CLOUD-BASED SERVICE FOR BIG SPATIAL DATA TECHNOLOGY IN EMERGENCE MANAGEMENT

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ABSTRACT:

Following the development of spatial information acquisition technology, more and more spatial data have been collected through various approaches. There has been a full utilization of geospatial information in emergency management than the past. Increasing demands are being put forward on use of spatial information in emergence system. Recent evolutions in GIS technology and spatial information acquisition technology have led to a more distributed information process and computing environment. "Cloud" technology has emerged as technologies by its focus on large-scale resource sharing and low cost for big data storage technology. In this paper, we proposed an approach which employs cloud-based service to solve the big spatial data technology in emergence management. To provide effective spatial information services is the aim of such a spatial information platform to better for spatial data analysis and support in emergence management.

1. INTRODUCTION

Today, spatial information technologies play increasingly important roles in emergence management (Li, 2007). Large numbers of applications enhance the level of emergency management and the capability of the prevention and disposal of cases for sudden natural disasters, such as earthquake, Hurricanes, forest fire, hailstorm, freezing, landslides and mudslides, epidemic etc. Increasing demands are being made on use of spatial information in emergence system. In this paper, using cloud-service to achieve spatial information access and management is presented, especially in the emergency management system for massive spatial information management and sharing. The aim of this paper is to provide an idea for spatial information support in disaster preparedness, emergency response, disaster relief and rescue, rehabilitation and disaster mitigation planning based on the theory and technology of cloud-service. In this paper, Firstly, to explore the use of cloud service technology for the solution of resource sharing approach in current emergency management, we study big data problems in EM, and especially indicate that spatial data storage and process is critical to a successful EM system. In this section, characteristics of cloud-based service and potential using in GM for big spatial data are discussed. Secondly, we go into detail for advances in many different technologies, including sensors, computer network, data storage, Cloud computing facilities and Data analysis. Architecture of Cloud-based service for big data technology in GM is explored; thirdly, we draw our conclusion.

2. BIG SPATIAL DATA TECHNOLOGY AND CLOUD-BASED SERVICE

2.1 Big Spatial Data Technology

Advances in remote sensors, photogrammetric instrument, laser scanner, and radar have created huge collections of spatial data, capturing spatial information of value to emergence management. We face unprecedented challenges in the field of big spatial data management and analysis in emergence system today. In emergency management system, geospatial data is different from other types of data with the following special features:

- Complex structure; there have not only mass of non-spatial data in emergency system but also large number of spatial data. Spatial data have complex structure in many facets, for example, the basic unit of spatial objects can be composed as a single distribution point or by a number of accumulative points, and they may have any shape, size. Another characteristic of spatial data is its high-dimensional attributes space (Bian, 2007).

- Enormous amount of data; in emergency management system, geospatial data is very large. Such as remote sensing image information, and with the improvement of resolution, the data is increased in geometry growth to several tens of GB or even GB bytes, so, it is impossible to store all the data in a single database, or even in one place.

- High computing; the operations of spatial data involve many spatial entities and spatial objects, each object or entity also contains a large number of points, lines or polygons. Therefore, the operations of spatial data are more complex than ordinary large text and digital data. In spatial data operations, there are not merely simple operations such as enlarge (Zoom in), narrow (Zoom out) and pan (Pan), but also complex spatial analysis and spatial data mining and knowledge discovery. And if there have specific models in some application, it becomes more difficult than the

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accustomed which needs efficient management and retrieval methods.

- Scale effect; spatial data is an abstract from the real world. As the real world has an infinite complexity, so, it is not possible to extract all the information. At the same time, as the realization limitation of the objective world, spatial information understanding is restricted by scale. Pan of map operation is only to change the information's display location to access to the same level of spatial information at different locations, but the information does not change the level of detail. Zoom in or zoom out of map operation may obtain different levels of spatial information, and information also changes in the detail.

At present, there is a trend that "3S" technologies are fully used in the field of emergency management, which takes RS technology for spatial information acquisition, and uses GIS technology for spatial analysis to support decision-making. But it must be taken effective strategies to change and improve the spatial data management and application level.

