WebGIS Applications and Cloud Computing for Disaster Management and Emergency Response

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Introduction

- Disaster management data is often complex, large, and heterogeneous.

- It requires a fast, scalable and accessible system to manage the complexity of the collected data.

- Cloud computing is a less complex cost effective mode of computing over Internet.

- The cloud provides large-scale asset sharing and storage technology.

- In emergency cases the need for elastic way for storing and analysis of data through the cloud, before, during and after the event.

- The cloud technology is known for providing synchronous, on-line information management with accessibility.

- This presentation highlights the advantages of using cloud computing combining with WebGIS in disaster response management.

Principles Of Cloud Computing And WebGIS

- **Cloud Computing**
  - Type of parallel and distributed system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements.
  - It is a model for enabling convenient, on demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services)
  - It can rapidly provisioned and released with minimal management effort or service provider interaction.
  - Provides variety of services that can be classified and organized into three major models:
    - Infrastructure as a Service (IaaS)
    - Platform as a Service (PaaS)
    - Software as a Service (SaaS)

Principles Of Cloud Computing And WebGIS(Cont,)

Saas
- Online game
- Electronic mail box
- Electronic commerce
- Others

Paas
- Running environment
- Developing environment
- Other environment

Iaas
- Data storage
- Compute service
- Load management
- Backup

virtualization

- Host Computers
- Memory
- Network
- Other equipment
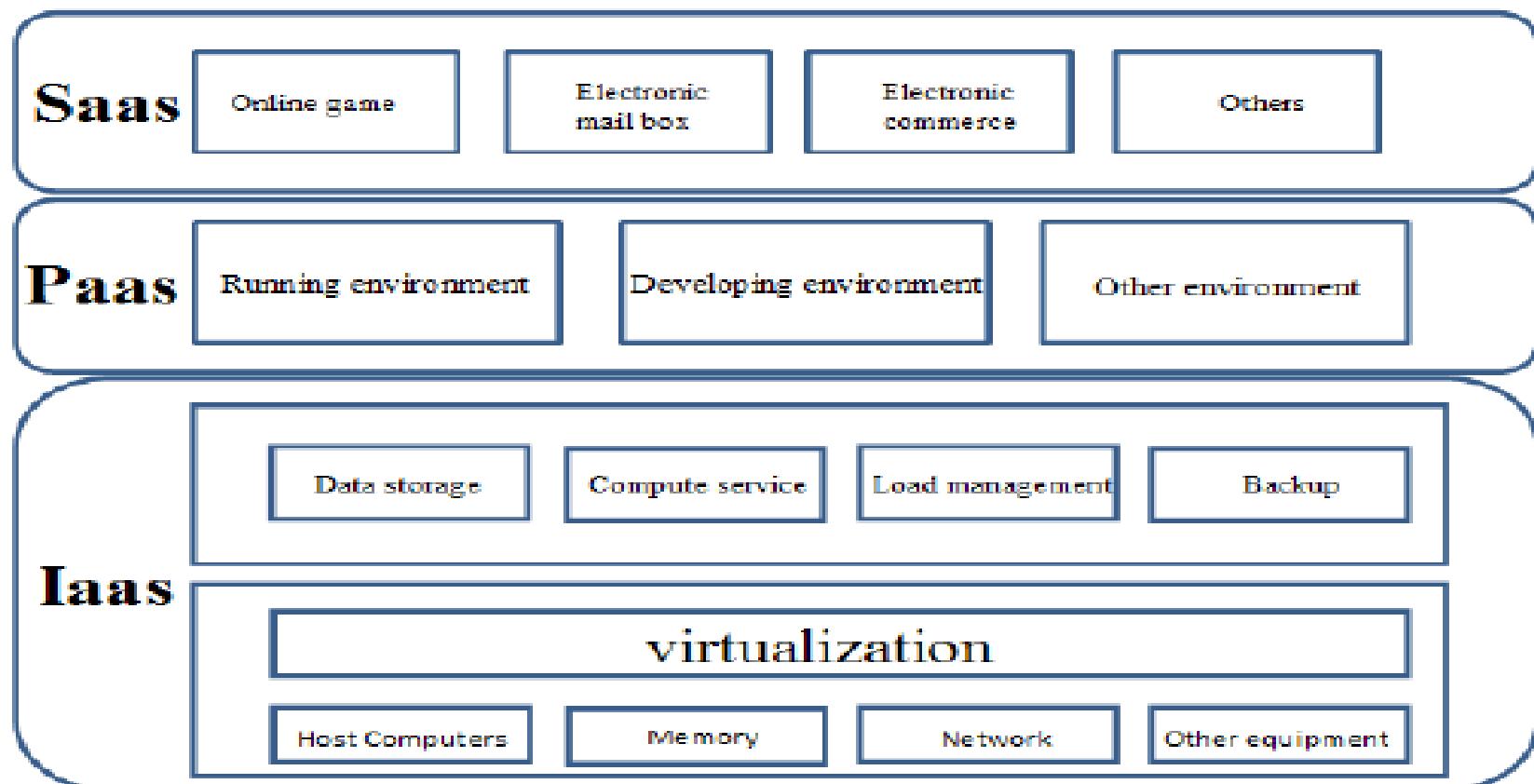
The basic architecture of cloud computing

