The Internet Of Things Is A Standards Thing

Electronic Design

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Everyone is talking about the Internet of Things (IoT). It promises to be one of the greatest technological revolutions mankind has ever seen. Yet many people may not realize that standards are the foundation of the IoT. Without them, this revolution cannot occur. The Internet itself operates on standards *(see "How Does The Internet Work? Very Well, Thanks To Standards")*, and standards will enable things to communicate with each other and with people.

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The IoT is an evolving phenomenon, so there are many different ways to look at it. Often, it is divided into parts to make it easier to understand. The different parts connect to each other and interact with each other, forming the overall IoT. We can divide the IoT into four areas for convenience: wearable devices, smart homes and appliances, connected vehicles, and smart cities.

Existing standards are being deployed in each of these areas, and new standards are being developed to fill in the gaps. As the IoT becomes a reality as a result of the standards that make it possible, huge new markets are emerging, with many new players and interesting dynamics. Some argue that the IoT is probably 10 to 15 years away. Others say the IoT is already here. The IoT will not suddenly be a reality. Instead, it is encroaching bit by bit into daily life.

Wearable Devices

Wearable devices are possibly the most visible evidence of the impending IoT. Smart watches, fitness monitors, Google Glass, diabetes instruments, and heart monitors are just a few of the gadgets people are beginning to carry on their bodies. And of course, the smartphones that connect these devices are part of the IoT.

There's an interesting distinction between two classes of wearable devices: those that deal with doctors and hospitals and those that don't. Things that have to do with doctors and hospitals are considered medical devices. As such, they require approval from the federal Food and Drug Administration (FDA) before they can be sold (at least from a U.S. perspective). FDA approval is not a fast process. Product approval can take 10 years. Hence, this part of the IoT is many years away from becoming commonplace.

However, non-medical devices are popping up everywhere. The increasingly popular fitness monitors that are conveniently worn on the wrist are broadcasting the amount and types of people's physical activities to countless smartphones and computers via standards and the Internet.

The standards for wearable devices that are in use today include Wi-Fi, 2G/3G/4G, Bluetooth, and Near Field Communication (NFC). Wi-Fi is the ubiquitous wireless communication standard, officially called IEEE Standard 802.11. The mobile network generations carry the moniker 2G/3G/4G. The International Telecommunications Union-Radio communications sector (ITU-R) created a set of standards that networks must comply with to be called 4G. The official name of this set of standards is the International Mobile Telecommunications Advanced (IMT-Advanced) specification.

Bluetooth is a standard for short-distance data exchange. It uses short-wavelength UHF radio waves and connects both fixed and mobile devices. Officially called IEEE Standard 802.15.1, it is managed by the Bluetooth Special Interest Group. NFC is a set of standards for devices to transfer data over very short distances—a few inches—or by touching. The NFC Forum oversees the set of standards that come from different standards organizations and offers compliance services for interoperability and branding.

Smart Homes And Smart Appliances

Smart homes and smart appliances are on the horizon. Security systems and thermostats are becoming more and more aware of the people who live inside their homes, observing and reacting to their behavior and personalities. It is amusing to think of a refrigerator "talking" to a car, saying, "Hey! We're out of eggs!" Or, imagine a washing machine communicating with a clothes dryer, saying, "Take care of these soggy garments, will ya?"

Yet there are also situations when smart appliances are really useful—for example, notifying the owner that the freezer door is ajar and all the food is melting. Smart homes could even save lives in adult assisted living centers by monitoring the location and vital signs of senior citizens.

Adding IoT features to products is relatively inexpensive for appliance manufacturers. But will consumers jump at the chance to buy a major appliance simply because it has Wi-Fi capabilities? It's unlikely they will dump their perfectly good large appliances in favor of IoT-ready new ones. More likely, they will wait until their appliances wear out before replacing them. Then, the IoT will begin moving into their homes and into their lives.

In addition to Wi-Fi, a few of the standards that are making homes and appliances smart are X10, Insteon, ZigBee, and Z-Wave. X10 is an old standard, developed in 1975, that is still used for home automation. It uses power-line wiring and radio signals to control lights and devices in the home. Insteon is a newer standard for home automation that also uses power lines and radio communications. It promises to enable a Jetsons-like home of the future and is more a commercial enterprise than a standards-setting body.

