Internet of Things

A Non-Geek's A-to-Z Guide

To the Internet of Things

INTRODUCTION

Defining the Internet of Things isn't easy. When it's defined in terms of market size, some focus on the potential revenue (it's in the trillions), while others focus on the number of potential "Things" (it's in the billions). Some definitions focus on the exponential growth of sensors, excluding smartphones, tablets and desktop computers, while others only consider devices with an IP address. Whether these definitions and forecasts are accurate or not, it can be downright confusing.

How would you define the Internet of Things (or IoT, as it is commonly called)? If you were to ask 20 people, you would most likely end up with 21 different definitions, including yours. And guess what? That's OK. It's not important that we all agree on a single definition. What's important is that we understand the context or frame of reference in which the Internet of Things is being discussed.

A good case in point is *big data*. When the term started to become popular in 2011, almost every article, research report, interview and panel discussion for the next few years began with a definition of big data. Was it necessary to define each time? Yes, it was – and it still is – because it is the responsibility of an author/speaker to provide the proper context for the reader/listener – especially when it involves emerging terms like big data and the Internet of Things.

Different Ways to View the IoT

While you won't find a canonical definition of IoT in this guide, it's still interesting to note how different organizations describe it. Here are a few:

- The IoT links objects to the Internet, enabling data and insights never available before. *(Cisco)*
- The network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment. *(Gartner)*

Whether these definitions and forecasts are accurate or not, it can be downright confusing.

- A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies. *(IoT-GSI)*

- IoT describes a world where just about anything can be connected and communicate in an intelligent fashion. In other words, with the Internet of Things, the physical world is becoming one big information system. *(Techopedia)*

- It's a concept of everyday objects – from industrial machines to wearable devices - using built-in sensors to gather data and take action on that data across a network. *(SAS Institute)*

These illustrative descriptions highlight IoT's common traits – connectivity, "things" and data/information – while giving us a good sense of the tremendous impact it will have on life as we know it. For a more thorough discussion on the Internet of Things – including its history, importance, who uses it and how it works – read *Internet of Things (IoT): What it is and why it matters* on sas.com.

About This Guide

This A-to-Z guide includes 101 common terms related to the Internet of Things. It's not an exhaustive list of terms, given that IoT is evolving so quickly, but rather a quick go-to resource for the technically savvy data professional who wants to get a handle on this vast IoT ecosystem. Even though this guide is for the "non-geek," it does include some technical terms, but they are explained sans technical "geek speak."

We also want to help you understand how a term may be connected to a larger discussion. The table on the next two pages will help you with that. It groups the terms by category, such as Analytics or Connectivity, so that it's easier to quickly grasp a group of related terms (and categories).

Each category also has its own colored icon – for example,  represents "digital currency." Throughout the guide, each term is tagged with at least one category icon and may include one or more links to other terms.

These illustrative descriptions highlight IoT's common traits while giving us a good sense of the tremendous impact it will have on life as we know it.

THE 101 TERMS
by Category

ANALYTICS

Advanced Analytics

Analytics of Things (AoT)

Big Data Analytics

Descriptive Analytics

Predictive Analytics

Prescriptive Analytics

SAS Analytics for IoT

SAS Event Stream Processing (ESP)

SAS Visual Analytics (VA)

SAS Visual Statistics (VS)

Streaming Analytics

ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI)

Augmented Reality (AR)

Automation

Chat(ter)bot

Cognitive Computing

Deep Learning

Facial Recognition

Machine Learning

Machine-To-Machine (M2M)

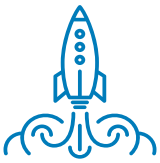
Neural Network

Speech Recognition

Vehicle-To-Vehicle (V2V)

Virtual Reality (VR)

Voice Assistant



APPLICATIONS

Connected Customer

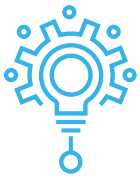
Connected Factory

Connected Vehicle

Smart City

Smart Grid

Smart Home



CAPABILITIES

Automation

Digitalization

Digitization

Legacy

Optimization

Real Time

Ubiquitous

COMPUTING

Cloud Computing

Cognitive Computing

Edge Computing

Fog Computing

Grid Computing

CONNECTIVITY

Subcategory: **WIRELESS**

Botnet

Connectivity

Geofencing

GPS

Integration

Interconnectivity

Internet of Everything (IoE)

