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Principles of Cloud Computing Application in Emergency Management

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Abstract: Recent emergency situations in the world show the tendency that the occurrence frequency of natural disasters is expected to increase in future. Therefore new approaches for emergency management need to be elaborated based on the latest IT developments. Cloud computing is considered as a possible way to lower the cost and complexity of computing by providing applications that run on the Internet. Many companies are looking at cloud computing as a new form of emergency management which will keep its business continuity. Cloud computing could contribute to emergency management since it could facilitate the sharing of information among private and government organizations. The aim of the current paper is to analyze the problems and peculiarities of the cloud computing application as a component of the emergency management and to propose principles, which use cloud-based services, to support the business continuity despite the occurrence of natural disasters.

Keywords: cloud computing, emergency management, natural disasters, information system

1. Introduction

Landslides, avalanches, earthquakes, tsunamis, volcanic eruptions and floods are some natural calamities that occur due to changes in weather patterns and soil erosion. Natural disasters come without warning and takes lives of tens, hundreds and thousands of people. Natural disasters can destruct entire cities if precaution is not taken. The types of natural calamities are earthquakes, floods, tornadoes, hurricanes, tsunamis, wildfires and thunderstorms. The effects of natural disasters are very serious and the destruction caused may take a very long time to recover. The damage caused by natural disaster is severe and may cause damage of billions of dollars. The natural disasters cause severe damage and after the disasters the destruction continues with outbreak of epidemic diseases, undernourishment, sickness and other diseases [1, 5].

With the increase of natural disasters that have occurred in the past years it is expected their frequency will continue to increase in the coming years. From a business point of view, the evaluation of the risk of a natural disaster occurring comes in when talking about investing in a large in-house infrastructure. However the idea of having everything at the same physical location is not reasonable since all could be destroyed in a flash [4].

In order to find alternatives to this problem, a lot of technology experts turn to Cloud Computing in a hope to solve this issue. Cloud Computing permits to have redundancy spread across the world to make sure that even if a part of the world is touched by such disasters, that everything can stay in operating order.

2. Cloud Computing

Cloud Computing is a model for providing on-demand Internet-based access to a shared pool of computing resources, including networks, storage and applications. The user of cloud services never has to

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buy or upgrade computing hardware, not to worry about disaster recovery and significantly simplifying business continuing planning.

The Cloud computing paradigm aims at supplying virtualized and dynamically scalable resources. It is a coresult of the convenience of Internet which lets people access even the distant computing sites. Web applications and tools which can be used easily from a Web browser is what it forms into. Internet is replaced by the metaphor "Cloud" relating it to the sketch which earlier used to depict the functioning of computer in a network.

Cloud computing turns the computer into a virtual software or application image, which resides on some physical server in the cloud hosting environment. The virtual software image can be diverted between hardware resources, breaking the hardware dependency associated with external hosting. With hardware dependency no longer an issue, a user system is insulated from hardware breakdowns. If a hosting system fails or overloads, the cloud provider would automatically move the user software image to another piece of hardware while it fixes the original hardware. If an application starts to demand more resources then what is assigned to it, more resources can easily be added to ensure the system does not suffer. Cloud connects the hosts with the users though the web. This allows the user to be able to access the resources as long as they have access to the internet [8].

The cloud computing environment usually consists of the following components [3]:

- Servers - Hosting servers in the cloud using the corresponding services means operating those servers a safe distance from any disaster. Cloud hosting providers generally have more redundancy of network connections, mirrored sites and other precautions to ensure access under adverse conditions.
- Applications - People that use cloud-based applications like Google Apps or Microsoft Office 365 can log in and be productive from virtually anywhere and any mobile device.
- Online data - Users will tend to keep their data stored remotely in the cloud. It is available from everywhere, and like cloud applications and it can be accessed from any device capable of connecting to the web.
- Cloud backup - Many companies fail to backup critical systems on a periodic basis at all, but it is even more severe when an organization has taken the time to create the backups, but the backups end up getting destroyed at the same time as the servers and data their backing up. Using a cloud-based backup solution provides for rebuilding the systems and resuming normal operations.

Under some circumstances, virtual appliances or virtual machine images of existing workloads can be created in the data center and stored in a cloud data center. In the event of a failure of the former, the virtual machines serve as recovery mechanisms that can be reactivated in the cloud.

Cloud computing handles resource management in a better way since the user no longer needs to be responsible for identifying resources for storage. If a user wants to store more data they request it from the cloud provider and once they are finished they can either release the storage by simply stopping the use of it, or move the data to a long-term lower-cost storage resource. This further allows the user to effectively use more dynamic resources because they no longer need to concern themselves with storage and cost that accompany new and old resources.

Cloud computing could contribute to emergency preparedness and relief efforts since it could facilitate the sharing of information among central and local governments and make the emergency notification system much more accessible to the public. Cloud computing would enable to build a sound and comprehensive system for disaster prevention and reduction, as well as relief and reconstruction [2].

3. Cloud Computing in Emergency Management

Emergency management is the generic name of an interdisciplinary field dealing with the strategic organizational management processes used to protect critical assets of an organization from hazard risks that can cause disasters or catastrophes, and to ensure the continuance of the organization within their planned lifetime [6].

Cloud computing offers capabilities to automate many services, to expedite the implementation of secure configurations to information devices, to reduce dependence on removable media due to broadband services, and to lower costs in disaster recovery and data storage.

Many companies and organizations typically store their business information in multiple data systems across many different servers located in different countries around the world. Trying to track down the information that is required and then accessing through some form of networked computer system can be difficult at the best of times. This is difficult if working remotely and there is a need to connect into a business system via a laptop computer. When losing the server architecture, the time needed to rebuild everything can cost a lot. If everything is in the cloud, the organizations can restart their operations as soon as they have access to the Internet.

