TECHNIKA TRANSPORTU SZYNOWEGO

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MOBILE DATA BASES IN CLOUD COMPUTING SYSTEMS FOR TRANSPORT PURPOSES

Abstract

The paper presents the new possibilities developing computing systems in reference to Data Bases as a Service realized by mean the mobile data bases making part of cloud computing systems that can be used for transport implementations. The advantages and disadvantage using the mobile data bases involved in cloud computing systems operating in wireless environment are shown. Systems demonstrated in the paper are illustrated the examples of service implementations addressed to the intelligent transport systems and logistics supply chain management.

INTRODUCTION

Business transport activities are predominated by the mobile services imposing necessity to use the aided computing systems able to work in mobile environment by mean of wireless exchange and communication of the data. The most advanced transport mobile services are mainly involved in the intelligent and logistics transport systems. In mobile environment both these areas cover services which are accomplished on the moving platforms characterizing themselves processing a huge volume of the data that are increased from application to application. At the various stages of processing to assure for these data good accessibility the data have to be stored directly on moving platforms usually making the parts of large fixed computing systems. Related systems and used in them the mobile data bases supposed to have an access to Internet and WWW more and more frequently oriented toward cloud computing systems [1].

The purpose of presented paper is demonstrating the working principles of the mobile data bases referred to the concept of the Data Base as a Service - DBaaS making useful work alternative for computer systems used in managing of transport services. Paper considerations are illustrated the implementation examples applying the mobile data bases in the intelligent and logistics transport systems.

1. DATA BASE AS A SERVICE (DBaaS): STORAGE AND BACKUP IN THE MOBILE CLOUD

In computing systems Database as a Service (DBaaS) is an architectural and operational approach enabling to deliver database functionality as a service to one or more consumers [2]. Recently, the service functionalities of such data bases are expanded on the Internet / WWW as well. DBaaS allows:

– consumer control and management of database records using on-demand, self-service mechanisms,
– reporting database usage for each individual consumer with arbitrary differentiated functionalities,
– automated service monitoring of attributes and quality of service levels.

DBaaS systems assure also the operational elasticity adjusted to use a broad range of various devices and their integration matched to individual discrete services which can be automatically managed and planned at required security level. DBaaS can operate also as the mobile data bases. Then, the mobile data base requirements have to meet the service attributes similar to attributes of common database services, mostly, determined by simultaneous use of the data from a number of mobile sources. Implementation aim of the DBaaS is improving the service levels at enhanced information access and reduced the system expenses resulting from the systems architectures oriented on the customer self-service interacted models.

In recent times the DBaaS began to be used in cloud computing systems as well, however, the actual Internet networking, conditioned by the network parameters, frequently is insufficient to perform more advanced operations required in mobile data base operations. This is conditioned the limited bandwidth of wireless data communication and used operating data base models not giving a guarantee of full data synchronization and data consistency in distributed multi-user environment.

An idea using DBaaS in cloud computing system is shown in Fig. 1.1

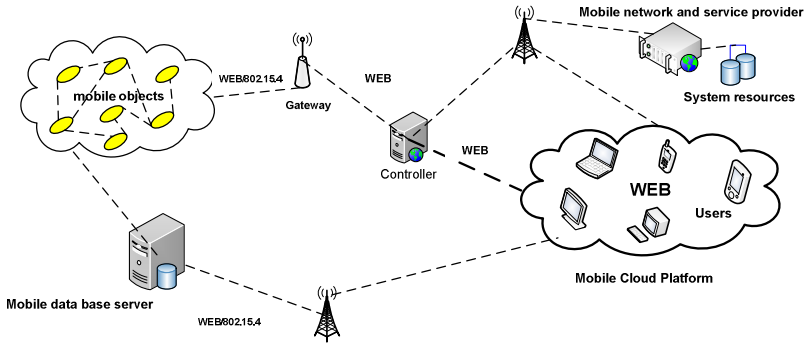

Fig.1.1 Idea of cloud computing supported with mobile data bases

As it is shown in fig.2.1 the mobile bases system make the part of cloud data storage with the data accessible from any terminal type being at any location. In a mobile cloud computing both mobile based services and handled data are stored and can be run directly from the cloud. Thus, relevant network servers and data center infrastructure can be arbitrary expanded at preserving the independency of the storage capacity and the end-user devices processing power.