Based on IEEE Standard 802.15, ZigBee allows devices that require a low data rate, long battery life, and secure networking to communicate over long distances. It is overseen by the ZigBee Alliance, and it is named after the waggle dance of the honeybee. Z-Wave is yet another communication standard for home control. It uses RF radio communication and was designed to not interfere with Wi-Fi or Bluetooth. The Z-Wave Alliance is a consortium of companies that oversee the technology and build products that comply with the Z-Wave protocol.

Connected Vehicles

Connected vehicles, including self-driving cars, will greatly change the way people get from one place to another. Already,

many new automobiles can communicate with their owners via RFID to computers and smartphones. When the auto's tire pressure is low, the owner gets notified via text message or e-mail. A device that allows cars to pass through tollbooths without stopping improves the flow of traffic while automating the billing process.

Also, cars that park themselves and have full-feature Internet access are on the market, awaiting customers to drive them off the lot. While self-driving cars are many years away from proliferating, and one occasionally can be seen in Silicon Valley with its laser radar atop its roof. Driverless cars promise an enormous increase in safety and efficiency.

As with major appliances, most consumers will adopt the IoT for automobiles when their current vehicles need to be replaced. People who lease their cars will trade up for the IoT faster than car owners who keep their vehicles for 10 years or more. But auto manufacturers are introducing kits that retrofit older vehicles with IoT technology so the number of connected vehicles may dramatically increase in a few short years.

Vehicles become connected with standards such as IEEE 1901, IEEE 2030, STMF, and V2V. The standards come from formal standards organizations, government, and private industry. IEEE Standard 1901 is a standard for devices to communicate over electric power lines. It is not only used for vehicle applications but also for local-area networks in buildings, smart energy management, and other data distribution.

IEEE Standard 2030 is for Smart Grid interoperability. The Smart Grid is an integral part of connected electric vehicles. STMF, the Simple Transportation Management Framework, was developed under the U.S. Department of Transportation's ITS (Intelligent Transportation Systems) program and created by the ITS Joint Program Office, which brings six transportation agencies together. V2V is vehicle-to-vehicle communication for roadside stations and the vehicles themselves. The Car-to-Car Communications Consortium in Europe, the U.S. government, several automobile manufacturers, and other global corporations with a vested interest in safe, connected vehicles are working on it.

Smart Cities

Smart cities will have vast applications of IoT technology. The United Nations predicts that by 2050, two-thirds of the world's population will live in cities. The congestion, energy demand, and health and safety concerns stagger the imagination. Even now, crowded cities face daunting challenges. Anecdotally, if a person lives in Paris today and reaches the age of 70 or 80, five years of that person's life will be spent looking for a parking place. A smart city would know where the empty parking spots are and would direct a (self-driving) car to the closest one.

Also, the Smart Grid would manage energy production and consumption efficiently, balancing the demand and sending electricity to the places where people need it most. Intelligent medical devices could eliminate unnecessary hospital stays and dispatch ambulances immediately when needed. Factory automation would serve the smart city to produce the most efficient products. Intelligent transportation and inventory management would put the products in the hands of city dwellers as quickly as possible.

Smart cities sound futuristic, but already smart governments are putting IoT capabilities into place to help their citizens. Chicago's "smart communities" program brings awareness of digital technologies and the Internet to businesses, families, and individuals. New York City provides its residents and visitors with a variety of important information from government, businesses, and other people through its City24/7 initiative. Information is displayed on any mobile device and on large screens that replace outdated pay phones.

Amsterdam's smart city initiative has 45 projects underway from energy management to health care collaboration to free Wi-Fi. Lyon's smart city strategy includes transportation solutions and resource management. Smart technology parks are

under development in Kalkara, Malta, and Kochi, India. At the heart of every smart city are communication standards and the Internet, which, of course, is built on standards.

Other Considerations

When technology takes a big leap forward, policy-makers are usually left behind. If a self-driving car gets into an accident, whose fault is it? How safe does a wearable heart monitor have to be before it can be sold to the general public? Is driving while wearing Google Glass more dangerous than or just as safe as a heads-up display in the windshield of a car? Who owns the rights to photographs of interesting people taken on a public street? Regardless of any other factors that might slow down the adoption of IoT technology, law will play an important role.

One of the essential aspects of the IoT that must be addressed is the "creepy factor." It's disturbing to think that people could be spied on through their smart electric meter or smart thermostat. It feels risky to have private medical data floating on a cloud somewhere. Can a driverless car have the same intelligence as a human driver? (It might have more.)

Privacy and security issues must be solved before the IoT is welcomed across the globe. Through technical standards and transparent standards-development processes, the creepy factor can be mitigated. Or, perhaps people's tolerance for it will increase automatically because the IoT is just so cool.

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