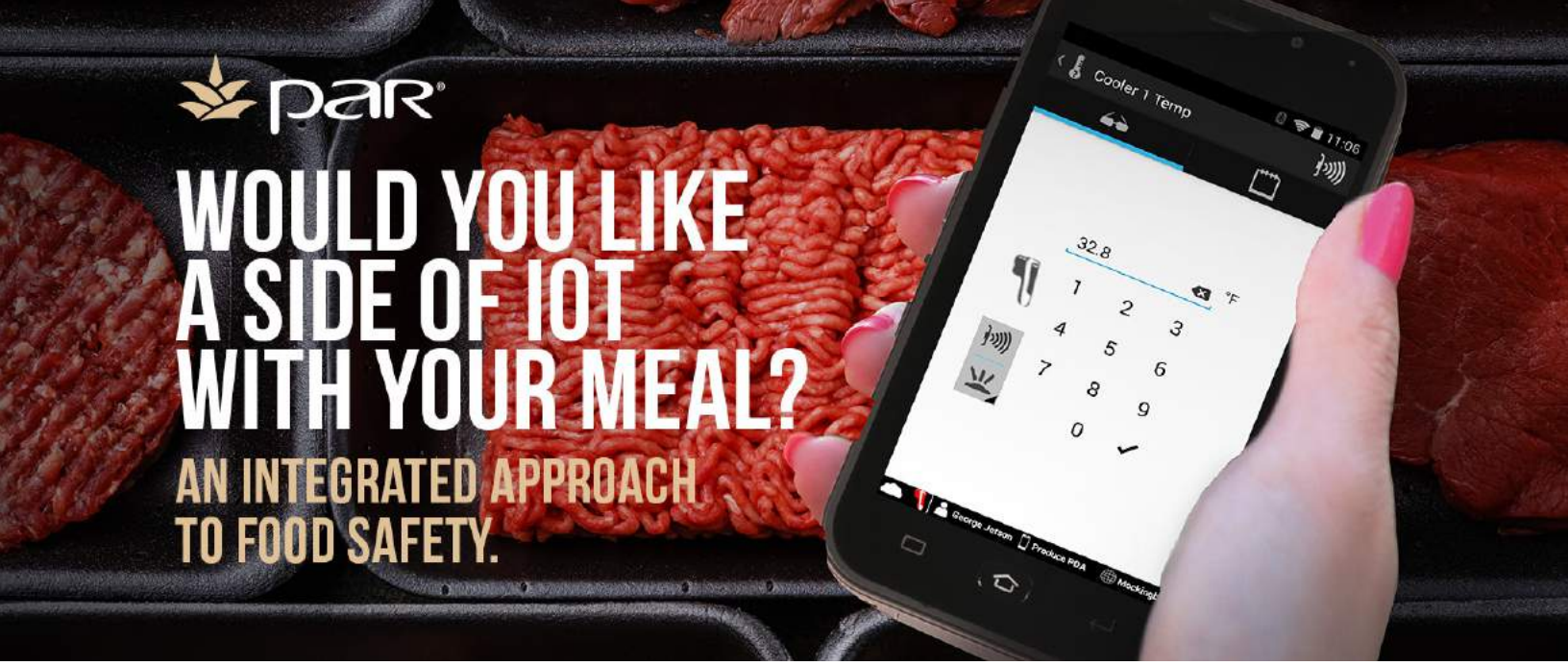
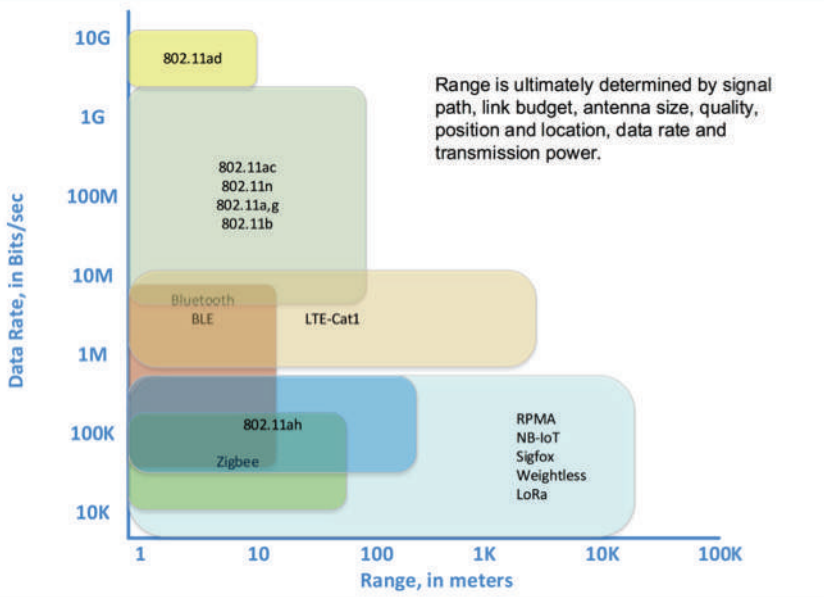


