Title: TESTING A DATA TRANSFER FUNCTIONALITY OF A MOBILE DEVICE

Abstract: The invention relates to a mobile communication device 21 with a data transfer functionality for exchanging data via the air-interface. In order to simplify and improve a testing of the data transfer functionality, the mobile communication device 21 comprises a testing component 32, 34 for testing the data transfer functionality. The invention relates equally to a testing system comprising such a mobile communication device 21 and a network server 23 supporting the testing on the network side. Moreover, the invention relates to a corresponding method.
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
Testing a data transfer functionality of a mobile device

FIELD OF THE INVENTION

The invention relates to a mobile communication device with a data transfer functionality for exchanging data via the air-interface. The invention relates equally to a testing system comprising such a mobile communication device and a network server. Further the invention relates to a method supporting a testing of the data transfer functionality of such a mobile communication device.

BACKGROUND OF THE INVENTION

Various known mobile communication devices can be employed for exchanging not only voice but also data via the air-interface. GPRS (General Packet Radio Service), for instance, is a mobile service which gives mobile communication devices packet-switched access over GSM (Global System for Mobile communication) to external data networks like the Internet.

It is desirable that the data transfer functionality of a mobile communication devices can be tested in a comprehensive and yet simple way.

Currently, a special testing device is needed for testing the data transfer functionality of a mobile communication device. In some cases, even several testing devices may be needed for the testing.
Figure 1 schematically shows in an upper part a conventional testing system.

The testing system comprises a GPRS mobile phone 11 as a mobile communication device, a radio communication network represented by a radio tower 12, a network end server 13 of the Internet and a dial-up laptop computer 14 as a testing device. The network end server 13 includes tester software for mobile devices. In the laptop computer 14, which can be used to browse the web, a proprietary testing software supporting a testing of data transfers by a mobile phone is installed.

The transmissions for testing purposes are illustrated in Figure 1 below the depicted system between a proprietary testing software (SW) associated to the laptop computer 14 and a testing software associated to the network end server 13.

When the data transfer functionality of the mobile phone 11 is to be tested, the laptop computer 14 is used to establish a connection to the Internet via the mobile phone 11, and then to perform the data transfer tests.

For an uplink data transfer testing, the testing software in the laptop computer 14 is used by a user to enter commands via the user interface of the laptop computer 14. A user interface is an interface via which a user can interact with software and peripheral equipment of a device. Thereupon, command parameters and test packets are transmitted via some medium, e.g. irda, rs232 or Bluetooth™, from the laptop computer 14 to the mobile
phone 11. The mobile phone 11 forwards the command parameters and the test packets using a specific data bearer via the radio communication network to the network end server 13 on the Internet end. The testing software of the network end server 13 receives the command parameters, counts thereupon how many packets are received correctly, and transmits the obtained information via the radio communication network and the mobile phone 11 back to the laptop computer 14. The testing software in the laptop computer 14 finally processes the information received from the network end server 13 for presenting it via the user interface of the laptop computer 14 to the user.

A bi-directional testing is not enabled. Thus, for testing in addition the downlink data transfer functionality, a further connection has to be established. To this end, the user has to enter further commands via the user interface of the laptop computer 14. Corresponding command parameters are transmitted via the mobile phone 11 and the radio communication network to the network end server 13. In response to the command parameters, the testing software in the network end server 13 takes care that the network end server 13 transmits test packets and associated parameters back via the radio communication network and the mobile phone 11 to the laptop computer 14. The testing software of the laptop computer 14 evaluates the quality of the received test packets and processes the evaluation results for presenting them via the user interface of the laptop computer 14 to the user.
It is a disadvantage of such a testing system that it is prone to errors due to problems in the connection between the testing device and the mobile communication device as well as to errors caused by the operating system running in the testing device, e.g. Windows®. The bearer configuration desired for a specific testing, for instance the selection of a reliability class mode, a compression, a quality of service etc., is moreover a complex procedure which involves the input of cryptic commands to the testing device, which are difficult to remember. It is further a drawback of the known testing system that always at least one testing device has to be carried along whenever a testing is to be performed.

