IoT PLATFORMS

EXAMINING THE WIDE VARIETY OF SOFTWARE THAT HOLDS THE IoT TOGETHER

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BI INTELLIGENCE

KEY POINTS

- **IoT platforms are the glue that holds the vast and growing network of connected devices together.** BI Intelligence defines an IoT platform as the soft technology that enables businesses, governments, and consumers to connect, manage, analyze, control, and/or automate their IoT devices.
- **The IoT platform market is poised to grow from $100 billion in 2015 to $315 billion in 2021, a compound annual growth rate (CAGR) of 21%.** This will be driven in large part by platforms released by industrial companies, which are raking in billions from IoT applications. For example, GE, which runs Predix, generated $5 billion from its analytical applications and software business in 2015, and the unit is growing 20% annually.
- **The market for IoT platforms is largely tied to the increased usage of IoT solutions.** BI Intelligence's Internet of Things 2017 Report forecasts that 22.5 billion IoT devices will be deployed by 2021, with nearly $5 trillion in total spending. These devices will require platforms to grow to accommodate new IoT projects and expand existing ones.
- **The three broad categories of IoT platforms include building block open platforms, closed high-end platforms, and product management platforms.** These platforms are targeted at different customers ranging from developers to businesses and cities. They serve varied purposes, and there is little competition between platforms.
- **Each platform is meant to help the end user achieve one of five stages of the IoT evolution,** which include connecting devices, managing devices, analyzing device data, creating interoperability between devices, and automating devices. An exclusive BI Intelligence survey found that while companies are analyzing their data, very few can automate portions of their workflow or have enabled devices to communicate with each other.
- **The top trend in the IoT platform market is consolidation.** Platform providers are increasingly trying to provide a near full-stack solution to fulfill all five stages of the IoT's potential. As a result, larger companies are snatching up smaller ones that may specialize in a single part of the technology stack, such as messaging or analytics.

Download the charts and associated data in Excel »

INTRODUCTION

It’s nearly impossible to discuss the Internet of Things (IoT) without talking about the platforms that act as the glue holding the vast and growing network of connected devices together. They allow users to monitor their devices, to store and analyze their data, and to control what those devices do. And though these devices usually grab the headlines when media attention focuses on the IoT, they can only provide value if there's some way aggregate the data they produce. Simply put, platforms make the IoT useful.

The term “IoT platform" has become somewhat nebulous — it doesn’t refer to a specific product group or category. Many in the industry refer to IoT platforms as the middleware that bridges the gap between dashboard and data storage. However, IoT platforms can include many components of the IoT including storage, analytics, and in some cases, data communication and visualization.

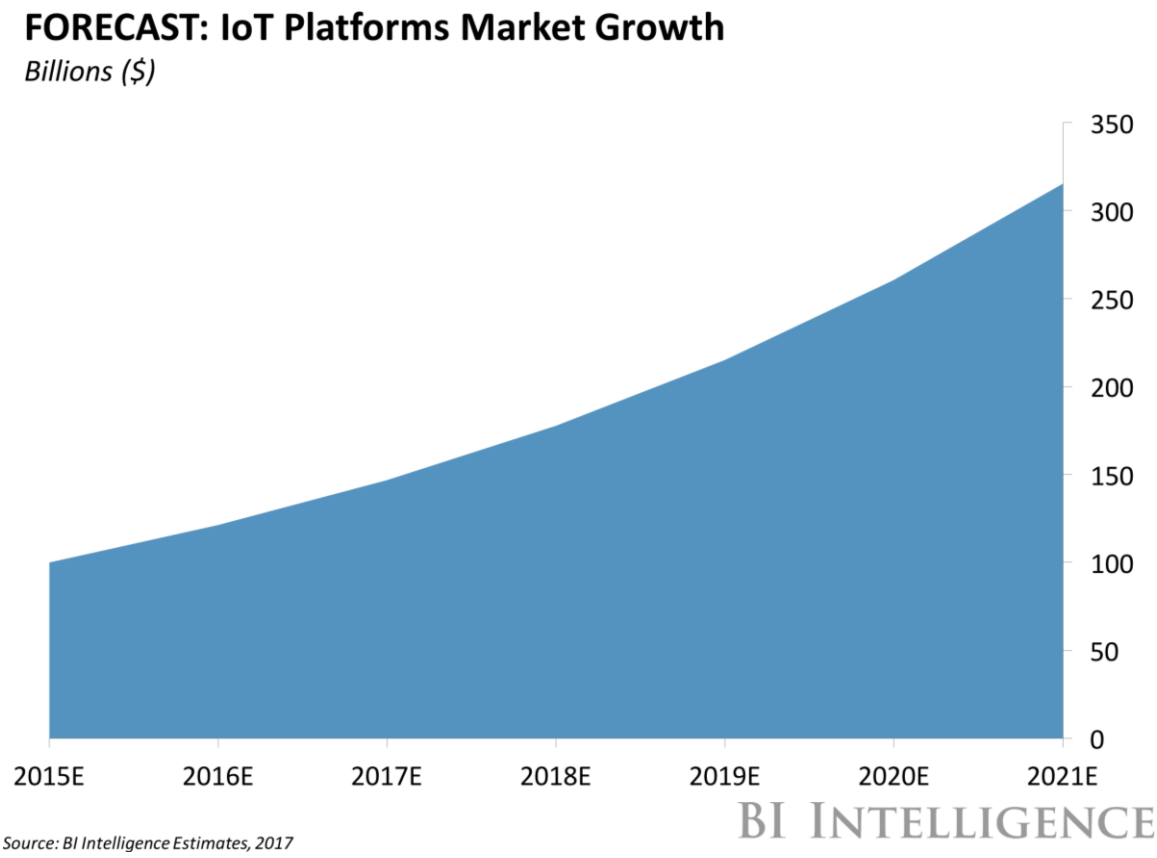
BI Intelligence defines an IoT platform as the soft technology that enables businesses, governments, and consumers to connect, manage, analyze, control, and/or automate their IoT devices. This includes device management platforms, building block platforms, product management platforms, high-end industrial platforms, messaging platforms, and more.

