A Cloud Security Model for IoT based E-commerce

Himanshu Gupta, Pramod Singh
Amity University, Noida, Uttar Pradesh, India

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Abstract—Nearly two decades have passed since the Internet began to fundamentally reshape the retail landscape. From the earliest dotcom vendors to the rise of e-commerce giants, retailers old and new have grappled with the ever-evolving ways consumers find and purchase goods. Today, at last, many businesses are coming to terms with Internet-enabled retail, adopting omnichannel models that provide seamless shopping with greater choices and lower prices across E-commerce, in-store, and mobile platforms. To that end, this paper will explore the implications of the IoT for retailers, as seen through the twin lenses of strategy and innovation. It will help you think through your current sources of competitive advantage; identify which if any could be undermined by the proliferation of the IoT; and identify new possibilities to differentiate yourself from competitors.

Keywords – Internet of Things (IoT), Internet of Everything, e-commerce, business model, innovation, smart device, information sharing, RFID, cloud computing;

I. INTRODUCTION

Nowadays the Internet has grabbed the popularity. Yet even as the Internet’s place in retail strategy has come to define the new normal, another suite of technologies the Internet of Things (IoT) threatens to reshape the competitive landscape again. Through the deployment of sensors and the collection and analysis of the data they generate, the IoT opens new avenues to influence and augment actions, from urging you to get up from your desk and move, to replenishing inventory when a store shelf empties. While elements of the IoT, such as product-level RFID sensors, have long been used to overcome specific challenges in retail,[1] the confluence of recent technological advances—cheaper and smaller sensors, omnipresent wireless networks, increased computing power, more sophisticated machine learning makes the IoT poised to have a broader and more transformational impact on business.[2] One way to understand this change is in terms of the strategic choices retailers have made to create competitive advantage. Here, the IoT looks set to break the very trade-offs that many retailers had been relying on to differentiate themselves from their competitors, such as offering greater product choice or increased customization. But it also creates new strategic choices that savvy businesses can exploit, helping them to close the new “digital divide” between consumer expectations and retailers’ ability to deliver. All of this comes as the retail industry is again in a state of flux. The pace with which market share is changing hands—a proxy for competitive intensity has increased every year since 2009. Over the same period, market concentration has decreased, with the top 25 established retailers losing the equivalent of $64 billion in market share to smaller player’s. [3] Those who can capitalize on emerging technologies and challenge established ways of doing business will be well positioned to create new value.

II. E-COMMERCE BUSINESS MODEL

A business model is a series of planned activities aimed to create profit for an organization in a marketplace. This being the case, an e-commerce business model is one that aims to use and leverage the unique characteristics of the internet and the World Wide Web. A successful business model, in both e-commerce and other areas, must effectively address eight key elements: value proposition, revenue model, market opportunity, market strategy, competitive advantage, organizational development and management team.

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value Proposition</td>
<td>How a company’s products or services fulfill its customer’s requirements</td>
</tr>
<tr>
<td>Revenue Model</td>
<td>How a company generates revenue and creates profit.</td>
</tr>
<tr>
<td>Market Opportunity</td>
<td>The marketplace that a company intends to enter, as well as the company potential financial opportunities in that marketplace. Many small market segments constitute a marketplace.</td>
</tr>
<tr>
<td>Market Strategy</td>
<td>How a company plans to enter a new marketplace and attract new customers.</td>
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One way to define strategy is in terms of the trade-offs in the performance of the activities that define the value created by a business. The limits of what can be provided describe the “production possibility frontier” (PPF) for a business model at a point in time. To illustrate, in figure 1, at point 1, a firm can appear to deliver greater nonprice value without an increase in cost; that is, it can move “right” to point 2 (an increase in nonprice value) without moving “down” (an increase in cost). This is because a firm is merely wringing out inefficiencies that others already know how to avoid. Once a firm gets to 2, however, that is as smart as it can work: The frontier defines the limits of what is possible at that moment. Of course, one could exploit different types of trade-offs, competing instead at 3 by moving “up” (a reduction in cost) from 2, but at the expense of moving “left” (a reduction in nonprice value). A company is strategically differentiated to the extent that it exploits a different set of trade-offs than its competition. This model is powerful but essentially static, because it takes the PPF as fixed. But in most industries, these trade-offs have been broken over time, essentially “expanding” the frontier. For example, even the slowest CPUs today rival the power of top-of-the-line processors from several decades ago, even as prices have come down.[4] A company competing based on nonprice value (point 4, figure 2) can offer more in absolute terms today than its similarly positioned counterpart (point 2) could in the past. The same holds for those competing on relative cost position. In short, the boundary of what is possible has expanded. Accordingly, we propose that strategy is defined by the trade-offs you exploit, while innovation is defined by the trade-offs you break. [5]
on store shelves or in on-site stockrooms. Because retailers had few ways to accurately gauge who would want what when, the only way to provide customers with what “they” wanted was to physically carry the goods. Providing that higher level of choice necessarily meant increased inventory-related costs from sourcing, moving, and holding a larger variety of products. As a result, such retailers required higher margins, achieved through higher prices, to attain a comparable level of profitability as those offering fewer choices. (In reality, of course, such “high-choice” retailers would charge higher prices on “exclusive” goods and the same price as competitors on goods they both offered.) Alternatively, a retailer could provide fewer choices and enjoy lower overall inventory costs, which it could pass along to consumers in the form of lower prices or keep for itself with higher margins (figure 3). A company’s strategy was determined, in part, by how it chose to address this trade-off.