Interoperability

Mirai

Network

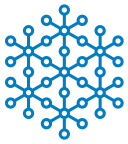
Platform

Protocol

Proximity Network

RFID

Standards



DATA

DIGITAL CURRENCY

INDUSTRIES

PEOPLE

THINGS

WIRELESS

Subcategory: **ANALYTICS**

Subcategory: **COMPUTING**

Algorithm

Big Data

Data Lake

Data Streaming

Digitalization

Digitization

Governance

Monetization

Privacy

Quality

Security

Yottabyte

Bitcoin

Blockchain

Cryptocurrency

Digital Currency

Ethereum

Health Care

Industrial IoT (IIoT)

Manufacturing

Retail

Tele-communications

Transportation

Utilities

Connected Customer

Data Scientist

Hacker

Innovation

Jobs

Kevin Ashton

Talent

Drone

Mobile Device

Quantified Self

Sensor

Things

Wearables

Xcoffee

4G LTE

Bluetooth

LoRa

Mesh Networking

WiFi

Wireless

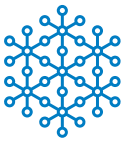
Zigbee

Z-wave

THE 101 TERMS
in Alphabetical Order

4G LTE

4G LTE is a high-speed wireless network. On mobile devices, connection speeds are at least 100MB/second; on stationary devices, speeds are at least 1GB/second. The anticipated rollout of 5G is in 2020 and will focus on supporting more users and data in a given density versus making speeds faster. Given the anticipated growth of IoT devices by 2020, 5G will be necessary to handle the network volume.



ADVANCED ANALYTICS

As SAS Chief Technology Officer Oliver Schabenberger puts it, "Data without analytics is value not yet realized. Wherever there is data, there should be analytics." This is especially true of IoT data. For example, advanced analytics allows companies to conduct what-if analyses and understand the impact of changing a business strategy. Advanced analytics includes: predictive analytics, data mining, big data analytics, forecasting, text analytics, optimization and simulation.

Learn More:

ALGORITHM

An algorithm is a software procedure, i.e., a set of instructions designed to perform a specific task. Since there's typically more than one way to complete a task, an algorithm may be modified over time to improve its performance, efficiency or even accuracy. Algorithms determine what data you will see in your Google search results or Facebook news feed.

ANALYTICS OF THINGS (AOT)

AoT is the analysis of IoT data, which is the data being generated by IoT sensors and devices. Data creation is the easy part; analyzing it is not. Without this data analysis, generating all this IoT data is a futile effort. Don't collect the data if you don't have an aggressive plan to analyze it and take action on it.

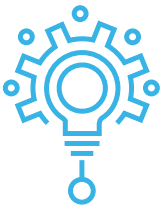
ARTIFICIAL INTELLIGENCE (AI)

AI is intelligence exhibited by machines, sometimes referred to as machine intelligence. AI focuses on making machines perform equal to or better than a human when it comes to accuracy, capacity and speed. AI is what's bringing a lot of our IoT Things to life, like Amazon Echo's "Alexa."

Learn More:

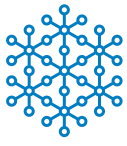
AUGMENTED REALITY (AR)

AR is the blending of virtual reality and real life. AR appeals to the senses by inserting computer-generated sounds, videos, graphics or GPS data into an existing real life setting. AR is converging with IoT; for example, data from hundreds of sensors can be visualized simultaneously, overlaying relevant and useful information from your environment through a headset.



AUTOMATION

The automation of data-driven decisions and actions is an obvious direction for the Internet of Things (and Industrial IoT). Analyzing all this IoT data will be a hefty task in itself, but the ability to automate decisions and actions based on this analysis will separate the leaders from the laggards in this IoT race.



BIG DATA

Paul Kent, Vice President of Big Data at SAS, describes big data simply as "the size or the complexity of your data that puts you on the other side of your comfort zone." Big data became all the rage in 2011. What we know now is that it was just the opening act for what we now call IoT data.

Learn More:

BIG DATA ANALYTICS

Big data analytics is a subset of advanced analytics. It allows you to examine large volumes of data to uncover hidden patterns, correlations, market trends and other insights. With today's big data technology, you can get answers to your business questions a lot quicker than with your traditional BI tools.

Learn More:

BITCOIN

Bitcoin is a cryptocurrency powered by the blockchain. Unlike government-issued currencies, bitcoin is operated by a decentralized authority and provides lower transaction fees than traditional payment mechanisms.

