Parallel processing of mobile banking transactions

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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.
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Fundamentals of parallel processing

In the recent years, the parallel and distributed systems become more popular for the data intensive applications like the ones used to simulate complex systems (aerodynamics, meteorology). The main advantage of such 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.

Geographically and spatially distributed waiting systems are special kind of queues where the servers from the service facility visit the customers located at different locations. Such systems are completely different than the classical view in which the customers are lining in a queue waiting to moment when they will obtain the service.

Implementing priority classes makes possible the existence of several parallel waiting queues that are competing for the access to the service offered by the service facility. Also, together with the classical waiting systems, it can be taken into account several extensions and variations that consider some consumer behaviors neglected by the fundamental model, like balking (prospective users that are not joining the queue) and reneging (an user becomes discouraged and decides to leave the queue without obtaining the service).

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.

The role of the interconnection networks is to link together the processors and the memory modules of a parallel system. The characteristics of these networks dramatically affect the global behavior of the system. The routing mechanisms are used top determine the path to be used by a message inside an interconnection network.

The communication between the processors of a shared memory system is performed by data stored in the common memory space. The mutual exclusion mechanism is intended to serialize the concurrent access to the shared variables in order to prevent the conflicts. The hardware mechanisms used to implement the mutual exclusion are helpful to obtain high level synchronization objects like semaphores, barriers, events, condition variables, mutexes and so on.

Banking transactions that can be performed 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 *e-banking* is very similar with Internet banking but the customers are using a dial-up connection and a modem in order to setup a connection with the bank.

The very quick development of the mobile devices allows the banking transactions to be performed through mobile phones and PDAs (*Personal Digital Assistant*). This is called *mobile banking* and implies the existence of some dedicated services. An example of a PDA device having an incorporated card reader is presented in the picture below.

Wireless PDA having a magnetic card reader incorporated

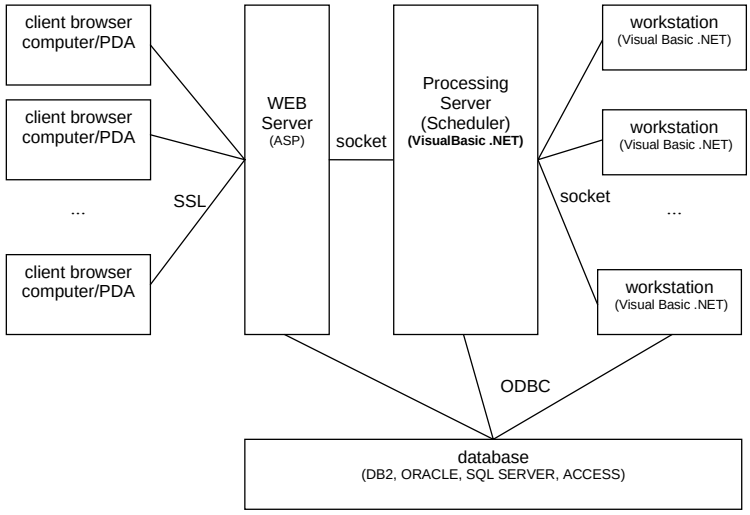
Security of banking transactions performed over the Internet becomes a huge potential problem.

A very good method that can be used to protect a private network is the implementation of a firewall between Internet and Intranet. This firewall will filter the packets that transit the network according with the security policy defined at the system level.

The *SSL* protocol allows verifying the identity of a *WEB* server based on a digital certificate issued by a certification authority. Secure data transport over the Internet is done by using encryption methods.

The *ProCard* system

The *ProCard* system represents a suite of applications used to perform mobile banking. It was intended to be a universal solution that allows *Internet* and *mobile banking*. The application architecture is presented below.

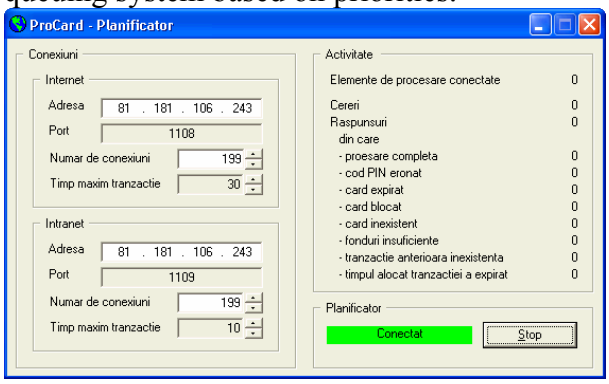


The architecture of the *ProCard* system

For the *Internet banking*, a customer needs an Internet connection, no matter if this connection is a classical one or mobile. For the *mobile banking*, an Internet connected PDA with magnetic card reader should be used.
Any card transaction is initiated using the client browser, like in the picture below.

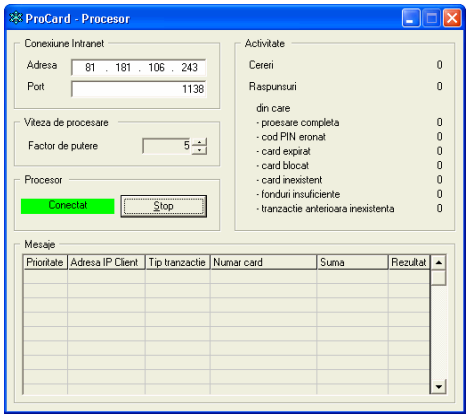
Transaction window of the WEB application

The transaction details are passed to the transaction server that basically implements a queuing system based on priorities.



Processing server

In order to process the request, the scheduler assigns the task a free workstation from the intranet.



Processing client

The processing result is sent back to the scheduler and finally it arrives to the customer browser window.

Processing result

The use of the *ProCard* system could generate important opportunities for the Romanian banking system and for the community of the big retailers from the market.
The *ProCard* system is composed by a suite of components that forms together a parallel application using a central scheduler having as the main scope the implementation of the serving discipline at the waiting system level. The queuing system is formed by the transactions waiting to be finalized by the processing elements distributed over the local network and connected to the transaction server.
From the information available at this moment, it is clear there are not known similar implementations of such a system at international and our country level.

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