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Connection Interface Designing for Grid and Mobile Devices

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Abstract

There area lot of mobile computer devices with a variety of applications and users Tend to use them more. Due to the limitations of mobile devices, running most of the procedures are impossible. To resolve this problem, mobile devices can be connected to the grid, to use the facilities of grid. On the other hand the communication mechanisms are different for each device and they cannot be connected to grid in a stable procedure. In addition, the mobile devices are moving from one place to another and grid cannot manage the successive connection-disconnection of communication. Main idea of this paper is to design an interface for controlling communications between these devices and grid. This interface allows each instrument to be connected to the grid with its own mechanism. For this purpose a database is used in interface. Simulation results show that transaction overhead is low.

Keywords: *Grid, Mobile Grid, Interface, Bluetooth, Infrared, Wi-Fi*

1. Introduction

Most people use Internet and it is part of their life. By using the Internet, you can send emails to any different computers, and anywhere in the world. As we know Internet capacity is not limited to send a letter or have a website. It is possible to use other system's hardware resources by Internet and may other tools will be available [8].

Nowadays, a new technology, called *grid*, exists that with downloading a special screen saver you can allow your PC to be connected to global networks. When the PC is idle, you allow larger research systems to use free and unused resources of your system [11].

Grid computation provides opportunities to use other system's hardware resources, via Internet. Indeed system's resources are connected to the network, and big resources of services and facilities are created. The grand and powerful center is able to do complex operations that a system cannot do alone [5].

In the past years, mobile devices such as cell phone, PDA, Laptop, were gradually increasing and spread everywhere. These devices are moving from one place to another. Mobile devices should have been light, to be portable. Portability feature limit these devices somehow. For example: a small screen, usually no keyboard, weak processor and the low battery power [6].

According to the limitations, most of applications cannot be loaded in mobile devices. Some strategies should be devised so that these devices can be used efficiently. By using grid a vast computing resources can be applied for running powerful process that mobile devices can't do alone [10].

Mobile devices constantly move from one place to another. These devices should be connected to grid through a station. When the mobile device moves from one point to another, its junction with the first station is disconnected and when it arrives to a new station, it will connect to this station. This may take long time for that device to find a station.

Fixed and desktop computers use fixed mechanisms for connecting to the Internet. But mobile devices are connected to networks with different mechanisms, such as Bluetooth, infrared, and Wi-Fi[9]. Mechanism identification, device type detection will be difficult to grid if there are different connection mechanisms.

In proxy model [1], the proxy acts as an interface and mobile devices are connected to proxy, through a wireless network. In this model, mobile devices connection with interface is not considered. At the gateway model [10], successive connections of mobile devices and cellular networks for connectivity are considered. In MAP grid model [3], two-layer architecture is used. None of these models covers incessant connecting/ disconnecting of moving.

Some problems must be solved in connection of a mobile device and grid: process segments should be tracked. Mobile device has to be equipped by introducing system to grid. When the device is moving and unable to find a station, historical tools must be added to the devices. Some resources are allocated to the running process. When a disconnection phenomenon is occurred, resources must be manipulated properly.

The designed interface in this paper can be used to solve all of mentioned problems. Interface situation is between grid and mobile devices. By using interface, grid is hidden and all activities and tasks are conducted properly. So the interface is the gateway to the grid form mobile devices.

The presented interface design is discussed in section two, and it will be evaluated in section three.

2. Interface Design

Figure 1 is an overview of the connection interface with in three elements, mobile devices, interface and grid. Different devices have different transaction format. Interface part is responsible to communicate mobile devices and grid together. The interface receives user's request from mobile devices, converts requests to a unique format and sends new format to the grid.

The mobile devices have application software which user's requests are sent through this software. Packets are generated through this software. Communication interface is a software system that manages the interaction between mobile devices and the grid. All actions are managed by this software. Interface is connected to grid via Internet by TCP/IP protocol.

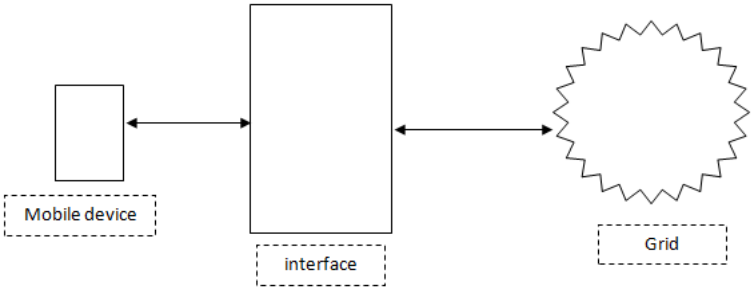

Figure 1. Overview of interface model

2.1 Interactions between mobile devices, interface and grid

Interaction between mobile devices and grid is shown in Figure 2. Communication is done with 5types of packets. Packets description are shown in Table 1.

