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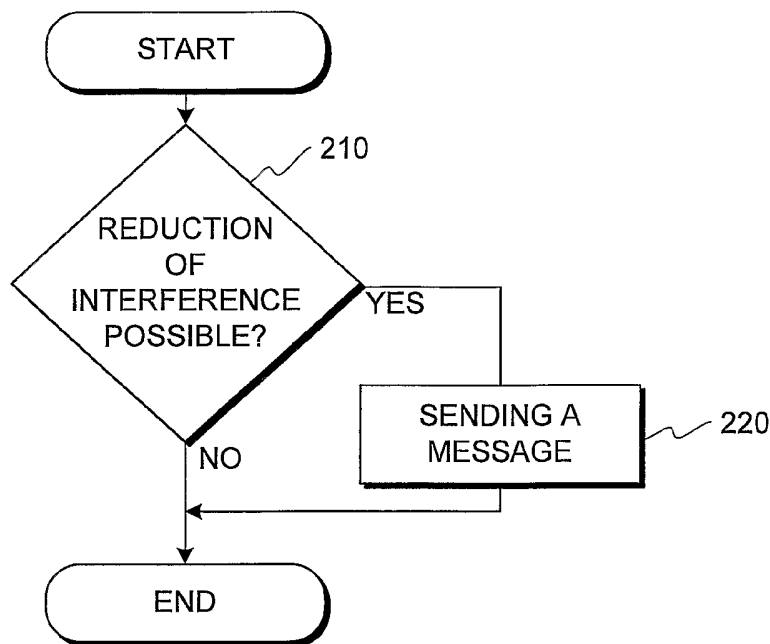
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(54) Title: A METHOD FOR REDUCING INTERFERENCE



(57) Abstract: This invention relates to wireless communication systems, specifically to methods for reducing interference. The invention allows a mobile station to determine if certain transmissions of the mobile station cause interference to reception by a second receiver in the mobile station, and indicate to the network that a change in a transmission parameter of the mobile station is desired. The network can then change a transmission parameter to reduce interference observed by the second receiver.

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A method for reducing interference

Field of Invention

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This invention relates to wireless communication systems, specifically to methods for reducing interference.

Technological background

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A communication system is a facility that enables communication between two or more entities such as user terminal equipment and/or network entities and other nodes associated with a communication system. The communication may comprise, for example, communication of voice, electronic mail (email),
15 text messages, data, multimedia and so on.

The communication may be provided by fixed line and/or wireless communication interfaces. A feature of wireless communication systems is that they provide mobility for the users thereof. An example of a
20 communication system providing wireless communication is a public land mobile network (PLMN). An example of the fixed line system is a public switched telephone network (PSTN).

A cellular telecommunication system is a communications system that is based
25 on the use of radio access entities and/or wireless service areas. The access entities are typically referred to as cells. Examples of cellular telecommunication standards includes standards such as GSM (Global System for Mobile communications), GPRS (General Packet Radio Servers), EDGE (Enhanced Data Rates for GSM Evolution), AMPS (American Mobile
30 Phone System), DAMPS (Digital AMPS), WCDMA (Wideband Code Division Multiple Access), UMTS (Universal Mobile Telecommunication System) and CDMA 2000 (Code Division Multiple Access 2000). In addition to cellular telecommunication systems, other types of wireless communication systems are also known. For example, WLAN networks (wireless local area networks)
35 are widely known. There are several WLAN standards in use, for example one for 2.4 GHz frequency (802.11b) and one for 5GHz frequency area (802.11a). There is also a technology called WiMax which is typically classified to be an

instance of wireless LAN technology. Radio communication technology using UWB (ultra wide band) techniques are presently being developed.

5 Combining different wireless technologies in a portable device such as a mobile phone or, more generally, a mobile station produces a number of problems. One difficult problem is interference of different wireless systems combined in the same device. For example, GSM transmissions can disturb WLAN connections, since harmonics of some GSM transmissions may in some cases fall within a WLAN frequency band. For example, the third
10 harmonic of transmissions using the GSM1800 technology will fall at least partially on or near the 5GHz WLAN frequency band. This is a significant problem, when a WLAN receiver and a GSM transmitter are in close proximity, for example integrated in the same device such as a mobile phone.