Because they can serve such a broad range of functions, many platforms don’t directly compete with one another. In fact, they often offer overlapping or potentially complementary capabilities or services, and only vie for customers against a limited number of other platforms. Some are built for very specific use cases or to provide a single component of an IoT ecosystem stack. Others are built to be broadly applicable and offer as near to a full-stack solution as possible. Further, these platforms often have to work in harmony with one another because it’s difficult to find a single platform that can do everything a user requires.

In this report, BI Intelligence examines the evolving IoT platform ecosystem. We size the market and identify the primary growth drivers that will power the IoT platform space in the next five years. In addition, we profile many of the top IoT platforms and discuss key trends in the platform industry, including platform consolidation.

MARKET SIZE

The market for IoT platforms is massive, primarily because the category's definition is broad. By BI Intelligence's count, there are at least 400 IoT platforms in operation today — and more are constantly popping up on the market.



Source: BI Intelligence Estimates, 2017

BI Intelligence values the IoT platforms market at about $100 billion in 2015. We expect that to grow at a six-year compound annual growth rate (CAGR) of 21%, reaching $315 billion in 2021. This estimate is based on the current market state and the growth trends of a variety of companies with IoT platforms, both public and private. The expected growth in platform revenue aligns with our overall projections of the total IoT market.

In addition to a plethora of startups on the scene, big players are transitioning or extending existing business units to include an IoT platform. In some cases, cloud service providers are revamping their products with added analytics and device integration tools, and rebranding the products as IoT-centric. For example, Microsoft's intelligent cloud business, which generated $22.7 billion in 2015, integrated an IoT component into its cloud platform. The goal was to make it easy for developers to connect their devices to the Microsoft Azure product suite. Similarly, Amazon Web Services launched its IoT product offering, AWS IoT, in 2015, after acquiring the enterprise IoT platform 2lemetry.