BLOCKCHAIN

The blockchain is the technology that powers bitcoin. It's a distributed database that serves as a public ledger of all transactions in a given system that have ever been executed. The blockchain is constantly growing as newly completed blocks are added to it. Blocks of transactions are added in a linear, chronological order through cryptography, ensuring that the blockchain is a tamper-proof record of all transactions on the network. It's also accessible to all participants.

BLUETOOTH

A radio broadcast communication system that allows you to exchange data over a short distance, typically 30 feet (but it can range from three to 300 feet). Bluetooth is commonly used with portable devices, many of which are IoT devices.

BOTNET

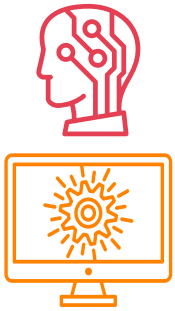
Also called a zombie army, a botnet is a collection of connected Things (basically anything with an IP address) that has been set up to forward transmissions, typically spam or viruses, to another unsuspecting machine on the internet, often forcing it offline. The owners of these connected Things are not aware that their Thing has been part of a botnet; hence, a key reason why IoT security is so important.

CHAT(TER)BOT

Similar to a voice assistant, chatbots are services you access through a chat interface. Some chatbots are powered by AI and some by a set of rules. Typically, a chatbot provides a single service, like updating you with the latest on weather or news, helping you pick out groceries, or scheduling a meeting for you.

CLOUD COMPUTING

Cloud computing is a major player in IoT. Like grid computing, cloud computing reduces costs by maximizing existing resources. The difference is that in cloud computing, an app doesn't access these resources directly. Instead, it accesses resources indirectly through a service, which in turn engages the physical resources necessary to respond to the app.



COGNITIVE COMPUTING

SAS describes cognitive computing as the holy grail of AI. Imagine asking a machine a question (like you do with Siri or Alexa) and having the machine answer. Then imagine the machine providing you with additional information about your question you never thought to ask, along with a narrative summary and suggestions on how to analyze further. This is how cognitive computing works. It brings the "smarts" to IoT.

Learn More:

COLLABORATION

Collaboration can be tough, especially within your organization. But it's only going to get tougher as we move into this IoT age. IoT will not only require increased collaboration and cooperation within your own organization, but also between technology vendors, the developer community, security firms, the open source community and government agencies. IoT is changing the game of how we all get along.

CONNECTED CUSTOMER

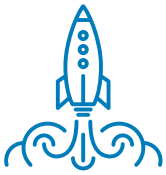
Have a smartphone? Consider yourself connected then. Whether you're commuting to work, shopping, or eating at your favorite restaurant, your favorite businesses and sites are using IoT to make sure you stay connected 24/7 any way you like.

Learn More:

CONNECTED FACTORY

Industrial IoT is improving how factories operate. By utilizing streaming data in real time, manufacturers have the opportunity to respond more quickly to changing conditions, tune up their operations for peak performance and maximize the value gained from their factory investments.

Learn More:



CONNECTED VEHICLE

The race is on. Automakers and tech companies alike are building out the next generation of smart, connected cars. Not only are they making cars safer to drive, but they're working on giving the responsibility of driving to the car itself. The vision? Collision-free driving and stress-free passengers.

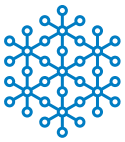
Learn More:

CONNECTIVITY

IoT connectivity boils down to how Things connect to each other. Connections can either be wired or wireless. This guide highlights some of the more popular "non-geek" connections: 4G LTE, Bluetooth, GPS, LoRa, mesh networking, RFID, WiFi, Zigbee and Z-wave.

CRYPTOCURRENCY

It's a type of digital currency that uses cryptography for security and anti-counterfeiting measures. Public and private keys are often used to transfer cryptocurrency between people. Bitcoin is a popular cryptocurrency.



DATA LAKE

A data lake is essentially a storage repository that can hold any and all types of data in its original format. Unlike a data warehouse, the data doesn't have to be cleaned up or structured before it's stored. This makes it easy for organizations to quickly capture and store all their big, IoT data.

DATA SCIENTIST

SAS defines data scientists as a new breed of analytical data experts who have the technical skills to solve complex problems and the curiosity to explore what problems still need to be solved. Read more about who these data scientists are, what they do, and why you want to be one: sas.com/en_us/insights/analytics/what-is-a-data-scientist.html

DATA STREAMING

Real-time data streaming processes data on the fly instead of waiting to process it after it's been stored in a database, which could be too late to react. Popular streaming applications include fraud detection, network monitoring, e-commerce and risk management.

