IoT 101
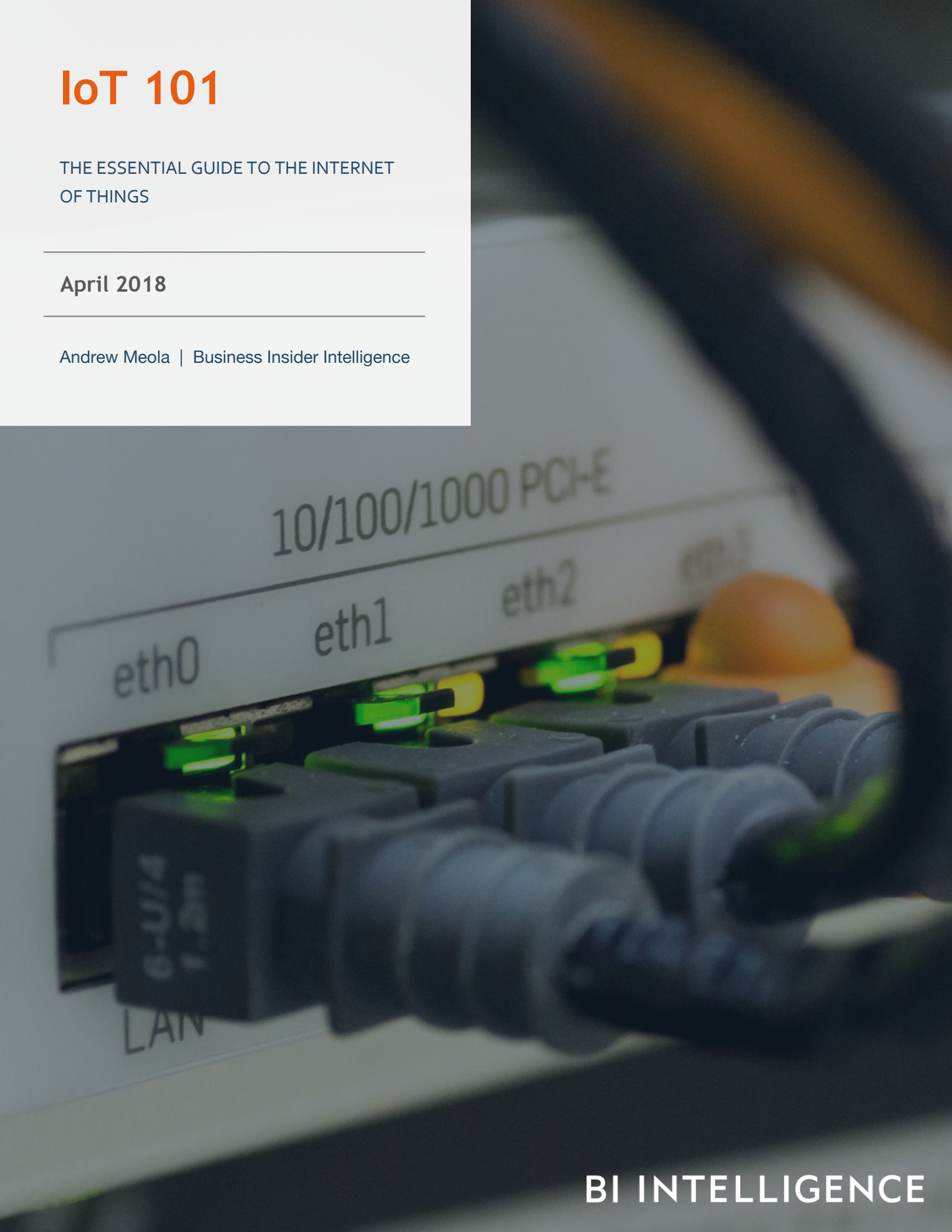
THE ESSENTIAL GUIDE TO THE INTERNET
OF THINGS

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Andrew Meola | Business Insider Intelligence

BI INTELLIGENCE

KEY POINTS

- **The Internet of Things (IoT) refers to the connection of devices and appliances to the Internet.** These include cars, refrigerators, juicers, wine racks, and heart monitors.

- **The IoT will surge into the mainstream by the end of this decade to include 24 billion devices.** This would mean that approximately four IoT connected devices would exist for every human being on the planet.

- **Governments and companies will invest billions of dollars into IoT devices in the next few years.** And that investment will pay off by generating trillions of dollars by 2025.

- **The IoT will profoundly transform daily life for governments, consumers, and businesses.** These changes will occur in transportation, agriculture, utilities, smart cities, and more.

- **There are dozens of companies with their hands in the IoT space, and more will soon join them.** The list includes Apple, Cisco, Microsoft, Fitbit, IBM, Google, Amazon, and more.

INTRODUCTION

You've likely heard the phrase Internet of Things, or IoT, at some point if you have been following any tech news in the last several years.

But at the same time, you might be scratching your head figuring out what it is or what it means past a flashy buzzword.

Simply put, the IoT refers to the connection of devices (other than typical fare such as computers and smartphones) to the Internet. Cars, refrigerators, juicers, wine racks, heart monitors, ovens, watches, and more are all candidates for connection.

As a starting point to understand the Internet of Things, consult this glossary of terms and basic definitions:

- **Internet of Things:** A network of internet-connected objects able to collect and exchange data using embedded sensors.

- **Internet of Things device:** Any standalone Internet-connected device that can be monitored and/or controlled from a remote location.

- **Internet of Things ecosystem:** All the components that enable businesses, governments, and consumers to connect to their IoT devices, including remotes, dashboards, networks, gateways, analytics, data storage, and security.

- **Entity:** Includes businesses, governments, and consumers.

- **Physical layer:** The hardware that makes an IoT device, including sensors and networking gear.

- **Network layer:** Responsible for transmitting the data collected by the physical layer to different devices.

- **Application layer:** This includes the protocols and interfaces that devices use to identify and communicate with each other.

- **Remotes:** Enable entities that utilize IoT devices to connect with and control them using a dashboard, such as a mobile application. They include smartphones, tablets, PCs, smartwatches, connected TVs, and nontraditional remotes.

- **Dashboard:** Displays information about the IoT ecosystem to users and enables them to control their IoT ecosystem. It is generally housed on a remote.

- **Analytics:** Software systems that analyze the data generated by IoT devices. The analysis can be used for a variety of scenarios, such as predictive maintenance.

- **Data storage:** Where data from IoT devices is stored.

