HUAWEI

Unclouding the Cloud

A simple, plain English guide to Cloud Computing and why it's important

HUAWEI TECHNOLOGIES CO., LTD.

Part 1

What is the Cloud, and why should I care?

What is Cloud Computing?

Let’s start with a simple definition:

Cloud computing is the use of computing services delivered over the Internet. For a consumer, those services might include music downloads, stock trading, or calling a ride with Uber.

The Cloud isn’t really a cloud, of course. It’s thousands of servers — computers sitting on racks in a warehouse someplace, cooled by a giant air-conditioning system.

You’re probably already using the Cloud. When you take a picture with your smartphone, the photo stays on the phone for a while. Then, at some point, you may notice a slight delay when you call it up. That’s because the photo has been sucked up into the Cloud, to be stored in one of those big servers, thereby freeing up space on your phone.

Benefits of the Cloud

The benefits of the Cloud go far beyond storage

For consumers, the main advantage is convenience. It's convenient to call a ride with Uber, or to have a Gmail account, or to back up your photos online.

For companies (and government agencies), the Cloud's main advantage is lower costs. Instead of having to buy lots of expensive hardware (all those servers), a company can sign up for a Cloud service from a provider that has bought the hardware already. The company can use as much of the service as it needs and pay accordingly, just as one would pay for electricity or tap water. If company management decides it doesn't need the service anymore, they can cancel their subscription.

Say, for example, that a dentist wants the ability to store, and search, years of her patients' X-rays. The more X-rays the dentist stores, the more she pays.

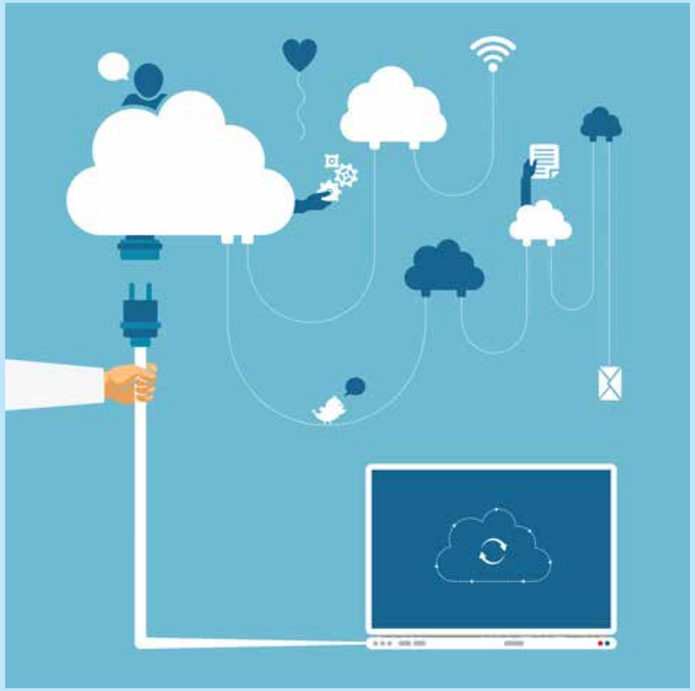
This is advantageous both for a large practice with a dozen dentists and several thousand patients, and for a single dentist with just 50 patients. That's because even the single dentist would have to store the images on a computer. If that computer failed, the dentist (not being an IT expert) probably wouldn't know how to fix it. She wouldn't be able to access her X-rays, and would have to call for tech support to get the computer running again. If the computer couldn't be repaired, she might lose all her patients' records — a big blow to her business. And she'd have to buy a new computer.

With the Cloud, the dentist doesn't have to worry about maintenance, repair, or upgrades. She doesn't have to worry about backing up her files. Her Cloud service provider handles all of that.

Today, the Cloud is mainly used by large enterprises that buy pre-fabricated Cloud modules for particular business functions — Finance, for example, or Sales. An organization's IT system can easily connect to these Cloud modules to use their capabilities. This saves time and money, and gets the functions up and running quickly.

