IoT Inc.

How Your Company Can Use the Internet of Things to Win in the Outcome Economy

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CHAPTER 1

IOT TECH DEFINED FROM A VALUE PERSPECTIVE

The Internet of Things is a technology you can use in your product and your company to greatly increase value and competitiveness. Since it's new, we need to understand how it works before we can put it to work. Right now, it may seem futuristic, but it's not. It's being used today to make money—and how it works is not complicated, at least not for our purposes.

TECH TALK

An IoT product can be:

1. A discrete product
2. A system
3. An environment

Let's start with a few definitions. I'll be using the term *Internet of Things product*, or *IoT product*, in this book. I don't like the term *connected product*, or *smart product* for that matter. I don't like them because I think they set the bar too low.

We've had smart products for over half a century. For a long time we've been using embedded systems to make dumb products smart—so nothing new here. And connected products are at least a decade old; I was using an iPhone 1 in 2008 to control devices and access sensors across the world to demonstrate my then company's connected home platform. It's for these reasons I use the term *IoT product*. The IoT product goes beyond the smart product and the connected product by bringing to bear the full capability of the Internet into physical products. Unfortunately the "IoT home" doesn't have the same recognition or ring to it as the "smart home" or "connected home," so I'll still use *smart* and *connected* as adjectives for certain types of products.

Having said that, an IoT product is actually a system, or more precisely, a system of systems. It's self-aware and communicates with other systems and people. In this book an IoT product is overloaded to mean a discrete product, or a closed system, or a closed environment. An example of an IoT product is a connected clothes dryer. An example of an IoT system is a telematics product for transportation logistics. And an example of an IoT environment is a smart building. In all cases, these are physical things . . . physical products.

The Internet of Things is still being standardized. As such, when developing an IoT product, the company often needs help "gluing" the different subsystems or components together. My clients employ one of two types of assembly partners to help their internal engineering team. When building systems or environments, like telematics or smart buildings, we work with system integrators. When building discrete products, like clothes dryers, we work with design houses. Reliance on these partners will decrease as IoT technology matures and standardizes.

Both types of service providers are new to IoT, and they naturally approach it based on their experience and institutional knowledge. System integrators approach IoT as they do networks. Design houses approach IoT as they do industrial design or mobile app development. And as expected, both view the technology behind IoT products differently.

THE SYSTEM INTEGRATOR VIEW

Engineers look at IoT technology as a networking stack, which is, in a sense, simply a protocol map (see Figure 1.1). Mapping protocols from where the sensor data come in, to the application is the absolute wrong way to look at the tech—at least for business. This is plumbing and not where the value originates. It does not mean that if you sell plumbing, you are not providing value, but plumbing is a means to an end; it is the way to get data from one place to another. I don't look at IoT tech as a networking stack because it doesn't properly isolate and highlight where value is created.

> **TECH TALK**
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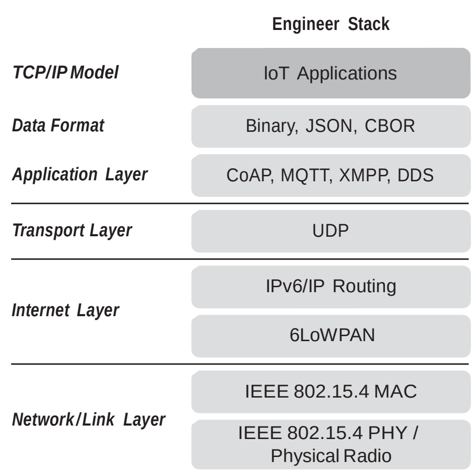
> A protocol is a language used to communicate between devices or systems. For details, see the section "Network Fabric" below.

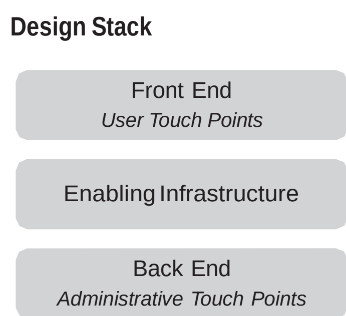
Figure 1.1 **Network engineer's view of IoT**



THE DESIGN HOUSE VIEW

Designers have a different view (see Figure 1.2). They ask, "What are the end-user touch points?" "What's the back-end interface for the customer?" And "How do we tailor the product to fit both their needs?" Designers look at IoT tech as a front end and back end with enabling infrastructure in between. That's a little better. That's a little closer to value, but there's a better way.

