CLOUD COMPUTING: A PARADIGM SHIFT?

Having read the two previous chapters, you know what cloud computing is and what it does. In this chapter we step back and ask some difficult questions. Why cloud computing? What does it give you? What is so special about cloud computing? And how will it affect you, your work, and our society? Just as Microsoft Windows became ubiquitous at home and work, and changed our lives, cloud computing represents a paradigm shift. This is because cloud computing is an enabling technology that bypasses many functions provided by your computer, the software installed on it, your workplace's IT and finance departments, businesses and government departments.

In this chapter we consider cloud computing's paradigm shift from three different viewpoints: (1) how it should affect you socially and personally, (2) how it will affect you in your work, and (3) how it will affect businesses.

Gartner's hype curve[1] shows that cloud computing is presently at its peak for inflated expectations. This chapter might be considered as providing a portent for those expectations whereas chapter 10, on transitioning to the cloud, will provide you with practical tools and frameworks to realize these paradigm shifts.

Social Paradigm Shift

How you spend your leisure and how you live, both at a personal and a societal level, are what we connote as social life. How that social life could be affected by cloud computing is the subject of this section. In order to consider that paradigm shift in your social life, let us examine the three types of clouds that would be the primary change agents: the societal or community cloud, the personal cloud, and the cloud of things.

Societal Clouds

A societal cloud is one that serves a group of people that have something in common. For instance, that common element could be defined by geography (along township, state, national, or international boundaries), hobbies (philatelists, numismatists, etc.), languages, or interests (trade unions, scouts, chambers of commerce, etc.). Your

membership of the societal cloud would be defined by the common element you possess.

An international societal cloud could be defined for NATO, UNO, EU, and other such bodies. The citizens of countries belonging to an international body would then be members of that cloud. Common benefits or issues could be considered by the cloud members, which could host, for instance, discussion boards, instant messaging, storage of shared documents, and video conferencing. All this would be done in a secure environment. This is an example of a PaaS societal cloud.

Similarly a societal cloud could exist at a national level: for health care, training, politics, farming, and the like. The data collected could be de-personalized and aggregated to provide trend analyses. For example, in health care, the information collected with regard to a particular morbidity could be analyzed in terms of its concentration in particular areas, age groups, and social or income brackets, in real-time and an automated manner. The information could be made available freely to anyone researching the prevalence of morbidities in the aggregate. That information could be used to link multiple morbidities and their effects on members of a relevant societal cloud. Moreover the range and dispersion velocity of infections could be gathered from such a medical cloud to predict the spread of a disease across a country or region. This information can

then be used to prepare the distribution of inoculations or medical resources.

A community cloud is one that provides a service to those who have a common interest. The common interest could be avocations such as farming, weather forecasting, trade bodies, banking, law and publishing. In a sense, with the Internet and various websites that cater to common interests, we already have Internet-based communities, known as social media. Converting these to societal clouds is more a case of using cloud elasticity and an appropriate price model. So the societal cloud is less of a paradigm shift from an individual's perspective. However, having a societal cloud that is a community cloud comprising of clouds (a societal cloud of clouds) enables member services to be defined in a unique and individual manner. Thus the societal cloud, at a high level, acts as a service broker for members belonging to a societal cloud and can tailor a society to suit an individual's background and interests.

Personal Clouds

A personal cloud is one that belongs to you for your use. You may already have come across such clouds in the form of Apple iCloud, Google Drive, or Microsoft OneDrive. These allow you to store files such as documents, eBooks, pictures, and music so that you may access those files from any device and any location. However, you should have a large choice in future with regard to various use cases[2] for

a personal cloud. In general, we can consider a personal cloud in terms of the following three use case categories: leisure and well-being, finance, and shopping. Some of the examples cited may seem futuristic, but they demonstrate the use to which a personal cloud could be put to.

Personal Cloud for Leisure and Well-Being The current plethora of storage clouds such as iCloud fall under this category. In the future, as storage becomes cheaper due to economies of scale, you should see video-streaming personal clouds that retain your collection of movies or video clips. This would be tantamount to having your own personal YouTube service.

Other personal clouds, such as a health wallet, could store information on the doctors you visited over a period of time, results of your health screenings, and the medical costs associated with the health checks. Various devices, such as your weight scale, pedometer, or blood pressure monitor, could be hooked up directly to your personal cloud to provide you with immediate alerts should your readings traverse the ideal thresholds. (While all those health devices hooked up might evoke an idea of an Internet, or cloud, of things, we classify such a cloud as a personal cloud rather than a cloud of things because such devices monitor you or are related to you and you alone.) A health service provider could aggregate everyone's health data, after de-personalizing it, to analyze the best fitness

and health plans for you. Alternatively, the analytics could be sold to a health insurance company that would be able to predict the likely probability of health costs associated with someone in similar circumstances to you.