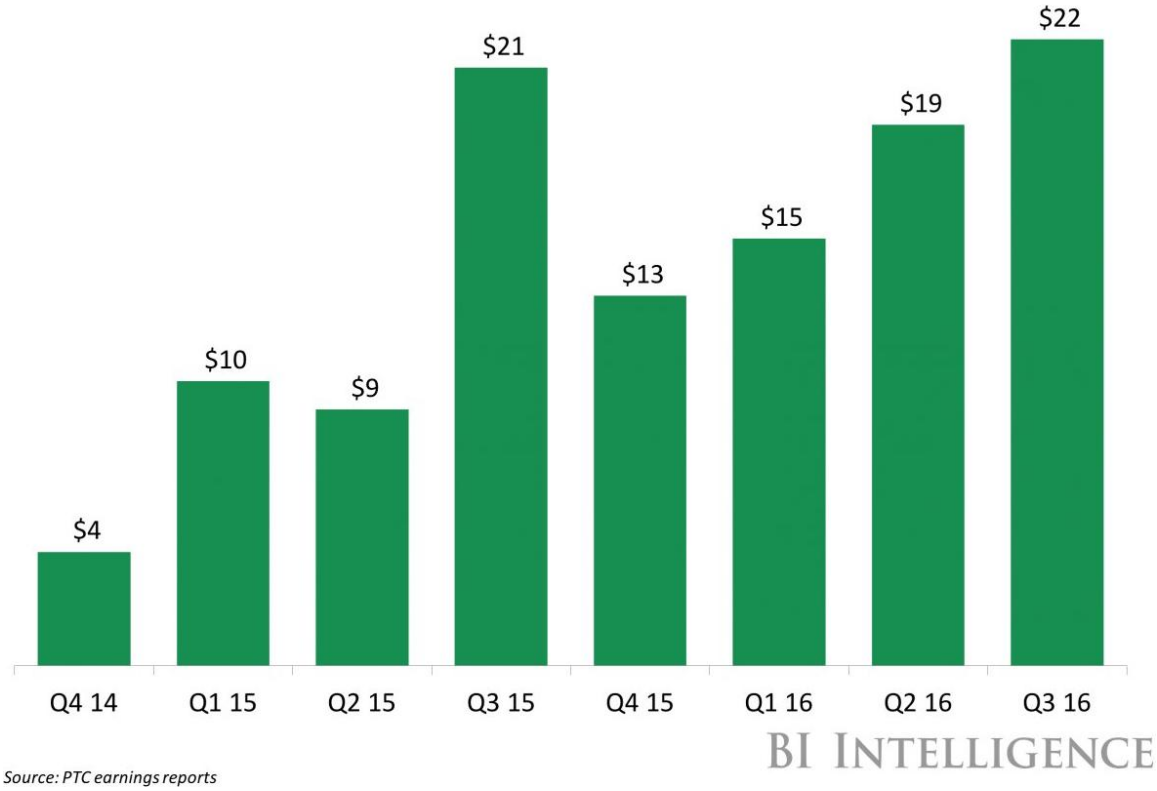
Some of the top users of IoT solutions are also making their own platforms. General Electric runs the Predix platform, which it uses both internally and sells to other companies. Overall, GE generated $5 billion in 2015 from its analytical applications and software business, which is growing 20% annually. GE indicated in its latest annual report that by the end of 2016, the company intended to have 200,000 assets under management, 100 GE applications, and 20,000 developers. At the end of 2015, the company reported $500 million worth of productivity gains from the Predix platform, and had implemented 75 "brilliant factories" enabled by the technology.

Following GE's success, Japanese industrial giant Hitachi launched Hitachi Insights Group in May 2016 and deployed the Lumada platform. The platform provides several components of the IoT software stack, including the ability to connect devices to networks and applications; data streaming, storage, and processing; and analytics and machine learning. The platform's solutions are built for a limited number of machinery designs, so a single predictive maintenance application can be applied across companies using them. Hitachi will invest $2.8 billion over the next three years to build up its platform through R&D and acquisitions. **The key differentiator of these platforms is that they're backed by industrial giants which are investing billions in their development because they can both sell the platforms' services — and use them in-house.**

There are also smaller, yet still well-known, platforms. For example, PTC's IoT Group, with its acquired ThingWorx platform, has become a healthy business, generating over $50 million in 2015. These companies offer a variety of products but tend to focus on niche markets, such as advanced analytics or specialized manufacturing applications.

PTC Technology IoT Group Quarterly Revenue

Millions ($)



Source: PTC earnings reports

KEY MARKET DRIVERS

The market for IoT platforms is largely driven by the increased usage of IoT solutions. BI Intelligence's Internet of Things 2017 Report forecasts that there will be 22.5 billion IoT devices by 2021, with nearly $5 trillion in total spending. These devices will require platforms to grow to accommodate new IoT projects and expand existing ones.