For example, Salesforce.com provides a website that lets you get a full Customer-Relationship Management (CRM) system up and running within a few days. In the past, you'd have had to buy a server, install networking and storage, build the database, create the application, load your data — and then test the system to make sure it all worked. That would have taken months, or even years. Now, it takes days. Companies save time and money with this Cloud-based approach.

‘Computing-as-a-Service’



The key to the Cloud

The Cloud delivers computing resources as a service. That means you subscribe to it, like cable TV. You get a certain number of features for a set price. If you want more features, or you use more computing resources, you pay more.

In this way, the Cloud delivers three main things:

- **Software-as-a-Service (SaaS).** With this model, an enterprise buys a license to use an application, such as email or CRM software, from a third-party provider. You access the app over the Internet instead of buying software on a disk and installing it on your computer.

- **Platform-as-a-Service (PaaS).** The platform has everything subscribers need to build, test, and launch their own apps. The subscriber does not control processing, networking, and storage (which would be IaaS). This allows a company to run apps that the company itself has created. That means that the company subscribes to a platform that has everything it needs to build, test, and deploy its own applications. For example, both Amazon Web Services and Microsoft Azure sell a developer platform for a fixed monthly sum.

- **Infrastructure-as-a-Service (IaaS).** Here, the enterprise is buying fundamental computing resources: processing power, storage capacity, and networking capability. Instead of buying an app (as with SaaS), you buy the computing infrastructure and pay a subscription fee for the resources you use. For example, for a single server with 1 Terabyte (TB) of bandwidth and enough connections for 100 users, you’d pay a set amount per month. Your apps and programs would then be installed and would run on this ‘rented’ infrastructure.

Four types of Cloud

In addition to the three types of Cloud services, there are four types of Cloud. The differences between them have to do with the degree to which resources are shared with other users.

- **Public Cloud.** Companies buy computing resources such as servers, storage, networking, and software. These resources are shared: Your company is using the same computing resources being used by others. Amazon Web Services is an example of this approach.
- **Private Cloud.** A company's information is stored on dedicated, private computing resources. These resources are not shared; no one outside your organization has access to them. A company can build its own Private Cloud, or it can lease one.
- **Community Cloud.** A number of organizations cooperatively build and maintain a Cloud.
- **Hybrid Cloud.** Lets you move data back and forth between public and private clouds. This approach benefits subscribers by combining the security of the Private Cloud with the affordability of the Public Cloud.

Here's an example of a Hybrid Cloud approach:

Every company has a payroll. Payroll for the current tax year is important, and companies need ready access to it. Payroll for last year is less important, but you still might need to get to it quickly. Payroll from seven years ago? You have to keep those records, but they don't need to be available at a moment's notice.

So you host the last two years' payroll records in-house on your own hardware systems, i.e., your Private Cloud. Anything more than two years old, you store in the Public Cloud. Those records are still accessible, but they're not 'right there' — so you don't waste money placing archival data on disks that could be used to store more up-to-date information. Again, this is a version of what happens to the photos on your phone: Recent pictures stay on your device, while older ones get stored in the Cloud.

Hybrid Cloud case study: Hunan TV and Shenzhen TV

Huawei created a Hybrid Cloud solution for Hunan TV, one of China's leading broadcasters.

Because TV programs increasingly are produced and broadcast in High-Definition (HD) format, video was consuming a large amount of storage space in Hunan TV's internal data center.

Huawei's solution enabled the station to store ultra-high-quality video in its own data center, while putting lower-resolution 'work-in-progress' video into a Public Cloud. Moving the work-in-progress material to the Public Cloud freed up enough space that Hunan TV can now store 50% more HD video in its own data center.

Another Chinese media outlet, Shenzhen TV, employed a Huawei solution to improve its resource use by 50%, shorten its average news program production time from two hours to 72 minutes, and reduce the amount of office space it needed to perform the same amount of work.

How does cloud technology work? A quick look at virtualization

In some ways, the fundamental computing technology behind the Cloud is not new.