- **Networks:** The internet communication layer that enables the entity to communicate with their device, and sometimes enables devices to communicate with each other.
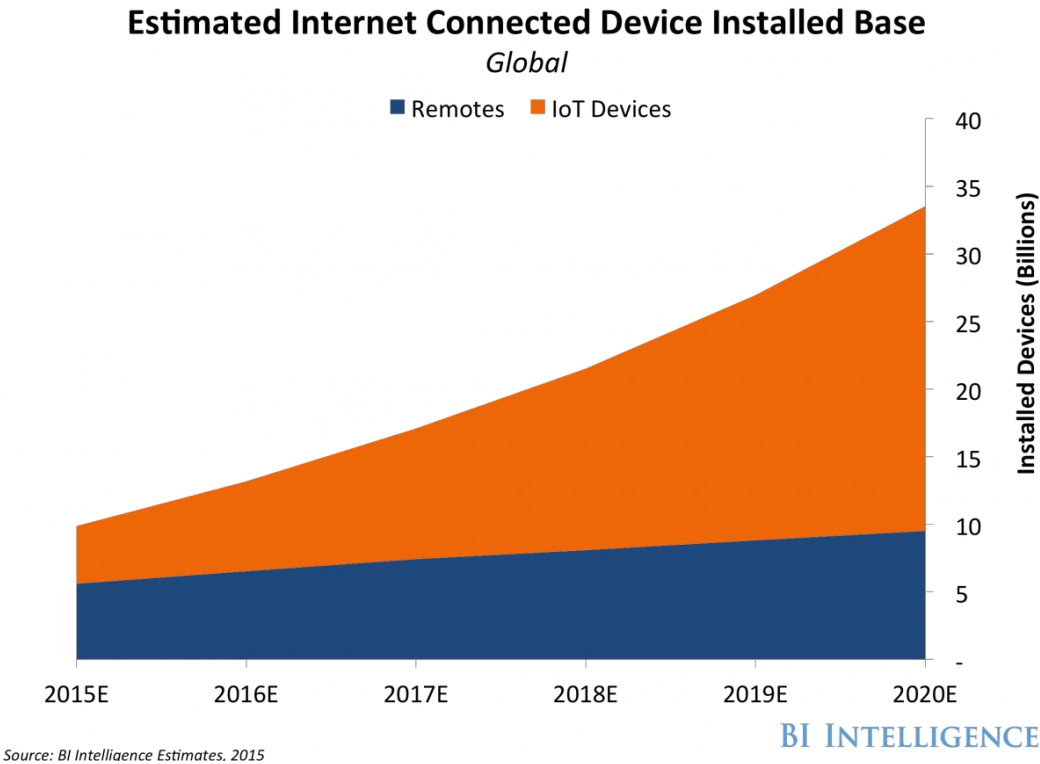
The Internet of Things Ecosystem
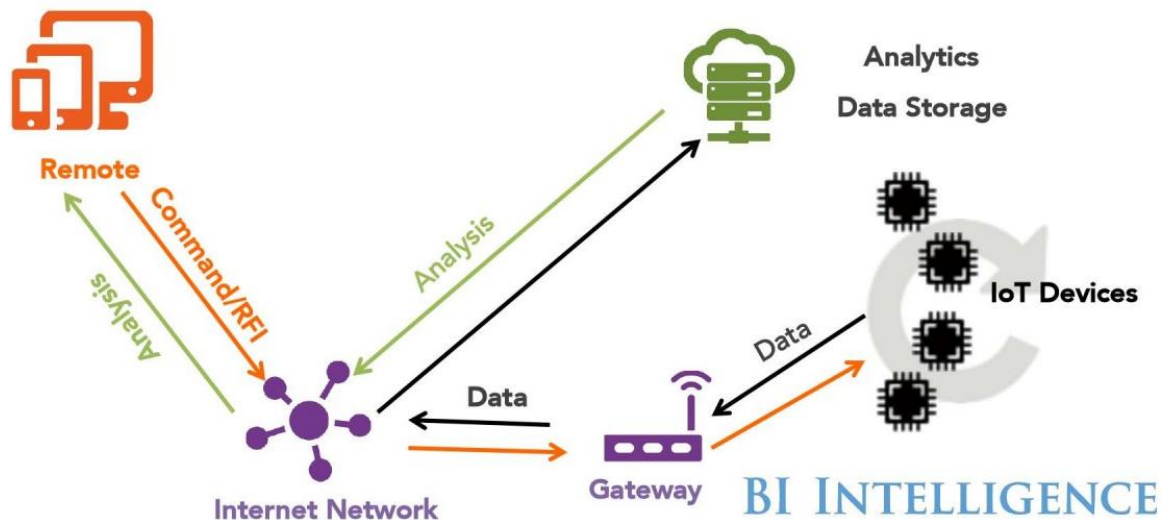
IoT PREDICTIONS, TRENDS, AND MARKET

The Internet of Things has existed as a concept since 1982 when a modified Coca-Cola machine at Carnegie Mellon University became the first truly Internet-connected appliance, as it could report its inventory and could tell users if the drinks inside it were cold.

In the 1990s, several papers discussed the IoT, and British tech pioneer Kevin Ashton coined the term Internet of Things in 1999. But it wasn't until a few years ago that the term truly caught fire and the idea of a vastly connected world started to become a reality.

And that vision will only swell in the coming years. We expect there will be more than 22.5 billion IoT devices on Earth by 2021 (or four for every human being on the planet), up from 6.6 billion in 2016.

As we approach 2020, governments and companies will pour $6 billion into IoT solutions. These will include application development, device hardware, system integration, data storage, security, and connectivity. But this will be money well spent, as we forecast those investments will generate $13 trillion by 2025.

Estimated Internet Connected Device Installed Base
Global

Source: BI Intelligence Estimates. 2015

THE 5 STAGES OF THE IoT

Business Insider Intelligence breaks down the Internet of Things into five distinct stages, yet the IoT is not anywhere close to realizing its full potential.

Stage 1 – Connection: The first stage is to bring the "Internet" to the "Things" by embedding and installing Internet connectivity into various devices. This qualifies the object as a connected device, at which point users can start gathering data about the product's use. A Business Insider Intelligence survey found that of individuals at companies that have or are implementing IoT solutions**,** 48% said their companies are connecting devices with those solutions.

Stage 2 – Management: The second stage involves the monitoring of devices and the data they produce. Interestingly, 33% of respondents in the Business Insider Intelligence survey blended connection and management because they indicated that they use IoT solutions to manage their devices.

Stage 3 – Analysis: The third stage involves analyzing the data from the management phase in order to glean useful and actionable insights. Unfortunately, only 47% of the respondents in the Business Insider Intelligence survey said they analyze the data they generate. Part of the problem is that users struggle to understand how to generate useful information from the data. As a result, platforms are trying to make this process easier, but this has proven difficult given the variety of IoT devices on the market and the lack of a universal standard for analysis.

Stage 4 – Interoperability: The fourth stage brings multiple connected devices together and allows them to "talk" to each other. For example, consider smart lights and smart locks in your home. When the smart lock unlocks, it would "tell" the smart lights to come on because someone is home. At this stage, the IoT truly starts to fail to live up to its potential, as just 17% of companies in the Business Insider Intelligence survey have implemented IoT solutions that talk to each other. And yet, this type of teamwork will be instrumental as the Internet of Things grows.