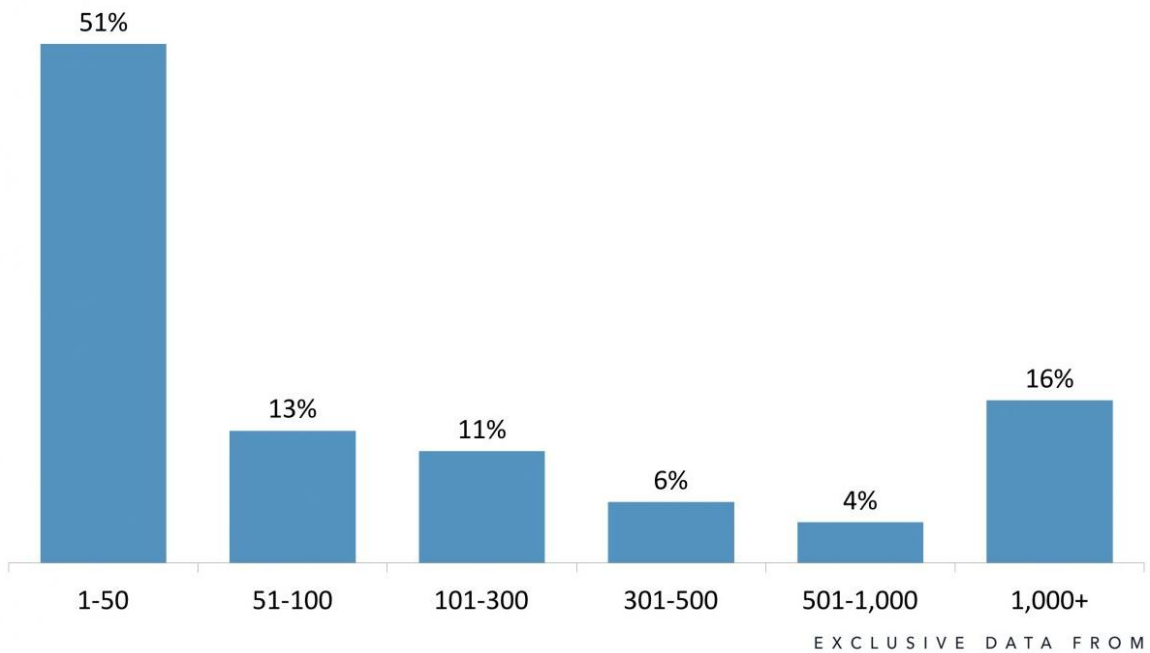
In particular, the amount of data generated and transmitted by IoT devices will likely play a major role in platform companies' revenue. Platforms generally charge users on a per-device or per-message-transmitted basis, which is primarily because the larger the deployment, the more capacity and work the platform will need to handle. As a result, companies tend to charge more for enterprise-grade IoT devices that constantly transmit messages, as opposed to consumer IoT devices that are more rarely checked. For example, Oracle's IoT pricing model charges $2 per month for telematics devices, which includes 100,000 messages per device per month. In comparison, the company charges 40 cents per device per month for a wearable that can transmit 1,500 messages monthly.

These enterprise-grade IoT devices will drive most of the growth in IoT platforms through 2021, due to their greater messaging frequency and higher upfront costs. In addition, the enterprise space is advancing considerably faster than the consumer IoT device market, as businesses see the potential for direct returns from IoT devices and are deploying them at a rapid pace. The consumer IoT device market is expanding slower because consumers don't necessarily understand, appreciate, or accept that things like wearables and smart home devices can impact their day-to-day lives.

Meanwhile, a company's cost to use a platform is tied to the size of its IoT implementation. Companies that use more devices can enjoy economies of scale and negotiate to pay less per message. Smaller IoT projects, meanwhile, provide platform companies with greater relative revenue. According to the BI Intelligence 2016 Global IoT Executive Survey, 51% of IoT projects use fewer than 50 devices, while just 16% use more than 1,000. These small projects will provide the boost that platforms need as users build out their IoT solutions and expand to larger implementations. However, as implementations grow in size, and more platform providers enter the market, the overall price of connecting devices and sending messages to platforms will likely drop.

The Number Of Devices Companies Use In Their IoT Solutions

Global, 2016



Source: Business Insider Global IoT Executive Survey, Q4 2016 (n=235 IoT Users)
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THE IoT PLATFORMS MARKET

Experts in the industry tend to sort IoT platforms into three buckets:

- **Open, building-block platforms.** These platforms are built mainly for developers implementing IoT solutions at their companies. They range in capabilities from powerful, high-end platforms to more basic, entry-level offerings. These platforms are often expansive and can be used in a variety of environments, such as the home or a factory. Further, the platforms tend to be modular and usually offer a variety of tools that users can choose from. Most importantly, these platforms tend to come from companies with experience hosting mobile applications and with deep roots in the developer community. Examples include Amazon's AWS IoT, IBM's Bluemix, and GE's Predix.

- **Closed, high-end platforms.** These platforms are accessible primarily to businesses and governments. They generally do not offer software developer kit (SDK) tools to the public, and their services are sold in a business-to-business relationship. Further, they're often targeted at a specific environment, such as hydrocarbon extraction or smart cities, and can be built for specific needs. An example would include Alarm.com or Hitachi Lumada.

- **Product management platforms.** These platforms enable companies to connect to and manage the products they provide. For example, automakers would use platforms that fall into this category to manage the cars they makes and sells — and, in fact, are major target customers for such technology. These platforms are generally sold on a business-to-business basis to manufacturers. Examples include Xively, Jasper, and Ayla Networks.

As mentioned, due to the unique nature of different platforms, many don't compete with each other. A platform built for smart city engagement wouldn't compete with a developer platform aimed at companies launching apps connected to IoT devices. Similarly, IoT platforms can provide a single part of the technology stack. For example, a messaging platform sending MQTT messages can provide connectivity but require the end user to have other platforms to manage and analyze their IoT devices and data. These types of applications can prove very fruitful to businesses if they're able to forge partnerships with others offering components that can fully optimize an IoT solution. One example of this is PTC's partnership with SAP Hana to make its ThingWorx platform available on Hana.