2.2 Cloud-based service

Cloud services, in the form of centralized web-based applications, where applications and files are hosted on a "cloud" consisting of thousands of computers and servers, all linked together and accessible via the Internet (Michael, 2009, John, 2009).
Recent evolutions in GIS technology and spatial information acquisition technology have led to a more distributed information process and computing environment. Cloud service technology provides such an environment. Cloud service technology is often seen as a useful tool for large corporations. From the point of resource service, Emergency management system may have users and sensors in numerous locations running specialized software to acquire data or carry out data-intensive tasks. These service resources are drawn from someplace beyond the user's location, and they exist at an ill-defined elsewhere, which all come from a cloud.

2.3 Advantages

Through the network， cloud services obtain the necessary services by the on-demand and easy expansion way. This could be the IT services and software, Internet-related, as well as any other service (Liu, 2009). In the emergency management system, it has the advantages in the following areas:

- Resource virtualization. Cloud services support users to achieve tasks by using a variety of terminal services anywhere. For the requested resources in emergency management, such as spatial information resource access, spatial information resources storage and other resources access and storage may come from the cloud services collection, rather than fixed entity resources. An application is running into the cloud services collection. In fact, users don't need to know or worry about the specific location of the running applications. They achieve their goals through the network services, including the data analysis tasks in a super-space data sets or spatial data warehouse, even for a knowledge discovery task. Cloud service can be easily implement data share between different devices.

- Large-scale pattern and high reliability. The current applications based on cloud services usually have a considerable size, such as Google's cloud computing already has more than 100 million servers. So, this is very suitable for large-scale scientific computing and big data storage in emergence management. At the same time, cloud services may provide a reliable, safe storage centres for spatial data, and it use multiple replica fault-tolerant, isomorphism of the computing nodes, and interchangeable measures to ensure the service reliability. Users do not have to care data loss. Strict rights management strategy can help achieve data sharing. In some certain, the use of cloud service is more reliable than the use of a local computer.

- Generality and high scalability. Cloud services are not designed for a specific application. There can construct multi-pattern applications under the cloud service support, and a cloud service can support different purposes. Cloud service is dynamically scalable which can meet the emergency management applications and the scale of users' growth.

- Low-cost and on-demand services. Cloud services provide different types of services, so emergency management system customizes their services in accordance with different need. As low-cost nodes to form the cloud employed special fault-tolerant measures, automation centralized management of cloud services enable a large number of users to achieve their goal without the burden of increasingly expensive cost of data centre management. Its generality can increase utilization rate of resources compared with the traditional system, so users can fully enjoy the low-cost structure of emergency management system, and be able to enjoy better service.

3. CLOUD-BASED SERVICE IN EMERGENCE MANAGEMENT

3.1 Emergency monitor network

It is very necessary to establish a highly efficient, fast and responsive monitoring and analysis and early warning network to provide effective spatial information services, which can meet the needs of a variety of monitoring functions of the emergency management. Such a disaster monitoring network provides a platform, in particular, a spatial information platform, which allows users to obtain a variety of data through the network in real-time access, analysis and process. Also, monitoring network allows users to receive timely the feedback information to understand the monitoring object; including its three-dimensional changes in the state, if necessary, employed by the spatial support, to give the right response, and to take corresponding measures.
At present, although many monitoring spots and stations have been established at the different areas for the access of some data, and formed of a certain amount of monitoring capacity. However, the monitoring station does not really realize and perform an effective emergency monitoring function, provide a timely spatial information services. So this situation is far from enough to meet the current needs of emergency management. There are many reasons, besides the absence of the hardware and software monitor network infrastructure, there is another important reason is the lack of spatial data acquisition and

processing system planning, and there is also no corresponding spatial data sharing network services designed for spatial information network services.

3.2 Big spatial data flow process in emergence system

Many scientific disciplines have become data-driven (Randal et al., 2008). So does emergence management. For example, Laser Scanners, Leica HDS6100 has a fast scan rates up to 508,000 points per second. As a result of the widespread use of sensor technology in the current monitoring system, the emergency management system has accumulated a large amount of data for the objects monitored to support daily task, especially the use of high-resolution satellite remote sensing images, it can be quickly acquire or update the latest data a few weeks ago or a few days ago which makes the data more true and accurate. However, spatial data transmission and processing has become the bottleneck of applications based on the data analysis result. It is difficult to store and manage such huge amounts of data by the traditional approaches (Chen et al., 2008).