Another example of a personal cloud for leisure comes from motoring. A car could capture your driving profile and send it to your personal cloud. The information could be, for example, the average speed you drive at, the locations you drive through, your general driving style (aggressive or passive), and the number of accidents you have. Some cars already capture this type of information at present, but it is stored onboard rather than made available to you in your own personal cloud. A car insurance company could then use this information to tailor its car insurance offering to your driving profile. Yet another example is having smart street lights that sense your proximity and provide lighting to you on the basis of whether you have paid the local taxes or the road tax; those motorists who have not paid these taxes would not have the roads lit up for them unless they pay instantaneously, using technologies such as Near Field Communications (NFC), to have the lighting turned on. Of course, this assumes that a pact is not formed between the compliers and noncompliers to journey together in a group to foil the lighting scheme.

Personal Cloud for Finance A personal cloud that receives your bank statements as well as credit card

transactions could provide you with a balance sheet and a budget on the fly. Then, at the end of the financial year when your personal finance cloud obtains income tax regulatory information from the government's INaaS cloud, this cloud could create an income tax statement for you automatically. If in the future a government agency were to allow the remittance of such electronic tax returns, your cloud would file the tax statement with the relevant government department upon your approval. Thus the chore of creating a tax return would be automated for most individuals, and they would not have the need to appoint an accountant. Another example of a personal finance cloud would be in terms of providing you with an integrated view of all your investments across various pension funds, IRA schemes, and brokerage accounts. This would enable you to assess, at a glance, what your investments' performance is over a given period at a moment's notice.

Personal Cloud for Shopping Your personal shopping cloud would store your shopping preferences based on your shopping history across all stores. It would then analyze your buying pattern and alert you of what you need to buy in a timely manner by using predictive analytics. It could even scan discounts or offers at various stores, physical or electronic, to provide you with a purchasing choice. Further, it could manage your electronic wallet so that you could pay for the goods in a quick and easy way. A lot

of work is currently being done by various companies on electronic payment schemes, and some of these payment schemes could be integrated to your personal cloud for shopping or to your electronic wallet.

Cloud of Things

A cloud of things is a cloud service that helps the management or use of a thing (a nonliving entity) by one or more living entities. (Those things are connected via the internet of things.) So, for example, you could have a cloud for your house. It would receive information from a number of sensors related to security, smoke, proximity, light, and other installed devices, and also automatically control other such things as curtains, fire alarms, lighting, and heating for you and other residents of that house. Moreover, depending on the room, each occupant of that room would have a personalized profile in terms of when curtains can be drawn or lighting turned on. Likewise, for your work environment, you could have a facilities cloud. Such a cloud is an example of a BPaaS because of the physical processes it manages automatically to benefit you, such as the drawing of curtains and monitoring of lighting. Another such example would be a meeting room cloud that keeps a logbook of the room's availability so that you can book the meeting room for a given period provided that it is available. The cloud could further inform various parties, such as security or catering, of its occupancy to enhance or ease the

use of the meeting room. The meeting room cloud itself could belong to an aggregate cloud comprising of meeting room clouds, and those then could act in concert so that if a meeting room is unavailable at a certain time, you will receive a choice of suitable available rooms. This way you would have a selection of meeting rooms that fulfill your criteria in terms of room size or location, for instance. The meeting room aggregate cloud could in turn belong to the facility cloud, which itself would be a composite cloud. The section headed "Cloud Relationships" in the previous chapter can play a prominent role in the cloud of things because you could have various relationships—such as encapsulation, federation, composition and aggregation—between clouds of things in order to create other clouds of things.

Work Paradigm Shift

Two major trends are currently taking place in the workplace:

- Workstations replaced by zero or thin clients.
- Ubiquitous computing: use any device for work.

Workstations (laptops and desktops) are being replaced by machines that do not have applications installed

on them. Such machines are known as zero clients if they have the operating system embedded on the silicon chips or thin clients if they require an operating system on disk. In order for a workstation not to have any applications installed on it, you need to use cloud-based applications to perform your work on the thin or zero client workstations. The clouds' hosting those applications can have varied deployment models: they can be private, public, community, or personal clouds, for instance. Generally, for productivity related applications such as Office or Email, you would use a public cloud service whereas for your own bespoke applications, you would use a private cloud service. But the applications do not necessarily have to be cloud based; they can be hosted on servers in the data center using traditional physical or virtual computing. As long as the application allows you access using a web browser, you should be able to use it regardless of the underlying technology used for hosting it. The benefit of a zero or thin client computing environment is that your company's IT department does not have to manage all those applications installed on a large number and variety of workstations. Instead, they manage just one application in the cloud or provide access to an application provided by a third-party's cloud service. Another benefit is that because the workstations do not contain any local disk or data storage mechanism, but instead use a cloud-based data store, the work information is stored at a central and, hopefully, more secure data store.