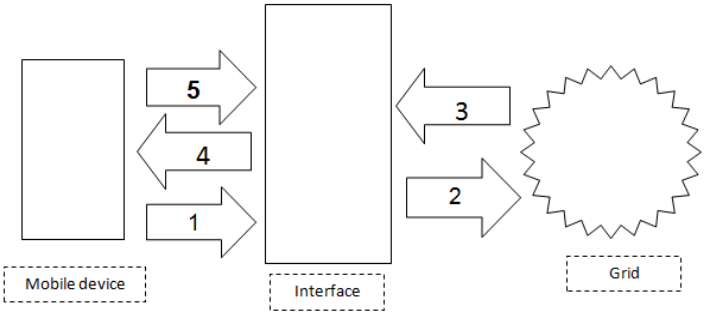

Figure 2. Interaction data between mobile device, grid and interface

Table 1. Performance description of packets

Name of packet	Performance description
packet 1	A mobile device request to interface for computing service
packet 2	sent data to the grid(TCP/IP mechanism)
packet 3	Data processing results(grid to interface)
packet 4	Data processing results(interface to device)
packet 5	Connection/disconnection notice

2.2 Management Software

Software in interface does all management processes. Database has an important role in this software and is demonstrated in Figure 3. The management information is part of this database. Database on interface management software is made of three tables: *management*, *request* and *connection.*

The *management table* includes device code, type of mechanism and statues fields. Information *request able* is related to the application process of the mobile device. This table has a number of application fields: ID, device code, time of process, information, time of wait and interrupt. *Connection table* distinguish connection point of mobile device. This table has a device code and connection point fields. Communication interface is composed of series of interfaces like a tree structure and each interface has a unique name that is specified in the connection point.

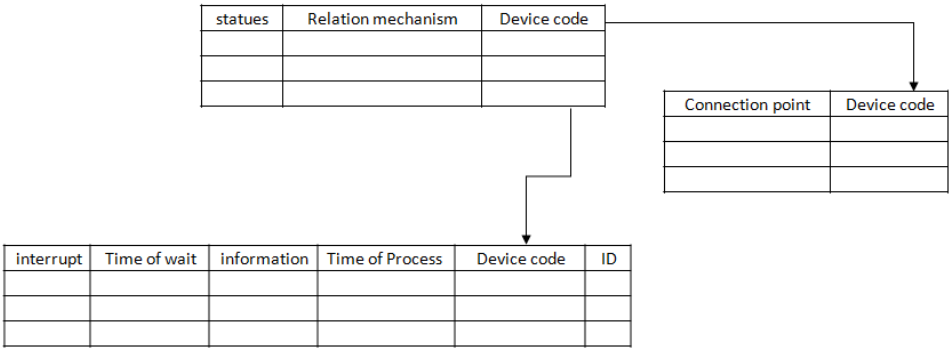

Figure 3. Database in interface management software

Management table is the main database table. Packet 1 information is updated in this table and packet5 records connection/disconnection of mobile device. A part of the *request table* is about user's application from the grid. The *connection table* determines connection path between the mobile device and interface.

As shown in Figure 4, the communication interface consists of a series of interfaces connected together as a tree and are related finally with mother-interface. Interface management database in the mother, child or stem interfaces in the end stage, are responsible for connection to mobile devices in different physical locations. Each child interface, has a unique name and mobile devices can be connected anywhere to the interfaces.

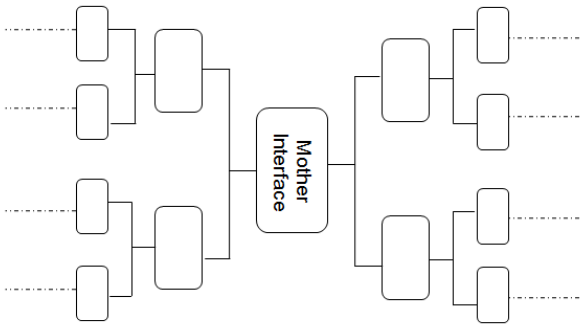

Figure 4. Interface tree structure

2.3 Communication mechanisms

Each mobile device as its own structure and is connected to interface by a specific mechanism. For example: laptop via Wi-Fi, mobile using Bluetooth and PDA via infrared mechanism. Designed interface must be able to cover all of the mechanisms. Grid and interface communicate with each other through the Internet based on TCP/IP. In order to communicate with these mechanisms their structure should be known to interface. The packet structure of different types of communication mechanisms are shown in Figure 5.