SUMMARY OF THE INVENTION

It is invented a means to simplify the testing of the data transfer functionality of a mobile communication device. The invention also improves the testing of the data transfer functionality of a mobile communication device.

A mobile communication device with a data transfer functionality for exchanging data via the air-interface is proposed, which comprises a testing component for testing the data transfer functionality.

Further, a testing system is proposed which comprises the proposed mobile communication device and in addition a network server of a network, to which network server the mobile communication device has access via the air-interface for an exchange of data. The network server handles a data transfer initiated by the mobile
communication device for testing the data transfer functionality of the mobile communication device according to instructions provided by the testing component of the mobile communication device.

Finally, a method enabling a testing of a data transfer functionality of a mobile communication device is proposed, which data transfer functionality allows exchanging data via the air-interface. The proposed method comprising testing the data transfer functionality at a testing component of the mobile communication device.

The invention proceeds from the idea that a testing component enabling a testing of the data transfer functionality of a mobile communication device can be integrated in the mobile communication device itself, instead of in one or more external testing devices. The control of the testing component can then be achieved e.g. via a user interface of the mobile phone.

It is an advantage of the invention that no external devices are needed for testing. All required tests can be performed via one simple-to-use and cost efficient generic tool in the mobile communication device itself. Thus, no testing devices like laptop computers are required on the field, and no proprietary testing software is required for the testing. Without an external testing device, the testing also becomes independent of media problems between an external testing device and the mobile communication device and of errors caused by an operating system running in a testing device.
Some advantageous embodiments of the invention become apparent from the dependent claims.

For supporting a data transfer, a mobile communication device will usually comprise a socket server. A socket server provides the IP (Internet Protocol) stack functionality for TCP (Transmission Control Protocol) and UDP (User Datagram Protocol), as well as bearer configuration and connection management for a testing server. TCP/IP is a public protocol defined by the US Department of Defense, offering roughly the functions of the transport layer, i.e. layer 4, of the OSI model. UDP is a data-message based protocol related to the TCP/IP protocol. The testing component is advantageously able to access such a socket server, for example in order to be able to provide configuration parameters for a connection which is to be established by the socket server, and in order to receive incoming information and incoming data via the socket server. Also command parameters to a network server supporting the testing on the network side may be transmitted by the testing component via the socket server.

The testing of the data transfer functionality of the mobile communication device may comprise in particular a testing of the bearers employed for the transmission of data and a testing of the socket server functionality of a socket server in the mobile communication device. The invention enables a comprehensive testing of a socket server in the mobile communication device. The socket server functionality is rather difficult to test in the field environment in a conventional testing system, as a
testing device has to be carried along e.g. while walking around in a city.

Advantageously, the proposed mobile communication device comprises a user interface enabling a control of the testing component by a user. Alternatively or in addition, the testing component may comprise an interface to which a unit external to the proposed mobile communication device can be connected for enabling a control of the testing component.

The invention can be realized in particular by adding a menu to the user interface of the mobile communication device, which can be used to launch the testing component. The menu, which can be realized by software, preferably allows to select all different test cases which are supported by the testing component. The menu may also allow to select a bearer configuration easily. Thereby, the necessity of cryptic at-commands can be avoided. For instance, the menu may allow to select the speed, the packet sizes and/or the block sizes, which are to be employed for data transfers based on which the testing component tests the data transfer functionality.

The supported test cases may comprise as well bi-directional and round-trip test cases, which are not enabled in the conventional testing systems. Some mobile communication device, like GPRS mobile phones, are further able to support multiple connections in parallel. The term connections is to be understood in this document to comprise as well packet data contexts. A GPRS mobile terminal may support for instance eleven simultaneous contexts. The test cases supported by the invention may
allow as well to test such multiple connections. With the conventional external testing devices, in contrast, a testing of multiple connections is not possible. Each connection requires an own application or local connection, that is, multiple connections cannot be tested with a single application. Further, the user interface of a mobile terminal prevents a usage of multiple external applications at the same time. As there can be only one external application connected to the mobile terminal at the same time, only one connection can be tested by using a dial-up over a local connection.