This means that if the workstation were to be lost or stolen, then the company's data would not be compromised. Indeed, in such a case, the zero or thin client workstation would be less expensive to replace as most of the application hosting, storage, and computing takes place elsewhere, in the cloud.

Ubiquitous computing started off with universities that needed to cater to a plethora of computing devices that students brought to the campus. Providing access to university-provided applications and information on various students' devices meant that a university's IT department needed to allow a secure way of allowing access to the university's resources on devices that the IT department did not manage or have any control over. As the technology developed, it became known as bring your own device (BYOD), which is currently being adopted by businesses to deliver IT to their employees. But ubiquitous computing is much more than BYOD; it means that you can compute and access corporate information from anywhere, not only from the campus or the workplace, by using any device and at any time. The onset of such a computing framework means that the IT department increasingly becomes a cloud service broker that maintains a service catalog of allowable cloud computing applications for an employee to use for work purposes. Those cloud-based applications then can be used from anywhere, at any time and on any device. Any data that need to be used or stored

locally on the device are stored in a secure area within the device known as a sandbox. The sandbox is created when you become an employee and deleted when you leave the company. It stores the information so that only allowable applications can access it and further, the data are optionally encrypted.

Organizational and Business Paradigm Shift

Most businesses have an IT department that looks after central applications such as mail servers and web servers. The more business-related IT is performed locally by the business units or groups that deal directly with delivering a product or service to the customer. So you have a hub-and-spoke model wherein the centralized IT acts as a hub and the various business groups work autonomously in the periphery as spokes. If the central IT function is unaware of applications used by the various units or groups in the business, then those applications and their computers tend to be classified as shadow IT. If something were to go wrong with such an application or the computer hosting it, then there would be a problem in terms of supportability. A strong central IT department would refuse to support shadow IT whereas a weak one would support it at the cost of extra effort and money expended at learning about the system. In any case, shadow IT represents a potential

security breach as well as an additional expense because of its nonstandard nature. For companies, shadow IT therefore represents a business risk.

As more applications become available via cloud computing, the business units are likely to increase their reliance on shadow IT because the spending threshold will be lowered, as figure 10 shows. Due to a greater level of abstraction provided by cloud computing, the skillset required to manage and support the shadow IT will diminish,

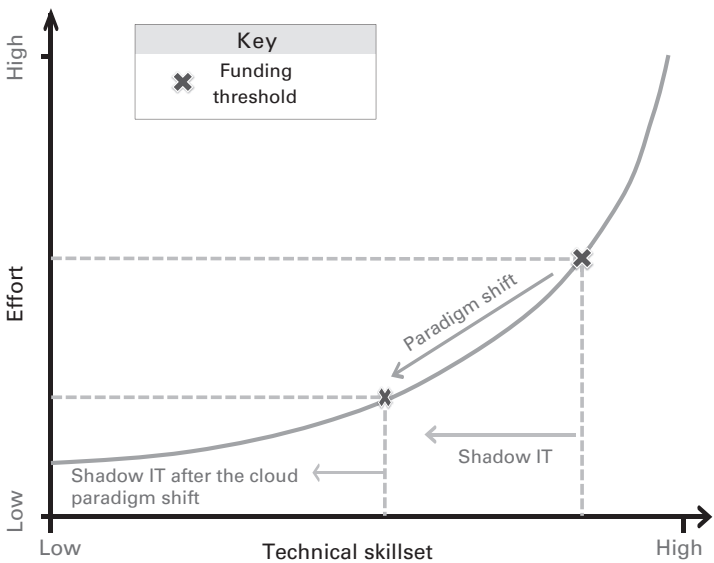

Figure 10 Funding threshold for shadow IT

and this will be a contributory factor in reducing shadow IT costs. Thus almost all the IT used in a company is bound to become cloud based. The central IT department, in order to survive, will need to evolve and become a cloud service broker. Doing this will ensure that the business departments will be enfranchised to work in a semi-autonomous centralized structure as far as IT is concerned. This will further ensure that shadow IT becomes mainstream IT and so will no longer be classified as shadow IT. As a cloud service broker, the central IT department would become a specialist branch of the purchasing department, since most of the IT and computational resources would be bought as services or used on a pay-as-you-go basis. The increased commoditization of IT due to cloud computing and related technologies will make this more possible as the technical skillset requirement to use and purchase IT diminishes, as shown in figure 10. The IT department's function will evolve to one that maintains cloud service contracts with cloud service providers, whose services would be listed and described in a cloud service catalog that the IT department would maintain.

How would the IT department then measure the value of a cloud service? How would it compare various pricing schemes from different cloud service providers in order to select the services to be made available via its cloud service catalog? We consider these questions in the next chapter where we discuss price and value models.