Platform Overviews

What follows is a review of a variety of IoT platforms. These aren't necessarily the most successful or lucrative offerings; they were chosen to help illustrate the breadth of the current landscape.

- **AWS IoT:** Launched in late 2015, AWS IoT allows companies to use Amazon Web Services to meet IoT needs by combining device communications, security measures, and a number of versatile application program interfaces (APIs) with Amazon's robust AWS cloud. Essentially, AWS IoT acts as a device gateway that facilitates messaging between IoT devices and the cloud. Amazon supplies clients with a device SDK that they can use to connect their devices to the gateway and communicate with the cloud using MQTT or HTTPS. The platform also creates what Amazon dubs a "device shadow," a persistent virtual representation of each individual device connected to the platform that takes note of metadata and the kinds of information the device can generate. Users are able to create rules that will send messages to other AWS services and prompt automated actions. AWS IoT's main strength is the scale at which it operates within Amazon's overall cloud portfolio and the additional services that it is able to leverage from that existing stable.

- **Buddy:** An easily configurable cloud-based analytics platform, Buddy enables users to connect devices through code runtime modifications on the device-end by accessing messaging protocols in order to transmit data to a cloud server for analysis. These analyses are customized based on the particular needs of the client company. Buddy also allows for scripted commands to be issued to compatible devices based on information received in real time, and provides configurable APIs to permit data integration and further automation. It also interfaces with dashboards to visualize data in an actionable manner for users in key positions. One central application for Buddy is in the connected-car space, where the platform can be used within vehicles to power dashboards and dynamic maintenance regimes, providing useful data to the manufacturer and the driver.

- **Jasper:** Cisco acquired Jasper, a top IoT service and analytics platform, for $1.4 billion in early 2016 to provide a key new service to supplement its networking offerings. The Jasper acquisition has allowed Cisco to provide a full-stack IoT solution geared toward enterprise, offering businesses the opportunity to use a single service to transform and take part in the newly digitized and connected marketplace. The platform is based around a single customizable code base that can be quickly and easily integrated into existing systems and provide real-time visualized data and analysis. It also includes the Jasper Control Center, which leverages the data to allow rule-based automation of procedures and reactive measures, and enables users to utilize Cisco's global mobile partnerships to connect to networks worldwide.

- **Predix:** As noted earlier, GE developed the open-source platform for both internal and external industrial applications. Users can connect industrial machinery to data-collection devices, which then process and transmit data at the edge or transmit data directly to a cloud server for processing and analysis. Predix includes authorization and authentication protocols at both the device and application level for security, which is integral in the industrial settings where it is used. Users are able to run analysis algorithms in order to parse and read the data. They can also develop, deploy, and manage applications and services based around data collected through the industrial platform, allowing for highly customizable uses and various forms of automation. Additionally, users can create mobile apps to serve as dashboards, with which they can tap into the data outputs in real time and view data based upon their particular IoT setup and needs — like monitoring equipment or output levels, for example.

- **Bluemix:** A versatile and modular platform, IBM's Bluemix allows companies interested in IoT deployments to employ a fully cloud-hosted, managed IoT platform. Bluemix can connect to existing devices or gateways through either the MQTT or HTTP protocols and transmit data in real time from a remote site to the cloud. It creates independent, scalable runtimes for each application on its cloud servers that can be accessed through a number of APIs, and leverages IBM's Watson AI computing system to engage in real-time analytics. IBM also allows users to create their own applications within Bluemix to communicate information from the cloud to relevant users via a dashboard and display the analytic findings.

- **Kaa:** Another open-source platform, Kaa is an IoT middleware platform that offers a full SDK which allows users to collect and manage data. It also provides cross-device interoperability and offers analytical tools. Kaa enables users to download the SDK to connect the platform directly into either Oracle VirtualBox VM or AWS. The platform is hardware agnostic, which means it can be put onto almost any device. As opposed to a platform-as-a-service (PaaS), Kaa makes it easy for IoT end users to fully control their IoT deployment.

- **Azure IoT:** With a number of premade solutions that can be specifically altered to meet a company's needs, Microsoft's Azure IoT Suite enables companies to implement a cloud-based IoT solution with minimal development. The suite offers device SDKs to connect devices to the cloud and transmit operational data and statistics. The platform builds a database and allows users to engage in real-time analytic observations through SQL queries. Users can access an existing algorithm library to draw on others' experiences and perform more informed predictive analysis. Azure also offers extensive device authentication security measures.