![Figure 3. The cost-choice trade-off in retail](image)

V. COMING FULL CIRCLE

The IoT can break the customization choice trade-off by enabling companies to create, collect, and act upon new sorts of data. To be sure, it is not the only trade-off that information can alleviate; for example, the tension between staffing levels and customer wait times can be mitigated by faster, more accurate data on store traffic patterns. But regardless of the specific trade-off being broken, the question for companies is: How to create value from this new information? Information generates value only when it is used to modify future action in beneficial ways. Ideally, this modified action gives rise to new information, allowing the learning process to continue. Information, then, creates value not in a linear value chain of process steps but, rather, in a never-ending value loop. In completing a circuit of the value loop, from action back to altered action, information is communicated from its location of generation to where it can be processed.[6] Information is aggregated over time or space in order to create data sets that can be analyzed in ways that generate prescriptions for action.[7] These prescriptions guide modifications to actions. New action is then sensed, which creates new information, starting the cycle anew. We capture the stages through which information passes in order to create value with the Information Value Loop, shown in figure 4.

![Figure 4. The Information Value Loop](image)
VI. THE BUSINESS CASE FOR THE INTERNET OF THINGS

One consistent barrier to wider adoption of the IoT by retailers arises from the costs involved. These include not only the deployment of sensors, but also the maintenance of networks and storage space to communicate and collect the data they generate and the investment in analytic tools and skills to make sense of it all. For a low-margin business like retail, these costs may seem prohibitive and can deter companies from taking the IoT plunge. Earlier forays into RFID, including some well-publicized setbacks, can leave retailers questioning the return on an IoT investment. [11] But the technology today is not the technology of even a few years ago. The price of sensors, for example, has declined dramatically; an accelerometer that cost $2 in 2006 costs just 40 cents today. [12] What’s more, consumers are already carrying an array of sensors their mobile device that retailers can tap in to. The price of moving data across networks and securing storage space have also plummeted, and there is little reason to think the costs of IoT technology will not continue to decline. [13] Likewise, the return on investment may be more compelling than some retailers appreciate. In a 2014 survey of large soft-line retailers, 40 percent of those who had implemented RFID for inventory accuracy and replenishment reported a gross margin improvement of 5 percent or greater. [14] And anecdotal evidence from retailers employing smart mirrors in dressing rooms suggests the technology is helping to secure higher conversion rates. [15]

