Chapter 12
Cloud Computing:
Future of the Past

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ABSTRACT

The growth pattern of mobile devices and wireless network technologies leads to revolutionized communication markets with constant advancements (e.g., partly realized 4G and yet-awaited 5G wireless networks, content centric networking, and mobile cloud computing). From the thin-client paradigm of the early computing history, where the bulk of the computing power was on the server side, we have witnessed a rapid transformation to powerful mobile end-user devices with ubiquitous connectivity. The cloud-computing paradigm is now promising to bridge those two ends in order to combine the best of both worlds. This chapter presents: 1) basic concepts of cloud computing in examining the different perspectives of stakeholders in the cloud market, 2) survey of existing approaches and solutions, 3) applications of cloud computing, 4) architectural approaches to cloud computing, including traditional and mobile cloud architectures, and 5) an overview of the related Software-Defined Networking and Network Function Virtualization concepts.

1. MOTIVATION TO USE CLOUD COMPUTING

The main motivation for the use of cloud computing instead of self-hosted infrastructures, hardware and software is that it brings down the costs, offers increased stability and is accessible from everywhere. Companies do not have to buy expensive hardware or worry about carrying out heavy tasks; they simply rent the hardware or allocate the computation tasks to machines in the cloud. After finishing their computation, they no longer have to pay for it (Agrawal, Abbadi, Das, & Elmore, 2011). However, reduction in costs is not the only driving force of cloud computation. It is envisioned that cloud computing will drastically change the information technology by offering businesses the opportunity to attain more gains in much faster and more effective ways. We can summarize those gains as follows:

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- **Availability:** Cloud services can be accessed through the Internet, which may be translated to connectivity everywhere and every time. This eradicates the need for large storage and compute services to be available on device; rather, a user may enjoy these services by associating to cloud through a simple user device even when he / she is mobile. It is worth highlighting here that most cloud architectures feature a broad band of backups and redundant storage, so data loss is no longer a threat.
- **Scalability:** Data and application resources can be quickly provisioned when and where they are needed.
- **Less Maintenance:** Given the fact that the consumer is just renting services, where hardware, application, and bandwidth are managed by the cloud provider, the consumer of cloud services incur no maintenance costs. Also due to the centralized structure of the cloud's data center, it is easier to handle defective hardware for the technicians resulting in even lower deficits.
- **Cost Effective:** Most of the business models follow pay-per-use model and the customer only pays for what he needs or uses. This makes cloud architectures and the process of outsourcing into the clouds even more attractive. It paves the path for new business models, where the stakeholders optimize their profits and resource utilization on smaller time quanta and more dynamic settings. Clearly, these models result in reduced incurring costs for consumers, whereas the cloud providers find their profit windows in optimal resource utilization. Due to the scalability, customers can easily upgrade their rented resources whenever they need additional storage capacity, performance, etc. (Otto, Stanojevic, & Laoutaris, 2012).
- **Facilitating Content Centric Vision:** As content-centric networks send named packets of data through the network, a new kind of caching, independent from the application layer, is created (Arianfar, Nikander, & Ott, 2010). This requires decreased latency, which the cloud achieves by routing the data directly where they are required. Often, when working on distributed clouds where it is not obvious where the information are stored, the latency increases by routing the data - in the worst-case through the whole network of the data center. In combination with content-centric services, this could mean that the services or applications get pushed onto servers which have the best connection or lowest latency or load to the customer who is requiring them. In a way, the cloud is re-organizing itself depending on the requests and needs of its customers.
- **Hosting Network Centric Services:** Network-centric services are also predestined to be used in datacenters, as they require a lot of data through either a local network or the Internet. As each request has its latencies, it greatly improves the overall experience owing to the choice of connectivity to different systems with better speed. For example, by being part of the same network, possibly a cloud-intranet, the quality of these services and applications increases rapidly.

Although cloud-based services offer a broad variety of features for common users (non-technicians), most users may not be able to make use of them. Therefore, a number of tools are developed to increase both the ease and the joy of use. These tools provide user-friendly interfaces, which resulted in millions of users using cloud based services.