From the 1950s to the 1980s, businesses used big mainframe computers with lots of processing power. Mainframes could split up tasks into separate batches and process them simultaneously. They could divide computer memory into segments, with each segment assigned to handle a specific task. That's basically what the Cloud does now.

But several things have changed. Today's computers have much more processing power than in the past. And, with the Cloud delivering Computing-as-a-Service, this processing power has grown much more widely available.

So the Cloud offers computing resources that are more powerful, and more accessible.

They're also less expensive. The Cloud relies on shared computing resources. Shared resources are more efficient, and therefore cheaper.

The process that allows resources to be shared is called virtualization — an aspect of Cloud technology that has changed significantly in the last 10 years or so.

Virtualization uses software to simulate hardware. It performs the tasks that would normally be done by a piece of hardware, such as a router or storage drive. In a virtualized environment, what looks to the computer's operating system like a piece of hardware is, in fact, only a snapshot or image of that hardware.

Virtualization lets you create something called a Virtual Machine, or VM, a piece of software that functions like a little computer. Each VM has an operating system and an application that runs on it — just like a computer. This is what enables computing systems to share resources.

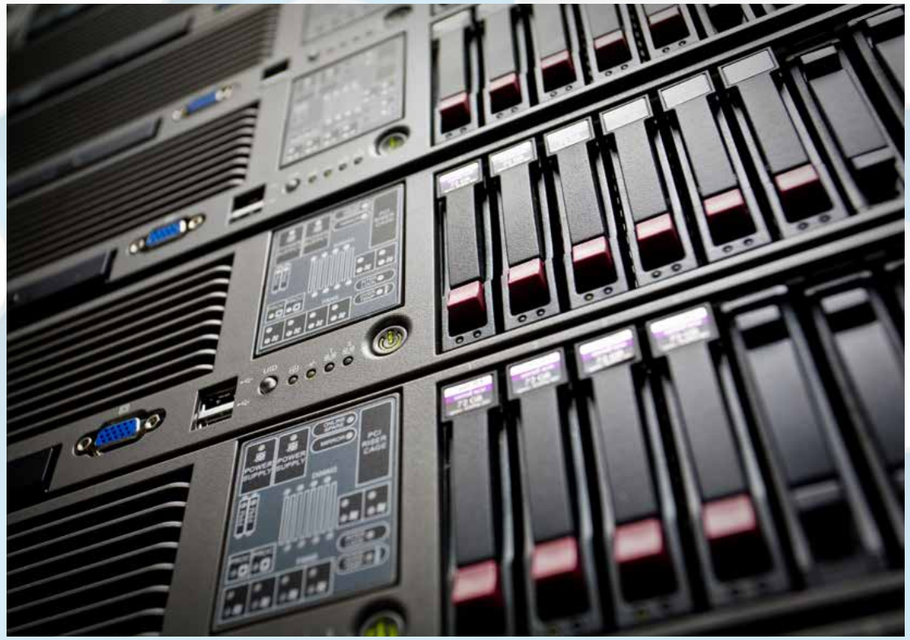
To understand why, it's important to appreciate the difference between the way your PC or Mac works, and the way a bigger, more powerful enterprise computer works.

Personal computers let you run multiple applications. You can simultaneously fire up Word, Excel, Skype, and Gmail, and it's no problem to have them all running at the same time.

But, at an enterprise level, applications are much bigger and need a lot more computing power. Before Cloud computing came along, each server had

just one operating system, and each operating system ran just one application. So there was a server for your HR function, and another for your CRM, and, maybe, another for your Product Development or Sales.

This was extremely inefficient. Most servers only used 5% to 10% of their actual capacity. And, as new applications were added, new servers had to be added too, leading to server proliferation. So, if you ran a small business, you might need 20 primary servers, plus another 20 backup servers in case the main servers crashed. That's 40 servers you had to pay someone to maintain and repair. And all those servers needed electricity to run — and they had to be cooled by large air-conditioning systems, so they didn't overheat.



