Cloud ITS Indonesia: Transportation Information Sharing Platform

Meizano A. Muhammad
Multimedia and Cyberspace Engineering Research Group
School of Electrical Engineering and Informatics,
Institut Teknologi Bandung
Bandung, Indonesia
meizano@students.itb.ac.id

Suhono H. Supangkat
Multimedia and Cyberspace Engineering Research Group
School of Electrical Engineering and Informatics,
Institut Teknologi Bandung
Bandung, Indonesia
suhono@stei.itb.ac.id

Abstract— **Information heterogeneity of ITS Indonesia becomes an obstacle to provide interoperability. The transportation information resource sharing is affected by this condition. ITS generally comprise a distinguished form of large-scale, distributed information system deployed in some form of tangible or virtual network. Cloud computing could benefits ITS for it's essential characteristics, which are on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service. By establishing Cloud ITS based on cloud computing, it is feasible to accommodate transportation information sharing platform.**

Keywords— **cloud computing, ITS, transportation, information sharing, interoperability, web service**

I. INTRODUCTION

ITS (Intelligent Transportation Systems) Indonesia developments is emerging, unfortunately it still not synchronized and coordinated. This is because the isolated model of ITS Indonesia development. Isolated model of ITS Indonesia developments is related to regional management. Often, managing authority of each region implement ITS with its own way without considering interoperability with other region. Information heterogeneity of ITS Indonesia becomes an obstacle to provide interoperability. Low level of transportation information resource sharing is affected by this condition. The overall strength of system, such as traffic control, emergency secure et cetera will be undermine by this situation. Interoperability can address different ITS models and provide interoperability to support transportation information resource sharing. Cloud computing, as one of the emerging technologies, could benefit ITS interoperability for it's ability as pervasive computing.

This paper is organized as follows. First, ITS Indonesia current conditions. Then in the following section, the key concept in designing ITS interoperability supported by cloud computing. Section 4 show the model of cloud computing to support ITS. Finally, in Section 5 the concluding remarks are given.

II. ITS INDONESIA CURRENT CONDITION

ITS itself has been developed in Indonesia since 1994, starting with the development of Area Traffic Control System (ATCS) in Jakarta, Surabaya and Bandung (1994); Batam and Surakarta (2006); Tegal (2007); Bukittinggi, Balikpapan, Manado, and Pontianak (2008); Sragen and Samarinda (2009), and Bogor (2010). CCTV cameras are also used to monitor the road conditions in real time which is implemented in cities such as Jakarta, Solo, and Surabaya. Then there is the Variable Message Sign (VMS) that have been used in Solo. Parking Management used in places like Terminal Bratang Surabaya, and several malls in Jakarta. E-enforcement for detecting violations of traffic rules and traffic signs also used in Jakarta. E-Toll has been used in Jakarta and Bandung. And, Integrated Public Transport System has been implemented in Yogyakarta for travelers to be able to ride a variety of transportation while still using the same payment card; this system has been implemented in Solo and Yogyakarta. [1]

ITS development of Indonesia is regionally segmented. There's little coordination on the direction of ITS development or availability of transportation information resources.

III. KEY CONCEPTS

ITS generally comprise a distinguished form of large-scale, distributed information system deployed in some form of tangible or virtual network. The specific needs for systems architecture of heterogeneous, distributed, networked systems that are designed, developed and deployed in ITS applications and which may interface to a wide range of existing systems – both ITS and non-ITS - need to be addressed. [2]

In this Section, we describe key concepts underlying ITS interoperability supported by cloud computing.

A. Cloud Computing

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of

configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [3].

Three service models available in cloud computing: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). Cloud computing could benefits ITS for it's essential characteristics, which are on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service. Cloud computing can minimized cost of infrastructure, simplify network, ease expansion, and centralized monitoring.

