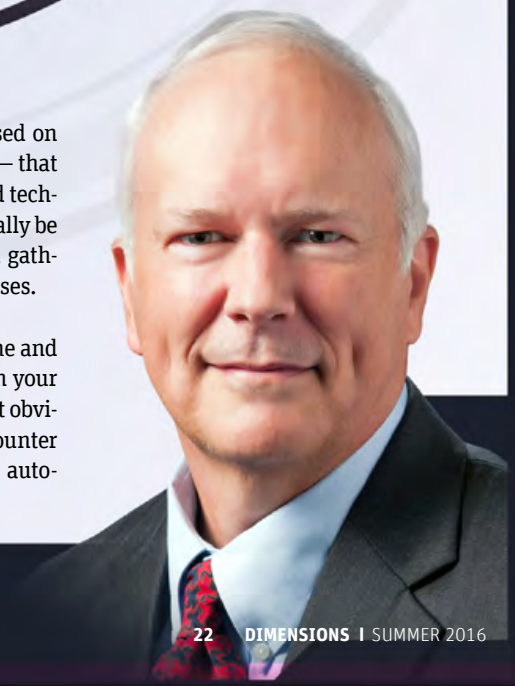
SENSING THE FUTURE

When we think about the Internet of Things, most of us picture a smartphone, a tablet, a smart watch or a fitness monitor. Underlying all these devices — and many others that you don't see — are advanced sensors that collect critical information in real time. Tim Saxe, CTO of sensor technology leader QuickLogic, points out that most businesses are overlooking the strategic value of these sensors to generate insights on product performance, customer needs and other key strategic considerations. Here, Saxe offers practical advice for executives on joining the sensor revolution.

By Tim Saxe, Chief Technical Officer, QuickLogic, Sunnyvale, USA



Much of the excitement about the Internet of Things (IoT) has focused on the ubiquitous personal devices — smartphones, tablets, wearables — that have replaced the last generation of big, clunky, largely unconnected technologies. At QuickLogic, we believe the bigger revolution might actually be the emergence of a global "swarm" of sensors that complement these devices, gathering huge volumes of data with enormous strategic potential for most businesses.

Think about it: Everywhere you go, there are sensors — in your car, in your home and all around you — that improve your quality of life. They collect information on your location, needs, surrounding conditions and even physical well-being. The most obvious examples are consumer applications: the faucets and hand dryers we encounter in public bathrooms, the thermostats in our homes, and the GPS devices that automatically sense where our cars are while we're driving.

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However, as the IoT grows in sophistication and complexity, unexpected new business-related applications for sensors spring up seemingly every day. Consider these examples:

- The newest hotels in Las Vegas have sensors installed in every bathroom, monitoring the water consumed by sinks, showers and toilets. Not only does this data help hospitality executives understand high-level water usage patterns, it actually helps to determine daily cleaning and maintenance schedules. If the shower in room 517 has not been turned on today, it does not need to be cleaned. If a restroom in the conference center has been used often, it can be scheduled for maintenance.

- More and more often, industrial equipment is rented on an actual-usage basis. Think of the large lights that illuminate construction sites at night or industrial floor cleaning machines. Increasingly, sensors determine how much time this equipment is actually in use, and feed this data back to the leasing company for billing purposes. Thanks to sensor technology, customers can now only pay for actual hours of service and not the time equipment is sitting idle.

- In the retail sector, product displays increasingly include sensors that can tell when a product has been removed from a peg or other fixture. Store personnel can intelligently restock products as they are depleted — and automatic replenishment to the store can occur as sensors interact with larger corporate technology systems.

- In the wine industry, grapes often ripen at different rates due to inconsistent water supplies. This leads to waste, since harvesting is a one-time activity across the entire vineyard. Now sensors are collecting data on soil moisture levels at various locations, spurring irrigation systems to water certain areas and leave others alone. This type of agricultural application has the potential to increase crop yields and solve the pressing global issues of hunger and nutrition.

While sensor technology has the power to deliver many benefits, fully leveraging its potential presents some significant challenges for both executives and engineering teams. These must be solved before the average company can fully capitalize on sensor technology to anticipate and meet customer needs, perform predictive maintenance, streamline and automate the supply chain, and accomplish other critical tasks.

EFFECTIVELY INTEGRATING THE THINGS

As the Internet of Things grows in size and scale, an obvious challenge is ensuring cross-platform integration and communication. After all, the full strategic value of the IoT can only be realized if information is shared and actionable across the entire business network.

As you think about the earlier example of products being sold from the retail store — with sales sensed at the shelf level — consider all the uses of this data. Employees can be alerted in real time to restock the display. New inventory can be shipped from the distribution center. Further back in the supply chain, materials can be ordered and new production can begin. Merchandising teams can eliminate slow-moving products, and marketing teams can promote the best sellers. There is so much to be gained from this data, but it has to be effectively shared across many operating systems and platforms, from the executive suite to the factory floor.

The companies driving sensor innovation are working to develop universal technologies that can integrate with many systems spanning today's diverse business environment. Eventually we might see the adoption of a global communications protocol, such as the low-energy Bluetooth® Smart standard, for linking devices — but, in the meantime, it is the job of companies like QuickLogic to design sensor technology for maximum scalability and integration. Our engineering team leverages advanced practices and technologies, including simulation, to ensure that our products are compatible with those of other IoT manufacturers.

