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DEVICES IN THE CLOUD: DRIVING INTELLIGENCE WHERE YOU NEED IT

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EXECUTIVE SUMMARY

Analysts predict that 15 billion intelligent devices will be connected to the Internet of Things (IoT) by 2015. Ultimately, connected devices will control everything from indoor temperatures to in-dash navigation, from the flow of energy through our cities to the flow of intravenous fluids. The prospects are at once exciting and daunting: exciting because of the potential to rejuvenate industries and create entirely new streams of revenue; daunting because of the complexities involved in making sure all those devices perform as promised.

Developers face many challenges in designing intelligent devices that will integrate smoothly with cloud-based control systems and perform mission-critical tasks safely and reliably. Those challenges tend to fall into three broad, often overlapping categories: connectivity, security, and manageability. The promise of IoT cannot be fulfilled unless all three are addressed.

As a global leader in embedded technology, Wind River® has worked closely with industry partners, system designers and developers, and end customers to build intelligent systems across a wide range of sectors. In this white paper, we will examine the challenges we have encountered in greater detail and some of the solutions we have developed to address them. In the process, we will also share a few use cases that illustrate the exciting potential of IoT when the technology challenges are successfully overcome.

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DRIVING BUSINESS TRANSFORMATION

IoT has already begun shaking up traditional business models and providing industries with new ways to generate revenue. For instance, one Wind River customer is a manufacturer of forklifts. The company traditionally made money selling or leasing equipment—a product. Now, with the confluence of embedded technology, wireless connectivity, and the cloud, management has identified an opportunity to evolve from selling products to selling subscription services—that is, to get paid for the usage of the product based on tonnage per month and not just for the product itself. Smart sensors on the forklifts can record and report how many tons they are picking up, how far they are traveling, and other variables relevant for the new business model.

It's a similar model to the telecom carriers who sell smartphones at deep discounts in order to sell monthly, renewable voice and data plans. Their recurring services are so profitable and “sticky” that it is worth taking a loss on the one-time, upfront hardware to sign up more customers. It's a model that more and more hard-goods industries are interested in adopting. And it is only possible because of the ability to connect smart on-board devices with cloud-based applications and analytics.

CONFRONTING THE CHALLENGES

In our enthusiasm for the new possibilities, however, we cannot overlook the real challenges to achieve this vision. In our experience, the main challenges can be summarized as follows:

Connectivity

With new products currently being developed, we can start building intelligence and connectivity into them from scratch. Today, though, much of the industry's effort is focused on connecting legacy or “brownfield” devices that until now have functioned alone. Most of these devices were not designed with connectivity in mind. On the contrary, many were designed to make connectivity difficult in order to protect them from network-borne threats. Now, builders and operators of large-scale systems want to take advantage of the efficiencies and economies that IoT promises. To reap those benefits, they must figure out not only how to connect brownfield devices but also how to protect them.

Another complication is that there is no single standard for connecting to networks. Many brownfield devices use proprietary protocols and will require gateways to connect with IP-based networks. And if they are already IP-based, they may be using a wide variety of protocols. Developers will need to be able to build gateways that support virtually any communication protocol.

The availability, accessibility, and cost of bandwidth are also constraints. For equipment operating in remote locations, the transmission of data from on-board devices to cloud-based applications via satellite can be an expensive proposition. We need to figure out ways to move data efficiently to where it needs to be. That starts with figuring out more precisely which data is needed at which level.

Security

As we become increasingly reliant on intelligent, interconnected devices in every aspect of our lives, how do we protect them from intrusions that could compromise personal privacy or threaten public safety? The number of network-based attacks on embedded devices that control critical infrastructure is increasing at an alarming rate, as is the attacks' sophistication. Security is arguably the overriding issue in the IoT, inseparable from performance and reliability.

Security needs to be factored in at every level, from the devices to the gateways to the cloud-based systems that control them. Virtually every known type of hardware and software security measure comes into play in IoT. Secure booting at the device level, access control and authentication, application whitelisting, and firewalls and intrusion prevention systems are just some of the tools at hand to respond to security threats.

Manageability

Once you have addressed the connectivity and security issues, the next challenge is how to manage the device remotely over time. You need to be able to provision it securely with software updates as they become available. You need to send security patches as vulnerabilities are uncovered. You need to be alerted when the device is not performing properly, and to be able to diagnose the problems remotely. And you need to be able to perform tasks like these without the risk of disruption or downtime.

THE INTELLIGENT SOLUTION

Wind River designed Wind River Intelligent Device Platform specifically to address these challenges. It's a scalable, sustainable, and secure development environment that simplifies the development, integration, and deployment of IoT gateways, with pre-configured components for smart connectivity, device and data security, and remote manageability.