VII. MAKING THE MOST OF THE INTERNET OF THINGS

TODAY, the IoT’s impact on retail is in its infancy. Just 8 percent of retailers reported having already implemented or having plans to implement an IoT solution as of 2012, the lowest percentage of more than a dozen industries surveyed. [16] But companies should not mistake a slow start for an indicator of the technologies’ full potential; the IoT of today and tomorrow is not simply a redux of earlier RFID experiments. As sensors proliferate, it seems inevitable that competitors will work to leverage its capabilities to undermine current sources of strategic differentiation. And with market share already changing hands more quickly than in the past to the detriment of the largest retailers the importance of thinking creatively and expansively about how the IoT challenges current sources of competitive advantage and opens new ones may be greater than ever. [17] What can retailers do to not only avoid the pitfalls of this IoT-fueled transformation, but to capitalize on it? First, companies should be clear-eyed about the strategic choices they have made. What is your source of competitive advantage? Do you offer superior levels of choice, bringing customers a “one-stop shop?” Or does your primary source of differentiation lie in Making the most of the Internet of Things customized selection and service? What are the other relevant strategic trade-offs aside from choice-versus-customization, and where does your company fall on the spectrum of those options? Most importantly, determine which of these choices could be made obsolete by the Internet of Things. Just as the seamless blending of digital and physical commerce has erased the competitive advantage derived from offering lower prices at the expense of customer choice, the IoT will similarly undercut the value proposition of offering the broadest selection of products without a bespoke experience (and vice versa). In short, be prepared to have your source of differentiation eroded. To date, most retailers have taken an incremental approach to adopting the IoT, using it to address specific problems, create targeted efficiencies, or tweak the customer experience. A test-and-learn tactic can be an effective strategy, allowing a company to familiarize itself with IoT capabilities while keeping costs in check. It can also lay the groundwork for expansion into new areas of the business. Kroger, for example, recently installed sensors in its grocery stores’ refrigerators, creating an automated system that alerts store employees IoT in retail’s transformative potential 13 when temperatures spike, ultimately limiting spoilage. While the company sees an immediate return on investment, it also creates a springboard for further IoT applications. Kroger CIO Chris Hjelm sees “a pipeline of innovation, such as a mobile shopping system with laser scanners and network-connected LED lighting sensors, that [the company] believe[s] will take advantage of this infrastructure investment.” [18] Consider which areas of your business would benefit from an immediate application of IoT technologies, and how you might branch out from there. That said, the greatest value is likely to be created from more fundamental transformations of business strategies and models. Increasingly, deploying incremental IoT applications will be a necessary condition for keeping up with the competition, just as the ability to present a seamless online and in-store experience is today. But in our view, to separate from the competition requires a more holistic approach that integrates the IoT and its data with all aspects of the business, from sourcing to inventory management to customer experience.

How, precisely, these more sweeping changes will manifest remains uncertain. But several important choices, discussed next, are likely to confront retailers willing to make the journey. One important decision confronting many retailers arises at the initial create stage, where sensors generate the basic building blocks of the IoT. Creating data is easy, but a key consideration is how and what information is collected. Do you seek greater visibility into your supply chain and...
inventory, your customers, or both? If the latter, how will you collect the data? For many retailers, the easiest point of entry into the IoT may be to take advantage of the array of sensors most customers—and employees—are already carrying in their smartphones. But that raises other difficult questions. Are data generated only on an opt-in basis, or is blanket collection used to sweep up all customers’ information? The latter has appeal in that it likely generates greater quantities of information, and that information is less likely to be biased toward a particular type of shopper. However, the undifferentiated collection of data poses real risks, especially when coupled with limited levels of individual consent; some companies have rolled back IoT programs in the face of customer resistance.[19] Consumers may be willing to surrender increasing amounts of personal information to companies, provided they feel they are capturing sufficient value to make the incremental loss of privacy worthwhile.[20] It is incumbent upon retailers to demonstrate how IoT generated data benefits not only companies, but customers. Importantly, consider how you will use the data you collect—before you collect it. If your answer starts with, “To better understand…,” you may need to think harder about how the data can be used to augment behavior.

VIII. TRANSFORMATION OF E-COMMERCE USING IoT

We summarize how the IoT will transform current e-commerce business in table 2. In this table, we apply the key elements of the e-commerce business model to IoT e-commerce practices and applications. We highlight the effects of the IoT on e-commerce with respect to value proposition, revenue models, marketing, and competitive advantage. We also highlight the differences between current and IoT e-commerce business models to address how the IoT creates value for end users, manufacturers and small businesses, produces new revenue absent from the current e-commerce scenario, gives rise to market opportunities, enhances marketing effectiveness, and generates new competitive advantage.

