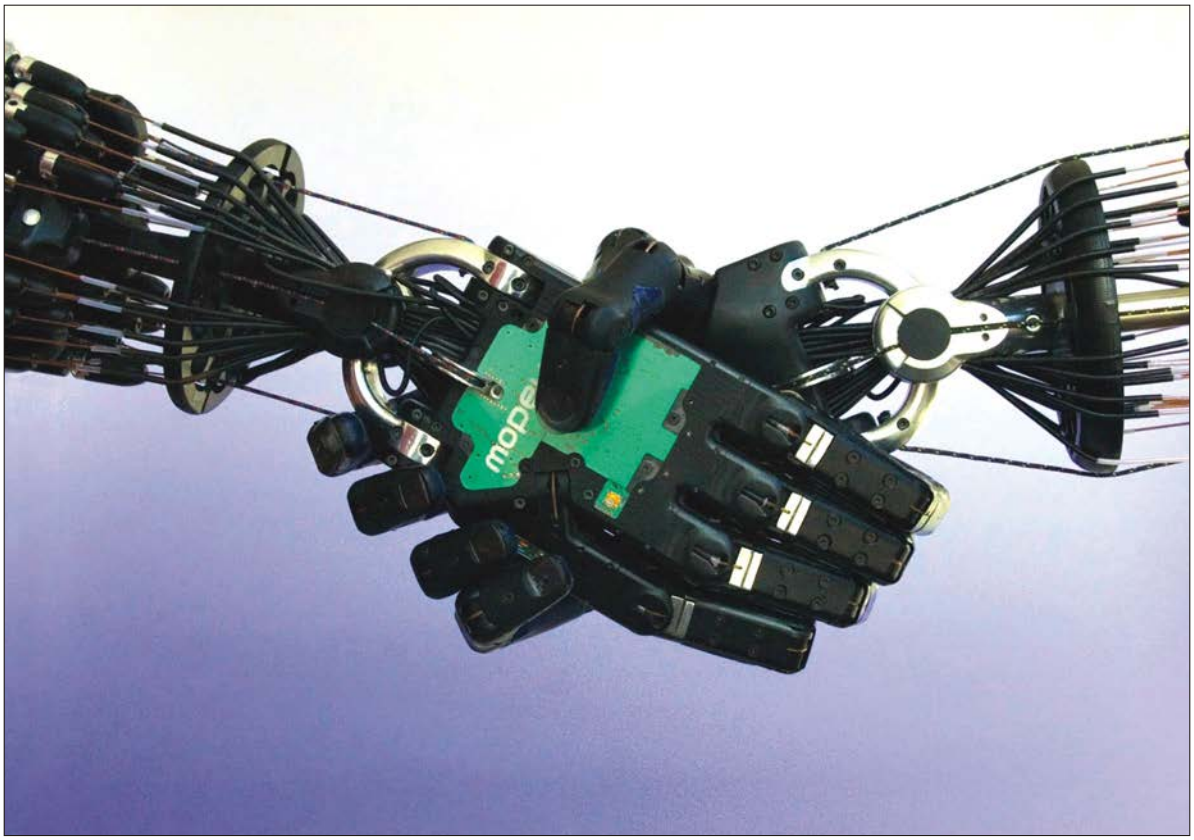

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Design and Development of Commuter Services Model in Trains using Cloud

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ABSTRACT

The cloud technology is becoming ubiquitous and making the things easier. The idea is to seep this technology into the trains and other transport systems also. Without technology, transport system is more complicated and boring and these can compensated with cloud. A central server on the train, with memory, processing capacity, internet connectivity and with a local network throughout the train (access points in each compartment or use directional antennas) could be of great use to passengers, railway authority and police. The technology improvement goes in hand with the use of clouds on train. With help of Global Positioning System (GPS) and internet, cloud can predict the train clash possibility and alert the concerned authority. This cloud can be used for some of the services like software as a service, infrastructure as a service, etc., and also enjoy on demand services like video streaming, etc., locally. The server can also be used by railway authority for updating the passenger details and know about vacancy of berths and other information which makes it easy for them to know anything at the snap of the finger, even when there is no connectivity between bogies. The cloud can be used to collect the information about the surroundings and give the notifications to the user/whoever is connected to the server.