In addition, there were costs you wouldn't think about unless you work in IT, such as the cost of all the cabling needed to connect servers to each other and to a data network. Plus, if your server proliferation grew severe enough, you might actually have to rent new office space to house all your servers.

And, remember, in this scenario, each server is only running at 5% to 10% of its capacity. That's like needing a different car for each place you want to drive to, plus a backup car. And you'd have to keep the motors running all the time — a terribly wasteful and inefficient way to run things.

Virtualization solved this problem. The key technology, again, is the VM, a little software program that functions like a tiny, independent computer. By putting multiple VMs on a server, you enable it to run multiple applications. One server now has lots of VMs running different programs. That lifts your capacity utilization rate up above 50% — a huge improvement over the 5% to 10% that was possible in the past.

Each VM can be contained in a single file, so it can be copied, just like a Word document. That lets you easily increase computing power when you need it (not indefinitely, but up to a point).

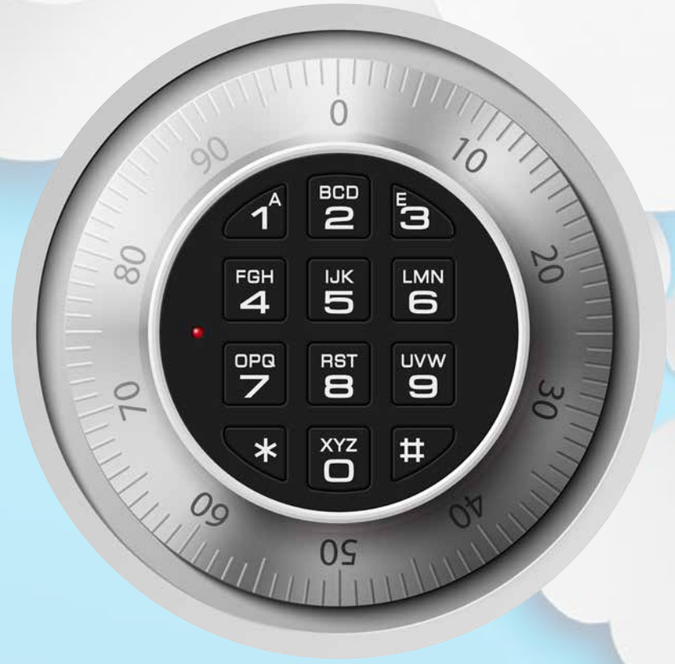
You can also make copies that serve as backup files in case of a power outage or system failure.

And you can move a VM among different servers, just as you'd 'drag and drop' a Word file from one folder into another. This allows you to allocate computing power wherever you need it most.

To recap: The Cloud is all about sharing resources, and virtualizing resources allows you to share them on a large scale. Virtualization is the first step on the road to the Cloud.

What about security?

Some companies are reluctant to use the Cloud because they perceive Cloud services as less secure. The main reason is that, in Cloud computing, data storage is centralized: With a Public Cloud in particular, you're entrusting your data to servers that are shared by other users. And, because virtual machines allow a single server to run multiple applications, computing resources are centralized as well.



But the Cloud also has some advantages when it comes to security. It allows the use of data analytics that provide a much more comprehensive threat analysis than was possible in the past. In fact, Public Clouds have a rich portfolio of security services that provide far better security for small- and mid-sized enterprises than such companies could afford to put together themselves.

The key to Cloud security is to have a comprehensive defense system that covers physical devices, networks, hosts, applications, and data.

Part 2

How the Cloud will develop

To understand how Cloud computing will develop in the future, it's necessary to understand two key concepts

KEY CONCEPT #1

The Cloud will change Information and Communications Technology (ICT) from a support system to a production system

Nearly every company, large or small, needs basic ICT infrastructure to support their business operations. But soon, the Cloud will transform ICT (which some have compared to a utility service), turning it from a support system into a production system that allows companies to create value and adopt new business models.