Stage 5 – Automation: The fifth and final stage is automation, in which connected devices work together without the need for user input. In the smart lock and smart lights example, the lights could sense that the resident is home sleeping and would automatically tell the locks to lock and other lights to turn off. This level of automation requires artificial intelligence and machine learning. In the Business Insider Intelligence survey, less than 16% of respondents have implemented IoT solutions at this stage. However, we expect Stages 4 and 5 to become more prevalent as the IoT expands in the coming years.

IoT INDUSTRIES

The Internet of Things will upend the way consumers, governments, and businesses operate daily. There are few areas of daily life that the IoT will not touch in the coming years.

Here's a list of areas that the IoT will transform, along with a description of how these industries will change once that happens:

- **Wearable Devices:** We expect the wearables market to grow to 162.9 million units by the end of 2020. The healthcare sector will be one of the top catalysts to push the wearables market to these heights, as consumer and professional healthcare trends will spur interest in wearable devices. Fitness trackers, in particular, will lead the way because consumers most frequently use wearables to track their exercise and health progress.

- **Healthcare:** Ultrasounds, thermometers, glucose monitors, electrocardiograms, and more are all starting to become connected and letting patients track their health. Multiple hospitals have started to use smart beds that automatically adjust to the patient. And smart medication dispensers can alert doctors if patients are not taking their medicine appropriately.

- **Smart Home:** Business Insider Intelligence forecasts that the number of smart home devices shipped will grow from 83 million in 2015 to 193 million in 2020. This includes all smart appliances (washers, dryers, refrigerators, etc.), smart home safety and security systems (sensors, monitors, cameras, and alarm systems), and smart home energy equipment, such as smart thermostats and smart lighting.

- **Small Business:** Business investments in the IoT will rise from $215 billion in 2020 to $832 billion in 2020. The IoT will help small businesses improve their bottom lines by reducing their operating costs, increasing their productivity, and expanding to new markets or developing new products.

- **Banking:** The ATM is actually an early prototype of an IoT device, and more of them are popping up around the globe. There were 2.7 million ATMs installed around the world in 2015, up from 2 million in 2010, according to estimates based on World Bank Data. These ATMs are now evolving with more security features and teller-assist functions. And of course, mobile banking apps are growing in popularity, particularly among millennials (71% of them say it's very important to have a banking app, and 60% say its very important to have one to make payments, according to a Business Insider Intelligence survey).

- **Education:** A recent Capterra study noted that 69% of students want to use their mobile devices more frequently in the classroom, and most of those students want to use them to automate tasks that they already do now, such as note-taking, schedule checking, and research.

- **Retail/E-Commerce:** The IoT is already getting its hooks into the retail sector. We expect the installed base of beacons, devices that retailers use to send notifications to shoppers' smartphones, to swell from 96,000 in 2015 to 3.5 million in 2018. Digital signage that advertises sales, smart shelves that automatically monitor inventory, the Amazon Dash Button that lets you reorder items without touching your computer or phone, and robots that stock shelves will all become commonplace thanks to the IoT.

- **Transportation:** Connected cars (which feature apps and in-car wi-fi) are already on the market, and we expect 381 million such cars to be on the road by 2020, up from 36 million in 2015. But public transportation (planes, trains, and buses) will start to have more smart features, which companies will be able to use to further enhance the travel experience. And let's not forget the link to smart cities, which will use data from connected cars to alleviate traffic and make parking easier.

- **Utilities:** The International Energy Agency expects global energy demand to increase by 37% by 2040. But the IoT will help deal with the strain this will put on energy supplies. Smart meters allow utility companies to effectively manage energy flow into buildings. Smart water sensors track water quality, temperature, pressure, and consumption. And smart home devices allow people to automatically conserve energy when they are not home.

- **Agriculture:** Farmers are already starting to use smartphones and tablets to remotely monitor equipment, crops, and livestock. Drones have become an invaluable tool to let farmers survey their lands and generate crop data. And satellite imagery has helped improve production output, minimize cost, and preserve resources. We expect IoT device installations in the agriculture sector to increase from 30 million in 2015 to 75 million in 2020.

- **Smart Cities:** The world is continually urbanizing, and major cities must upgrade their infrastructures to deal with the influx of residents. And several cities are already doing this. London is working on a smart parking project that would help drivers more quickly find parking spaces and, in turn, would alleviate congestion. San Diego is using cameras built into connected streetlights to reroute cars during peak hours. And Copenhagen is using sensors to monitor the city's bike traffic in real time, which is crucial because more than 40% of the Danish city's residents commute by bike each day.

- **Insurance:** The IoT will change home, life, auto, and health insurance, primarily by helping customers and insurance companies be proactive through the use of data collection, which would help identify and solve problems before they even occur. For example, wearable devices would help insurance companies keep track of patients' health and reward them for staying healthy through exercise and diet.

- **Supply Chain:** The Internet of Things is already helping logistics and shipping companies track products in more efficient ways. Asset tracking solutions allow these companies to find not just items in bulk, but specific items that belong to a specific customer to let him or her know precisely where the item is on the purchase journey.

Estimated Global Connected Car Shipments
In millions

Year	Shipments
2015E	13
2016E	21
2017E	33
2018E	48
2019E	64
2020E	83
2021E	94
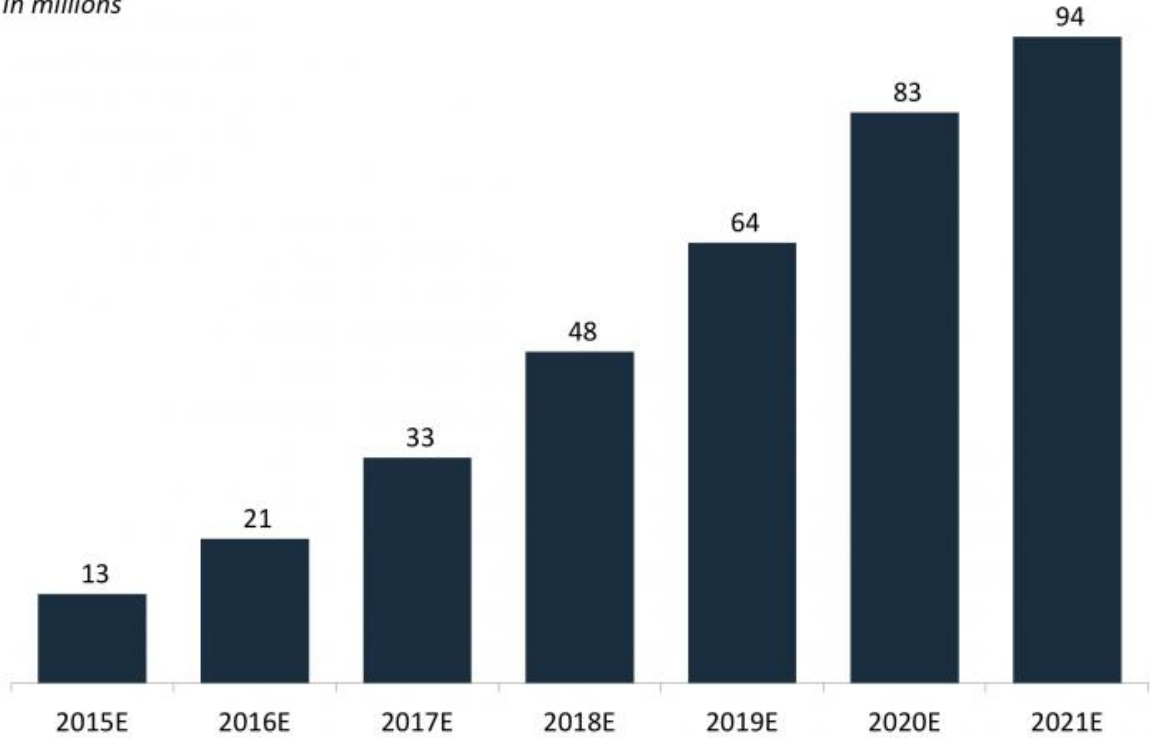
Source: OICA, KPMG, ITU, Google Consumer Baromter, GSMA Intelligence, BI Intelligence estimates, 2016