Figure 1.2 **Designer's view of IoT**



THE BUSINESS VIEW

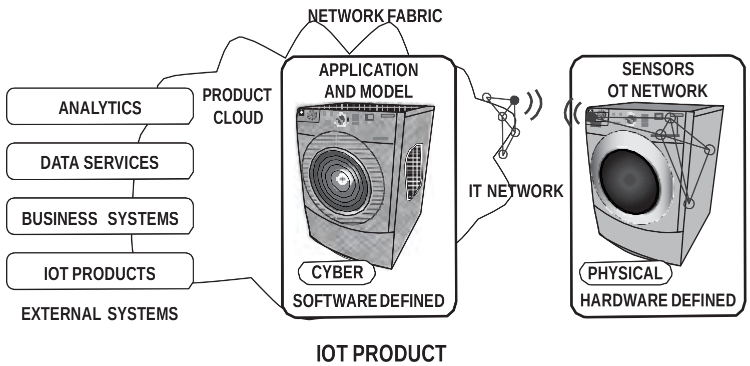
Of course, system integrators and design houses need a business angle, but that's not their primary perspective. Inspired by cyber-physical systems and software-defined networks, the business view (see Figure 1.3) groups IoT tech into these four parts:

1. The software-defined product
2. The hardware-defined product
3. The external systems

which are all linked by:

4. The network fabric

Figure 1.3 **Manager's view of IoT**



A fifth part, which isn't really a part, permeates the entire system. IoT cybersecurity is broader than IT security because it protects data at rest and data in motion, requiring knowledge in mobile security, network security, app security, web and cloud security, and system security. The business counterpart to cybersecurity is risk management.

> **TECH TALK**
>
> Cybersecurity is technology that protects the confidentiality, integrity, and accessibility of the IoT product's data at rest and in motion. See Chapter 16.

All incremental value from an IoT product comes from transforming its data into useful information. Information—IoT is pure information technology, and information is from where its value emanates.

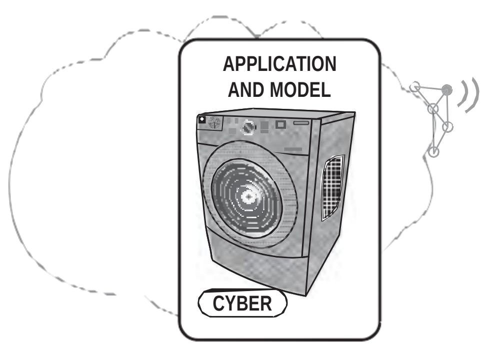
The ingredients of this information are different data, lots of data from the product's sensors and external systems. The recipe, which defines how the data are put together, is described by the cybermodel. Value is created by executing the model with the application and interrogating it with analytics. This top-down view, where value defines the information we need, which defines the data we need, is the best way to look at IoT tech for business. The trio of value is the cybermodel, the application, and the analytics. All other technology is there to collect and deliver data. Let's use this value-centric perspective to look at IoT tech in more detail.

Software-Defined Product

The software-defined product is the star of the show because it's where value is generated. It consists of a cybermodel and application (see Figure 1.4), well actually many models and multiple applications. It may be helpful to think about this as the physical product's digital twin—the software that describes the product's IoT functionality. In a sports video game, the players on your team and the opposing team that are controlled by the game are software-defined players. Their cybermodels represent their individual personality and skills. The game application controls the I/O and executes the model in different situations and environments.

> **TECH TALK**
>
> The software-defined product consists of:
> 1. The cybermodel
> 2. The application
>
> See Chapter 11.

Figure 1.4 **Software-defined product**



Cybermodels are software algorithms that represent IoT value and are shared by the application and analytics. Applications are software codes that provide product logic, orchestrate data collection, and interface with other apps, services, and people. The application executes the model, and the analytics uses data to build, compare, and solve the model.

The software-defined product and analytics generate all the value in an IoT product. As such, they must be the manager's priority, and they must drive all other tech choices. They also point to the internal know-how that needs to be cultivated by the manufacturer: software development and data science.

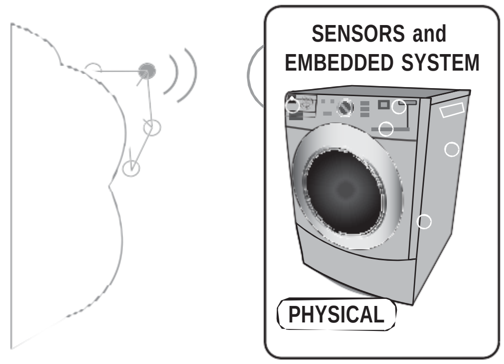
Hardware-Defined Product

Within the physical product, the hardware-defined product consists of sensors, actuators, and embedded systems (see Figure 1.5). Sensors are designed into the physical product or externally retrofitted in brownfield deployments. Connected sensors require an embedded system to convert the analog signal that comes from the sensor into a digital payload (data) and to send it over the network. The hardware-defined product's purpose is twofold: to collect sensor data and send the data to the application and analytics for processing, and to physically actuate the IoT product.

> **TECH TALK**
>
> The hardware-defined product consists of:
> 1. Connected sensors
> 2. Connected actuators
> 3. Embedded systems
>
> See Chapter 12.