Key words: Autonomic computing, train clash predictor, train ticket examiner, seat availability, on demand services, utility computing, virtualisation

INTRODUCTION

With rapid evolution of computer networks, information technology is seeping into every part of our life and everything is getting digitalised. In future, cloud computing will play an important role in how digital networks work and how it is used to solve almost every problem easily. Now a days, cloud computing is expanding in all the areas like education, business, security, traffic control etc. The main objective of this study is to explore how cloud can affect the normal transportation systems, especially railways. The outcome of this study is to provide some solutions for rail transportation system which helps it to make the work easier by providing digital networks in a train.

OVERVIEW OF CLOUD COMPUTING

Cloud computing: The name cloud is inspired from symbol that is used to represent internet in network flow diagrams and charts (Wang and Xing, 2011), which refers to the distributed systems

and it is available wherever one goes. Cloud is defined as pool of resources with very high processing, memory and networking capabilities. According to IBM, cloud computing is a model which provides on demand web based software, middleware and computing resources (Alabbadi, 2011). It is an internet based paradigm where internet is served as datacentre and computing centre for clients.

The cloud is based on business models like SAAS, PAAS, IAAS, etc. (Silas *et al.*, 2012). Software as a service (SAAS) provides software service on demand where client does not have to install software; but can access it over internet. Hotmail, yahoo mail, gmail are simple examples of this service. Infrastructure as a service (IAAS) provides the needed hardware resources like memory, processing power, networking, etc., which relieves the users of buying and maintaining the hardware resources (Ding *et al.*, 2012). Platform as a service (PAAS) provides a single platform with tools for developers to work over internet (Zhou *et al.*, 2010). Examples include Amazon Elastic Compute Cloud (EC2), google app engine, force.com, etc. With this technology growth, cloud computing increases the capabilities of client terminals virtually. And eventually I/O devices can perform seamlessly without inbuilt capabilities. Cloud can be accessed by any low capability device like mobile, iPad, table PC, etc.

Cloud computing is a combination of the following existing IT technologies:

- **Virtualization:** It creates virtual resource opposed to actual resource such as operating system, hardware platform, a storage device, desktop or network devices. It gives a feel of actual existence but it is separates and protects the resource from users (Petcu *et al.*, 2012; Bourguiba *et al.*, 2011)
- **Grid computing:** It can be thought of as a distributed system with non-interactive processes and involves large number of files. It executes tasks over set of computers which are distributed over geographical areas which is on par with supercomputer capability
- **Utility computing:** This gives a pay per use package provision for a resource. Resource may be software, hardware platform, network etc., which provides computation, storage and services as metered service
- **Autonomic computing:** Systems can manage automatically by itself by dividing the tasks between resources and maintaining the resources
- **Client-server model:** It refers to distributed application model, which differentiates between service providers called servers and service requesters called clients
- **Web services:** Web service is defined as "a software system designed to support interoperable machine-to-machine interaction over a network" by W3C. This has a machine processable format called Web Services Description Language(WSDL). WSDL uses Simple Object Access Protocol (SOAP) which is an XML-based open source message transport protocol. This is used to update the components and publish on registry and make it dynamically discoverable by client applications. Web service is the basis for Service Oriented Architecture (SOA)

The advantages of cloud computing:

- Provides good security, though the information is stored in other servers, they are trustable. And they provide robust security by leaving security aspects to professionals
- Convenient to use, as people don't have to download software. It will be dynamically loaded and can be used from anywhere

- Economically efficient, as there is no need to buy resources and spend more money on resources, but can lease whatever the resource one needs. It eliminates the maintenance cost of the resources
- Provides supercomputing capability as the tasks are divided among lot of processors on cloud, when there is no enough capacity on the system it can be leased on pay per use basis instead of upgrading to newer configuration
- Scalability, when there is high demand for resources, there will be enough resources on cloud to scale to the need of client
- Availability, when one resource is down there will be redundant resources to replace it dynamically
- Upgradability, the cloud is upgraded and there is no need to upgrade local resources
- Manageability, cloud uses autonomic computing to manage itself by dividing the processes, replacing and scaling the resources etc.