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IoT COMPANIES

There is no clear leader or winner in the IoT space, but there are several companies that are leading the pack. Some of these household names are getting involved with the cloud, while others are pushing into the connected car or smart home space.

These are some of the companies who are making headway in the IoT space and some of the main projects they have in the works.

- **Amazon:** The e-commerce giant has plunged into the IoT with its cloud platform called Amazon Web Services. AWS, which now controls almost half of the global cloud center data market, allows companies to achieve greater economies of scale, eliminates the need for operating data centers, and increased the speed and agility of making resources available for developers. And lest we forget, Amazon dominates the smart home market with its voice assistant Alexa and the Echo device.

- **Apple:** Apple is firmly in the smart home with its app called Home, which integrates with cameras, door locks, and more. You can tell Siri to turn off the lights and lower your shades, or turn on your coffee pot when you wake up in the morning.

- **Cisco:** Cisco has famously coined the phrase "Internet of Everything," which is the tech company's way of making the world more connected. Cisco has its hooks into several IoT-affected industries, including utilities and public works, television, the cloud, and transportation.

- **Google:** Google has famously been working on self-driving car and drone projects for several years, but it also runs the Google Cloud Platform.

- **Microsoft:** Microsoft operates its Azure IoT Suite, which allows users to monitor devices remotely, analyze data, and predict maintenance needs to avoid interruptions and downtime.

- **Fitbit:** Fitbit remains the unquestionable leader in wearable devices, specifically when it comes to the fitness sector. The company recently released its Flex 2 and Charge 2 wearables, which should help secure its position at the top of the activity tracker market.

- **IBM:** IBM's major IoT project is Watson, its cognitive technology that can answer questions in natural language, think like a human being, and learn and grow through information retrieval and analysis.

- **AT&T:** The telecommunications company added 1.3 million connected cars to its network in the second quarter of 2016, which brought the total number up to 9.5 million. Drivers do not have to subscribe or pay a monthly fee for data in order for AT&T to count them as a subscriber.

- **T-Mobile:** The poster child for unorthodox but successful methods in the wireless carrier wars partnered with Twilio to create Twilio Programmable Wireless, a cellular communications platform that could change how IoT developers work. Moreover, T-Mobile was ahead of the curve, as it debuted its IoT program through its Value Added Reseller channel in 2005 and created a full, dedicated IoT team in 2008. Today, the company offers a full hub that serves as one-stop shop for IoT customers.

- **Comcast:** The mass media company recently acquired Austin-based IControl Networks, which develops technology and platforms for connected home security devices. Comcast is focusing on Icontrol's "Converge" software platform, which is the muscle behind Comcast's Xfinity Home touch-screen panel and back-end servers, that lets the devices communicate with and manage security sensors in the home, along with providing support for home automation devices such as cameras and thermostats.

IoT SECURITY & PRIVACY

All of this connectedness will have numerous benefits. It will generate billions in revenue, remove friction in multiple areas of our work and home lives, and help save energy and money. But of course there are concerns, primarily with security and privacy.

IoT Security Issues

1. **Public Perception:** If the IoT is ever going to truly take off, this needs to be the first problem that manufacturers address. The 2015 Icontrol State of the Smart Home study found that 44% of all Americans were "very concerned" about the possibility of their information getting stolen from their smart home, and 27% were "somewhat concerned." With that level of worry, consumers would hesitate to purchase connected devices.

2. **Vulnerability to Hacking:** Researchers have been able to hack into real, on-the-market devices with enough time and energy, which means hackers would likely be able to replicate their efforts. For example, a team of researchers at Microsoft and the University of Michigan recently found a plethora of holes in the security of Samsung's SmartThings smart home platform, and the methods were far from complex.

3. **Are Companies Ready?:** AT&T's Cybersecurity Insights Report surveyed more than 5,000 enterprises around the world and found that 85% of enterprises are in the process of or intend to deploy IoT devices. Yet a mere 10% of those surveyed feel confident that they could secure those devices against hackers.

4. **True Security:** Jason Porter, AT&T's VP of security solutions, told Business Insider Intelligence, Business Insider's premium research service, that securing IoT devices means more than simply securing the actual devices themselves. Companies also need to build security into software applications and network connections that link to those devices.

IoT Privacy Issues

1. **Too Much Data:** The sheer amount of data that IoT devices can generate is staggering. A Federal Trade Commission report entitled "Internet of Things: Privacy & Security in a Connected World" found that fewer than 10,000 households can generate 150 million discrete data points *every day*. This creates more entry points for hackers and leaves sensitive information vulnerable.

2. **Unwanted Public Profile:** You've undoubtedly agreed to terms of service at some point, but have you ever actually read through an entire document? The aforementioned FTC report found that companies could use collected data that consumers willingly offer to make employment decisions. For example, an insurance company might gather information from you about your driving habits through a connected car when calculating your insurance rate. The same could occur for health or life insurance thanks to fitness trackers.

3. **Eavesdropping:** Manufacturers or hackers could actually use a connected device to virtually invade a person's home. German researchers accomplished this by intercepting unencrypted data from a smart meter device to determine what television show someone was watching at that moment.

4. **Consumer Confidence:** Each of these problems could put a dent in consumers' desire to purchase connected products, which would prevent the IoT from fulfilling its true potential.