DEEP LEARNING

Deep learning is a subset of machine learning, which is a subset of AI. Deep learning helps automate predictive analytics. It can take lots of unstructured, unlabeled data (like IoT data) and create its own highly accurate predictive models. It emulates how we learn, as humans, to gain certain types of knowledge. Common applications include image and speech recognition.

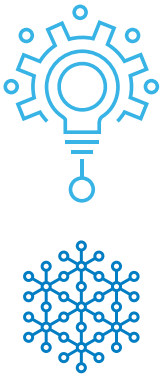
Learn More:

DESCRIPTIVE ANALYTICS

Descriptive analytics is the simplest form of analytics. Its primary purpose is to answer the question: "What has happened?" It transforms large volumes of stored data into useful summaries of insightful information. Descriptive analytics is a foundational component in many BI/ data visualization environments.

DIGITAL CURRENCY

Digital currencies are intangible, electronic payment methods that can be used to purchase goods and services through the internet. They allow for instantaneous transactions and borderless transfer of ownership, and they eliminate the middle man, such as a bank. Cryptocurrencies and virtual currencies are two types of digital currencies.



DIGITALIZATION/DIGITIZATION

Gartner defines digitalization as "the use of digital technologies to change a business model and provide new revenue and value-producing opportunities. It is the process of moving to a digital business." This parallels what the IoT journey is all about: transforming our analog world into a digital one. So whether we're digitizing a document (e.g., scanning a PDF) or digitalizing our city, it's all part of making our world smarter and more connected.

DRONE

A drone is essentially a flying robot. More specifically, it's an unmanned aircraft guided by remote control. Drones are not just for the military anymore. Consumers are buying drones with cameras, delivery companies are figuring out how to deliver your next bag of groceries, and farmers are using them to help with crop management.

EDGE COMPUTING

In a traditional IoT architecture, the data that is collected or generated by a Thing is often sent to the cloud for storage and analysis. This isn't very efficient because a lot of unnecessary data gets sent, which takes up bandwidth and slows down response times. Both edge computing and fog computing focus on pushing intelligence and processing capabilities to the network edge, closer to where the data originates and away from the cloud.

The difference between the two is that with edge computing, Things are hardwired into a smart controller. The controller then decides how to handle the data coming from the Thing, i.e., store the data locally or push it to the cloud.

Fog computing, in contrast, works with the local area network (LAN). Data is gathered, processed and stored within the network via an IoT gateway or fog node. Each computing solution tackles the same problem in very different ways. Leave it to your technical folks to determine which one is a better fit for your company.

ETHEREUM

Ethereum is a platform that offers many benefits for the IoT. It uses its own decentralized public blockchain to store, execute and protect smart contracts securely. For example, with Ethereum, your washing machine could request more detergent from your grocery store and provide an automated payment.

FACIAL RECOGNITION

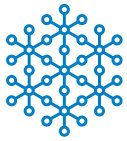
How would you like to unlock your door with your face? It's possible with facial recognition software, which uses facial features in a digital image or video frame to identify a person. Making our smart homes more secure is just the beginning of how facial recognition is converging with the Internet of Things.

FOG COMPUTING

See edge computing.

GEOFENCING

Geofencing uses GPS and RFID technologies to create a virtual geographic boundary, like around your home property. A response is then triggered any time a mobile device enters or leaves the area. It's another smart way to turn the lights off when you leave and on when you get back home.



GOVERNANCE

When big data arrived on the scene, companies began asking about big data governance frameworks. That was the wrong question. What they needed to do was extend their existing data governance framework to address big data. The same holds true for IoT data.

GPS

GPS is another way our Things – like our smartphones, fitness bands and connected cars – keep track of where we are and where we're going. The Global Positioning System (GPS), originally developed by the US Department of Defense, is a free satellite-based navigation system that works anywhere, at any time, under all weather conditions.

GRID COMPUTING

Grid computing is another major player in IoT. Like cloud computing, grid computing reduces costs by maximizing existing resources. This is accomplished with multiple machines working together to solve a specific problem. It's especially powerful with number-crunching problems.

HACKER

A hacker is a highly skilled computer expert capable of breaking into computer systems and networks using bugs and exploits. "White Hats" are ethical hackers who specialize in making sure an organization's information systems are secure. "Black Hats" are hackers who maliciously break into a system to destroy files, steal data, etc., for some future purpose, like blackmail or ransom. "Grey Hats" may violate laws or ethical standards, but not with malicious intent like a Black Hat. The weak, or missing, security within the IoT ecosystem, existing and future, makes it a rich playground for the hacker community.