The invention can be employed for any mobile communication device with data transfer functionality which has to be tested, for example for a GPRS, an EDGE (Enhanced Data rates for GSM Evolution), a CSD (Circuit Switched Data) and/or a WCDMA (Wideband Code Division Multiple Access) device.

The invention can further be employed for any kind of desired testing, for instance for a live testing carried out in a real network setup.

BRIEF DESCRIPTION OF THE FIGURES

Other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings.

Fig. 1 illustrates a conventional testing of the data transfer functionality of a mobile phone;
Fig. 2 illustrates a testing of the data transfer functionality of a mobile phone according to the invention;

Fig. 3 is a schematic block diagram of an embodiment of a mobile phone according to the invention; and

Fig. 4 is a flow chart illustrating the operation of the mobile phone of Figure 3.

DETAILED DESCRIPTION OF THE INVENTION

Figure 2 schematically shows in an upper part an exemplary testing system according to the invention. The testing system enables a testing of the data transfer functionality of a GPRS mobile phone. It is understood that the data transfer functionality of any other mobile communication device could be tested in a similar system as well.

The testing system comprises this GPRS mobile phone 21, a GSM radio communication network represented by a radio tower 22 and a network end server 23 of the Internet. The network end server 23 comprises a testing software for supporting the testing on the network side. Thus, the system comprises the same units as the conventional system depicted in Figure 1, except for the dial-up laptop computer. The mobile phone 21, however, is designed according to the invention.

Selected components of this mobile phone 21 are depicted in Figure 3 in a schematic block diagram.

The mobile phone 21 comprises an ISI (Intelligent Software Interface) server as socket server 31, which can
open a communication socket functioning as an endpoint of a TCP or UDP connection, and which supports thereby a data transfer to and from a network end server of a data network via a radio communication network. As mentioned above, the socket server 31 provides the IP stack functionality for TCP and UDP, as well as bearer configuration and connection management.

A testing software is implemented as a further ISI server 32 which is connected to the socket server 31 via a respective ISI (not shown) of the two servers 31, 32. The testing software ISI server 32 further has a simple and generic ISI 34, which allows to access the testing software ISI server 32 for configuring connections, for opening and closing connections, for performing and aborting tests and for keeping track of the test status.

ISI is an interface which allows separate software components, both internal and external, to communicate by passing well specified messages between them. Each software component has its own ISI via which it is accessed.

The mobile phone 21 further comprises a user interface UI 35, which is connected via the ISI 34 to the testing software ISI server 32. The user interface 35 comprises a software for presenting to a user menus for all different options supported by the ISI 34 of the testing software ISI server 32. The user interface 35 thus enables a user to control the testing software ISI server 32 via the ISI 34 as desired.
The ISI 34 can be used in addition by any device having the capability to send or receive ISI messages. Therefore, any other suitable software component within the mobile phone 21 can access the interface in addition, and equally, if desired, any suitable external device via an available medium.

The transmissions in the system of Figure 2 for testing purposes are illustrated in the lower part of Figure 2 between a testing software associated to the mobile phone 21 and a testing software associated to the network end server 23. The operation of the mobile phone 21 for testing purposes is further indicated in the flow chart of Figure 4.

When the data transfer functionality of the mobile phone 21 is to be tested, the user selects from the menus presented by the user interface 35 the type of connection or connections which are to be tested and sets the desired configuration parameters.

The available test cases may comprise for example UDP data transfer tests with varying speeds and packets sizes in uplink, downlink or bi-directional format, TCP data transfer tests with varying speeds and block sizes in uplink, downlink or bi-directional format, and round-trip time tests. Also combinations of the above tests on a single connection can be offered. In addition, several of the offered tests can be selected to be performed running on different connections, for instance on separate GPRS contexts. UDP and TCP data transfers are tested to be able to emulate almost any real life application, such as web browsing, file transfer or video streaming. Different
test cases may also be provided for bearer specific issues and/or socket server specific issues.

