Implementation of cloud computing in higher education

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Abstract. Cloud computing research is a new trend in distributed computing, where people have developed service and SOA (Service Oriented Architecture) based application. This technology is very useful to be implemented, especially for higher education. This research is studied the need and feasibility for the suitability of cloud computing in higher education then propose the model of cloud computing service in higher education in Indonesia that can be implemented in order to support academic activities. Literature study is used as the research methodology to get a proposed model of cloud computing in higher education. Finally, SaaS and IaaS are cloud computing service that proposed to be implemented in higher education in Indonesia and cloud hybrid is the service model that can be recommended.

1. Introduction
Cloud computing is a new trend in distributed computing, where people can develop SOA-based service in Internet network. There are numerous companies that calculate and evaluate the advantages of cloud service implementation. Cost effectiveness is the main thing that is calculated in order to implement cloud computing. Although there are other factors that must be thought in order to determine the implementation of new technology.

Higher education in Indonesia is institutions that have potential to use cloud computing service. But, operational management is not aware of the importance cloud computing to support academic and operational activities. There are many reason of this condition. But, usually the thing that can be a reason behind this condition is the difficultness to choose an implementation model that support academic and operational activities.

Based on the problem above, this research tries to conduct the needs and the suitability of the cloud computing implementation in universities in Indonesia and then propose cloud computing models as the first step to determine a cloud models that support academic and operational activities.

2. Methodology
Literature study in order to propose service cloud computing model in higher education is used as the research methodology.

3. Cloud Computing
Cloud computing is an internet network-based computation style where resource dynamically changed as the service. Cloud refers to the hardware and software for data centre that support the needs of users such as storing data and remote-host application. In the implementation of cloud computing,
infrastructures can be cut to reduce cost. An example for this thing is using outsourcing data storage, so hardware device can be neglected to provide in physique.

Cloud computing is a style of computing where dynamically scalable and virtualized resources are provided as a service over the Internet. The cloud refers to the data centre hardware and software that supports a client’s needs, often in the form of data stores and remotely hosted applications. These infrastructures enable companies to cut costs by eliminating the need for physical hardware, allowing companies to outsource data and computations on demand [4].

There are several clouds computing service that can be used in a higher education such as [2]:

- Infrastructure as a Service (IaaS): can be used to satisfy the infrastructure needs of the students, faculties or researcher globally or locally with some specific hardware configuration for a specific task.
- Platform as a Service (PaaS): certain providers are opening up application platforms to permit customers to build their own application without the cost and complexity of buying and managing the underlying hardware and software layers.
- Software as a Service (SaaS):the application service provider is hosting the application which runs and interacts through web browser, hosted desktop or remote client. It eliminates the need to install and run the application on customer own computer and simplifying maintenance and support.
- Computing as a Service (CaaS):providers offer access to raw computing power on virtual server such as Amazons, EC2 service.

There are the deployment models of cloud computing [4]:

- Private Cloud: The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party, and may exist on premise or off premise.
- Community Cloud: The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, and policy and compliance considerations). It may be managed by the organizations or a third party, and may exist on premise or off premise.
- Public Cloud: The cloud infrastructure is made available to the general public or to a large industry group, and is owned by an organization selling cloud services.
- Hybrid Cloud: The cloud infrastructure is a composition of two or more clouds (private, community or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

4. Cloud Computing In Higher Education
In many technology arenas, higher education exhibits two behaviors. As regards networking and high-performance computing, higher education enjoys a reputation as an innovator [3]. The use of Cloud Computing in higher education must be analyzed both from the benefits point of view, as well as from that of the risks and limitations presented in Table 1 [1].
**Table 1. Main Benefit And Limitation Of Cloud Computing In Higher Education**

| Benefit | Limitation |
|---------|------------|
| Access to applications from anywhere | Offline usage with further synchronization opportunities |
| Support for teaching and learning | Risks related to data protection and security and accounts management |
| Risks related to data protection and security and accounts management | Risks related to data protection and security and accounts management |
| Software free or pay per use | Organizational support |
| 24 hours to access infrastructures and contents | Dissemination politics, intellectual property |

After the analysis, one or more models of Cloud Computing may be chosen to be used. The decision must take into account the real needs and be aligned with the higher education strategy.

**5. Proposed Model of Cloud Computing Service in Higher Education**

The main users of Information Technology services in higher education can be grouped into 4 classifications: students, faculty (researchers), administrative staff, and IT staff (developers). Based on this condition, there is a model of cloud computing that depend on user. This model is shown by Table 2 below.

**Table 2. Proposed Model of Cloud Computing Services in Higher Education**

| Users                      | Service |
|----------------------------|---------|
|                            | SaaS    | PaaS   | IaaS    |
| Students                   | √       | -      | √       |
| Lecturer/Researcher        | √       | -      | √       |
| Administration Staff       | √       | -      | √       |
| Staff IT (developer)       | -       | √      | -       |

Table 2 shows that SaaS (Software as a Service) and IaaS (Infrastructure as a Service) are services can be proposed for students, lecturer/researcher, and administrative staff. Meanwhile, PaaS (Platform as a Service) and IaaS (Infrastructure as a Service) are services can be proposed to IT staff. For distributed cloud computing service model, hybrid cloud is the suitable one to be implemented. Hybrid cloud is a combination of public cloud and private cloud. Public cloud is owned and managed by the cloud provider. This means the higher education does not have full control over it, and have limited access to the private cloud as a temporary subscriber. Access can be made by user that shows based on cloud computing service.

**6. Conclusion**

Cloud computing service is an important development in distributed computing where people can develop and create many application and service in Internet network. A higher education is a potential institution to use cloud computing service. In order to use cloud computing service in higher education, SaaS and IaaS are proposed to be implemented. Both of them are very useful for student, researcher, administration staff. Cloud hybrid is the service model that can be recommended because its flexibility and blended characteristic between public cloud and private cloud. Public cloud is managed by cloud provider with limitation access as a subscriber, meanwhile private cloud means the service is owned by the higher education with access limited only for students, researchers, administration staff, and IT staff (developer).
Based on the explanation above, cloud computing can be a new things for higher education to be implemented. Cloud computing can support tridarma activities for a higher education, especially in Indonesia. Besides, it has many potential opportunities to make revolution in education area.

References
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