HEALTH CARE

IoT is affecting the health care industry. Many of us use wearables to monitor our physical activity, sleep patterns and other health-related habits. Hospitals use IoT sensors to better monitor patients and track equipment. This is just the beginning of how IoT will be used to improve our health and help save lives.

Learn More:

INDUSTRIAL IOT (IIOT)

IIoT is the use of IoT technologies in manufacturing and is part of the Industry 4.0 trend. It incorporates machine learning, big data technologies, sensor data, M2M communication and automation technologies. The philosophy behind IIoT, according to TechTarget, is that "smart machines are better than humans at accurately, consistently capturing and communicating data."

INNOVATION

When it comes to IoT, the truth is that innovation is less about technology and more about the creative and disruptive transformation of business processes, many of which are decades old. Process innovation – for instance, streaming a patient's secure vital signs to the smart device of a specialist thousands of miles away – can not only save time and money. It can save lives.

INTEGRATION

Data silos are an age-old issue, and data integration is an age-old challenge. With the growing volumes of big data, IoT data and yes, data silos – organizations are being forced to address integration in a larger, more comprehensive way. This is a must-do for any data-driven organization.

INTERCONNECTIVITY

Interconnectivity is about the quality of being connected, or the potential to connect in an easy and effective way. This is especially important for consumers as they make their world a little bit smarter and a little more connected, one step at a time.

INTERNET OF EVERYTHING (IOE)

A term originally coined by Cisco, IoE is the intelligent connection of people, data, process and things. In essence, IoE adds network intelligence to IoT.

INTEROPERABILITY

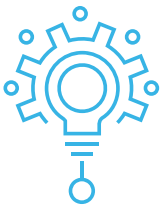
The success of IoT in your organization may very well be dependent on your ability to get your ecosystem of IT systems and software applications communicating and exchanging data more efficiently and effectively with each other. This is called interoperability. Your systems have to talk to each other for the data to be combined.

JOBS

The projected growth of IoT (market size, number of devices) over the next five years is mind-blowing. Not only will data scientists continue to be in high demand, but watch for jobs in data security and cloud computing to increase. We will also see a whole host of new roles rise. Does anyone want to be a wearable tech designer?

KEVIN ASHTON

Known as the "father of the Internet of Things." It all began with a tube of brown lipstick in 1999: newsweek.com/2015/03/06/meet-kevin-ashton-father-internet-things-308763.html



LEGACY

If IoT is about getting Things connected to the internet, what are organizations doing if they have value-adding Things that weren't designed to connect? One approach is to develop IoT strategies that drive technology/process improvements and enhancements for existing investments. Whatever your approach, one thing is certain: doing nothing is not a sustainable option.

LORA

LoRa is a long range, low power wireless platform that's being used to build IoT networks worldwide, especially by smart cities and communities. It securely transmits data and is being integrated into many Things, including connected vehicles, street lights and home appliances.

MACHINE LEARNING

Machine learning (ML) is a subset of AI. Modern ML techniques use neural networks to help machines learn without human intervention. For example, Facebook uses ML to dynamically personalize your news feed based on what you're stopping to read, like and comment on. ML helps make our IoT data smart.

Learn More:

MACHINE-TO-MACHINE (M2M)

Some say this is where IoT got its start. M2M began when mobile devices started to become smart and were able to connect and send data to other devices through cellular (or wired) networks. M2M typically refers to isolated instances of device-to-device communication, while IoT has a broader scope by automating and managing communication between multiple devices.

MANUFACTURING

Manufacturing is one of the early adopters of IoT and is often referred to as Industrial IoT. Data-collecting sensors embedded in factory machinery or warehouse shelves can communicate problems or track resources in real time, making it easy to work more efficiently and keep costs down.

Learn More:

MESH NETWORKING

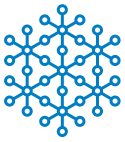
In a wireless mesh network, the network is spread out among dozens of Things that communicate with each other. The more Things in the mesh network, the stronger the network. Only one Thing, called the controller, needs to be hardwired to the internet via a modem/router. Mesh networks are growing in popularity in smart homes, especially Zigbee and Z-wave.

MIRAI

Mirai is a popular malware program that turns Linux-based machines into bots that can be used as part of a botnet in a large-scale network attack. Mirai tends to target remote cameras and home routers by using the default passwords that come with the devices. It's a cautionary reminder to always change the password on all devices that are added to your network, at work or home.