Principles Of Cloud Computing And WebGIS(Cont,)

- **WebGIS** is a kind of geographic information systems, which is based on internet platform. It can realize storage, query, management, analysis, display and output functions of spatial data in internet environment.
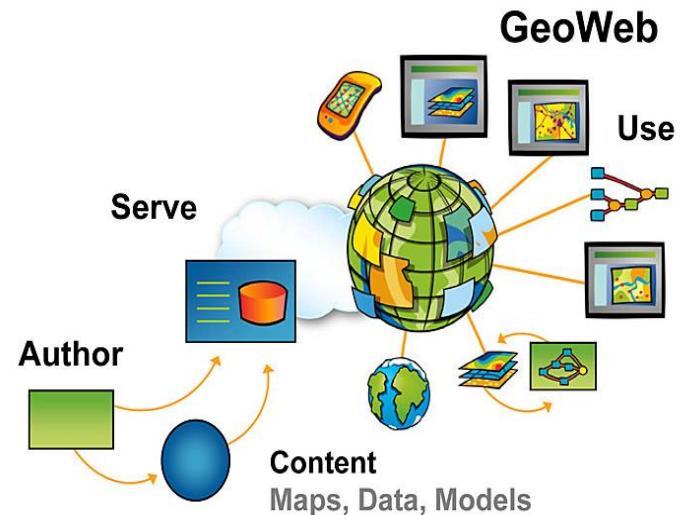
# Principles Of Cloud Computing And WebGIS(Cont,)

Characteristics of WebGIS:

- Dynamic interactivity: interaction with users to adjust the display dynamically to complete diverse requirements.

- Extensibility: WebGIS can combine with Java, ActiveX to build flexible GIS applications.

- Cross-platform: Ability to use the browser to get to GIS servers.

- Distributed data storage: provide secure data storage over several servers, which ensure data security and efficiency.

GIS on the Cloud

- Cloud GIS is a next generation Web GIS (Geographic Information System) solution with advanced capability of collecting, processing, analyzing and publishing geospatial and database data.

- The main goal is to provide the power of desktop GIS solutions on a web based platform and in such way bring GIS closer to a wide audience.
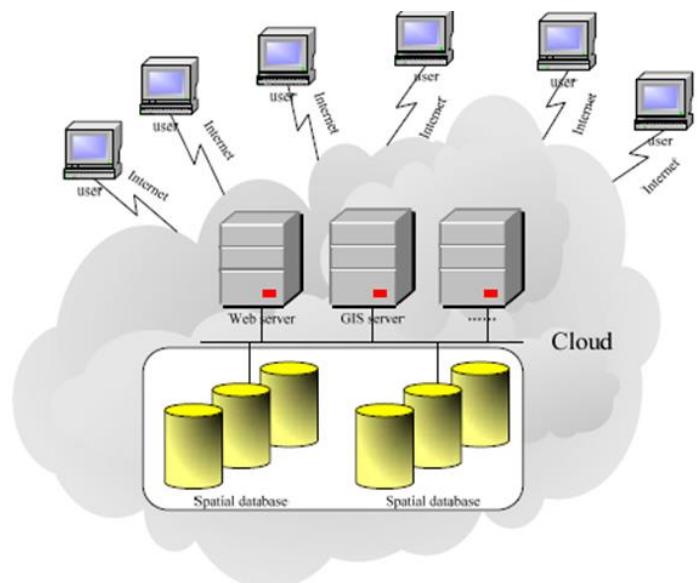
WebGIS applications based on cloud computing

Cloud GIS Benefits

- Full featured GIS available over the web in any browser with powerful data processing capability, as well as tools working with maps including spatial analysis.