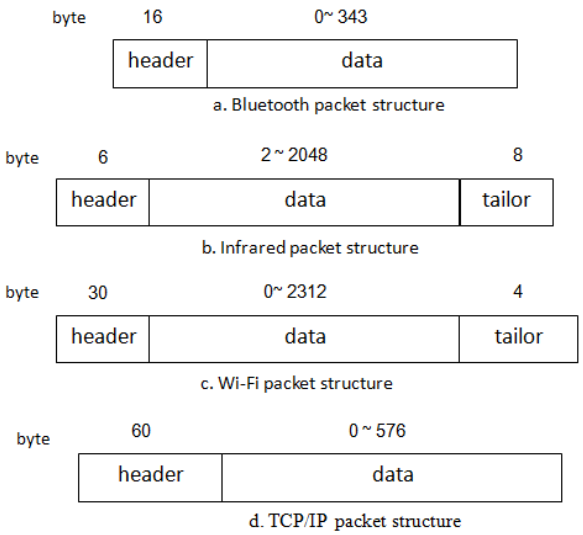

Figure 5. The packet Structure of: a. Bluetooth, b. Infrared, c.Wi-Fi, d. TCP/IP

Each packet by Bluetooth mechanism has a maximum of 359 bytes and 16 bytes of header information on it[7]. Infrared packet has a maximum of 2054 bytes, with 6 bytes header and 8bytestailor [4]. Wi-Fi packet as the maximum range of 2346 bytes and 28 bytes header and 4bytestailor [2]. Headers of these packets are defined in the interface to determine mechanisms. TCP/IP packets can be a maximum of 636 bytes and 60 bytes header[12].

2.4 Performance description

Communication and connection/disconnection management mechanisms are shown in this part. Section2.4.1discussesthe covering of different mechanisms and section 2.4.2 examines the connection/disconnection capability.

2.4.1 Communication mechanisms management

The interface mechanism is shown in Figure 6. Before a process running request, at first the device should be introduced in the interface and then applications are introduced. So, the initial packet contains from application software of the device. In the information section of the packet, "ENTER = Code" is sent. Interface knows the format of packets so detects the type of mechanism and updates tables and waits for next packets.

At this stage, application software on device prepares data for applying request and sends it to interface. These data are delivered from one of child interfaces. That interface takes the packet and delivers to mother interface for analyze. The mother interface takes the packet and updates data packet in *request table.*

After extracting the data from packet 1 and updating the *database tables*, packet-2 is prepared and is sent to grid for processing. Packet-2 is transferred in Internet by TCP/IP mechanism. When packet 2 is sent, the *time* of process in *request table* is updated. Application of this *time* is for resources allocation in extremely busy state. The *time* is decreased, when *time* reaches to zero but process is non-complete, implemented process will finish and all the resources allocated to this process are recaptured.

The data are processed in the grid. Two situations may be occurred. In the first situation, grid completes the operation process and sends response to the interface in the form ofpacket-3and interface sends result to the device. In the second situation, grid needs some more information from mobile device, so "Interrupt = ON" is placed inpacket-3, and other necessary information will be sent. With this packet, interface sends interrupt to mobile device.