MOBILE DEVICE

A mobile device is a portable, handheld computer – like a smartphone, tablet or DSLR camera. They are battery powered and typically connect via WiFi, Bluetooth and/or a cellular network.



MONETIZATION

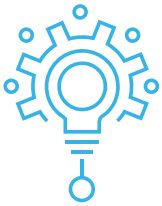
Companies are looking for ways to monetize their IoT data. Here are four possible approaches: (1) improve internal processes, (2) enhance existing products/services, (3) enhance the customer experience, and (4) develop new digital products/services.

NETWORK

A computer network, also called a data network, uses a mix of wired and wireless technologies to connect "endpoints" (servers, personal computers, phones, etc.) for the purpose of transmitting, receiving and exchanging data, voice and video traffic. Each endpoint has a unique identifier, often an IP address or media access control (MAC) address, to identify the source and destination of the transmission. This is the foundation upon which the Internet of Things is built.

NEURAL NETWORK

It's a powerful computer system used in modern machine learning and deep learning that's patterned after the operation of neurons in our human brain. Some popular applications of neural networks include speech-to-text transcription, facial recognition, musical genre/song recognition, data classification and fingerprint recognition (even if your hands are sweaty).



OPTIMIZATION

Optimization happens when business scenarios are improved mathematically using data. Improvements in data collection, storage and processing have made analytics more responsive, scalable and efficient just at the time when IoT data is making big data even bigger. The result is that organizations can realistically use all the available data (as opposed to sampling and extrapolation) to optimize their operations and do it in real time. Robust event stream processing is what underlies an innovative approach to optimization based on IoT data.

Some important considerations include:

- Are you able to analyze big data while it's in motion and make instant decisions?
- Can you get measurable value from low-latency responses to high-volume throughput at millions of events per second?
- Do you consolidate streaming data sources to process data streams out to the edge?

PLATFORM

An analytics platform is a must-have for the data-driven organization, especially if IoT data is involved. It's a software foundation that makes it easier to derive insights from your data in any computing environment and supports every phase of the analytics life cycle – data, discovery and deployment. SAS® Viya™ is a strong example.

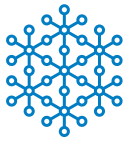
Learn More:

PREDICTIVE ANALYTICS

Predictive analytics is the next step after descriptive analytics. Its primary purpose is to answer the question: "What could happen?" It uses the data you have to predict data you don't have. It's not a fortune teller, though. Its job is to help you understand the future based on the data you provide.

PRESCRIPTIVE ANALYTICS

Prescriptive analytics comes after predictive analytics. Its primary purpose is to answer the question: "What should we do?" It can recommend one or more courses of action and show you the likely outcome of each decision. Self-driving cars live and breathe off of prescriptive analytics.



PRIVACY

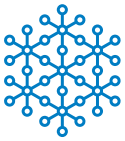
Big data privacy isn't a discussion reserved for data geeks and privacy freaks anymore. It's for all of us. With data and Things growing at an alarming rate, we can no longer afford to sit on the sidelines. We each need to take proactive steps to protect our data and our privacy.

PROTOCOL

A protocol is a set of communication rules for hardware and/or software that define how two or more entities are to communicate with each other. For example, HTTP is a protocol. For a protocol to be accepted, the participating parties must agree on the rules. A protocol may be developed into a standard to help reach an agreement.

PROXIMITY NETWORK

Also called a near-me area network (NAN). It allows devices in close proximity to wirelessly communicate with one another. For example, two smartphones with different mobile carriers can communicate, even though the communication path could be a long distance – i.e., going from one phone's LAN through the internet to the other phone's LAN.

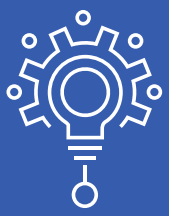


QUALITY

One of the challenges of IoT data, such as sensor data, is the sheer volume and velocity at which it's being created. The tricky part is to quickly identify and isolate the "right" data for analysis. Once identified, this is the data you'll want to prep for service.

QUANTIFIED SELF

The quantified self is all about self-tracking and lifelogging. Equipped with wearables and body sensors, an individual can keep track of every aspect of his life – from exercise to sleep, heart activity to calorie expenditure, and nutrition to food consumption – and that's just for starters. The IoT is changing how we perceive and interact with our bodies.



REAL TIME

Real time describes an immediate (or nearly immediate) level of responsiveness by a device or machine. If the response is sufficiently immediate or if the machine is keeping up with some external process (like showing us up-to-the-minute weather changes), we say it's functioning in "real time." Note that "real time" describes our sense of time, not a machine's.