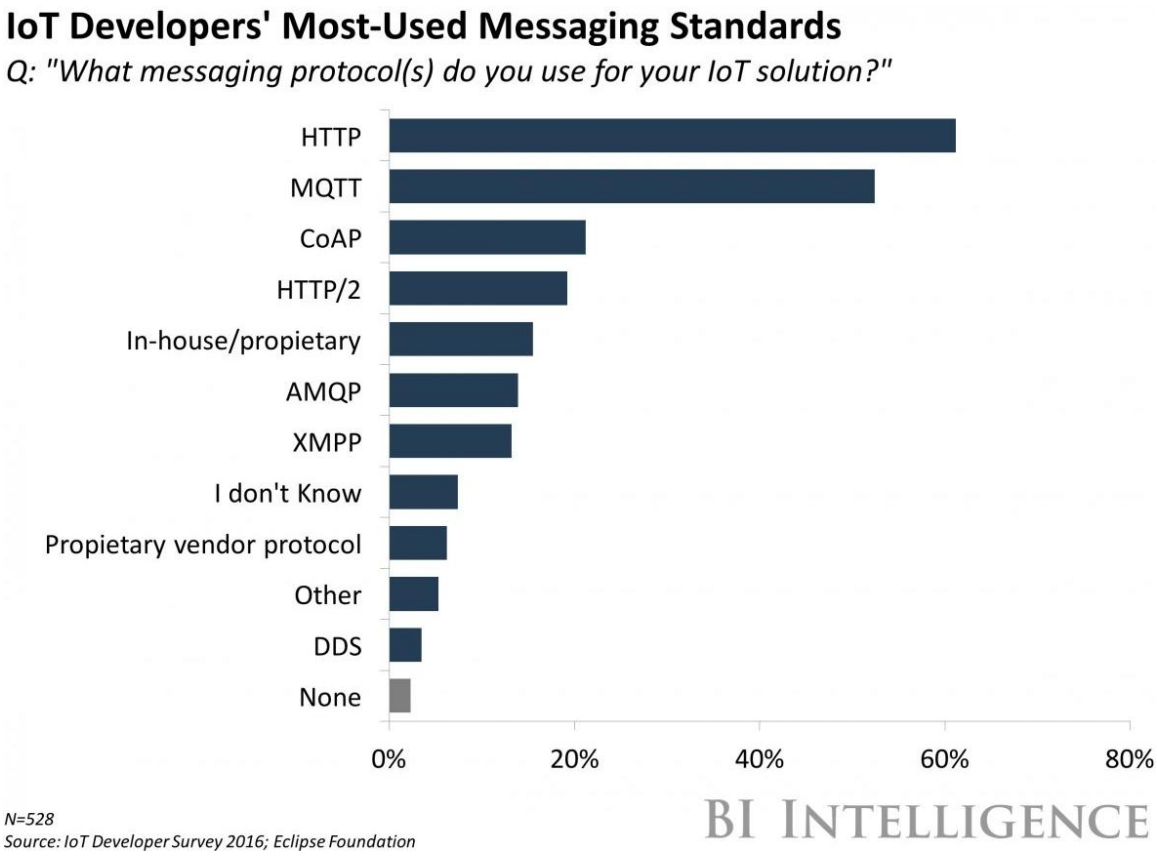
- **ThingWorx:** Industrial platform Thingworx was acquired by PTC in 2013 for approximately $112 million. It primarily caters to industrial IoT settings and has seen significant growth over the past few years. Like many of the top platform providers, Thingworx has an extensive list of partners that either help implement the platform or offer additional capabilities. Notable partners include AWS, Bosch, Cognizant, Intel, KORE, Libelium, Splunk, SAP, and Jasper. In 2015, PTC generated $53 million from its IoT Group — up from just $5 million a year earlier.

- **SAP Hana:** Running within computer memory and available either as a cloud service or as a locally managed database system, SAP Hana allows companies to connect devices to a data analysis system to engage in real-time predictive analytics. It provides modules that enable users to connect and manage their devices while also providing the flexibility to quickly and easily reorient or redeploy IoT implementations. Another central feature of SAP Hana is the syncing relationship it builds up between edge computing devices and remote cloud computing servers. It tracks data at both ends and in transit to ensure its structural integrity and allows for analysis at multiple points within that chain while minimizing network traffic.

- **Xively:** Targeted at device makers, Xively is a connected product management platform that acts as middleware to connect products to data centers and other third-party platforms. It is owned by the enterprise software company, LogMeIn. The platform is primarily centered around its MQTT message broker, which transmits encrypted messages between IoT devices and the data storage and management platform. This would enable a user to easily connect to their products via a mobile application. The company has partnered with outside companies, including Salesforce, so clients can easily integrate and manage their products.

Developer Demands

Platform companies' goal is to provide developers with an easy-to-use portal that makes integrating IoT devices and other applications seamless. To do that, these companies want to ensure that their platform has the tools to enable developers to make that possible. Therefore, it's crucial that platform companies understand developer demands to best mold their tool sets.



In February and March 2016, the Eclipse Foundation surveyed 528 IoT developers about their plans for building and implementing IoT devices. The majority of developers surveyed (56%) either developed IoT solutions for their company or were researching IoT solutions for their company.