Reported Cyber Incidents Against US Critical Infrastructure

295

257

245

198
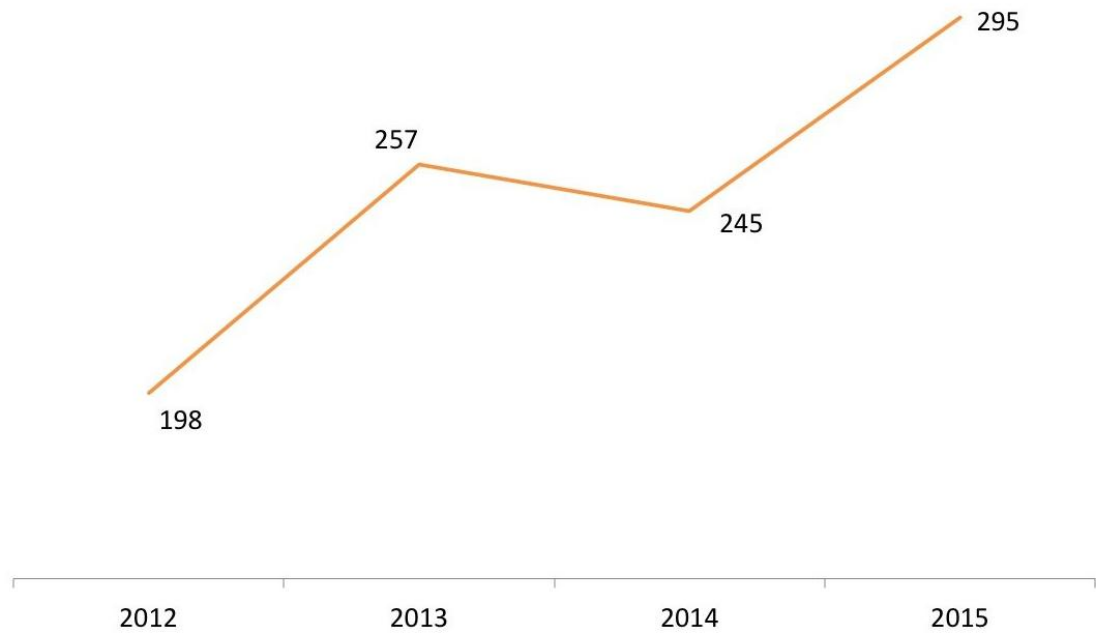
2012   2013   2014   2015

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IoT COMPANIES TO INVEST IN

The Internet of Things (IoT) is expected to be worth trillions of dollars by 2020, and several companies and startups will certainly reap the benefits of that explosion. But investors can do the same if they know which IoT stocks to watch.

Each of the companies and startups below rates as one of our IoT companies to watch, as each one is doing something innovative and important in the IoT space. These range from IoT startups to more established IoT companies to invest in.

Honeywell

Honeywell's primary focus is in the Industrial Internet of Things (IIoT), the integration of digital technologies into manufacturing. This puts the emphasis on information rather than physical machinery, even for areas that traditionally require physical labor.

Investors would be wise to consider Honeywell because of its considerable size and resources. Accenture conducted a worldwide survey of more than 1,400 business decision makers and found that 84% think their organization would potentially benefit from IIoT in multiple ways. But a mere 7% said they have actually created a comprehensive IIoT strategy and invested appropriate funds to support that strategy.

This creates a tremendous opportunity for Honeywell, which can step in and increase that 7% figure considerably.

Hitachi

The Japanese conglomerate is leveraging the IoT by becoming a consultant to help clients become what it calls "Enterprises of Things." Hitachi Consulting helps other companies apply IoT solutions to maximize their business value and lets them become innovators in the IoT space all on their own. The company also runs an IoT and Innovation workshop.

As the Internet of Things grows, more companies will need to rely on experts to squeeze the juice out of it, and Hitachi is perhaps best positioned to guide other organizations into the future of the IoT.

Comcast

Like many of its peers, Comcast has been contending with fleeing cable subscribers thanks to Netflix, Hulu, and other streaming media companies that are threatening traditional pay-TV. To offset this somewhat, Comcast has decided to forge ahead into the IoT.

The mass media company recently acquired Austin-based IControl Networks, which develops technology and platforms for connected home security devices. Comcast is focusing on Icontrol's "Converge" software platform, which is the muscle behind Comcast's Xfinity Home touch-screen panel and back-end servers, that lets the devices communicate with and manage security sensors in the home, along with providing support for home automation devices such as cameras and thermostats.

The cable company also hired former HP executive Sridhar Solur as Senior Vice President of Xfinity Home and IoT products. Solur received credit at HP for debuting the company's IoT and wearables businesses.

If Comcast can keep making strategic acquisitions, then investors should be able to ride the stock higher as a result.

T-Mobile

T-Mobile has been the poster child for unorthodox but successful methods in the wireless carrier wars, and it's also been extending its arms into the Internet of Things.

The carrier partnered with Twilio to create Twilio Programmable Wireless, a cellular communications platform that could change how IoT developers work.

Moreover, T-Mobile was ahead of the curve, as it debuted its IoT program through its Value Added Reseller channel in 2005 and created a full, dedicated IoT team in 2008. Today, the company offers a full hub that serves as a one-stop shop for IoT customers.

Other Companies and Startups to Invest in Include...

GE (GE)	AT&T (T)	Cisco (CSCO)	IBM (IBM)
Amazon (AMZN)	Skyworks (SWKS)	Apple (AAPL)	Sierra Wireless (SWIR)
Google (GOOGL)	Iridium Communications (IRDM)	Ambarella (AMBA)	ARM Holdings (ARMH)
Texas Instruments (TXN)	PTC (PTC)	Fitbit (FIT)	ORBCOMM (ORBC)
Garmin (GRMN)	Blackrock (BLK)	InvenSense (INVN)	Microsoft (MSFT)
Control4 (CTRL)	Silicon Laboratories (SLAB)	CalAmp (CAMP)	LogMeIn (LOGM)
InterDigital (IDCC)	Ruckus Wireless (RKUS)	Linear Technology (LLTC)	Red Hat (RHT)
Nimble Storage (NMBL)	Silver Spring Networks (SSNI)	Zebra Technologies (ZBRA)	Arrow Electronics (ARW)

THE TOP TRENDS IN THE IoT

We've already established that the IoT will take off in the next few years, but there are multiple underlying trends at play that will help the industry reach those new levels.

For starters, companies are focusing on IoT initiatives as part of a larger overall shift to digital. Many of these companies are transforming themselves to be digital from top to bottom in order to become faster and more flexible, which helps them keep up with consumers' demands. The IoT is absolutely part of this digital undertaking, but in many cases it is not the sole focus. As a result, businesses are incorporating and implementing IoT solutions into their digital initiatives.

But the overall Internet of Things is starting to get overcrowded, which means that intense consolidation is coming in the next few years. Some IoT companies are massive and employ thousands of people, while others are small operations with only a handful of employees. Consolidation has been a growing trend within the IoT, as mid-size companies acquire smaller ones, large companies gobble up mid-size ones, and massive corporations swallow them all.