- Clients do not need to install updates delivered over the network, with cloud GIS users share single geographical data storage that is updated centrally.

- Cloud computing capabilities has emerged recently and can support GIS system to have better data acquisition, and spatial data processing.

- GIS Cloud can also support dynamic scaling, resource pooling of network resources, databases and storage. The management of large volume of spatial data and processing of spatial data.

Uses and Platforms of Cloud GIS

- Public safety and emergency management system, e-commerce and geo-targeted advertisement, web mapping, geo-earth observation analysis, geo referenced weather analysis, and social science.

- There are number of cloud providers which support dealing with both cloud technology and hosting or deploying GIS application.

- The most provider are Amazon EC2, Google App Engine, Microsoft Windows Azure.

Proposed GIS Cloud Model Layers

- **The proposed GIS Cloud model consists of six layers:**
  - GIS Cloud Client Layer
    - This layer provides flexible and robust web based interface which will be one of the core components of GIS Cloud.
  - GIS Cloud Application Layer
    - This layer provides the applications and services which can be executed in the GIS cloud by end users.
    - The application and services containing in this layer are built based on lower layers such as the GIS platform layer.
  - GIS Cloud Data Management Layer
    - This layer will govern all the processes, mechanisms and procedures used to store and access of spatial, nonspatial data in the GIS Cloud System.
    - This layer unify the communication between a GIS Cloud System and the spatial- non spatial DBMS used for the system such as SQL Azure Database with spatial data types.

Proposed GIS Cloud Model Layers

- Cloud Storage Layer
  - In this layer data is not stored in the user's computer, but in virtualized pools of storage, through this layer the GIS.
  - Cloud System uses the Cloud Storage Services such as Azure Virtual Machine Storage.

- GIS Platform Layer
  - This layer provides some basic GIS functions and services such as map services, metadata services and spatial analysis.

- Infrastructure Layer
  - In this layer the GIS Cloud model uses the windows azure cloud infrastructure (infrastructure as a service).

WebGIS Applications Based on Cloud Computing

- Spatial Data Storage Services

  - Various types of spatial data: geometric data, attribute data, and relational data that expresses the mutual relationship of map elements.

  - Data changes respectively with time, and in the process of data analysis, it integrates the history data and present data to make more intelligent service foe users and enterprise, so the amount of data is very large.

  - As a result, the management and maintenance of spatial data storage may cost a lot of hardware, human and financial resources .

  - Cloud storage services may be accessed through a web service application programming interface (API), or through a web based user interface.

WebGIS Applications Based on Cloud Computing

- Spatial Analysis Services
    - In WebGIS system, after spatial data is collected and converted into a usable format, enough hardware and software resources need to be allocated for analyzing the data.
    - Spatial analysis is the core function of GIS, and it is also the basic difference between GIS and other computer system, to obtain derived information and new knowledge from spatial relationship of GIS targets.
- GIS Web Services
    - Uses data and related functions to complete basic geo-processing tasks, in order to make a reality the vision of creating a platform independent distribution channel for GIS data.
    - Developers and Applications can share data from different data sources and formats and have them combined in a single application. Regardless of different sources or locations of data. This allow users to perform Geo-processing and return the results to the customized applications.

Issues in WebGIS Application Based On Cloud Computing

- Security of data transmission is the responsibility of the cloud providers.

- In many cases, GIS data is confidential, because data is deposited in cloud providers' computers instead of in the local, so data leaks may occur .

- Leaking of data, will impact owner with huge risk and crisis of confidence.

- Privacy issue is also one big problem. Different from the traditional computing model, cloud computing utilizes the virtual computing technology, users'.

- Personal data may be scattered in various virtual data center, even across the national borders, at this time, data privacy protection will face the controversy of different legal systems.
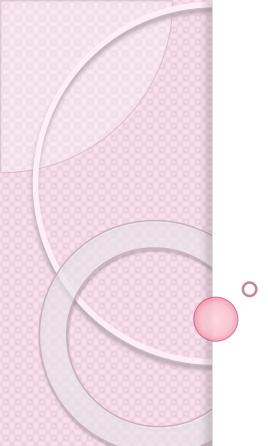
Conclusion

- In this presentation, we discussed cloud computing applications in the WebGIS field.

- First described the principles of cloud computing and WebGIS, and

- Then focused on how to apply the cloud computing techniques in the spatial data storage, spatial analysis and GIS web service, Cloud GIS platforms.

- last several issues are proposed in the process of using cloud in GIS industry.

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Many Thanks!

Any Questions ?