- **Language:** Developers use a variety of programming languages when developing IoT devices. The most common languages include Java (52% of developers) and C (48%), according to the survey. JavaScript (42%), Python (38%), C++ (34%), and Node.js (32%) round out the top six. However, the survey showed a steep drop off of use for languages including C# (12%), PHP (11%), Lua (7%), Assembler (6%), Go (6%), Ruby (5%), and Apple's Swift (5%). Interestingly, IBM recently integrated Apple's Swift capabilities into its Bluemix platform.

- **Operating Systems:** Linux is the most common OS, with 73% of developers saying they used it on their IoT devices. The second most common is "bare metal," or no OS at all.

- **Messaging Protocols:** Unsurprisingly, the survey found the two most common messaging protocols are HTTP (61%) and MQTT (52%). Interestingly, the survey found that CoAP is more commonly used for smart city applications.

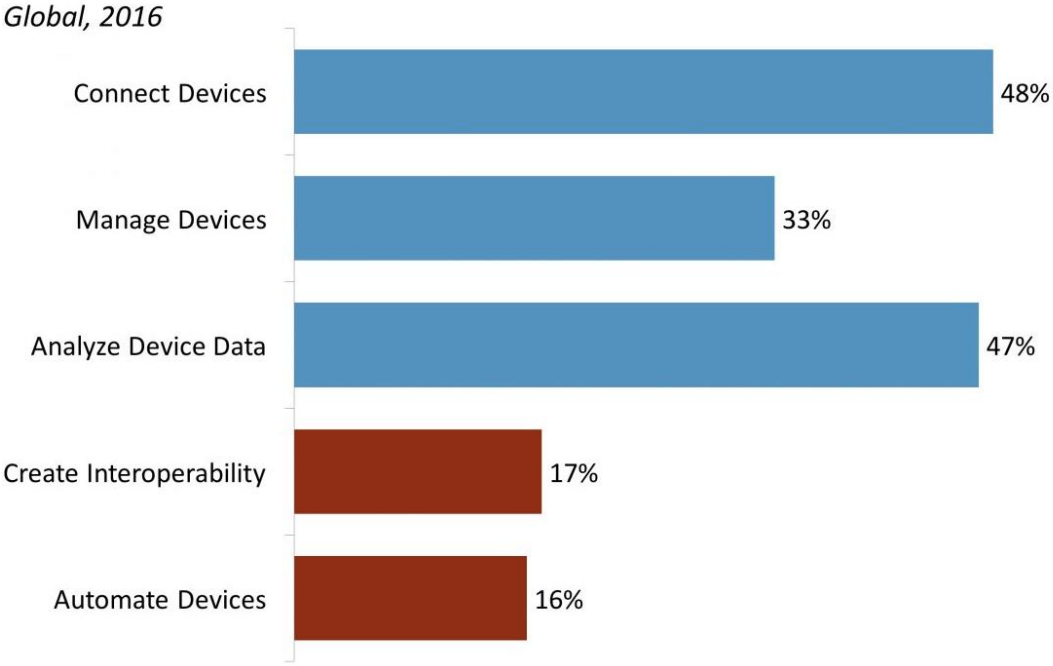
- **Cloud services:** The majority of IoT developers (82%) connect their devices back to a cloud service. AWS is the most popular of those cloud services at 37%, followed by Microsoft's Azure (21%), Google Cloud (17%), and IBM's Bluemix (17%). However, a large portion (35%) of developers are using an on-premise cloud.

Platforms And The Five Stages Of The IoT

Based on discussions with IoT platform executives and exclusive survey data, BI Intelligence breaks down IoT deployments into five separate and distinct stages: connecting devices, managing devices, analyzing device data, creating interoperability between devices, and automating devices.

The 5 Stages Of The IoT — What Companies Do With Their IoT Solutions

Global, 2016



Source: Business Insider Global IoT Executive Survey, Q4 2016 (n=233 IoT Users)
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Each stage makes an IoT solution more useful and valuable, and platforms enable users to move incrementally from the first stage to the fifth.

- **Connecting devices:** This is the stage where internet connectivity hardware is embedded into "things." After a device is connected, an end user can start to manage it and collect data about its use. **Exclusive BI Intelligence survey data shows that 48% of respondents said their companies are connecting devices with IoT solutions.** Connecting devices gives users visibility into where devices are and what they are doing. Devices use their built-in connectivity to connect from their dispersed locations to a central platform where users gain this insight.

- **Managing devices:** The second stage is reached when users begin to manage the devices in an IoT deployment and the data their devices produce. They can monitor devices, implement authentication and security practices, and control data collection. **Just 33% of respondents in our survey stated that their companies use IoT solutions to manage their devices, but this is likely because it is common to conflate connecting and managing devices.** Platforms are the tools that users and companies employ to manage their devices, as they provide the interface and various options that make device management useful. Implementing the first two stages can allow companies to start to see value from their IoT solutions.