POWERING THE THINGS

There are a number of aspects of the "sensor revolution" that are creating power-consumption issues. First is the sheer number of sensors in operation around the world today, with billions more coming as applications become more innovative and diverse. Second is the portable nature of most sensors. While wired connections are more reliable, power-efficient and cost-effective, relatively few sensors can be hard-wired. Most must instead rely on battery power.

Sensor-technology leaders like QuickLogic are engineering solutions to this problem with the aid of simulation, including designing sensors that operate on as little power as possible. Another potential solution is designing an energy-harvesting system into the sensors themselves, so that they become self-powering. For example, an agricultural sensor might be able to collect and store solar energy to support its own functionality. The heat from the human body — or the mechanical energy generated by a running shoe in motion — might someday power personal fitness monitors.

There are some energy-harvesting technologies that already exist; however, they are currently cost-prohibitive for the typical business. A coin-cell portable battery currently costs about 28 cents, while a solar cell costs three to four dollars. It's hard to justify this expense, even when long-term energy cost savings are factored in.

Market leaders in both energy and sensor technology are working hard to develop more-affordable, energy-efficient solutions. I believe we will see a much greater adoption of energy-harvesting sensor technologies within the next five years. A likely key to energy harvesting will be more simulation, both of materials and environments. Executives should keep an eye on developments that will place environmentally sustainable, cost-effective sensors within easy reach.

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ENGINEERING THE THINGS FOR RELIABILITY

Many sensors, such as those installed in planes and cars, are absolutely mission-critical. If they fail, human lives are at stake. Sensor manufacturers rely on advanced tools, including engineering simulation, to deliver the high level of reliability needed to minimize risk and maximize long-term performance levels.

As applications for sensors grow in both number and diversity, an increasing concern is the ability of these product systems to deliver reliable results in harsh, unpredictable environments. Consider the agricultural example above, in which sensors are exposed to the extremes of temperature and weather over months or even years.

QuickLogic works in partnership with other companies to deliver not only the most durable and reliable sensors, but also the most rugged, structurally sound housings that protect them over time. Simulation plays a role in both these areas, helping engineering teams ensure that real-world performance is consistent and predictable — without investing a lot of time and money in prototyping and physical testing. As the demand for sensors rises, simulation helps QuickLogic and our partners meet market needs without sacrificing product robustness.

The new EOS S3 sensor processing platform is a multicore system that enables a vast array of concurrent sensor applications on smartphone, wearable and Internet of Things devices.

MANAGING DATA COLLECTED BY THE THINGS

The power needs of sensors are determined, to a great extent, by how detailed their data collection activities are. When it comes to capturing data, we've come to believe that the finest-possible level of detail is always best; but that attitude has contributed to the enormous power drain created by today's growing network of sensors. After all, highly detailed collection means higher data volumes, increased processing demands, more-complex algorithms and longer solution times, all of which consume large amounts of power.

Data collection that is too granular creates other practical problems. For instance, as data volumes increase, it becomes harder to separate vital, strategic insights from unimportant information. And as technology systems become overwhelmed, data needs to be purged more frequently — increasing the probability that something critical will be overlooked.

To fully capitalize on the IoT in our businesses, we need to shift away from the notion of "fully accurate" and embrace "accurate enough." Most sensors don't need to operate 24 hours a day, seven days a week, and they don't need to capture every single performance parameter. Today's artificial intelligence and machine learning solutions have the power to extrapolate key findings and identify trends based on smaller and smaller numbers of inputs. This means the typical company does not need to collect performance or sales data every single second of the day.

In an age in which we can collect an incredible wealth of data, occasionally we need to remind ourselves that this is not always the smartest or most cost-effective course. Making the most of sensor technology means understanding how to apply it in the most strategic manner, instead of drowning in a sea of big data that is too overwhelming to properly apply.

JOINING THE SENSOR REVOLUTION

With their power to collect real-time, real-world data on product performance, customer service needs, sales trends and other vital business parameters, today sensors are revolutionizing many industries. Most businesses can benefit from the ability of leading-edge sensor technology to gather insights that can help to reach their most important strategic goals.

What can executives do now? Perhaps the smartest course of action is to start thinking about what data you can collect, and how it can be used in unexpected ways. If you have equipment in the field — such as a generator or an oil rig — certainly you can monitor its uptime, downtime and overall performance parameters. But can you also schedule maintenance? Feed information back to the product development team so engineers using simulation can address any design shortcomings? Use environmental readings to optimize the future placement of any equipment? As big data volumes increase, it's easy to be overwhelmed just by collecting information and storing it. But don't forget to apply it strategically to your company's most pressing challenges.

Along the path to adoption, there are many issues to consider — including the cost of installing sensors, retrofitting existing equipment and ensuring the security of the data you're gathering and storing. These are not insignificant issues. However, given the potential of modern sensor technology to provide real-time insights with high strategic value, every executive today should consider how this often-overlooked aspect of the IoT can be applied to impact company-wide performance.

QuickLogic

About the Author

Tim Saxe joined QuickLogic in May 2001 and has served as the company's senior vice president and chief technical officer since November 2008. Prior to joining QuickLogic, Saxe was vice president of FLASH engineering at Actel Corporation, a semiconductor manufacturing company. He was part of the founding team of GateField, which was the semiconductor division of Zycad, a design verification tools and services company. Saxe holds a B.S.E.E. from North Carolina State University along with an M.S.E.E. and a Ph.D. in electrical engineering from Stanford University.

QuickLogic at a Glance

2015 revenues: $19 million Employees: 100 Headquarters: Sunnyvale, USA