B. *Web Service*

Web services used to promote crossplatform communication and get the best interoperability among different systems. Web services can be characterized by three properties. First, Web services are accessed over the Web through standard Internet protocols, such as HTTP. Second, Web services describe themselves using XML and typically rely on registries to aid the lookup and invocation of the services. And Third, Web services talk to their clients using an XML-based protocol, i.e., remote procedure calls to a Web service operation are transmitted in their form of XML messages. From its contents, Web services defined Simple Object Access Protocol (SOAP), Web Services Description (WSDL) and Universal Description, Discovery and Integration (UDDI). [4]

System integration technology based on Web services solves the problems of long-distance communication on the Internet that original integration technology cannot solve. Web services provide an environment for building loosely coupled, decentralized applications where the diverse services and collaborate in a platform-independent and multilingual way. Application interoperability is the primary motivation for adopting Web services. [4]

IV. CLOUD ITS INDONESIA

Based on the Indonesia characteristics and ITS principles [5], we proposed ITS plan for Indonesia in four different areas of ITS for development. The four areas consist of: Advanced Traveler Information Systems (ATIS), Advanced Traffic Management Systems (ATMS), Advanced Public Transportation Systems (APTS), and Commercial Vehicle Operations (CVO). Cloud ITS Indonesia and it's four area depicted in Figure 1.

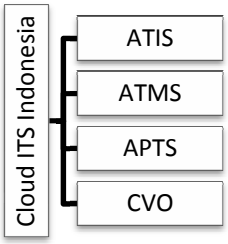

Figure 1. Cloud ITS System Architecture

A. *Cloud ITS System Model*

Cloud ITS system model consist of four areas: Centers, Vehicles, Field, and Travelers. Centers as the main control contains Archived Data Management System, Commercial Vehicle Administration System, Fleet and Freight Management System, Traffic Management System, Information Service Provider, Transit Management, Maintenance and Construction Management System, Toll Administration System, Emergency Management System, and Emission Management. Figure 2 shows example model for transportation information sharing through Cloud ITS involving three cities.

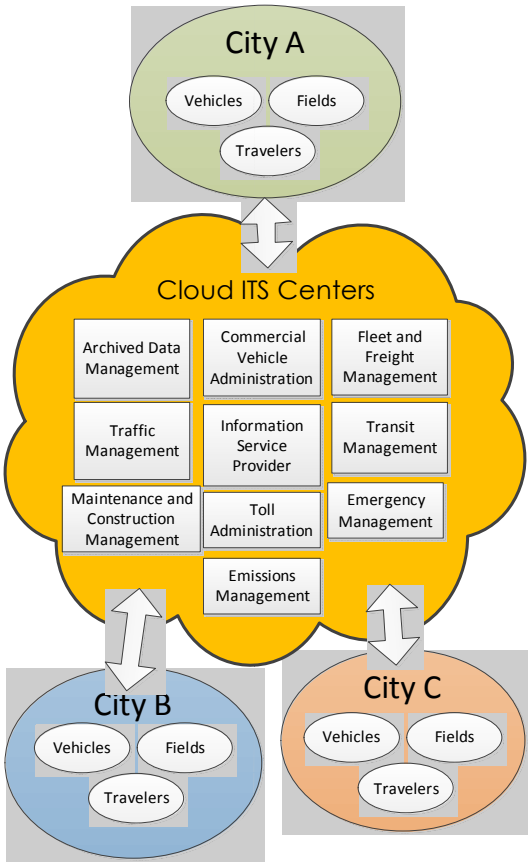

Figure 2. Cloud ITS System Model

Centers connected to Field with Fixed-Point to Fixed-Point Communications which consist of Commercial Vehicles Check, Roadway, Security Monitoring, e-Toll, and e-Parking. Vehicles and Travelers connect to Centers from Wide Area Wireless (Mobile) Communication. Vehicles also connect to Field with Dedicated Short Range Communications (DSRC) to be validated in Field Systems. Vehicles consist of Private Vehicles, Transit Vehicles, and Commercial Vehicles. Travelers consist of Personal Information Access (through smartphone or web portal) and Remote Travelers (through vehicle navigation).