- **Analyzing data:** The third stage is to analyze the data generated by IoT devices and create actionable insights. This can power benefits of the IoT like predictive maintenance. **However, less than half of companies that have implemented an IoT solution (47%) analyze the data their devices generate, according to our exclusive survey data.** This is likely because it can be difficult to get actionable insights from the massive volumes of data produced. Many platforms offer analytics, but since no two solutions are alike, each model has to be adjusted to fit the specific devices within each IoT deployment.

- **Creating interoperability:** The fourth stage is to make devices used in an IoT solution talk to each other. For example, in a home, connected door locks may speak to a connected thermostat. If the lock is opened, it will tell the thermostat that someone is home. Reaching this stage requires meeting all of the steps above and equipping devices with extra software that enables them to coordinate with one another, which is extremely difficult — **only 17% of companies that have implemented IoT solutions utilize devices that talk to each other, according to our survey.** Interoperability will be easier to achieve over time once standards are put in place that create a common language for devices to use, leading to immense increases in efficiency. McKinsey estimates that by achieving interoperability, the potential value of the IoT increases by 40%. Platform companies should continually push for interoperability standards to ensure their customers achieve the highest output from their IoT solutions.

- **Automation:** The fifth and final stage is to automate portions of the environment where an IoT solution operates. For instance, if the connected door lock senses someone is home, the thermostat will change the temperature setting and signal to connected light bulbs to turn on in certain rooms. This requires machine learning and advanced AI to achieve, and it's often associated with replacing workers with machines. IoT platforms will help enable automation by providing many of the advanced analytics and the inter-device connectivity that such processes need. **Just 16% of respondents at companies surveyed by BI Intelligence that have implemented IoT solutions use their IoT devices to automate portions of the workflow.**

Some companies only have to achieve one or two steps of this linear progression in order to see value in their IoT solution. For example, an oil and gas company that simply connects oil wells and monitors their movement can see tremendous value because they can prevent workers from traveling out into the field to periodically check on the wells. This application alone creates a massive return on investment. However, if the oil company could take the data generated by the connected well and analyze it for irregularities, it could automate the well to shut off before it malfunctioned and caused further damage.

IoT PLATFORMS AND CONSOLIDATION

A major trend in the platform space is platform providers trying to provide a near full-stack solution to fulfill all five stages of the IoT's potential. For example, a platform provider's roots may be in facilitating connectivity, but it has decided to build out the device management and analytics portions of its platform through a combination of acquisitions, infrastructure investment, and hiring. These steps allow companies to offer expanded services while maintaining their core strengths by bringing on new teams to operate new units. Since the start of 2016, notable acquisitions include Greenwave purchasing Predixion, SAP acquiring PLAT.ONE and Fedem Technology, and Cisco acquiring Jasper Technologies. The goal of these acquisitions is to offer clients the most complete product suite in order to fully optimize their IoT solutions.

As a result, it's likely that legacy and more established tech companies will be the winners of the platform wars. Many of the largest tech companies have allocated hundreds of millions, and sometimes billions, of dollars to develop their IoT businesses. For example, IBM recently invested $2 billion and SAP spent $2.2 billion on IoT development, while Samsung announced it's putting $1.2 billion into IoT initiatives. We expect that investments will be made to improve internal product offerings, but also in the acquisition of new companies, including IoT platform providers.

At this stage, the platform market seems ripe for consolidation, and small players will likely continue to be acquired by larger competitors. More than half of executives (53%) involved in the IoT have already seen more "a lot" or "some" consolidation in their market sector, according to exclusive BI Intelligence survey data. This consolidation will only increase given the ambition of major players in the platform market and the potential gains resulting from a viable full-stack solution, especially with the rapid expected growth in the IoT overall.

THE BOTTOM LINE

- IoT platforms are the glue that holds the vast network of IoT devices together.
- We expect the IoT platform market to grow from $100 billion in 2015 to $315 billion in 2021, at a compound annual growth rate (CAGR) of 21%.
- The market for IoT platforms is largely tied to the increased usage of IoT solutions. We estimate there will be 22.5 billion IoT devices by 2021. This will require platforms to grow to accommodate new IoT projects and expand existing ones.
- The three broad categories of IoT platforms include building block open platforms, closed high-end platforms, and product management platforms.
- Each platform is meant to help the end user achieve one of five stages of the IoT, which include connecting devices, managing devices, analyzing device data, creating interoperability between devices, and automating devices.
- The top trend in the IoT platform market is consolidation. Larger companies are snatching up smaller ones in an effort to provide a near full-stack solution.

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