CURRENT STATUS OF RAILWAYS

The train journeys are uncomfortable, long, boring and complicated. For passenger verification, the Train Ticked Examiner (TTE) gets long sheets of paper when train reaches station. It is complicated to maintain those sheets and give them to TTEs coach wise. For passenger verification to go through the names of passengers is difficult again. Whenever passenger couldn't arrive, filtering the details of the available seats for replacing with new passenger is difficult. When a ticket is in waiting list and the passenger needs to search for TTE to know about the seat availability. If the seats are not available in the present coach and as the TTE doesn't know the details of other coaches, TTE can't go into another coach to see availability as it would be difficult for him. For getting food items also, commuters need to go all the way through the coaches to pantry car or else if lazy, they starve at same place. Getting information about the places travelling through and the information about how late the train is to arrive at a station is impossible and commuters don't even know what's happening (Petcu *et al.*, 2012). A long train journey without entertainment and especially without internet is hard to get over with. When there is a robbery or a need to call the police to solve the problem, one cannot go all the way through bogies to search for police. Now a days it has become common to see the trains slamming into each other, it's because the driver does not have any information about the other train timings, location and their speed with which they are arriving on a single track. While travelling, people are unaware of delay by which train is running and also the reasons of delay, one always wants to know the timings to catch the train at the next station. All these problems could be overcome with some solutions using cloud services to provide all the above mentioned facilities.

THE APPLICATION OF CLOUD COMPUTING FOR TRAINS

Cloud installation and positioning: The local server (cloud) is installed in a separate bogie and access points are placed in each compartment according to the requirements and these access points are connected to server to form a LAN. As shown in Fig. 1, the cloud could possibly have following components processors, GPS, SMS server, memory and internet. Following are the details of components:

- **Internet:** As trains move fast, there would be discontinuous internet and to solve this, cloud records the internet operations and completes it when it reaches a place where internet is available. Internet can be provided as pay per use as with utility computing

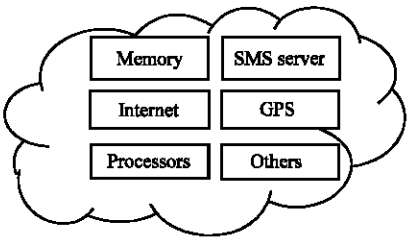

Fig. 1: Components of cloud for trains

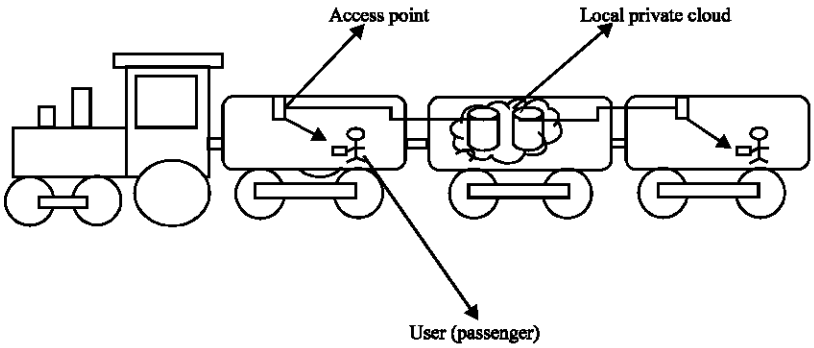

Fig. 2: Cloud model in a train

- **GPS:** The GPS can be used to give the information about the places, the train travelling through. This can be replaced with Google maps if continuous internet could be provided
- **Memory:** The memory contains passenger details, multimedia content, bookstore etc.
- **Processors:** These provide parallel processing power to the cloud
- **SMS server:** The users who don't have digital devices with Wi-Fi, they can use SMS services by sending SMS to the cloud. The cloud uses artificial intelligence to reply to the query
- **LAN (Local Area Network):** To access the cloud, the access points placed in each compartment are connected to cloud with wire forming a LAN
- **Software as a service (SAAS):** The cloud will have software and hardware to implement autonomic computing in the cloud and it will be loaded with software's which can be used by the clients for their work and entertainment some of them are pdf reader, video players, games, business applications which run on cloud and can be used virtually

The clients (TTE, passenger, caterer, etc.) can access the cloud and use the services with a handheld device with Wi-Fi connection. The services can be accessed through a browser since web applications are platform independent and can work on any browser.

Figure 2 shows the simple model of the cloud in a train. A central compartment consists of the server and the hardware needed for cloud, each compartment consists of an access point, these access points are connected to the cloud through Local Area Network (LAN) and a client can access the cloud using wireless handheld devices.