RETAIL

As consumers, retailers can take advantage of our mobile devices to provide us with a better, more personalized shopping experience. Retailers can also use IoT sensors and devices for inventory tracking or security purposes.

Learn More:

RFID

RFID (radio-frequency identification) uses electromagnetic fields to identify and track tags attached to objects automatically. These tags can carry up to 2,000 bytes of data. Kevin Ashton, the father of the Internet of Things, studied RFID technology while at MIT.

SAS® ANALYTICS FOR IOT

This solution is a bundle of SAS' core offerings for IoT: SAS Event Stream Processing, SAS Visual Analytics and SAS Visual Statistics. It's a powerful industry-independent platform for IoT analytics.

Learn More:

SAS® EVENT STREAM PROCESSING

If you need to analyze IoT data on-the-fly, then SAS Event Stream Processing is the streaming analytics solution you're looking for. It can analyze millions of events per second, detecting patterns of interest as they occur. It will help you take immediate action and store what's relevant so that you can ignore the rest.

Learn More:

SAS® VISUAL ANALYTICS

To make sense of all your IoT data, you need to visualize it. SAS Visual Analytics is an intuitive drag-and-drop web application that allows anyone in your organization to explore the data, find pertinent answers, and then collaborate and share with others.

Learn More:

SAS® VISUAL STATISTICS

Fully integrated with SAS Visual Analytics, this SAS product allows users to create and refine descriptive and predictive models interactively. SAS Visual Statistics' distributed, in-memory processing provides you with results in minutes, not hours or days.

SAS® VIYA™

This next generation of SAS analytics has been built from the ground up to handle today's analytics challenges. The open, cloud-ready platform of SAS Viya is ready for anyone to use – from business analysts to data scientists and developers to executives. It's a product made for the IoT age.

Learn More:

SECURITY

Security is a hot topic, and it could well make or break the Internet of Things. It's not only about securing the Things of IoT, but also all the data and the networks that tie it all together. Security by design is one of the rally cries for the IoT.

Learn More:

SENSOR

A sensor is a device that can detect an event or change in the environment, and send that information to a machine that can then act (or not) on the data it has received. Sensors have become ubiquitous and contribute significantly to the Things population.

SMART

Any physical entity that can exchange data with another entity through a wired/wireless connection is said to be "smart." From smartphones to smart homes to smart cities, it is hard to ignore or escape the transformational changes being ushered in by the IoT.

SMART CITY

Local governments can take advantage of all the IoT data coming from water and energy resources, housing, traffic and parking, social media – not to mention open data. Today's technologies are not only cheaper, they're faster and allow governments to do more with less.

Learn More:

SMART GRID

You may already have a smart meter collecting your energy usage data. This is just a small slice of the IoT data utility companies need to manage. With IoT analytics, they can more easily predict equipment failures before they occur, integrate renewable resources more efficiently, and restore power more quickly after a storm.

Learn More:

SMART HOME

There's no easier way to experience IoT than to bring it into your home. Add a voice assistant like Amazon Echo or Google Home to the mix, and you're now controlling your home access, lighting, temperature, entertainment system, window coverings, and security system with your voice.

SPEECH RECOGNITION

It's the ability for a machine to "listen" to spoken words and phrases and convert them into machine-readable text. Natural language processing (NLP) can then take this text and extract its meaning. Voice assistants, like Siri, use both speech recognition and NLP techniques to respond to you.

STANDARDS

To maximize the reliability and safety of a product, method or service, a standard will be developed to establish consistent protocols that can be universally understood and accepted. Per the IEEE Standards Association, "it is only through the use of standards that the requirements of interconnectivity and interoperability can be assured." Many standards apply to IoT; however, some standards compete, while others overlap. It's still not clear which standards will prevail for IoT.

STREAMING ANALYTICS

Streaming analytics makes use of data in motion just as traditional analytics makes use of data at rest. Streaming analytics works in real time on data streaming in from applications, sensors, social media, devices and more – handling up to 1GB of data per second. Streaming analytics can be used to issue alerts immediately when fraud is detected or trigger a speeding ticket for the speedy tollway driver.

TALENT

The Internet of Things is forcing companies to ask this question: Do we have the right talent onboard to take on the opportunities and challenges of IoT? Whether the talent is internal or external, getting the right people in place should be a key priority for any data-driven organization.