The companies that get acquired oftentimes provide a niche product or service that fills a gap in the larger companies' operations in order to better serve customers' needs. In turn, the larger companies help the smaller ones enhance their offerings.

A recent Business Insider Intelligence survey found that 58% of IoT solution providers and device makers have already noted some consolidation within their circles. Consider Cisco's acquisition of Jasper, Verizon's purchase of Fleetmatics, and Softbank's acquisition of ARM.

Company Size

Interestingly, the majority of companies that have started to take advantage of the IoT are not doing so at a large scale. According to a Business Insider Intelligence survey, 51% of respondents said they use fewer than 50 IoT devices at their companies, 13% use between 51 and 100 devices, and 11% use between 101 and 300 devices.

Furthermore, just 16% of respondents said they use more than 1,000 IoT devices. Companies are largely using a smaller and more manageable number of devices when shifting to digital in order to keep costs and investments under control as they continue to study and learn about the Internet of Things.
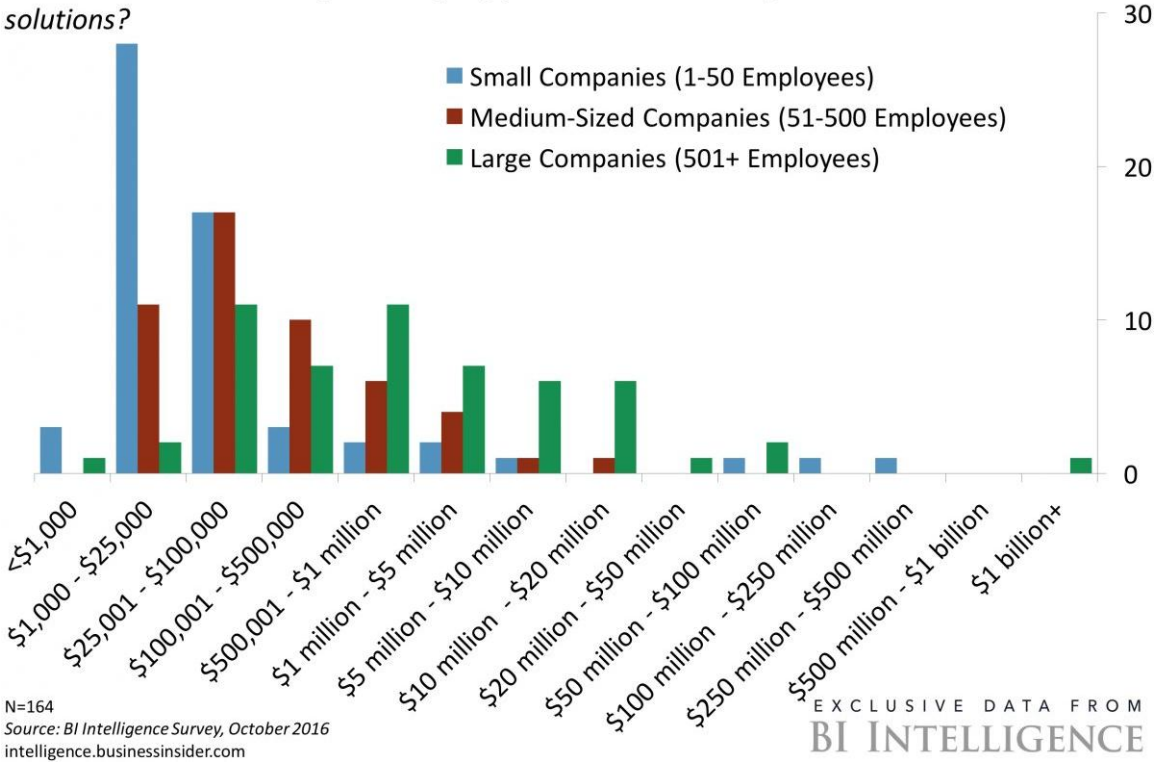
Size, however, is a key factor in the aforementioned survey responses. The majority of companies that indicated they had fewer than 50 IoT devices also had fewer than 50 employees at their businesses. This makes sense, as smaller companies with limited manpower and resources can only handle IoT projects on that scale.

Conversely, companies with more than 50 employees are undertaking larger IoT projects because they have the resources to do so. And most importantly, the largest IoT implementations (with more than 1,000 devices) occur at companies with more than 500 employees.

We expect this last category of IoT implementations to remain unchanged, as smaller companies cannot handle IoT projects on that scale. However, some smaller companies will start to expand their IoT programs, though this will take considerable time. Furthermore, these smaller companies will want to become more efficient by leveraging multipurpose devices to handle their IoT needs.

IoT Investment By Company Size

Q: About how much does your company plan to invest in total for IoT solutions?

Legend:
- Small Companies (1-50 Employees)
- Medium-Sized Companies (51-500 Employees)
- Large Companies (501+ Employees)

N=164
Source: BI Intelligence Survey, October 2016
intelligence.businessinsider.com

EXCLUSIVE DATA FROM
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IoT Timeline

When we look at the timeline of the Internet of Things, we see that the IoT has been picking up steam in the last few years. Business Insider Intelligence surveyed company executives about if and when they implemented IoT solutions and if and when they started looking into IoT technology.

Among those who have implemented IoT solutions, 85% of respondents only did so in the last two years. This is largely because IoT devices have become more practical and have received more media coverage since 2014.

Among companies that have thought about but not actually implemented IoT solutions, 72% said they had internal discussions within the last year and 21% had internal discussions more than a year ago. This response data indicates two possibilities: 1) These companies have just begun looking into IoT solutions; 2) They have decided or been forced to reconsider IoT solutions but have yet to pull the trigger on investing.

Given these responses, particularly the overwhelming percentage of companies that are at least considering IoT solutions, the number of IoT devices should grow in the coming years.

Where in the World is the IoT?

The Internet of Things has infiltrated most regions of the world, but it is definitely more prevalent in certain areas of the planet. Business Insider Intelligence surveyed companies that have implemented IoT solutions about where they offer their IoT services.

An overwhelming majority of respondents (86%) offer IoT products and services in North America, which makes sense given that these IoT solutions focus on the high-tech office space. Furthermore, North American homes by and large have greater technology adoption and homeowners have more disposable income to spend on smart home products.

Meanwhile, 49% of respondents offer their IoT solutions in Europe, which is a significant percentage but not a surprising one given that European nations follow similar patterns compared to North American countries.

Finally, 37% of providers offer their IoT products and services in Asia, 25% in Australia, 24% in South America, and 16% in Africa.