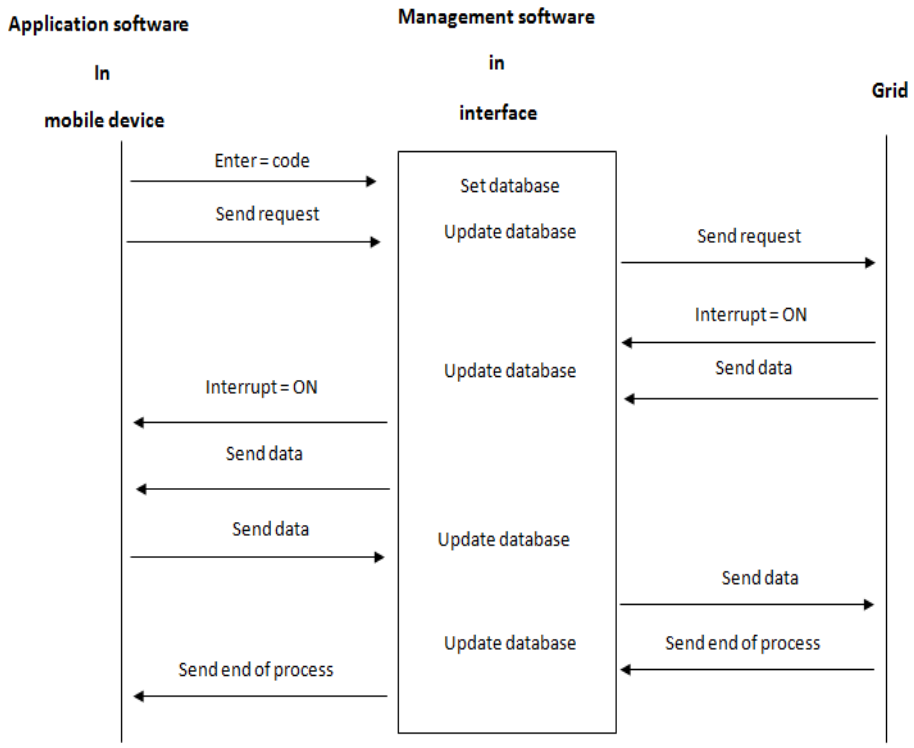

Figure 6. The communication interface operation

Interface is preparing to sendpacket-4 to mobile device by analyzing packet-3 fields and updates *request Table*. Packet-4 should be prepared with device own mechanism. Mobile device and interface connection point are specified from *connection table*. Mother-interface prepares Packet-4 information and transmits it to the connection point, and then to the mobile device. Now, If there is a connection in the *connection table*, it means device is connected to interface, otherwise, device has no connection to interface and has to wait.

Before sending the interrupt information, packet-4 will be sent with "interrupt = ON" in its data section. Device application software check the information part, and if detects interrupt, answering to interrupt will be started.

2.4.2 Connection/Disconnection management

During the process, devices and interfaces are connected to each other; the connection may be broken off any way. To notify disconnection to the interface the packet-5 will be sent to the interface with "quite = code" in information section. Interface receives this packet and notices that the device is going to disconnection situation and turns the “current situation” field in *management table* to off.

If break is occurred during the processing, operations carried out in a grid, interface should keep the processed data and send it in next reconnection time (from any station). The duration of waiting time is available through the “time of wait” field in *request table.* This field is a waiting period during which the mobile device is connected to the interface. In this period if the device wouldn’t be connected to the interface, all allocated resources to this process must be returned and all resources devoted to this process should be released.

To reconnection of the mobile devices, a packet with "ENTER = code" in information part is sent.

If the connection is disconnected suddenly, the interface will find a connection point from *connection table*, deliver this point to the child interface, and child interface will send the data to the device. Since the device is not connected, interface cannot find the device for sending data, so notifies this situation to the mother interface. Mother interface also reforms connection point in *connection table* and in *request table,* adjusts the wait field and spots a *time*. Now, if the device connection with interface was not established, the process will be finished and will recapture all resources.

3. Evaluation

In this section, the required data exchange for process will be checked in two cases: with and without interface. Mobile devices have different connection mechanism and grid is unfamiliar with these mechanisms. By introducing these mechanisms to grid, there are yet some overhead. Table 2 shows the transfer by the amount and data byte amount for different mechanisms.

Table 2. Data exchange without interfaces to transfer 1000 bytes of data

Mechanism	sent data	Transfer information
Bluetooth	1000	1048
Infrared	1000	1014
Wi-Fi	1000	1034

In this mode, each devices ends packet to the grid according to its own format. For example, the Bluetooth mechanism breaks data into the343-byte packets and adds 16 bytes overhead, with final packet size of 359-bytes. So 1000 bytes of data needs to 1048 bytes this means we have 48 bytes overhead. But in this mode mobile devices intended as a fixed station. So If they move, their relevance to grid will be disconnected and will be unknown for them.

If the interface is set between grid and mobile devices, each devices is connected to interface with its mechanism and interface connect them to the grid. The exchange of information on mobile devices, interface and grid are shown in Table3.