Most of them operate in the storage patterns referred to IaaS and/or PaaS service models [3-4] offering user-friendly services and interfaces to cloud data storages from multiple fixed and mobile devices.

The business examples of such systems are the systems with online cloud-based data storage and backup services, they are:

- **SugarSync** assuring synchronization and data sharing across multiple devices including iPad, iPod, Blackberry, Android, iPhone and Symbian. This system uses

SSL encryption for secure file transfer and 128-bit AES encryption on stored data as well as backing up customer data in two separate data centers,

- **DropBox** with extended functionalities and configuration of backups as well as security features as SugarSync and support for mobile handsets,
- **IBackup** offering similar system possibilities as both mentioned above systems.

In the cloud online computing the data backup services make obvious system advantage while the limitations make loading large amount of data order of 100GB and more, as then the data storage uploading of Internet connections, they become costly and time consuming. Therefore, the data base system benefits can be obtained just at operating limited amount of the data.

2. DISTRIBUTED MOBILE DATABASES

Similarly as above the mobile databases can be defined as the databases that are associated with mobile computing devices over a mobile wireless network. The client and server have wireless connections assuring for collected data to hold them for repeated transactions independently from connection failures. Each data base makes a structured way to organize information using e.g. the list of vehicle traffic location, customer contacts, price information, distance data travelling etc. [6].

In wireless environment the data accessing is done usually using the laptops, mobiles and various type of handsets systems of which number is continuously dramatically increased. For the mobile databases a large percentage of wireless applications require at the same time using the special purposes data with ability to download information from an information repository. They operate a given information independently on occasional disconnections. This type of work differs itself from the common client–server systems, mainly, by the manner of data accessing and data exchange under condition to work at any time, from any distance and for any data location. Mobile databases should assure the data enter on the fly while information can be able to be synchronized with a server database later on.
Basic requirements for mobile databases used to be characterized by:

- applications which have to be
  - interactive,
  - able to access local device e.g. vehicle hardware, such as printers, bar code scanners, or GPS units …
- users
  - have not the access to truly data, but only to recently modified data,
  - who should accept the topology changes of network and limited life of power suppliers,
  - who should be able to work for time to time without a wireless connection under poor or even non-existent connections,
- communication system bandwidth which must be preserved for the work in a whole operating time.

Under such requirements the systems of the mobile databases have to be able occasionally to accept malfunctioning of wireless frame networks at arbitrary geographical location of the user and limited computing power of the portable device.

Mobile databases systems typically consists of three main units: stationary fixed hosts, mobile units, and base stations. Fixed hosts perform the transaction and data management functions with the help of database servers. Mobile units usually are portable computers that move around a geographical region, they operate using the cell networks similar to cellular

telephones assuring a given cell of mobile devices to exchange the data with the base stations. Base stations make 2-directions wireless system at fixed locations that transfer data with the mobile units to and from the fixed host computers.
Used mobile units operate using low-power devices mobile phones, portable phones, or wireless routers etc.

When a mobile unit leaves a communication cell with access to a particular base station, according to known the handover procedures the station transfers the mobile unit's transaction and data support to neighboring base station, which "covers its electromagnetic range" for the mobile unit's of new location.

For mobile data base purposes usually the middle sized relation data bases are implemented [5]. The representative characteristic features of such data bases can be referred to:

- **SQL Anywhere Server** - it can operate till thousands of users in server environments using as well as the desktop, the mobile applications at really low administration requirements. This system is supported with
  - **UltraLite** database-management system designed for small mobile devices such as PDAs and smart phones,
  - **MobiLink** a highly-scalable, session-based synchronization technology for exchanging data among relational databases and other non-relational data sources,
  - **QAnywhere** unit of robust and secure store-and-forward mobile messaging applications.