Where Companies Offer IoT Servies

Q: Which regions do you provide services or products in? Select all that apply
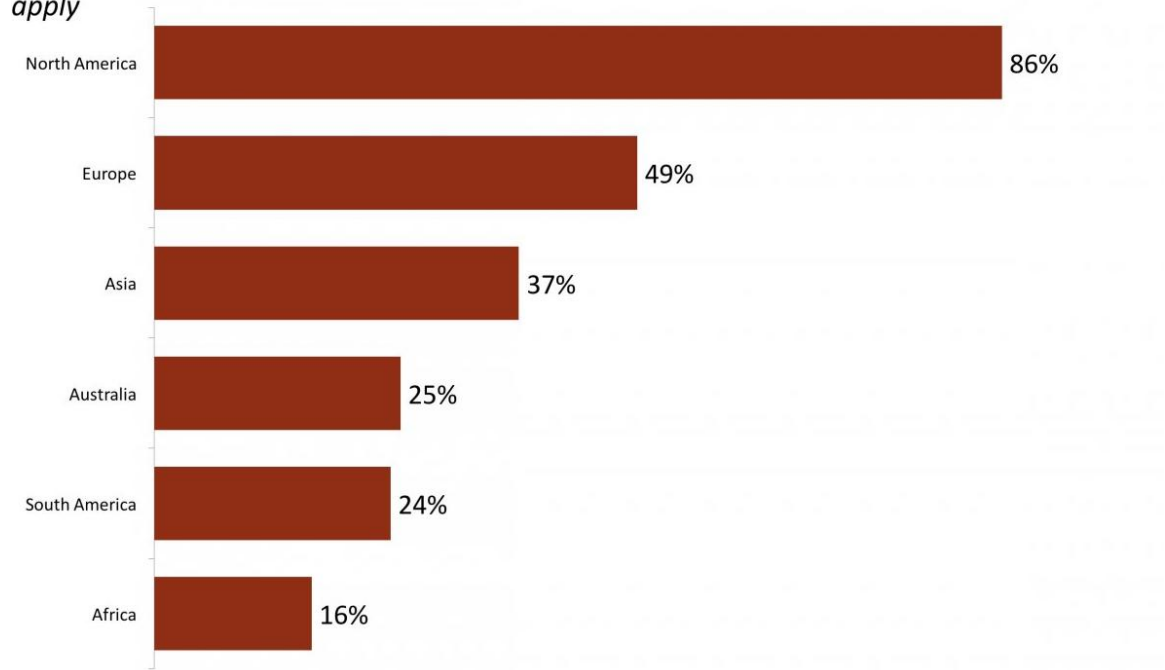
North America — 86%
Europe — 49%
Asia — 37%
Australia — 25%
South America — 24%
Africa — 16%

N=120
Source: BI Intelligence Survey, October 2016
intelligence.businessinsider.com

EXCLUSIVE DATA FROM
BI INTELLIGENCE

IoT CHALLENGES

The Internet of Things is certainly growing, but plenty of roadblocks still exist to true mass adoption. Business Insider Intelligence surveyed IoT providers to ask what are the greatest challenges and hurdles they have faced to date.

System integration was the greatest problem, according to 46% of respondents. IoT companies provide services that would radically transform their clients' everyday operations and long-term productivity. With such a change comes the need for education, and providers must inform their clients how the IoT will affect them in the near and distant future.

As a result, Business Insider Intelligence has concluded that many companies want IoT solutions that fit seamlessly and organically into their existing operations. The problem, though, is that these operations could be outdated or disparate, which makes it difficult for IoT providers to help them.

Consider, as an example, a manufacturing plant that wants to integrate its equipment, transmit data from that equipment, use the cloud to store and analyze the data, display that data for the workers, and finally send automated signals to the equipment to fix any problems. The plant's managers might already have a cloud infrastructure in place, so the IoT provider would need to incorporate this existing solution while also enhancing the rest of the process and filling in any holes.
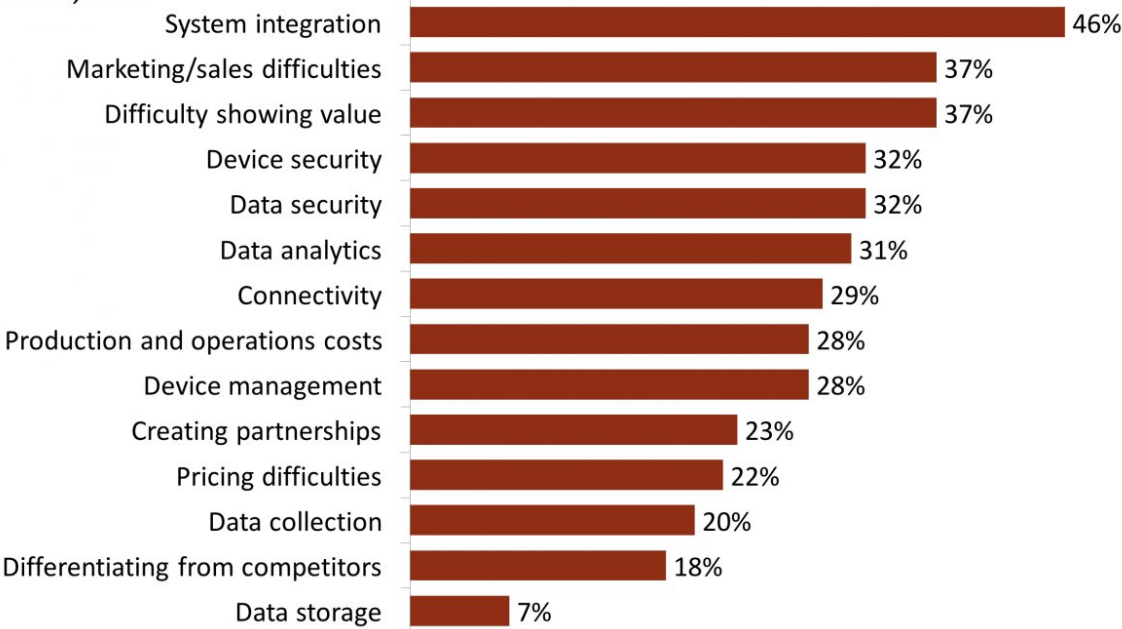
The second biggest problem was defining value, as 37% of respondents noted difficulty with sales and marketing of their products, while 37% also said they had problems demonstrating the value of their IoT solutions. This ties back to the aforementioned education component and the need for IoT companies to help their clients understand the benefits of the products.

Third on the list of challenges is security, as 32% of respondents highlighted data security issues and another 32% noted device security problems. As we mentioned earlier in the IoT Security & Privacy section, IoT companies face several security and privacy concerns from their clients and the public at large. Again, education is key to put consumers' minds at ease.

Finally, data analysis ranked fourth on the list with 31% of respondents. This problem largely stems from a lack of necessary personnel at each company to analyze big data.