Table 3. Data exchange with interface for transfer 1000 byte data

Mechanism	Send data	Transfer information
Bluetooth	1000	2519
Infrared	1000	4188
Wi-Fi	1000	4492

In this mode, if the mobile device wants to send 1000 bytes of data, at first it connects to the interface with defined mechanism and transmits data. Then interface sends back data to the grid with TCP/IP. Grid has not any concern on devices. In data sending from device to grid, for example, on Bluetooth mechanisms, at first one 359-yte packet will be sent to interface as an introducing part of devices, then data will be sent in 359 bytes packet to the interface. Interface receives packet with 632 bytes length, transfer it with TCP/IP. So for sending 1000 bytes of data, we have 2519 bytes data exchange.

The diagram of exchange data are shown for Bluetooth, infrared and wireless mechanisms with and without interface in figures 6,7,8.

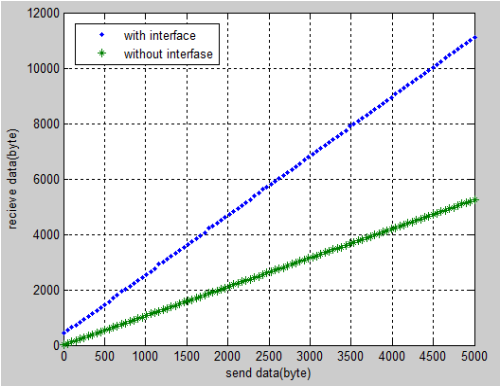

Figure 6. The exchange of data with and without interface in Bluetooth mechanism

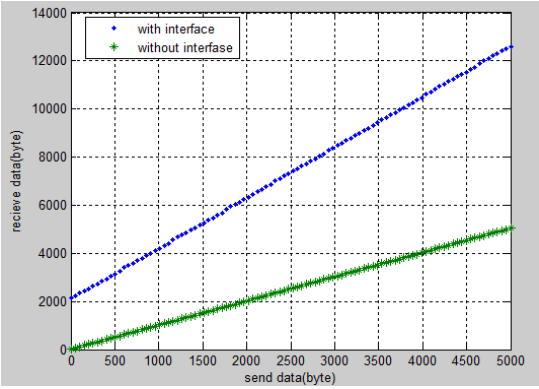

Figure 7. The exchange of data with and without interface in infrared mechanism

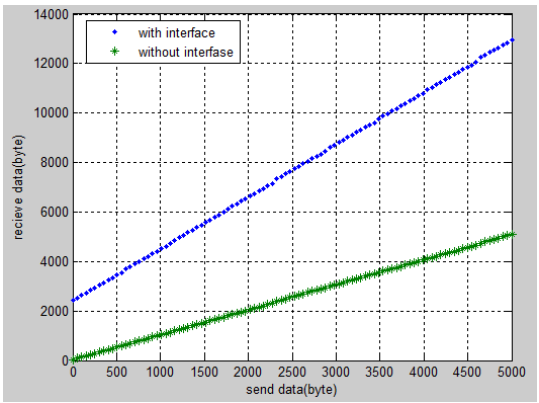

Figure 8. The exchange of data with and without interface in Wi-Fi mechanism

In these figures, the horizontal axis is the amount of sent data while the vertical axis shows the received data. Table 4 compares the amount of data exchange to send 1000 bytes of data with and without interface. As shown, data exchange transfer rate goes up with interface, but note that interface gives the link capability to mobile devices.

Comparing the exchange rate at connection/disconnection situation is shown in Figure 9. In this diagram the horizontal axis determines the number of connection or disconnection. For example, 2 mean two disconnections and re-connections. The vertical axis shows the amount of data exchange.

Table 4. Comparison of data exchange with interface and without interface

Mechanism	Send data	Transfer data (Without interface)	Transfer data (With interface)
Bluetooth	1000	1048	2519
Infrared	1000	1014	4188
Wi-Fi	1000	1034	4492

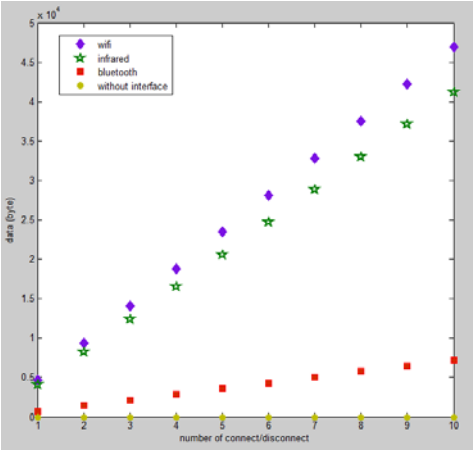

Figure 9. Data exchange rate on device connection/disconnection with and without interfaces with Wi-Fi, infrared and Bluetooth mechanism

If a device has two disconnections with interface, there are four packets to send. But when there is no interface, it does not stop the exchange of spatial data. Table 5 shows the amount of information exchange mechanism with and without interface.