The testing software ISI server 32 receives the user input, which is indicated in Figure 4 as first step 401. Depending on the entered commands, the testing software ISI server 32 configures and opens connections to the network end server 23 via the socket server 31, which is indicated in Figure 4 as step 402. The testing software ISI server 32 thus directly accesses the employed data bearers via the socket server 31 of the mobile phone 21. Consequently, there is no media between the testing software ISI server 32 and the bearers which are to be tested.

Then, the testing software ISI server 32 causes the socket server 31 to transmit command parameters by an opened socket via the air interface. The command parameters comprise instructions to the testing software in the network end server 23 corresponding to the selected test case. In case the uplink data transfer is to be tested on at least one connection, also test packets are transmitted on this at least one connection. These uplink transmissions are indicated in Figure 4 as step 403.

The command parameters and the test packets reach the network end server 23 via the radio communication network. The radio communication network is part of the system under test by providing media to transfer data between the mobile phone 21 and the network end server 23. The network end server 23 handles the network end data receiving and sending according to the instructions
sent by the testing software ISI server 32 of the mobile phone 21.

By transmitting instructions, the testing software ISI server 32 of the mobile phone 21 can thus perform various operations with the network end server 23. For a downlink testing, for instance, the testing software ISI server 32 can request UDP or TCP packets to be sent to the mobile phone 21 together with employed connection parameters. For an uplink testing, the testing software ISI server 32 can request UDP or TCP packets to be received from the mobile phone 21 together with the employed connection parameters, such that the network end server 23 will keep track of incoming packets. For a bi-directional testing, the testing software ISI server 32 can request a combination of both from the network end server 23. Moreover, the testing software ISI server 32 can request information on how well packets sent from the mobile phone 21 to the network end server 23 were received. The network end server 23 can be requested for example to count how many packets are received correctly. This information is equally transmitted to the mobile phone 21 in form of parameter values.

The mobile phone 21 receives downlink test packets and parameters from the network end server 23 via the radio communication network. These downlink receptions are indicated in Figure 4 as step 404. The testing software ISI server 32 evaluates the received information and how well the downlink packets were received. The evaluation of received information may comprise for example comparing the number of transmitted uplink packets with the number of packets which were received correctly by
the network end server 23. Similarly, the number of received downlink packets may be compared to the number of packets which were transmitted by the network end server 23. In addition, the testing software ISI server 32 may evaluate the content of received test packets. Every test packet has a specified data content. The knowledge about the data content can thus be used by the testing software ISI server 32 to verify the correctness of the received data. All evaluation is summarized in Figure 4 as step 405.

The obtained information on uplink and/or downlink data transfers is then presented to the user via the user interface 35 of the mobile phone 21 as information on the data bearer and/or socket server functionality. This is indicated in Figure 4 as last step 406.

On the whole, it becomes apparent that the problems resulting from the necessity of an external testing device, from a proprietary testing software and from a media between the testing device and the data bearers are avoided with the proposed testing system.

It is to be noted that the described embodiment constitutes only one of a variety of possible embodiments of the invention.
**Claims**

1. Mobile communication device (21) with a data transfer functionality for exchanging data via the air-interface, said mobile communication device (21) comprising a testing component (32,34) for testing said data transfer functionality.

2. Mobile communication device (21) according to claim 1, further comprising a socket server (31) for supporting said data transfer functionality, wherein said testing component (32,34) has access to said socket server (31) for exchanging at least one of configuration parameters, command parameters and information.

3. Mobile communication device (21) according to claim 1 or 2, further comprising a socket server (31) for supporting said data transfer functionality, wherein for testing said data transfer functionality, said testing component (32,34) is enabled to perform a testing of data bearers employed by said socket server (31) for a data transfer and/or a testing of the functionality of said socket server (31).

