Applications of Parallel Processing in Mobile Banking

Alecu Felician
Academy of Economic Studies, Bucharest, Romania
E-mail: alecu.felician@ie.ase.ro

The future of mobile banking will be represented by such applications that support mobile, Internet banking and EFT (Electronic Funds Transfer) transactions in a single user interface. In such a way, the mobile banking will be able to cover all the types of applications demanded at the market level.

The parallel processing of credit card bank transactions could be performed with the help of a grid network. Excluding some limitations, the grid processing offers huge opportunities to exploit the parallelism. For this reason, a lot of applications of waiting queues in grid processing were developed in the last years. Grid networks represent a distinctive and very modern field of the parallel and distributed processing.

Keywords: mobile banking, electronic transactions, electronic funds transfer, mobile terminal, *PDA*, *SSL*, parallel processing, grid networks, clusters.

Introduction

The main advantage of parallel systems is the attractive balance between the initial investment and the speedup that can be obtained. In order to extensively use the multiplicity of resources, parallel programs are divided into independent tasks that compete each other to be executed on the processors available in the parallel system.

The operation of computing systems, sequential or even parallel, is based on the existence of waiting queues for the access to the shared resources of the system (processor, memory, peripheral devices). For each resource there will be a waiting system in which the resource represents the service facility and the tasks from the system form the customers. If the resource is the processor, the waiting system is called execution queue and it makes the transition from sequential programming to the concurrent one.

The main goal of the study of the waiting systems is to minimize the total cost of the delays for the customers and for the service facility. The queuing theory has a wide range of applications in the study of the congestion phenomena that appear when the number of customers from the system exceeds the capacity of the service facility.

Queuing theory could be used not only to design parallel systems and application, but also for performance prediction of such systems and applications in

order to find out the ways of improvement. The scheduler is responsible to implement the queuing system discipline by allocating the existing tasks to the available processors of a parallel system.

A grid is a collection of machines that contribute any combination of resources as a whole. Basically, grid computing represents a new evolutionary level of distributed computing. It tries to create the illusion of a virtual single powerful computer instead of a large collection of individual systems connected together. These systems are sharing various resources like computing cycles, data storage capacity using unifying file systems over multiple machines, communications, software and licenses, special equipments and capacities.

The use of the grid is often born from a need for increased resources of some type. Grids can be built in all sizes, ranging from just a few machines in a department to groups of machines organized in hierarchy spanning the world. The simplest grid consists of just few machines, all of the same hardware architecture and same operating system, connected on a local network. Some people would call this a cluster implementation rather than a grid. The next step is to include heterogeneous machines but within the same organization. Such a grid is also referred to as an *intragrid*. Security becomes more important as more organizations are involved. Sensitive data in one department may need to be protected from access by jobs running for other departments. Dedicated grid machines may be added to increase the service quality. Over time, a grid may grow to cross organization boundaries and may be used for common interest projects. This is known as an *intergrid*.

Banking transactions over the Internet

Internet Banking (known also as online banking) allows performing transactions and payments over the Internet through a bank's secure website. This can be very useful, especially for banking outside bank hours (which tend to be very short) and banking from anywhere where internet access is available. In most cases a web browser is used (such as *Internet Explorer* or *Mozilla Firefox*, *Opera*) and any normal internet connection is suitable. No special software or hardware is usually needed.

The major players of a successful e-commerce business are the following:

- seller – it should have a website with specific capabilities and an Intranet network to be used to quickly process the orders;
- customers – consumers having Internet access and owning credit cards to be used for payments. These customers should accept the idea of buying an item by seeing its pictures and reading about its features but without actually inspecting it;

- transaction partners – financial institutions that are able to process electronic funds transfers and the credit card payments;
- international express, overland transport and air freight companies – are moving physical items form the seller to the buyer;
- authentication authorities – they guarantee the security and the integrity of the transactions;
- government – it provides the legal framework for the e-commerce activities and also it protects the customers from fraud;
- Internet connection – reliable infrastructure and access packages not based on the time spent or on the traffic performed.

Basically, an electronic payment system involves the use of a digital financial instrument that allows the money exchange between the buyer and the seller. The most common issue regarding the electronic payments is the transaction security.

The most important barriers in developing the electronic payment systems are the following:

- incomplete legal infrastructures regarding the card transactions and the lack of a framework involving the fraud by using stolen or lost credit cards;
- underdevelopment of the credit card industry in some countries;
- the existence of the explicit consent – a transaction cannot be considered as being valid until the owner of the credit card is physically signing on a specific receipt;
- the cash payments are preserving the anonymity, while the electronic payment systems not.

Mobile banking trends

Today, the mobile banking is based on dedicated services offered by the telecommunication operators. Some systems are using SMS messages exchange but others involve smartcards that store the details of the accounts that are used. The security of these transactions is one of the most complicated challenges that need to be addressed.

The service can be requested anytime by a user located anywhere. Customers do not need to go to the bank office and also there is no need to access a computer having an Internet connection in order to perform the banking transactions.

Other applications of mobile banking are connected with different financial services like online brokers, online banks, wealth managers, stock trading and so on.

Of course, the mobile banking has some limitations. Customers cannot access accounts that are not assigned with their smartcards and they cannot pay at the supermarket by using the phone, for example.