TELECOMMUNICATIONS

The telecommunications industry will be significantly affected by the IoT since it will be charged with keeping all the data the IoT uses. Smartphones and other personal devices must be able to maintain a reliable connection to the internet for the IoT to work effectively.

Learn More:

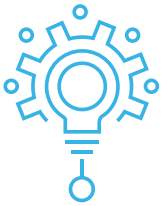
THINGS

When we talk about the Internet of Things, what exactly is a "Thing?" The answer depends on who you ask. There's no single "right" answer because it depends on context - and it's your job to understand that context. But generally speaking, a Thing may refer to a sensor, a device (mobile or not), and/or anything with an IP address. One point all will agree on is that the Things population is exploding. By 2020, there will tens of billions of Things on the planet. Without connectivity, a smart Thing won't really be smart, and the IoT vision will become stagnant.

TRANSPORTATION

In addition to connected vehicles and vehicle-to-vehicle communication, IoT is changing how delivery companies manage their fleets and how roadways are being monitored. IoT is not only making the transportation industry more efficient, it's making our roadways safer for all.

Learn More:



UBIQUITOUS

Inherent in the concept of connecting Things, IoT is transforming our world into one where the lines are blurring between online and offline.

Connected devices are growing in number to the point that IoT is fast becoming ubiquitous. That ubiquity by its sheer size is synonymous with big data, so it's no surprise that IoT is making big data bigger. That means the importance of data management is growing (along with data integration, data quality and data governance), as are the opportunities for value creation with analytics.

UTILITIES

Smart meters not only collect data automatically, they also make it possible to apply analytics that can track and manage energy use. Likewise, sensors in devices such as windmills can track data and use predictive modeling to schedule downtime for more efficient energy use.

Learn More:

VEHICLE-TO-VEHICLE (V2V)

This technology will allow vehicles – including cars, trucks, buses and trains – to "talk" with one another. By exchanging important safety and mobility information, these vehicles could help save lives, ease traffic congestion and improve the environment.

VIRTUAL REALITY (VR)

VR is the term used to describe a three-dimensional, computer-generated environment that you can explore and interact with. It's an immersive experience that makes you feel like you're actually interacting with your digital environment. Early IoT pioneers are exploring how to integrate VR into our smart cities.

VOICE ASSISTANT

Also known as an intelligent personal assistant. With your voice, you can ask an "assistant" to perform a task or service for you, like manage your schedule or provide traffic info. Many assistants are integrated with IoT – like Alexa (Amazon Echo), Google Home and Apple Siri – but some are not (such as Microsoft Cortana).

WEARABLES

Wearables are Things that are worn under, with, or on top of clothing. They are a primary tool for the quantified self.

WIFI

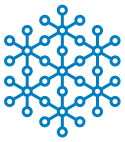
A popular networking technology that allows you to connect to the internet or other devices wirelessly. It's similar in concept to Bluetooth. This is how many, if not most, IoT devices communicate with one another. Even though connecting is easy, you need to make sure your device is secure.

WIRELESS

It's a form of communication that uses electromagnetic waves, not physical wires or cables, to transmit a signal. Popular wireless technologies include WiFi, Bluetooth and mesh networking.

XCOFFEE

Also called the Trojan Room coffee pot, it's one of the first examples of IoT in action. It was 1991, and the first webcam was set up outside the Trojan Room at CERN to watch a coffee pot. Read the story, written by one of the academics who wrote the code: https://www.cl.cam.ac.uk/coffee/qsf/coffee.html



YOTTABYTE

A yottabyte is one septillion bytes, or 10^{24}. It's bigger than a zettabyte, which only has 21 zeros. For you *Star Wars* fans, the yottabyte was named after Yoda.

ZIGBEE

A wireless mesh networking protocol popular in home automation. It provides a way for all the smart Things in your smart home to communicate with one another. It competes with Z-wave.

Z-WAVE

Another wireless mesh networking protocol popular in home automation. It competes with Zigbee.

SUMMARY

The term *Internet of Things (IoT)* may shift as we progress towards a more connected planet, but we can count on its ubiquity. Regardless of the label, IoT is changing life as we know it.

The 101 terms (and categories) in this A-to-Z guide have provided you with IoT's building blocks. It's a good start, but it's just the beginning of a richer, and yes, quite complex discussion of what IoT means for you and your company. You're not alone. SAS is here to help with that discussion.

Learn how SAS has been working with companies to give context to the Internet of Things, allowing them to digitize their businesses, increase customer satisfaction, and improve the bottom line.

Regardless of the label, IoT is changing life as we know it.

THE POWER TO KNOW®

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