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# Leveraging the Internet of Things with Wireless Networks

**Internet-connected devices allow businesses to gather detailed information about their operations in real time, enabling them to make decisions that can benefit the bottom line.**

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In 1982, a group of students at Carnegie Mellon University connected a soft drink machine to the Advanced Research Projects Agency Network (ARPANET), the Department of Defense-funded packet-switching network that was the precursor to the Internet. The students installed switches and timers that could sense how many bottles were in the machine and how long each bottle had been there.

By running a software program on the computer department's mainframe, the students could print a report detailing the status of the soft drink supply and which rack in the machine held the coldest cans.

In 1991, students at the University of Cambridge in England took the concept a step further, using a camera in the lounge of the computer laboratory to monitor the amount of coffee remaining in the brewing machine. The camera provided gray scale images of the coffee pot in real time to help students avoid a wasted trip when the pot was empty, although it still was necessary for someone to visit the lounge occasionally to brew a fresh pot.

At the time, those projects did not serve much of a purpose other than as a creative outlet for computer science majors. They did, though, offer a glimpse of the potential for using digital networks to track all sorts of information.

Today, companies are using the same concepts in their enterprise networks that the connected soft drink machine used in 1982 to improve their operations and increase their bottom line. As those companies expand their use of Internet of Things (IoT) devices, more are using wireless networks to control those devices.

### Defining IoT

Although definitions vary, according to the International Telecommunication Union, IoT is a term attributed to physical devices incorporating software,

sensors and network connectivity that enable those devices to collect data. Those devices then can be accessed and controlled remotely via the Internet.

Combining IoT devices with machine-to-machine (M2M) communications and the Internet of Things has revolutionized the way many companies operate by reducing costs and improving accuracy through automating communications between central systems and remote devices, and eliminating the need for regular human intervention.

"If we had computers that knew everything there was to know about things — using data they gathered without any help from us — we would be able to track and count everything, and greatly reduce waste, loss, and costs," Kevin Ashton, credited with originally coining the term "Internet of Things," wrote in a 1999 article that appeared in RFID Journal. "We would know when things needed replacing, repairing, or recalling, and whether they were fresh or past their best."

According to Framingham, Massachusetts-based research firm International Data Corp., spending in the worldwide IoT market is expected to grow at an annual rate of 16.9 percent, reaching $1.7 trillion by 2020, compared with $655.8 billion in 2014. An estimated 50 billion devices are expected to be accessible via the Internet within the next five years.

What those devices may be is limited only by the imagination and creativity of their users. Current applications include restaurant menu boards that allow companies to change menus and update prices from the corporate office, self-service kiosks that allow companies to establish a presence in areas where it may not be feasible to open an office, and telepresence health care solutions that allow doctors to communicate with patients in remote locations via interactive digital screens.

Helping drive the reach and capability of IoT devices is widespread 4G LTE cellular coverage. Trucking companies can leverage 4G LTE to monitor the location of vehicles in their fleets as well as measurements ranging from speed to fuel levels to engine temperature and even the pressure of air in a vehicle's tires. First responders are saving time, money and lives by employing 4G LTE solutions in emergency vehicles, allowing doctors to evaluate patients' vital signs while they are still in the ambulance.

In addition, more and more IoT applications are connecting via cloud computing, offering ease of scalability in distributed enterprise IoT deployments. A recent study by Santa Cruz, California-based software developer Evans Data Corp. found that 55 percent of IoT devices were connecting via the cloud.

"We've also seen a dramatic shift in the way remote appliances are managed," said Ken Hosac, vice president of business development for Boise,

Idaho-based network solutions provider Cradlepoint. "We are seeing a big trend where the management of these remote devices is being accomplished with smartphones and tablets."

## A caveat

Unfortunately, IoT devices can serve as on-ramps to a company's private network, making it critical for companies to be vigilant about security. Hackers can easily buy an IoT device and study its weaknesses, exploiting those weaknesses to gain access to a device in use by a bank, retail store or other operation. They then can leapfrog, or pivot into the broader network.

Once a device is compromised, companies likely will find it both difficult and costly to update or replace the other devices on their network.

One of Cradlepoint's banking customers, for example, is running all of its digital signage applications on a separate network because it wants the person who is managing the digital signage content to do so without being on the secure financial network. Another customer, a quick-service restaurant chain, put all of its point-of-sale systems on a separate LTE network to keep them off the corporate network. That way, even if the corporate network were breached, hackers wouldn't be able to access credit card numbers or other financial information.

"We've had a lot of customers who have been using LTE to create separate networks for specific applications," Hosac said, "so that those devices are not a point of ingress into their networks."

*Source: SRI Consulting Business Intelligence/ National Intelligence Council — Disruptive Technologies Global Trends 2025*

*https://en.wikipedia.org/wiki/Internet_of_ Things#/media/File:Internet_of_Things.svg*

*Public domain*

### Where is the Internet of Things headed?



Technology Reach

Software agents and advanced sensor fusion

Miniaturisation, power-efficient electronics, and available spectrum

Teleoperation and telepresence: Ability to monitor and control distant objects

Physical-World Web

Ability of devices located indoors to receive geological signals

Locating people and everyday objects

Ubiquitous Positioning

Cost reduction leading to diffusion into 2nd wave of applications

Surveillance, security, healthcare, transport, food safety, document management

Vertical-Market Applications

Demand for expedited logistics

*Source: SRI Consulting Business Intelligence*

RFID tags for facilitating routing, inventorying, and loss prevention

Supply-Chain Helpers

2000    2010    2020    Time