B. *Cloud ITS System Architecture*

Cloud ITS system architecture consist of three layer based on service modes of Cloud Computing. The three layers include infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS). The design adopted from CTS architecture [6] to accomodate the need of transportation information sharing platform. Figure 3 shows the architecture for Cloud ITS with three layers consist of IaaS, Paas, and SaaS.

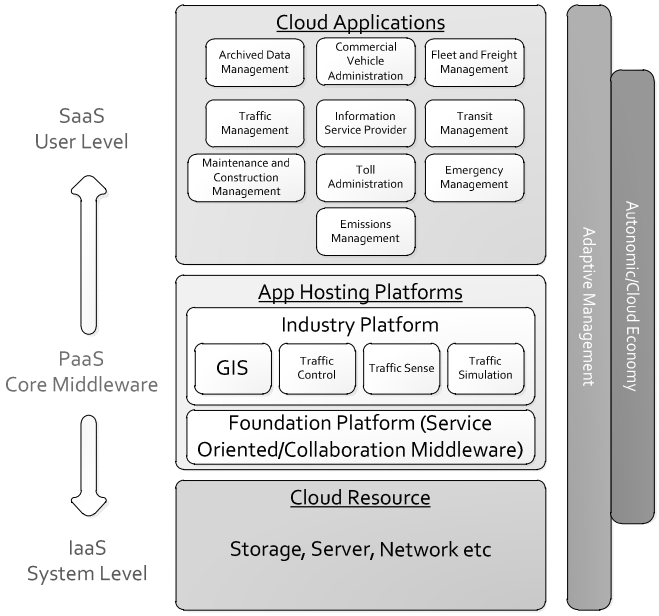

Figure 3. Cloud ITS System Architecture

IaaS provide Cloud ITS needed infrastructure with virtualization technology. Apparent advantages is the decrease equipment cost with effective development and easily realize the information sharing.

PaaS will help solve information silo problems in urban traffic and help fully mine useful information in the traffic data [7]. Virtualization technologies used such as virtual machines to hide the physical characteristics of resources from users to ensure the safety of data and equipment. Unified access interface available for lower SaaS applications to shared services such as GIS (Geographic Information System). This will reduce the needs for multiple instances of the same service.

SaaS use large-scale platform to make information resource integration easier and resources more abundant [6]. And, access to the PaaS services reduce the complexity of the applications.

C. Web Service

Web service is the method to exchange information. It can exchange information from Centers, Vehicles, Fields, and Travelers. Then it classified and reintegrated the information it gathered for ITS applications. Web service meant as a way to communicate between centers, systems, applications, devices, vehicles, fields, and travelers.

V. INTEGRATION TO EXISTING SYSTEM

There are many ITS applications such as car navigation; traffic signal control systems; container management systems; variable message signs; automatic number plate recognition or speed cameras to monitoring applications, such as security CCTV systems; parking guidance and information systems; weather information; etc [8]. Underlying key technologies such as Global positioning System (GPS), Dedicated-Short Range Communications (DSRC), Wireless networks, Mobile Telephony, Radio wave or Infrared Beacons, Roadside Camera Recognition and probe Vehicles or Device [9] supported those applications.

Advances in vehicle electronic provide us with more capable computer processors. The microprocessor modules with hardware memory management and Real-Time Operating Systems is allowing a more sophisticated software applications to be implemented, including model-based process control, artificial intelligence, and ubiquitous computing [8].

Sensing technologies such as state-of-the-art microchip, RFID, and inexpensive intelligent beacon sensing technologies used in sensing systems. These sensing systems are vehicle and infrastructure based networked [8].