The number of user accessing the mobile banking is growing faster from one year to another. The use of the 3G mobile networks will generate the development of more sophisticated services involving multimedia.

In the last years, the banks invested o lot of money to develop Internet banking systems. Now, they need to adapt to the market and to offer to the users mobile banking solutions in the shortest possible time.

By creating applications that are able to join online banking with *EFT* ones, the mobile banking will become very attractive for big retailers (like hypermarkets and supermarkets) because they will not need to invest so much money in the infrastructure (wires, cables, dedicated lines and so on). The customers will be able to pay by the credit cards using mobile devices (*PDA*s) located at the payment points and connected with a dedicated bank server by using the Internet.

All the requests by this type will be processed by specialized bank servers. If the expansion of the mobile banking will grow faster, the banks will have huge problems in processing the incoming requests generated by the mobile systems. The dedicated servers will need to complete very fast a huge number of the transactions but in a secure manner. In order to achieve very good response times, the servers could dispatch the transactions in the bank Intranet by implementing a grid network of workstations.

The use of a grid network is an economical and convenient solution because it is based on existing resources (computers located in the Intranet of the bank) that are not 100% used during the day. Their idle times could be used to process bank transactions generated by the mobile devices. Once a transaction is processed by a workstation, an answer is sent back to the server and the mobile device will receive a message containing the result of the transaction processing. Also, the parallel processing of the transactions will guarantee very quick and accurate responses even if the number of concurrent requests has a very large value. This is why grid processing can definitively contribute to the expansion of the mobile banking.

The future of mobile banking could be represented by applications that support mobile, Internet banking and *EFT* (*Electronic Funds Transfer*) transactions in a single user interface. In such a way, the mobile banking will be able to cover all the types of applications demanded at the market level.

The *EFT* transactions are basically performed by using a dedicated device that is able to read a bank card. The user enters the *PIN* code by using a secured *PINPAD*. The *EFT* terminals are permanently connected to the bank by using dedicated wired phone lines.

The *ProCard* Application

The *ProCard* system represents a suite of applications used to perform mobile banking. It was intended to be a universal solution that allows *EFT*, Internet and mobile banking in a single package. No special software or hardware is required.

The card transactions should be processed as fast as possible. To achieve such an objective, the system is actually processing the transactions in a parallel manner by using a grid network. The use of a grid network is an economical and convenient solution because it is based on existing resources (computers located in the Intranet of the bank) that are not 100% used during the day. Their idle times could be used to process bank transactions generated by the mobile devices. Once a transaction is processed by a workstation, an answer is sent back to the server and the mobile device will receive a message containing the result of the transaction processing. Also, the parallel processing of the transactions will guarantee very quick and accurate responses even if the number of concurrent requests has a very large value.

Today, the *EFT* transactions are completed by using dedicated phone lines. A special device is calling the bank server and is discussing with it by using a predefined protocol. The average time of a transaction is around 5 seconds. The maximum number of workstations that can be connected to the *ProCard* system is equal with 32.000. If a number of 32.000 of card transactions are generated in the same time, the *ProCard* system, when running at its full capacity, is able to complete all the requests in 5 seconds. A classical system will need 160.000 seconds to finish (45 hour, almost 2 days). The parallel processing of the card transactions generates a huge speedup at the application level.

The components of the *ProCard* system are listed below:

- The application at the WEB server level – written in ASP (Active Server Pages), it represents the interface used by the customer in order to specify the transaction details into the browser. This application also includes an administration module that can be accessed by providing a special password;
- Processing server – this application is written in Visual Basic .NET. It receives the transaction details from the WEB server and places all the requests into a waiting queue. The scheduler manages the queuing system and it implements the system serving discipline based on priorities.
- Processing clients – are applications running on the workstations and, speaking in terms of queuing theory, they represent the service facility units. These clients are processing the card transactions coming from

Internet and the results are sent back to the server and finally to the browser. More than one client is allowed to run on each workstation.

- Database application – allows performing queries and updates in a graphical form focused on the non-initiated users.

Conclusions

In the last years a lot of applications of waiting queues in grid processing were developed. The parallel processing of bank transactions done by using credit cards is performed with the help of a grid network. The complete implementation of Internet and Mobile Banking allows to the individual users to access the *ProCard* system. Another possibility is to connect a few systems together in a transactional network that will cause faster response times and better characteristics. I can conclude that grid processing can definitively contribute to the expansion of the mobile banking.

References

[1] Tanenbaum A. S. — *Computer Networks*, Prentice Hall, 1996

[2] Surcel T., Mârşanu R., Pocatilu P., Reveiu A., Bologa R., Alecu F. — *WEB Technologies and Databases*, Tribuna Economică, 2005

[3] Brewer M. — *Internet Banking: Strategies, Tools, and Best Practices* Sheshunoff & Co, 2000

[4] Chapman G. — *Internet Banking and Shopping* Bernard Babani Publishing, 2004

[5] Noonan W., Dubrawsky I. — *Firewall Fundamentals* Cisco Press, 2006

[6] Cheswick R., Bellovin S. — *Firewalls and Internet Security* Addison-Wesley Professional, 2004