4. Mobile communication device (21) according to one of the preceding claims, wherein said testing component (32,34) is enabled to perform a testing of said data transfer functionality based on at least one of the following types of data transfers:
- an uplink data transfer;
- a downlink data transfer;
- a bi-directional data transfer; and
- a round trip data transfer.

5. Mobile communication device (21) according to one of the preceding claims, wherein said testing component (32,34) is enabled to perform a testing of said data transfer functionality based on data transfers via at least two connections in parallel via the air-interface.

6. Mobile communication device (21) according to one of the preceding claims, further comprising a user interface (35) enabling a control of said testing component (32,34) by a user of said mobile communication device (21).

7. Mobile communication device (21) according to claim 6, wherein said user interface (35) comprises a software for presenting a menu to a user which offers different test cases supported by said testing component (32,34) for selection.

8. Mobile communication device (21) according to claim 6 or 7, wherein said user interface (35) enables a user to access said testing component (32,34) for at least one of configuring connections for a data transfer, opening connections for a data transfer, closing connections employed for a data transfer, initiating tests of said data transfer functionality of said mobile phone (21) by said testing component (32,34), aborting tests of said data transfer functionality of
said mobile phone (21) performed by said testing component (32,34) and keeping track of a status of tests of said data transfer functionality performed by said testing component (32,34).

9. Mobile communication device (21) according to one of claims 6 to 8, wherein said user interface (35) enables a user to access said testing component (32,34) for selecting at least one of speeds, packet sizes and block sizes, which are to be employed for data transfers based on which said testing component (32,34) performs said testing of said data transfer functionality.

10. Mobile communication device (21) according to one of the preceding claims, wherein said testing component (32,34) comprises an interface (34) to which a unit external to said mobile communication device (21) is connectable.

11. Mobile communication device (21) according to one of the preceding claims, wherein said testing component (32,34) includes a software (32) for realizing said testing.

12. Testing system comprising a mobile communication device (21) according to one of the preceding claims and a network server (23) of a network, to which network server (23) said mobile communication device (21) has access via said air-interface for an exchange of data, wherein said network server (23) is enabled to handle a data transfer initiated by said mobile communication device (21) for testing said
data transfer functionality of said mobile communication device (21) according to instructions provided by said testing component (32,34) of said mobile communication device (21).

13. Method enabling a testing of a data transfer functionality of a mobile communication device (21), which data transfer functionality allows exchanging data via the air-interface, said method comprising testing (steps 402-405) said data transfer functionality at a testing component (32,34) of said mobile communication device (21).

14. Method according to claim 13, further comprising receiving (step 401) an input from a user, which input defines a desired test case, wherein said data transfer functionality is tested (steps 402-405) in accordance with said received input.

15. Method according to claim 14, wherein said step of testing (steps 402-405) said data transfer functionality comprises:
   - configuring and opening at least one connection via the air interface (step 402) in accordance with said received input;
   - causing an exchange of signals (steps 403-404) via said at least one opened connection in accordance with said received input; and
   - evaluating (step 405) signals received via said at least one opened connection in accordance with said received input.
16. Method according to claim 15, wherein said at least one connection comprises at least two connections in parallel enabling a data transfer via the air-interface.
FIG. 2

SW in network end server

Command parameters and packets via air-interface for all test cases including bi-directional cases

Testing SW in mobile phone: commands entered with mobile UI
FIG. 3
Receive a user input via UI defining a desired test case

Configure and open at least one connection to network end server according to received user input

Transmit command parameters and eventual uplink test packets via opened connection(s) according to received user input

Receive eventual downlink test packets and feedback information via opened connection(s)

Evaluate received test packets and received information

Present evaluation results via UI

FIG. 4
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

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According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the International search (name of database and, where practical, search terms used)

EP0-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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Further documents are listed in the continuation of box C. Patent family members are listed in annex.

**Date of the actual completion of the international search**

27 January 2004

**Date of mailing of the international search report**

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**Name and mailing address of the ISA**

European Patent Office, P.B. 5818 Patentian 2 NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2000, Tx. 31 651 epo nl, Fax (+31-70) 340-3016

**Authorized officer**

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