Table 2. The summary of how the IoT will transform current e-commerce

<table>
<thead>
<tr>
<th>Element</th>
<th>Current E-commerce Business Model</th>
<th>IoT E-commerce Business Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value Proposition</td>
<td><strong>Highlight:</strong> The IoT creates new customer value, advances information sharing, and catalyzes innovation.</td>
<td>New customer value, such as more convenient and smarter living, and highly personalized products and services.</td>
</tr>
<tr>
<td></td>
<td>Personalized recommendations; reduction of search costs and prices; facilitation of online transactions,</td>
<td></td>
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<tr>
<td>Revenue Model</td>
<td><strong>Highlight:</strong> E-commerce firms will transform themselves into information-flow intermediaries, and their businesses will expand to knowledge generation.</td>
<td>Revenue from facilitation of information flow.</td>
</tr>
<tr>
<td></td>
<td>Advertising, content subscriptions, transaction services, sales, and referral services.</td>
<td></td>
</tr>
<tr>
<td>Market Opportunity</td>
<td><strong>Highlight:</strong> Cross-industry parties jointly build an integrated IoT ecosystem; the IoT will facilitate higher degrees of customer participation.</td>
<td>Construction of integrated IoT ecosystem. Consumers’ active involvement in product design and marketing activities.</td>
</tr>
<tr>
<td>Market Strategy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competitive Environment</td>
<td><strong>Highlight:</strong> The IoT will create competitive advantages other than lower prices.</td>
<td>Superior products and services and lower prices.</td>
</tr>
<tr>
<td>Competitive Advantage</td>
<td></td>
<td>Competitive advantage generated from integrated IoT ecosystem, standards and valuable knowledge.</td>
</tr>
<tr>
<td>Organizational</td>
<td></td>
<td></td>
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<tr>
<td>Development</td>
<td></td>
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<tr>
<td>Management Team</td>
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IX. COMPETITIVE ENVIRONMENT AND COMPETITIVE ADVANTAGE

In the current e-commerce business model, e-commerce companies can leverage their existing experiences to create new competitive advantage. For example, Amazon established its online grocery business by leveraging its huge customer database and years of experience in e-commerce. Customers can choose products and services from a certain e-commerce website or other websites that provide similar or identical products and services. In this scenario, superior products and services and lower prices make for competitive advantage.

As is the case with Amazon, when moving into the IoT market, leverage its enormous customer database, including credit data and customer preferences and browsing behavior, its AWS Cloud capability, its huge merchant networks and multiple ecommerce marketplaces, and its sixteen years of e-commerce operational experience. AWS could generate competitive advantages by using its integrated IoT ecosystem, thus establishing standards and creating valuable knowledge. On the other hand, smart devices could notify end users to reorder complementary items at the right time, before existing items run out, or automatically make orders online, thus reducing fierce manufacturer competition for repeat buying.

X. CONCLUSION

THE Internet fundamentally reshaped how retailers operate. As the long-standing trade-off between inventory-related costs and customer choice weakened, old sources of differentiation disappeared and new competitors emerged. Today, with the near-ubiquity of digital influences on customers’ retail experiences, “e-commerce” has become simply “commerce,” with customers increasingly expecting a seamless interface between their online and in-store experiences.[21] As retailers have grappled with this challenge, some have sought to maximize the choices available to consumers, while others have sought a more tailored approach to giving customers what they want. Even as retailers have begun to come to grips with a new set of strategic choices, another technological innovation—the Internet of Things seems set to undermine some of today’s sources of competitive advantage. The automated collection, aggregation, and analysis of new sorts of data provide a way for retailers to offer a customized experience for consumers while still drawing from a large pool of product options. To take advantage, retailers should be honest with themselves about the strategic choices they have made, and think hard about which of those choices might be rendered obsolete by the spread of IoT technologies. A “more options” approach might be received coolly by customers who increasingly demand an individualized experience built on their own history, preferences, and needs. Similarly, bespoke providers could see consumers asking for options beyond what they are prepared to provide. But along with the critical assessment of current strategic choices, retailers should also consider how the IoT can create value for them and their customers. Our own thinking on the Internet of Things in retail continues to evolve, and we expect to share additional perspectives in the coming months. But one thing seems clear: Companies able to address the thorny problems the IoT poses around data management, privacy, analytics, and other areas will likely be well-positioned to separate themselves from competitors. To truly build value from IoT investments, retailers should be expansive in their thinking, considering innovative applications and the use of supporting technologies, such as augmented intelligence.

REFERENCES

[6] Sometimes this distance is trivial—the nanometers between a sensor and the logic circuits on a nearly-atomic-scale microprocessor; sometimes it is thousands of miles to a cloud-based big data cruncher.
[7] Sometimes analysis and action are informed by simulations or analysis based on models created from data created outside a given loop, sometimes based on data created within a given loop, but every loop depends upon aggregated data, since a single data point is not a useful foundation for any generalization.


O’Connor, “Can RFID save brick-and-mortar retailers after all?”

Holdowsky, Mahto, Raynor, and Cotteleer, Inside the Internet of Things.


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