In cloud operations, it is expected that multiple copies of a data set will be created and kept in sync.

The practice of a business offering a free service to another in an area hit by natural disaster could become a new form of international aid. Under some circumstances virtual machine images of existing workloads can be created in the enterprise data center and stored in a cloud data center. In the event of a failure of the former, the virtual machines serve as recovery mechanisms that can be reactivated in the cloud.

Natural disasters may severely damage Internet access and communications which makes it difficult to access cloud-based servers, applications and data storage. The interruption of network availability is usually temporary, while companies that relied purely on local infrastructure may find their servers completely destroyed and their backup totally lost [9].

When a disaster occurs, telephone lines in disaster areas are overloaded with calls. Using cloud computing for the emergency management could also improve the computer database by providing government agencies with detailed, real-time disaster information. Recovering data after as disaster costs typically twice as much as replacing compromised hardware and software. In the case of cloud computing, recovery costs are considerably lower since only local computers used to access the Internet are at risk and user data and cloud servers are protected far from the disaster site.

In the case of a disaster striking a cloud computing data center, user data will not be lost since suppliers of cloud infrastructure replicate user data and cloud servers across multiple data centers. If a city that uses cloud computing to manage its community development department had the misfortune to lose all its IT equipment in a hurricane or tornado, it could start the task of rebuilding the next day from any location using laptops and an Internet connection [3].

A common concern about using a cloud computing application is that data will be less secure. In practice, however, entrusting information assets to a recognized cloud computing provider generally increases the safety of those assets since on premise IT security practices are often sub-standard. Given that smaller IT departments struggle to design, fund and maintain secure systems while cloud computing providers deliver IT infrastructure as their primary business and competence, moving to cloud computing and SaaS will almost certainly increase security for the majority of IT users [3].

One of the benefits of cloud computing is that information and operations are hosted in well protected data centers. Top cloud providers keep information on thousands of systems and in numerous locations. Redundancy, availability and reliability are hallmarks of cloud computing, so that users can access your information quickly, no matter where they are located. For example, Amazon and Microsoft have data centers all over the world, with tens of thousands of processing units and storage. They have miles of cables, generators and batteries to run these systems for days or even weeks in the event of power disruptions. Many are located in places less susceptible to harm from natural disasters. Some service providers build data centers underground inside massive concrete buildings. All these precautions ensure that you have access to services and data 24 x 7.

The location of a data center can have a significant impact on the performance of applications running in a cloud computing environment. If a cloud computing provider's primary data center is in country that is to far away from the current location of the natural disaster, the performance of that application will be adversely affected by the prorogated time needed for the messages to travel between the data center and the users in disaster condition.

However, there are certain requirements that must be imposed on the utilization of cloud computing in emergency management [7]:

- The cloud provider must be responsible for data confidentiality, integrity and availability. This accounting should not be a cursory exercise, but one that demonstrates complete detailed controllership and accountability at each point (and each vendor they use) within the cloud. Yes, this means during access, authentication, transmission, processing, storage, recovery and destruction.
- Specifications must be prepared regarding ways how the cloud provider will preserve and produce data from requests. Depending on the compliance and legal objectives, this can extend to a few more providers within the cloud and can impact systems that are shared with other cloud clients.
- Data encryption must be considered. The geographical and logical location of its use must be taken into account, the minimum and maximum levels required, laws that may impact use, and if encryption will block the ability to monitor and track the data and threats.
- The cloud provider must possess a crisis management process that will have the appropriate technical, organizational and procedural measures. This can include financial crisis such as vendor bankruptcies, mergers, acquisitions along with traditional areas like weather, geological disruptions, epidemics, etc.

Several additional objectives can be defined regarding cloud computing application in emergency management [10]:

- Using the computing cloud to rapidly converge geographically dispersed global experts at the start of an international incident, deploy a foundation of guidance in accordance with community leaders in a manner that empowers community members through education and smart technologies to support mitigation, response, recovery, and a resumption of societal normalcy at a level of functioning an order of magnitude higher than existed before.
- Using mobile communication devices for rapid threat/damage assessment of occurring events, as well as damage to critical infrastructure inland that necessitates mass sheltering of displaced community members.
- Using the power of non-governmental organizations, rapidly responding government and corporate groups, international groups, social networking communities and other resilient networks to locate and gather information, as well as to send help.

Clouds are secure and though adaptation of authenticity, encryption, and meeting security software regulation large concern about secure can be put aside. Furthermore, the cloud is not in one place, meaning the risk of systems failures substantially decreases. In the case of cloud computing, recovery costs are considerably lower since only local computers used to access the Internet are at risk and user data and cloud servers are protected far from the disaster site. In the case of a disaster striking a cloud computing data center, user data will not be lost since suppliers of cloud infrastructure replicate user data and cloud servers across multiple data centers.

4. Conclusion

Cloud computing is the best solution to the needs and requirements of the government, organizations and individuals responding to catastrophic disasters. The availability, scalability, cost, speed of communication and potential security offer solutions to current dilemmas within the emergency response and relief work community are considered. Cloud computing services are more readily available for a response to a catastrophic event. Since the cloud applications are hosted at geographically dispersed locations, they are not at risk of going down if one of the facilities fails. Cloud computing is effective because they can scale when user load dramatically increases. The Clouds allow for flexibility since they can expand quickly as the application demands increase. Cloud computing provides the ability for users to communicate between those in the field with those coordinating efforts outside the field. With cloud computing if one has access to the Internet, whether though cell phone or a computer they can connect with the cloud.

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