Cloud services: Figure 3 represents the services provided by the cloud and following definitions give detailed view of services (Pareit *et al.*, 2012):

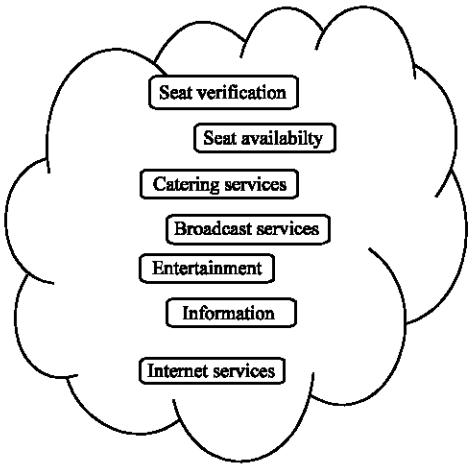

Fig. 3: Services provided by cloud implemented for train

- **Seat verification:** Instead of carrying long sheets of paper, TTE uses hand held device for the passenger verification. By filtering the desired details of passenger within no time can re-allot the seats or replace easily
- **Seat availability:** When a passenger is waitlisted, there is no necessity to search for the TTE for a seat. Rather one can check the seat availability in this service and could get a list of empty seats and timings for which they would be empty based on the request sent to TTE
- **Catering services:** Commuters can order their foods from their seats and shall get their food instead of waiting for the caterer to take orders
- **Broadcast services:** If the journey is boring without entertainment, then with this service, videos are broadcasted on demand
- **Entertainment:** The passenger can enjoy his journey by playing games, reading novels, magazines, etc., available on cloud (SAAS)
- **Information services:** The information about the places the passenger is travelling through and the delay of train if any can also be got. When this information is updated by the TTE or administrator, the passenger can get notifications
- **Internet services:** The user can get the internet services either as a utility or free service. If internet is not available in a place, the user actions are recorded by cloud and repeated when there is internet availability at stations/junctions
- **Train clash predictor:** This takes location from GPS and compares train speed of other trains running on the same line through internet and predicts the possibility of clash and alarms the authority to ensure nothing is going wrong

Cloud application method: After installing the cloud and network, whenever reaches a station it downloads the details of passengers entering into the train automatically and these details are shown to the TTE and passenger. In general, discontinuous internet access shall hinder the services. With a cloud, when a user requests data from web, the data is downloaded into the cloud on the go and when it is ready it is given to the client (Bourguiba *et al.*, 2011). If one wants to upload anything to the internet, because of discontinuity, the cloud shall take care of uploading even after getting down from the train. The cloud will have process running and can

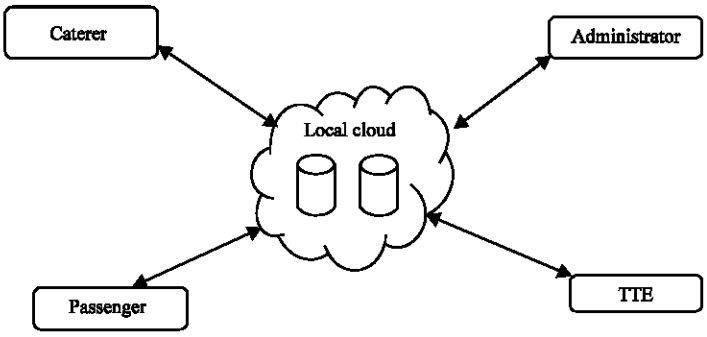

Fig. 4: Cloud access by clients

automatically update content whenever the internet is available. For the information about the places, Cloud gets position from GPS and searches on the web for information and provides it to user. If there is no internet connectivity limited information can be known from local database.

Cloud leverages the characteristics of autonomic computing to calculate the possibility of train clash by getting the dynamic information of trains timings, speed and position, running on a single line through internet and can alert the concerned authority. If there is no internet in some places it will calculate from recent updates or from static local database having the schedules of other trains. Cloud can also automate the traffic management process.

When there is an emergency and if the police are not available it is impossible to find them. But using cloud one can contact them using cloud services which shall be fast and easy.

Figure 4 depicts the cloud access by clients. Every user has different privileges to access cloud. TTE can use it to verify seats, check availability, re-allotment, etc. User have privileges only to check availability and for other entertainment services. Administrator has privileges for cloud monitoring and maintenance. The Caterer has privileges over maintenance of catering database. Cloud can be used by police for security monitoring.

FUTURE ENHANCEMENTS

In future, when cloud computing completely takes the position there could be lot of applications that could run on any platform. The passenger can demand services required for the train journey from day of booking to the day of journey any time. The services needed are downloaded from web whenever the internet is available and will be ready for the passenger on the day of journey.

CONCLUSION

In future, as handheld devices would be available with Wi-Fi at cheaper rates like AAKASH the high computation ability can be provided by cloud Technology and this technology is used by almost everyone. Thus there would be a great need for cloud access in a fast moving train. This can cater to the needs of the society at all times in their journey by all means.

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