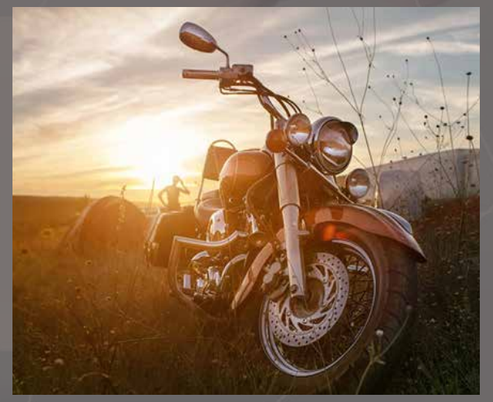
To become truly digital, companies must integrate the Cloud into their production processes. The Cloud gives enterprises access to advanced technologies such as data analytics, mobile broadband, and the Internet of Things. With these new resources, companies will be able to deliver products and services in a way that is flexible, customized, and innovative.

Case study: Harley-Davidson

Harley-Davidson, the maker of iconic motorcycles, offers its customers the option of customizing their bikes to reflect their individual tastes. Each motorcycle is made of more than 1,200 components, many of which can be personalized for fit, style, and performance. Customers can choose the engine, the tailpipes, the intake system, and the transmission; the height and style of the seat or handlebars; and, of course, the color and finish of the paint.

This is great for customers, because it opens the door to nearly unlimited combinations. But from a business standpoint, it was problematic for Harley. Producing a single customized bike required 21 days. The personalized, single-batch manufacturing that was so important to its customers was affecting the company's productivity.

Using a Cloud platform developed by SAP in conjunction with Huawei, the Harley-Davidson production center in Germany reduced the time needed to produce a customized bike from 21 days to just six hours. Customers can now place an order in the morning, wait half a day, and ride their dream bikes home that same afternoon. This Cloud solution has boosted manufacturing productivity at the plant, while keeping customers happy.



KEY CONCEPT #2

As all companies operate in a digital ecosystem, cooperation will become more important than competition

The Internet of Things, or IoT, is the system created by interconnecting computing devices embedded in everyday objects, enabling them to send and receive data. Huawei estimates that manufacturing, utilities, and Smart Cities will make up a bit more than half of the IoT. The remaining 45% will involve consumer applications such as home appliances, as well as vehicles, including driverless and semi-autonomous cars.

The IoT will create an estimated 100 billion Internet connections by 2020. That same year, the average person in a developed country will have 4.3 connected devices. This means companies will operate in a web of digital connections — a digital ecosystem. In order for that ecosystem to work, industries that have never worked together before will have to start collaborating to succeed.

Much of this collaboration will take place in the Cloud. To cultivate a healthy cloud ecosystem, companies will have to make a fundamental shift: from managing competition to managing cooperation.

In the past, companies ‘managed’ competitors by trying to kill them off. Hence the bias toward vertical integration, where companies tried to control the entire supply chain, from raw materials to final product. Today, the Internet has enabled small companies to launch quickly and cheaply, using software instead of physical assets. As a consequence, competitors are everywhere. Putting them out of business simply isn’t possible.

Instead, companies have gone from controlling resources to orchestrating them — from managing competition to managing cooperation. This can be even harder than competing, since instead of trying to vanquish your opponents, you’re trying to get them to work together toward a common end, using resources that may not belong to you at all.

The big trend that Huawei sees in Cloud computing is what might be called the Industry Cloud. It’s actually not a single cloud at all, but thousands of distinct, separate ones. Huawei believes that by 2025, all enterprises will use Cloud technology to implement business models. We estimate that 85% of enterprise applications will be deployed in the Cloud, and we believe the Cloud will be integrated into nearly every company’s core business.

What is Huawei doing to promote the Cloud?

First, Huawei has established alliances aimed at growing the ICT industry and fostering digital ecosystems. Huawei belongs to many IoT organizations, including the Industrial Internet Consortium, the Alliance of Industrial Internet, and the Cloud Security Alliance. We're actively involved in open-source communities such as ONOS, OPEN-O, OpenStack, and Carbon, which promote collaboration and innovation.