As emergency systems generate enormous spatial data, so, automatic analysis task is required. There is an urgent need to study big spatial data technology to build a powerful mass data management and process systems. Advances in many technologies enhance the possibility of cloud-based services for big spatial data technology in emergence management system. Such as sensors, computer networks, data storage, cloud computing and data analysis tools. So the spatial data process flow changes with the advances of these technologies. From the point of this, we can regard the main steps of big spatial data process and application in emergence management system as the follows:

- Spatial data collection: The spatial data collection industry is rapidly changing and encompasses a wide range of products and services. Digital cameras, LIDAR, stereo collection and sensors all give contribution to the spatial data collection. We have to do is to package these spatial data collection terminal’s function into cloud services to form effective service collection.

- Spatial data storage: Due to the characteristics of spatial data, spatial data storage is more complicated than the others. Magnetic disk technology has dramatically decreased the cost of storing data. On the other hand, as the development of computer and network technology, data storage technology has improved, such as Web-based data storage and distributed spatial data storage (Robert et al., 2009). Distributed spatial data storage is a C/S mode, and has a balanced load between the client and server. Network storage pattern mainly refers to the way that the data is stored by Web-based service delivery model in the network environment. This way has a better adapt to the cloud services model.

- Spatial data analysis: The enormous volumes of spatial data require automatic or semi-automatic analysis. Spatial data mining, or knowledge discovery in spatial databases, is the extraction of implicit knowledge, spatial relations and discovery of interesting characteristics and patterns that are not explicitly represented in the databases. There are some tools can help this process. For example, many tools have designed in the ArcGIS software for overlay analysis, proximity analysis, surface analysis, and raster processing and conversion. Also, the "Geominer" is spatial data mining software which has capabilities includes mining characteristic rules, comparison rules, and association rules, in geo-spatial databases, with a planned extension to include mining classification rules and clustering rules(Han et al., 1997).

- Spatial data application: for a long time, the emergency management has done a great deal of fruitful data collection, and there are accumulation of a large number of the basic data and maps for disaster management, mitigation, and emergency response as a spatial data platform. Spatial data platform is not only to meet the urgent needs for decision-making support information in emergency management, but also to support the basis of scientific research and knowledge innovation。So, spatial data platform based cloud service can better solve the issues. For example, CRATER project was to create a complete tool for Tsunami risk analysis in coastal areas Alessandra (Alessandra, 2007).

3.3 Architecture of spatial information application in emergence management system

The original form of cloud service is c/s computing and distributed computing and p2P computing. Since the concept of cloud computing is proposed by Google, many software vendors, such as IBM, Yahoo, Amazon, Trend Micro, regard cloud computing as a key trend of the next generation software, have released their own cloud computing services. In view of the overall situation, there can be broadly divided into two categories, one is represented by Google's cloud technology, which is mainly provide horizontal capacity expansion by parallel distributed technologies such as MapReduce, as long as new machines can join the cloud, cloud service may continue to expand existing services for storage and computing power to solve the increasingly network problems. Another type of cloud computing is represented by Amazon's EC2 service, by the Xen virtualization technology, cloud service provides flexible configuration of virtual machines to implement application requirements, and can dynamic increase the number of virtual machines to cope with unexpected demand for the use. In short, Google cloud technology aims at scalability, and the Amazon service is universal.

Under cloud environment, there will be significant changes to emergency management in many aspects such as information storage, programming. Cloud is a set of services provided by many computers and servers which can be accessible via the Internet. These hardwares usually belong to different departments, which are jointed in one or more data centre and spawned on demand to meet user’s needs. These machines can run a variety of operating systems, especially is the processing power of machines rather than desktop look. Users and a variety of sensors connect to the cloud through Internet. To users in emergence management, the cloud is an independent application, equipment or documents. Cloud hardware (as well as the operating system management of the hardware) is not visible.

4. CONCLUSION

“Cloud” technology has emerged as a technology by its focus on large-scale resource sharing and low cost for big data technology. In this paper, a cloud means an infrastructure that provides resources and/or services over the Internet. Often the services are layered to create a stack of cloud services that serves as a platform for developing cloud-based emergence management applications. We also face new challenges as we try to manage our spatial data that might be stored in a variety of devices. Web-based applications have long been considered potential security risks. So we must create safeguards to solve the security problems of data and system.

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