Technological advances allowed ITS applications to be more sophisticated. Therefore, implementing web service to exchange information in Cloud ITS is possible. The comparison between existing system and and proposed system implementing web service is shown in Figure 4 and Figure 5. Existing system shows no interaction between different ITS systems in Center. Proposed system manage ITS systems inside Cloud ITS and provide interaction between ITS systems and access to industry platform.

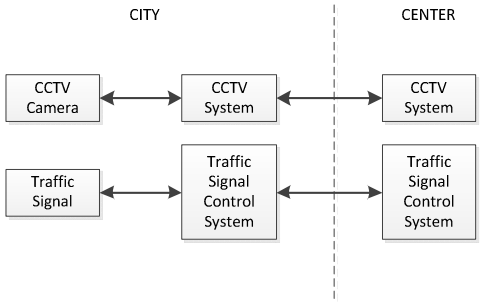

Figure 4. Existing Transportation System

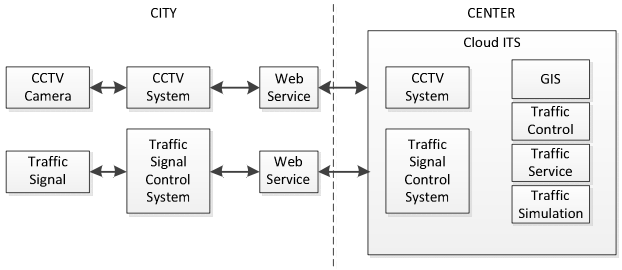

Figure 5. Proposed Cloud ITS Indonesia System

Web service allowed Cloud ITS to manage information in a more standard format and provide a better interoperability between ITS systems. Communication between ITS systems inside Cloud ITS became available and resources can be shared either from ITS systems or from Cloud ITS Industry Platform.

VI. CONCLUSION

The paper presents an assumption of establishing Cloud ITS based on cloud computing, it is feasible to accommodate transportation information sharing platform. Cloud ITS, while providing interoperability with web service, face a challenge with increasing information quantity and high request of data. Fortunately, cloud computing characteristics can address this problem. Of course, implementation and testing of Cloud ITS Indonesia will have to be done in order to prove assumption above. Other ITS research is advised to consider using web service as it's transportation information sharing method of communication in order to support the development of Cloud ITS.

References

[1] S. H. Supangkat dan M. A. Muhammad, "Indonesia Intelligent Transportation Roadmap," ITB, Bandung, 2011.

[2] C. J. Skinner, "ITS logical architecture for ITS service interoperability – an investigation into user acceptance," dalam *CAITR – 8-10 December 2004*, Cremorne, 2004.

[3] P. Mell dan T. Grance, "The NIST Definition of Cloud Computing," *NIST Special Publication 800-145,* September 2011.

[4] L. Wenyun dan B. Lingyun, "Application and Exploration of Travel-service&information System Based on Web Service," dalam *2009 Second International Symposium on Computational Intelligence and Design*, 2009.

[5] J. M. Sussman, PERSPECTIVES ON INTELLIGENT TRANSPORTATION SYSTEMS (ITS), Massachusetts: Springer, 2005.

[6] W.-H. Cai dan T.-t. Sun, "CTS: The New Generation Intelligent Transportation System," *2011 Second International Conference on Innovations in Bio-inspired Computing and Applications,* pp. 137-140, 2011.

[7] Z. Li, C. Chen dan K. Wang, "Cloud Computing for Agent-Based Urban Transportation Systems," *IEEE - Intelligent Transportation Systems,* pp. 73-79, 2011.

[8] L. Qi, "Research on Intelligent Transportation System Technologies and Applications," *IEEE Computer Society: Workshop on Power Electronics and Intelligent Transportation System,* no. 124, pp. 529-531, 2008.

[9] S.-h. An, B.-H. Lee dan D.-R. Shin, "A Survey of Intelligent Transportation Systems," *IEEE Computer Society: Third International Conference on Computational Intelligence, Communication Systems and Networks,* no. 76, pp. 332-337, 2011.