What is the Internet of Things (IoT) and how does it relate to Food Safety? The Internet of Things, or IoT as its commonly called, is the interconnection via the internet of computing devices embedded in everyday objects, enabling them to send and receive data. These devices continually collect and exchange data with other devices within a network so the data can be aggregated for further analysis, reporting, or predictive alarming. IoT devices can connect to the internet by a variety of technologies or technology combinations ranging from WiFi, BlueTooth, Ethernet, Zigbee or Cellular, depending on the available network infrastructure present or the desire of the end user to segregate devices or data from their network. Typically, end-users will work with the vendor to select the appropriate technology to deploy - based upon the following criteria: Network type/availability, frequency, maximum range required, ease of deployment, facility layout, and network security required.

The following table illustrates criteria for selection of the backhaul infrastructure based upon distance to other sensors or gateways.

This image breaks down:

- Range
- Maximum Data Rates
- *Note- Data from IoT temperature sensors are typically sub 100 kilobit*



Courtesy of Azimuth Systems

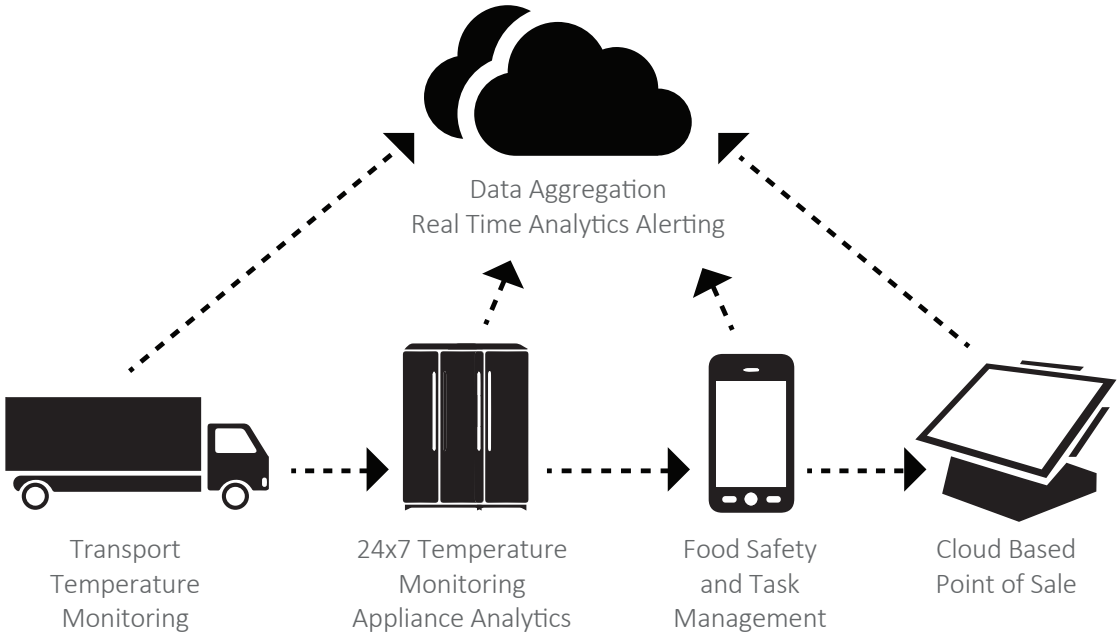
So how is the Internet of Things or IoT relevant for a Food Safety strategy? In an integrated approach to food safety, IoT temperature sensors dispersed throughout the cold and hot food chain, coupled with a food safety/task management system for taking HACCP (Hazard Analysis and Critical Control Points) required food safety temperature measurements, provides unprecedented visibility and traceability, for an end-to-end food safety strategy for groceries or restaurants. It's worth noting that customers are not necessarily looking for an IoT solution when they start the process for acquiring a solution for monitoring coolers/freezers or grills, but for an automated temperature monitoring system whose data is cloud-based and just so happens to be available via the internet.