  SQL Remote related technology based on a store and forward architecture that allows to connected users occasionally to synchronize data of **SQL Anywhere** databases by the use of a file or message transfer mechanism,
- **DB2 IBM data base** that stores, retrieves, organizes and manages data on a handheld device to synchronize them in a server-based relational database management system. This data base allows to use Java ME Sync Client system for cell phones and pagers
- **Oracle9i Lite** - a complete system solution for mobile or wireless applications that require the use of a relational database addressed to the mobile clients. It includes support for Win32, Windows CE, PalmOS, and EPOC database clients.
  This data base supports using the JDBC drivers and the Java stored procedures allowing programming.

While implementations of mentioned above data bases are rather focused on the logistics and the retail operations, recently, there is observed as well the increased implementation of mobile data bases in aviation and transportation industry. This allows to state, that contemporary mobile database systems provide full data base and mobile communication functionalities assuring the needed transactions to perform by the mobile users from any place, at any time, however at above pointed out limits.

3. TRANSPORT CLOUD MOBILE DATA BASE APPLICATIONS

As it was mentioned before in the transport the mobile bases support the mobile services mostly oriented toward the intelligent and logistics transport systems, both such type of the systems operate a large volume of data generated on mobile system platforms. The main benefit to use mobile data bases is an extension of data availability for further data processing impossible to be reached in fixed, commonly used data bases. A price paid for that, especially, in distributed mobile databases, is temporal inconsistency, isolation and durability of the data [1]. This is a result of the relaxed data properties across different data locations.

Periodically, the users have even to trust the data for disconnected locations creating disconnected operating modes of data bases.

The mobile bases used on moving platforms are addressed to store the data mostly generated by the various type of the sensors and the data resulting from data preprocessing at different service stages. Recently, such data are referred also to Internet/Web operations covering the cloud computing systems as well.

3.1 Intelligent transport systems

In this area more advanced mobile implementations are oriented towards the traffic prediction and transport planning based on processing enormous large data volumes of sensor detected data and data from disparate computers operating in mobility environment. The examples illustrating such operations are referred to moving single and multi-vehicles co-operations. First one can be characterized on example using the systems called the systems of small scale autonomous driving (SSAD) [6], while second one is addressed to the groups of vehicles in which system operations are focused on exchanging and preprocessing data provided by the wireless communication. In the traffic environment the small scale autonomous driving resolves itself to the wireless vehicle navigation able to detect the random locations of fixed and moving obstacles. This is done by mean of exchange and collaboration of sensing data detecting the neighboring vehicles. Then, on the highway traffic the free moving way of each vehicle is determined in computing process of detected sensor data collected from highway vehicles. These vehicle control processes have to be dynamic to assure how to avoid traffic obstacles from detected sensor data [7].

By the use the short distance wireless communication the data from the sensor arrays are collected as the real time records of mobile data bases and allow to build the navigation maps for each vehicle according to rewritten base records. They show fixed and dynamic obstacles features of the traffic and allow dynamically to determine a trajectory database enables for neighboring vehicles to model their current location, speed, and motion plan at continuously revised the data base records. In other words the records of the local mobile data base make basic real time control sub-system depended on the traffic constrains described by detected vehicle data.

In adequate systems the described traffic features of moving vehicle used to be evaluated using two levels of collaboration, high and low. At a high level of collaboration the vehicles transferring their own trajectories to neighboring vehicles are capable to build the autonomous navigation. At a low level of collaboration the vehicles broadcast only their vehicle IDs. Thus, as long as all the neighboring vehicles are at a high level of collaboration, vehicle navigation can be autonomous till to be switched on low level of collaboration corresponding to vehicle navigation pass over to the human driver mode. This assures the data processing of mobile data base – records under conditions of system adaptability to non standard situations, first of all, determined by the vehicle speed.

Mentioned above a second one approach the multi-vehicle co-operation, making a vehicle group, is equivalent to expansion the described single operations on a number single situations referred to the vehicles described by continuously exchanged data. These operations need more advanced vehicle hardware than sensors, at least there are used the laptops, GPS receivers, and vehicle-to-vehicle data communications equipment. In real highway traffic under such conditions, the main system operations covered then the computer predicting trajectories of vehicle convoys travelling with assumed an average vehicle distance, usually 200 meters between successive vehicles. According to such assumptions the computer computing determines not only described above traffic characteristics but also allows answering a question: “what then is the average speed of a given vehicle e.g. one mile

ahead?" Then, the advanced wireless mobile multi-hop communication systems together with advanced work algorithms have to be used, they require further increasing of data volume and corresponded to them increased number of the records in used mobile data bases.

