TECHNOLOGY

# 'Internet of Things' in Reach

*Companies Rush Into Devices Like Smart Door Locks, Appliances, but Limitations Exist*

By DON CLARK

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Workers prepare to hang the LG Electronics logo in preparation for the 2014 Consumer Electronics Show at the Las Vegas Convention Center. *Reuters*

From meat thermometers monitored with a smartphone to Wi-Fi-equipped dog collars, devices and services in homes and businesses are increasingly being connected to the Internet, a long-awaited trend that is causing a surge of optimism in the tech sector.

Large and small companies are churning out a number of Internet-connected gadgets, a central theme as the Consumer Electronics Show opens this week in Las Vegas.

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Devices on the market or the drawing board include smart door locks, toothbrushes, wristwatches, fitness trackers, smoke detectors, surveillance cameras, ovens, toys and robots.

But the much-ballyhooed Internet of Things still is largely a collection of possibilities. Sales of the new-wave products are threatened by a number of stumbling blocks that could slow investment—from conflicting wireless-communications standards to debates about how much processing power should be built into gadgets.

Some industry executives say privacy concerns may be even more serious, without a consensus on how to exploit all the data that could be generated by a flood of new sensors and Internet-connected video cameras.

"Big data is worth absolutely nothing without big judgment," says Joseph Bradley, director of what Cisco Systems Inc. calls its "Internet of Everything" consulting

practice.

Nonetheless, heavyweights like General Electric Co. , Intel Corp. and Qualcomm Inc. are jockeying for position.



SmartThings sensors detect motion, water leaks or other home events. Here, its $99 wireless hub. *SmartThings*

"I've never seen our industry go as fast as it is, or create as much value," says Marc Benioff, chief executive of Salesforce.com Inc. "It's a very magical time."

Cisco estimates that the number of devices connected to the Internet will swell from about 10 billion today to 50 billion by 2020, as wireless links spread beyond smartphones and PCs to many other kinds of devices. The Silicon Valley giant's chief executive, John Chambers, is expected to discuss the opportunities Tuesday in a keynote speech at CES.

Gartner Inc. puts the number of connected devices at fewer than 30 billion, but sees $309 billion in additional revenue for product and service suppliers by 2020 and $1.9 trillion in total economic impact from cost savings, improved productivity and other factors.

The vision of a world of smart gadgets emerged even before the Web. A.C. "Mike" Markkula, a co-founder of Apple Computer Inc., had a brainstorm in the mid-1980s about combining functions for networking and controlling devices on a single chip. Those "neurons," as they came to be called, were expected to spread widely once their cost fell to around $1. But the company he founded, Echelon Corp. , didn't hit that target and has had a bumpy history.

"I keep kicking myself," he says. "I was 20 years too soon."



Sproutling's wearable baby monitor sends data about baby's vital signs to users' smartphones. *Sproutling*

Chip makers did steadily push down the cost of adding intelligence to everyday gadgets, often to less than $5. Another driver has been the onslaught of smartphones and tablets, which can serve as handy Web-connected remote controls for devices in the home and workplace.

Potential benefits range from fairly prosaic to profound. Consumers, for example, can now use smartphones to remotely check if they locked doors, left the lights on or turned down the thermostat. Retailers can help smartphone users find goods on store shelves, and wirelessly pitch sales promotions. Parking meters can communicate with smartphone users.

Companies like Silver Spring Networks Inc. sell wireless meters to manage energy usage, while GE exploits data generated by sensors to monitor the health of jet engines and gas turbines.

The opportunities have attracted a number of startups, some of which have managed to raise substantial funding from venture capitalists. The best-known is Nest Labs Inc., a maker of Wi-Fi-equipped thermostats and smoke detectors led by former Apple Inc. executive Tony Fadell. Another example is August, which is developing smart door locks and has raised $10 million to date.



Silver Springs Networks sells gear to help cities and utilities manage digital lights and energy. *Silver Springs Networks*

Others are leaning heavily on crowdfunding sites like Kickstarter and Indiegogo, as investors worry about the potential costs of hatching hardware startups—and the likelihood that entrenched companies will adapt their existing products to dominate Internet-of-Things opportunities.

"The body count is quite high of startups that have made hardware," says Jason Johnson, August's CEO and founder of the Internet of Things Consortium.

For those reasons, some startups are developing new services to help manage connected devices, while existing companies are modifying business models to exploit the data likely to flow from them. Insurance companies, for example, can respond to sensors and wireless connections in cars to charge drivers by the mile and speed they drive, instead of by where they live.

"The value of the devices will be secondary to the services they enable," says Thomas Lee, a Stanford University professor of electrical engineering and co-founder of Ayla Networks Inc., an online service hoping to help turn ordinary products into cloud-connected devices.

Startup Nest Labs' smoke and carbon monoxide alarm. *Associated Press*

So far, however, smart-home products seem mainly to be attracting technology enthusiasts. Only 1% to 2% of American consumers surveyed by Forrester Research in mid-2013 were using five widely touted home-automation offerings. Some 28% of respondents said they were interested in controlling appliances with a smartphone, but 53% weren't.

Other hurdles face companies tackling the Internet of Things, including a fragmented assortment of wireless communications technologies. In home automation, for example, device makers face options that include Insteon, Wi-Fi, Bluetooth, Zigby, Z-Wave and earlier proprietary technologies.

"It's not that things aren't getting connected—they are getting connected badly," says Rob Chandhok, president of Qualcomm's interactive platforms unit.

Qualcomm is trying to rally hardware makers around a technology called AllJoyn to help devices discover each other and collaborate. Meanwhile, startups trying to sell their own control devices are going through contortions; Revolv Inc., for example, is marketing a hub that can communicate using seven different radio technologies.

Mike Soucie, Revolv's co-founder and marketing head, says agreements on key communications technologies may be five to 10 years away. Any standards that do emerge are likely to apply to a single market—like home security or transportation —rather than to many industries, predicts Gilad Meiri, chief executive of Neura Inc., a startup developing technology to help orchestrate connected devices.

Assuming devices can communicate, manufacturers need conventions for telling them what to do and how to work together. Meanwhile, other basic questions remain—like just how much intelligence should everyday devices have?

Companies like Intel and ARM Holdings PLC, which license technology to chip makers, stress the benefits brought by processors that can run sophisticated software and protocols that allow them to connect directly to the Internet.

But others believe such complex technology can reduce the reliability of home appliances and other devices, while raising the odds of bugs or security holes that could be exploited by attackers. They prefer simpler chips called microcontrollers, which are harder to reprogram to do unintended things.

Whistle's $129.95 clip-on wireless device uses Wi-Fi and Bluetooth to track dog activity levels. *Whistle*

"I want my refrigerator to be a thing; I don't want it to be a computer," says Shane Dyer, chief executive of Arrayent Inc., a startup marketing a Web-based service to manage microcontroller-powered devices.

Moreover, the data generated by connected devices could be used in ways consumers don't like and create liabilities for companies. Chris Bruce, chief executive of Sproutling—a startup developing a smartphone-connected baby monitor—wonders if services that store data from connected devices might get subpoenas if something bad happens.

There are at least as many questions about the fast-growing flood of data from Internet-connected security cameras.

"It is more than a little creepy," says David Alan Grier, an associate professor of science and technology policy at George Washington University and 2013 president of the IEEE Computer Society. "There is going to have to be some clear thinking and some clear understanding of what is going on."

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