Data from IoT sensors dispersed through the food chain is continually collected and analyzed to ensure temperatures do not exceed pre-defined limits. These limits are based upon HACCP guidelines. The collected data is then subsequently stored electronically for a period specified by the user, typically up to two-years from the collection date per FSMA Regulations. If a temperature measurement falls outside pre-defined limits, an alert via text or SMS can be sent to the end-user for corrective actions. Recent developments in IoT have also coupled active monitoring with predictive analytics to determine appliance health. An example of this would be looking at the temperature profile in a cooler to anticipate the longevity of the cooler based upon compressor behavior.

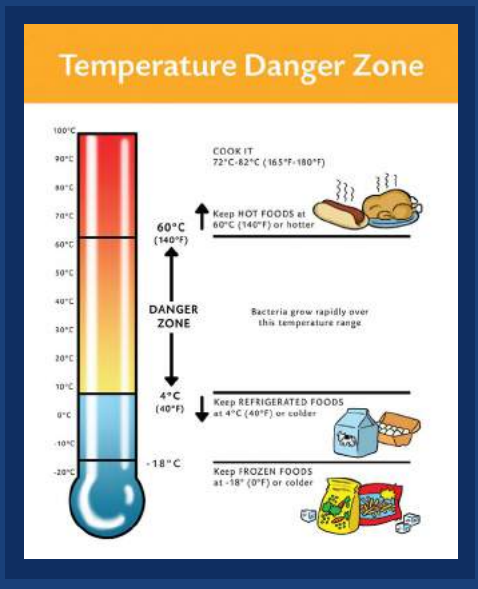
The following photo illustrates an IoT sensor monitoring temperature and humidity of a cooler.

This data can be further combined with temperature data collected during the transportation process for increased end-to-end visibility, but in most cases, data monitored or collected within the facility is sufficient for the majority of Health Department requirements.

In the not so distant future, you can also imagine that the collected Food Safety and Food Quality data may also be combined with Point of Sale (POS) data to provide unprecedented visibility of food operations.



Temperature data being acquired as part of a Food Safety task list to ensure HACCP compliance



Should an issue occur in the food chain, food safety data would then be correlated with transactional data to not only define when a limit was exceeded, but to potentially trace the impact to the consumer or in- store sales/profitability. Additionally, high or low sales of a specific item could also be equated to how the item is prepared.

As an example: low sales of a chicken wing SKU could be correlated to the temperature required for crispiness or tenderness of the product. The Chef or food manager defines as an internal Quality Control Point.

It should be noted that the implementation of IoT in establishments utilizing checklists that guide operational efficiency is not only limited to food safety. The capabilities of IoT can be deployed for task management or facilities maintenance practices such as Entry/exit applications, facility maintenance/sweep logs, CO2 sensing (beverage and condiment), customer que length for ordering or check out and incident reporting –where the documentation of an incident is required should a customer or employee incur an injury within the facility.

The implementation of comprehensive end-to-end Food Safety and Task Management Strategy utilizing remote monitoring based upon IoT promises to provide businesses with a new cornerstone for building a comprehensive and preemptive Food Safety and Facilities plan. By meeting the strict requirements of HACCP regulations, companies can continually reduce operational expenses, decrease waste, and potentially predict events that could affect the food chain and subsequently the consumer. An integrated approach to food safety utilizing a Food Safety/Task Management system with IoT can positively influence all consumers within the restaurant, grocery, and food chain realms.

For example – check out our Case Study on *The Balanced Chef*, our restaurant on the PAR campus:

The Balanced Chef was looking for a method to prevent loss of product due to cooler or freezer malfunctions. By implementing an Integrated Food Safety approach utilizing remote monitoring via IoT, the company now has 24x7 visibility into the temperature of all foods in deli cases, with reach in refrigerators and storage freezers. They now have protected both their brand and their customer-the employees of PAR!

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