3.2 Logistics

In logistics main implementation of the mobile data bases are addressed to the logistic supply chain management aided by computing systems supported with various type of data provided by the mobile logistic units. Quality and sort such services is continuously expanded, frequently across of the world. This imposes the new operations related to necessity to process a huge volume of the data under condition of high data availability provided by the systems of which expenses should be acceptable low. These requirements can meet the systems supported with the mobile data bases assuring data availability by managing computer systems referred to the Internet / Web. Then, the new services can be introduced and managed in real time. All of this causes that related computing system solutions are focused on the cloud computing approach easily integrating at lower stages above considered mobile bases involved in data gathering operations. Unfortunately in supply chain management, if cloud computing based, a some problem makes assuring the proper security level of information flow between users and service providers.

In a given supply chain accomplishing main service functions assures the data which:

- supposed to be collected according to time dependent requests
- suppose to determine the service parameters
- suppose to update service transmission
- should assure system management: configuration, user security control, etc.
- should assure control strategy of custom reports which in real time should be adjusted to the suppliers' and customers' needs.

Above functions extensively supported by the mobile data bases used to be categorized [8], in three layers: infrastructure, application and service. Infrastructure layer covers the cloud service, the user access, and user's interactions referred to corresponded data, chain logistics, consumers and cloud service providers by mean of the Web, wireless transmission and terminal operations. Application layer concerns the services: their definition, management and calls, while application layer determines e.g. the cloud type to be used [3]. The last one application layer covers: the hardware and software resources to support the system platform - computer, a storage device, network equipment, etc. and the software resources applied for storage service, a queue service, an application service purposes. At this layer the data base applications are particularly strongly supported by the mobile data base operations. They support the services oriented toward transport of the goods and services to arrange by use of Internet links: the chain data collection, data computing, data transmission, data updating etc., they allow also to develop the needed service working algorithms.

As it was shown in presented logistic chain a key role of data bases play the mobile data bases creating the effective basic service platform to exchange the business information of both parties: customers and service providers. Recently, as it was aforementioned such operations are expanded on the cloud computing systems supported with the mobile data bases operating in wireless environment. Using the mobile platforms the short wireless messages fulfilling differentiated user requirements of the service are generated by mean the wireless handset terminals mainly: mobile phones, PDAs, etc. In many cases a mode operation of mobile data bases are the same as was presented in the intelligent transport systems presented earlier.

4. CONCLUSIONS

The paper is focused on two subjects: the Data Bases as a Service shown in using perspective applying the mobile data bases referred to the cloud computing approach and the implementing of such mobile bases for the transport purposes. These later were illustrated on examples of implementation of mobile data referred to the intelligent transport systems and logistics supply chain management. There were pointed out the benefits of such implementations and the disadvantages to use such systems in wireless environment. While benefits make substantially better system effectiveness, data availability and relatively low system expenses the disadvantages make still poor computing system performance, mainly, referred to wireless network, real time operations and data security. Independently building for logistics purposes a cloud computing system platforms meet some problems of enterprise integration, government regulations, and specified regulations concerning all parties involved in the Web oriented services.

Therefore, instead benefits to use the cloud computing systems supported with the mobile data bases the cloud computing systems still are in a stage of development, nevertheless, according to predictions the wide implementation of cloud systems are unavoidable also in transport and soon the logistics can mange the services called the cloud logistics.

MOBILNE BAZY W SYSTEMACH CHMUR OBLICZENIOWYCH DLA POTRZEB TRANSPORTU

Streszczenie

W pracy zaprezentowano nowe możliwości tworzenia systemów chmur obliczeniowych wykorzystujące jako usługę bazy danych realizowane poprzez mobilne bazy danych, które mogą być użyte dla potrzeb transportu. Podano zalety i wady implementacji takich systemów w bezprzewodowym środowisku pracy systemów chmur obliczeniowych. Systemy demonstrowane w pracy są ilustrowane na przykładach zastosowań mobilnych baz danych w usługach adresowanych do inteligentnych systemów transportu i systemów zarządzania łańcuchami dostaw.

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