Table 5. Data exchange with 2connecting and disconnecting, with and without interface

Mechanism	With interface	Without interface
Bluetooth	1436	Tolerated disconnect
Infrared	8248	Tolerated disconnect
Wi-Fi	9384	Tolerated disconnect

As shown in Table 5, in each communication mechanism, exchanged information is specified with an interface. Without interface, off state misses the last connection data. Although there is a redundant with presence of interface, but disconnection and reconnection is not problem.

Table 6. Necessary data exchange for 32 KB data transfer with 10 times connection/disconnection, with and without interface

Mechanism	With interface	Without interface
Bluetooth	77803	377344
Infrared	112268	361504
Wi-Fi	118504	366058

Table 6 shows the 32KB data transfer with 10 disconnections. For transferring 32KB of messages in presence of an interface, disconnection would be a hidden event for grid but in absence of interface, the process would be resumed.

Based on information in Table 6, there is need to less data exchange in presence of interface.

4. Conclusion

An interface between grid and mobile devices was designed. The limitations of mobile devices limitations can be compensated by connecting them to the grid. These devices are connected to the grid with different mechanisms. The movement of these devices, cause disconnection/ connection event. Interface is used to manage a variety of communication mechanisms. Variety of communication mechanisms are defined in the interface in order to know each packet structure and interface acts according to mechanism of any device. For managing exchanges, interface uses a database to manage the exchanges. This interface has a tree structure, which has been defined as stations in tree structure. Finally they are connected to mother interface that equipped with database.

Although data exchange has redundancy in presence of interface and with no disconnection, but practically there are a lot of disconnection in the mobile device communication. In this situation, efficiency of interface decreases with less data exchange.

5. References:

[1] Guan T, Zaluska E, De Roure D. 2005. "A Grid Service Infrastructure for Mobile Devices".Procedings of the IEEE.p 42 – 48.

[2] Bathmann R, Perrone F, 2009, "A comparison of wireless network protocols from a Simulation perspective". Faculty of Bucknell University In Partial Fullment. Bachelor of Science with Honors in Computer Science

[3] Huang Y, Venkatasubramanian N, Wang Y. 2007. " MAPGrid: A New Architecture for Empowering Mobile Data Placement in Grid Environments". Seventh IEEE International Symposium on Cluster Computing and the Grid(CCGrid'07) 0-7695-2833-3/07, p 178-183.

[4] Infrared Data Association (IrDA). http://www.irda.org.

[5] Kumar A ,Qureshi S. 2008." Integration of Mobile Computing with Grid Computing: A Middleware Architecture" .Proceedings of 2nd National Conference on Challenges & Opportunities in Information Technology RIMT-IE. COIT'08, p104-107.

[6] Litke A, Skoutas D, VarvarigouT.2005. " Mobile Grid Computing: Changes and Challenges of Resource Management in a Mobile Grid Environment ".http:// .www. akogrimo.org.

[7] Lindholm T. Schoeberl M. 2007. "Setting up a Bluetooth Packet Transport Link". Copenhagen Business School, p 312-318.

[8] Lv X, Zhang R. 2005. "Grid: The Future of the Internet", China-USA Business Review,ISSN 1537-1514, Volume 4, No.5, p76-79.

[9] Phan T, Huang L, Dulan C.2002. " Challenge: Integrating Mobile Wireless Devices In to the Computational Grid". MOBICOM'02, p221-227.

[10] Reda H, Yong C.2007." Applying Mobile Agents on Mobile Grid Computing". Computer Science Postgraduate Colloquium, CSPC'07, p 98-100.

[11] Roure D, Jennings R, Shadbolt R. 2005. "The semantic Grid: Past, Present and Future". Procedings of the IEEE .p 669-681.

[12] The TCP/IP Protocol Suite. http://www.fujitsu.com/us/services/telecom/training/.