Intelligent Device Platform supports a wide variety of communication protocols for transmitting data from the device through the gateway to the cloud, including Wi-Fi, Bluetooth, ZigBee, and short-range wireless protocols frequently used in IoT devices. For security, Intelligent Device Platform delivers built-in features designed to ensure that an end device is secure when it boots, the communication channel is secure whether wired or wireless, and data is secure from unauthorized access both in transit and at rest. The platform also includes an intuitive web-based tool for provisioning and device management.

In addition to meeting the core requirements of IoT performance and reliability, Intelligent Device Platform's standardized approach and pre-configured capabilities enable developers to jump-start projects, contain costs, and accelerate time-to-market.

THINKING END-TO-END

Delivering secure and reliable IoT solutions requires an end-to-end view that encompasses the endpoint device, the connectivity layer, the gateway, and the application running in the cloud. We need to understand what the entire system is meant to do and the role each component plays, or could potentially play, in its overall operation. By looking along the whole continuum, we can identify opportunities to deliver intelligence where it's needed to optimize performance.

Consider, for example, the issues of processing capacity and bandwidth. One of the big challenges in IoT is how to deal with the enormous volumes of machine-generated data flowing through it, from devices through gateways to applications in the cloud and back. It puts a huge strain on bandwidth, which can drag down performance and drive up costs. Conventional thinking is that all that data is necessary for cloud-based applications to do what they're supposed to do—analyze the data from the devices, monitor performance, make decisions, and send instructions back to the devices.

Bandwidth constraints could be overcome if much of the computing—the intelligence—were moved from the application to the gateway or even all the way to the device level. Imagine if the device could perform various services, such as smart data aggregation and filtering, and figure out which data needs to be sent to the cloud. The cloud applications would continue to perform the heavy processing works of analytics and creating statistical models for analyzing data. Ultimately, though, once the model were fine-tuned and running properly, a scaled-down version of it could be sent to the device, which could then take over much of the processing.

This vision is quickly becoming a reality. Wind River is developing a "write once, run everywhere" development platform with a scripted programming language optimized for resource constraints. It will enable developers to create small-footprint applications that bring intelligence to the device level. Bandwidth constraints will be less of an issue as smart devices become more selective in the data they send to the cloud and systems distribute their processing more efficiently.

FROM TECHNOLOGY ADVANCEMENT TO BUSINESS ADVANTAGE

Ultimately, of course, the end benefit of optimal IoT performance is the business advantage it delivers, whether the growth in profitability occurs by increasing productivity or by creating sources of revenue that didn't exist before.

Predictive maintenance is one of the more compelling cost-saving advantages of IoT. Consider, for example, a wind turbine. Typically located in remote, hard-to-access places, such as on mountainsides or on a rig at sea, uptime is critical for turbines. To prevent failure, operators historically sent crews of technicians out to the turbines to perform routine inspections and preventive maintenance according to fixed schedules—a labor-intensive process with no guarantee that failure won't occur. Today, smart sensors can predict failure in real time with great accuracy based on any number of symptoms, such as changes in blade vibration patterns. Automatic software adjustments can often rectify the issue without the need for a crew onsite, or when physical changes do need to be made in person, maintenance crews can be sent to make "just-in-time" repairs.

Moreover, control systems in the cloud can collect data not only from the wind turbines themselves, but also from external sources, such as reports on airborne dust accumulations from the National Weather Service. The system can aggregate and analyze all these variables and determine precisely when a specific piece of equipment needs servicing or repair, avoiding unnecessary disruption or downtime and dramatically reducing maintenance costs.

Cost reduction is what initially attracts many companies to IoT solutions. However, once they experience the power of data analytics, they begin to identify new business and revenue opportunities. The forklift manufacturer mentioned above is one such example.

Another is a medical device company that had evolved from marketing stand-alone biofeedback devices to connected ones. The new devices can transmit data directly from patient to doctor, eliminating the need for an office visit. But in the process of creating greater efficiency and reducing costs for both patient and provider, the company realized it was also accumulating valuable data on multiple patients with similar conditions. Individual patient data, of course, must be kept confidential by law. Once aggregated and rendered anonymous, however, the data yields patterns that are very useful to anyone who wants to better understand a particular medical condition. The company could create a new source of revenue by selling the data on the progression of a disease to medical researchers and insurers.

CONCLUSION: UNLOCKING THE POTENTIAL OF IOT

The full potential of IoT is only beginning to be recognized, let alone realized. Wind River is well positioned to help organizations accelerate development and deployment of IoT solutions and start reaping the benefits quickly.

With over three decades of experience in embedded technologies, and as a pioneer in machine-to-machine communications, we have the expertise and tools to bring smart connectivity, high security, and manageability to intelligent devices and the systems that control them. Working closely with our customers to understand their business drivers, we are developing end-to-end solutions—from the device to the gateway to the application level—that enable them to make the leap from imagination to reality.