Challenges Providers Face In Developing An IoT Service
Global, 2016

Challenge	Percentage
System integration	46%
Marketing/sales difficulties	37%
Difficulty showing value	37%
Device security	32%
Data security	32%
Data analytics	31%
Connectivity	29%
Production and operations costs	28%
Device management	28%
Creating partnerships	23%
Pricing difficulties	22%
Data collection	20%
Differentiating from competitors	18%
Data storage	7%

Source: Business Insider Global IoT Executive Survey, Q4 2016 (n=120 IoT Providers)
intelligence.businessinsider.com

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IoT DEMOGRAPHICS

In broad terms, those who use the IoT fall into three categories: enterprises, governments, and consumers. And each of these sections offers different benefits and drawbacks for the companies that sell IoT solutions.

Enterprise is by far the most targeted demographic, as businesses are the top adopter of IoT products and services. This section will be the main driver of future Internet of Things growth, as businesses have the resources and personnel to invest in the IoT and also feel the most strongly that they will reap significant benefits from becoming connected.

Government is second in IoT targeting, and this category breaks down into cities, education, defense, and other applications. This is a bit of a high-risk, high-reward situation for IoT providers, as government projects like this are rare but can be quite massive and lucrative.

Finally, IoT companies target consumers least because the devices in which they are most interested (smart home products, smartwatches, fitness trackers, etc.) don't offer the same growth or scale as governments and enterprises; however, the consumer sector does provide some significant long-term growth potential.

A majority of IoT companies in the Business Insider Intelligence survey had only considered or actually implemented IoT solutions starting in 2014. But Business Insider Intelligence dug deeper and asked these respondents how long their companies have been engaged in any capacity with the IoT.

The survey said that 53% of these companies have been engaged with the IoT for at least three years, including 17% who have done so for seven or more years.

Length Of Engagement With The IoT
Q: How long has your company been active in the IoT?
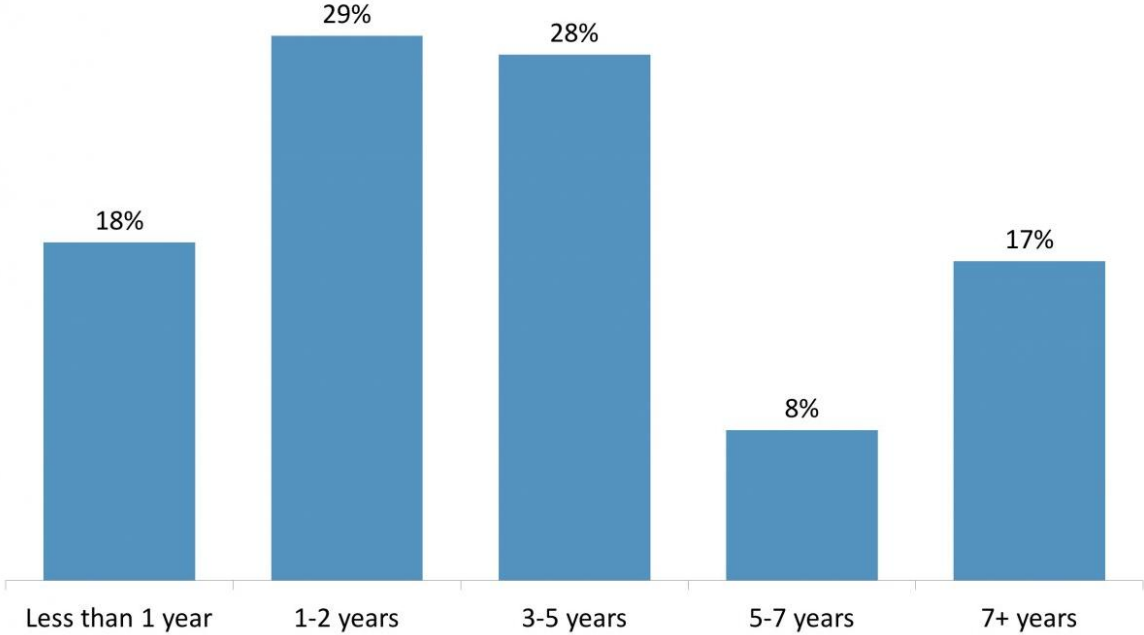
29%   28%

18%   17%

8%

Less than 1 year   1-2 years   3-5 years   5-7 years   7+ years

N=120
Source: BI Intelligence Survey, October 2016
intelligence.businessinsider.com

EXCLUSIVE DATA FROM
BI INTELLIGENCE

THE FUTURE OF THE IoT

The Internet of Things has been coming into its own in the last several years, and now the IoT ecosystem has settled into five major components: remotes, networks, platforms, hardware, and security.

Each of these segments will develop in their own ways in 2018. Below, we've outlined the path ahead for each component.

- **Remotes**: A plethora of smart home executives predict that the remote will disappear in lieu of artificial intelligence, which will help the smart home react to its environment. For example, a user would not have to speak a voice command in order to turn off the lights and lock the doors at night. Instead, the AI would anticipate and perform these functions automatically. AI should start to take on a greater role in the IoT in the coming years.

- **Networks**: The single greatest development for networks in the coming years will be on 5G, as this cellular standard is poised to push the IoT to new heights. An Ericsson survey found that 95% of leaders at mobile network operators believe that 5G will help support the surge in data from these IoT devices. Furthermore, 5G will also decrease maintenance costs on some of these IoT solutions, specifically by reducing power consumption and allowing longer battery life. This in turn would reduce the cost of maintaining these battery-powered devices. And operators have significant plans for 5G adoption, as most plan to start 5G trials sooner rather than later.

- **Platforms**: Many major players in the IoT space are trying to create a soup to nuts offering that fulfills all of a customer's needs. Some have done this by investing in their own IoT solutions, while others have acquired companies that fill the gaps. Expect the investments and acquisitions to pick up speed in the coming years.

- **Hardware**: IBM and ARM are pioneering cheap embedded semiconductor technology, which would help push the IoT forward by making this key component available to a wide range of companies.

- **Security:** Unfortunately, security will continue to lag behind despite the coming upward trend in IoT device sales. As of the end of 2016, security remained a problem. In October 2016, hackers attacked Dyn, one of the biggest DNS providers in the world, and caused massive disruption to the Internet, primarily in the eastern U.S. But more concerning is that the hack used common connected devices such as cameras, printers, and routers.

THE BOTTOM LINE

- The Internet of Things will make the world truly connected by 2020.

- The companies that succeed in this new connected world will be those who embrace consumers' desire to seamlessly integrate their devices and improve their quality of life.

- Transportation, energy, and wearable devices will be three of the areas most affected by the Internet of Things in the next several years.

- Major tech companies such as Apple and Google are wholly embracing the IoT, but smaller companies can carve out their own niche in this growing market.

- IoT companies must address consumers' valid concerns regarding security and privacy in order to win their trust and earn their money in this connected world.

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