Second, Huawei is investing in digital ecosystems. In 2015, we committed to investing US$1 billion to help developers create the software that connects the different nodes of digital life for consumers and businesses. The goal is to help software developers create innovative services that respond quickly to customers' needs. For example, a bank or telecom company may want to develop particular apps for their customers. We'll help them do it by providing an interface that allows their apps to work with our hardware.

We're also giving them access to a suite of technical services, including security and data analytics, to help them create maximum value for the apps they create. Just as smartphones created a platform for apps, Huawei wants to create an open platform for software developers who will write the applications that power the digital ecosystems of tomorrow.

Third, Huawei provides a three-part foundation that makes the Cloud easy to understand, build, and grow, regardless of the user's needs:

- Hardware. We make servers, storage, and networking gear (routers and switches), providing the technical foundation on which the network is built.
- Software. Virtualization and Cloud-ready software provide functionality that allows the hardware to work smoothly, even though it may come from many different vendors. 'Vendor lock-in' is no longer a problem.
- Platform. Huawei provides an industry-standard OpenStack platform that allows you to create a template for almost everything. It is an automation layer that allows all hardware, software, and management tools to speak the same language. For example, when you need a new order processing system, the automation layer will build an environment that matches your requirements, getting you online in minutes — not weeks, as in the past.

What all this means is that new equipment is easier to install, and new services easier to set up, because they are Cloud-ready. All the components of the system work together, allowing you to control products and solutions made by any vendor you want to do business with.

Case Study: South East Water

In Australia, leaky pipes lead to the loss of 30 billion liters of water every year. South East Water wanted to install sensors into its pipe network to monitor water pressure, flow, and quality, and to provide new services to major water users via the Cloud.

But the 3G connections the utility used for its communications were not adapted for the connected objects in the Internet of Things. The systems could not link up wells, pipelines, or reservoirs. And they didn't support low-power, widely distributed, low-cost terminals.

Huawei worked with South East Water to introduce narrow-band IoT technology that enabled the deployment of low-cost, low-power terminals connected over a wide area. The system is projected to save South East Water millions of US dollars every year, and covers 99.5% of their network.

When water utilities go digital, their device challenges cannot be solved on the device level only. They require the collaboration of the network, and of the Cloud.

What do companies need to do next?

Huawei traditionally has served telecom companies — that's our legacy business, and it's still a big focus for us. As the telcos that run the networks undergo their digital transformation, they will stop relying solely on the voice and data revenue that has been their bread and butter for decades. They will become providers of digital services.

But it's not just telcos. Companies in every industry will eventually have to make this digital transformation. As digital technology permeates every area of our lives, customers will expect a particular type of experience from all of their service providers. That experience can be described with the acronym ROADS:

- **R**eal-time: The network has sufficient bandwidth to produce zero wait time
- **O**n demand: The network is customized according to user requirements
- **A**ll online: The network accommodates an environment where every device is always connected
- **D**IY: The network allows operators to customize apps and services, and to define their own network requirements
- **S**ocial: The network integrates with social media networks so that customers can make maximum use of social media sharing.

As consumers and enterprises come to expect a ROADS experience, the Cloud will enable telcos and other industries to deliver it. The Cloud is the key to innovating new business and operating models, while improving efficiency and customer experience — and doing all of this at a lower cost.

New applications are emerging quickly, with video taking center stage. Already more than 70% of today's data traffic comes from video. Soon other sectors, such as manufacturing, security, healthcare, and entertainment, will also embrace Ultra-High-Definition, as well as virtual and augmented reality.

More widespread adoption of the Cloud will substantially enlarge the ICT industry. For the telcos that run the networks, and for companies across all industry sectors, the efficiencies of the Cloud will lower costs and enhance their digital capabilities, allowing them to provide new services and grow their businesses.

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