The hardware-defined product of the antilock braking system found in your car consists of sensors, an embedded system, and actuators: the sensors recognize when the brake is applied and if the wheel has stopped, the embedded system collects the data from

Figure 1.5 **Hardware-defined product**



the brake sensors and sends the data on to the brake network, and the actuators work the other way, applying the brakes based on the data they receive.

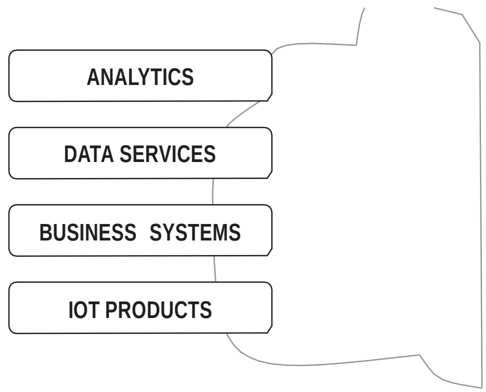
External Systems

The IoT product interfaces with external systems over the Internet to augment its functionality in much the same way online software does, connecting with analytics, external data services, business systems, and other IoT products (see Figure 1.6). These external systems provide external data to complement the internal data collected by the product's sensors.

> **TECH TALK**
>
> For more information on analytics, see Chapter 15. And for more information on external systems, see Chapter 14.

Analytics is all about answering questions. It deciphers data from the past to answer, "What happened?" It processes streaming data in the present to answer, "What is happening?" And it makes predictions about the future to answer, "What's going to happen?"

Figure 1.6 **External systems**



Functionally, analytics builds models, improves models, solves models, and makes comparisons between models and between models and data.

Internet data services, sometimes packaged as microservices, are tapped to provide raw data. Examples include weather, pricing, and inventory data.

IoT products interface with business systems such as CRM and PLM, as well as ERP and SCM, to exchange enterprise operational data.

Finally, IoT products are connected to other IoT products—extremely powerful sources of data and key to technically enabling outcomes.

NETWORK FABRIC

The network fabric stitches it all together (see Figure 1.7). It includes the OT (operational technology) and IT (information technology) network (also referred to as the fog network), the uplink, the public cloud (Internet), and private product clouds that

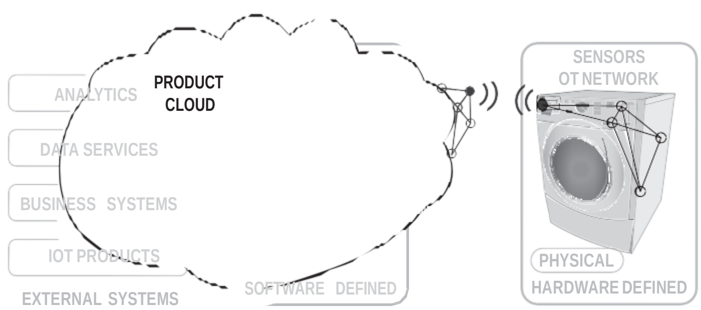
TECH TALK

For more information on the network fabric, see Chapter 13.

can reside "on prem," locally in the enterprise's network, or externally, most likely in a data center.

The OT network is the network within the IoT product that provides data to and from the sensors and actuators. The IT network is external to the IoT product. It connects to the OT network, often over the air by radio, and links it to the Internet via an uplink connection. Communication is enabled by protocols in the stack, which for IoT include the media layer (such as Bluetooth, Wi-Fi, 802.15.4, LPWA, cellular), the network layer (Internet protocol and proprietary OT protocols), and the application layer (such as MQTT, CoAP, DDS) that puts the collected data into context with metadata for the application.

Figure 1.7 **Network fabric**



BRINGING IT TOGETHER

Generally, the narrative around the Internet of Things is about, well, the things. But that's missing the point; it's the tail wagging the dog. Value in IoT is created from the top down. The IoT value proposition defines the information needed, which identifies the data to be collected, which then, and only then, identify which tech and “things” are needed. Technically, the top of the top-down approach starts with the software-defined product and the analytics, which is fed data from the hardware-defined product and external systems, through the network fabric.

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Before we define the tech, we must first define the value we want to create. In the next chapter we discuss the four ways that value is created with the data that are collected.

ABOUT THE AUTHOR

Bruce Sinclair started in the business of IoT in 2008 as CEO of a networking company that sold a smart home–enabling platform to Internet service providers. He began his career as a mathematician and then programmer who quickly found his way to business through marketing, and he has been CEO of companies in the visual computing and IT industries.

Today Bruce is the publisher of http://www.iot-inc.com and advises brands, manufacturers and vendors on their IoT strategies, and also keynotes on the Internet of Things at events around the world.

Bruce is known in the industry from his podcast, video series, and monthly meetup in the Silicon Valley, and he is a featured author for leading business and technology publications. He lives in Northern California with his wife and two children.

Find out more about Bruce and his consulting, speaking, courses, and workshops at http://www.brucesinclair.net.

IoT Inc. Book

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