15 Harmonics are a problem for example in a device transmitting on a frequency band near 850 MHz, and having a Bluetooth receiver. Certain cellular technologies such as the GSM850, CDMA850, and WCDMA850 use a frequency band near or around 850 MHz. The third harmonic frequency of transmissions of such cellular transmitters fall at least partially on or near the
20 Bluetooth reception frequency band.

Filtering can help remove the unwanted harmonics, but the filtering structures can be complicated and expensive. Also, filtering in high frequency such as in the 5 GHz WLAN frequency band, it is technically difficult to build high quality
25 filters. This is due for example to self-resonance effects resulting from parasitic capacitances of inductors. Inductors can also be implemented using RF lines or micro lines on a substrate. However, the substrate material also causes loss of RF signal. The 5 GHz WLAN band is troublesome for filtering also because of its wide bandwidth of 675 MHz, which complicates filter design.

30 In some types of mobile terminals transmitted and received signals are separated by filtering in a so-called duplexer. Such a duplexer can reduce interference between a transmitter of one wireless system and a receiver of another wireless system. However, some systems such as a typical
35 GSM/EDGE mobile station use a switch to connect the transmitter and the receiver to the antenna. In such a case, adding a filter to reduce interference of the transmitter to a second service would increase complexity and cost of the receiver. Receiver and transmitter insertion losses will also increase when

extra filtering is added. This results in higher current consumption in transmitter and lower sensitivity in receiver.

5 Filtering is very difficult also in cases where a frequency band of a cellular communications network is very close to a frequency band of a second service. The bands may be so close that sufficiently good filters cannot be reliably or economically manufactured.

10 In addition to harmonics, another source of disturbances is wideband noise of a transmission, which can cause a significant increase in noise level experienced by a receiver in the same device as the transmitter. For example, wide band noise of GSM1800 transmissions outside of the transmission band may disturb GPS reception at GPS L1 band (1575.42MHz) during the transmission slot. Also, wide band noise of a GSM900 transmitter can interfere
15 with reception on the GPS L5 band (1176.25 MHz).

A mobile terminal may locate geographically itself with multiple methods. In a cellular network a straightforward way to locate the terminal is to use the cell identification information, which indicates the identity of the current base
20 station. A network can also locate a terminal by observing the arrival times of the transmissions from multiple base stations. A growing trend for producing location information is integration of a satellite based locator device such as a GPS or Galileo receiver in a mobile station. However, transmissions to a wireless network from a mobile station can appear as interference to a GPS
25 receiver in the mobile station.

There may be also devices, which have shared functionalities in different physical units. Such devices are often called multipart products. The first unit of the multipart product may comprise an earpiece and a microphone, while a
30 second unit of the multipart product communicates with the cellular networks. Units of a multipart product can communicate between each other e.g. via Bluetooth air-interface.

Some radio communications whose reception in a mobile station can suffer
35 due to transmissions of a cellular part in the mobile station are for example digital video broadcasts (DVB), WLAN transmissions, UWB transmissions, and bluetooth transmissions. The degree to which different services may be interfered by cellular transmissions depend naturally on location of frequency

bands of these services, which varies from country to country, and even between operators in a given country. For example in US one cellular band can be shared between two operators.

5 Terrestrial digital video broadcasting (DVB-T) was first adopted as a standard in 1997, and has been deployed throughout many areas of the world. DVB-T offers about 24 megabits per second (Mb/s) data transfer capability to a fixed receiver, and about 12 Mb/s to receivers in mobile stations. Mobile stations including such mobile receivers have already been produced and are able to
10 receive the DVB-T signals.

While DVB-T allows high quality video broadcasting to be delivered to various devices, the DVB-T standard has certain problems with respect to mobile stations. One such problem is power usage, as mobile stations that implement
15 DVB-T tend to consume too much power. Since mobile stations are battery powered unless plugged into a secondary power source, power usage is a critical design element. In response to this power usage and other effects of DVB-T, the DVB-H (a version of DVB for handheld devices) standard was created. DVB-H offers, among other things, reduced power usage as
20 compared to DVB-T.

Because of the benefits of DVB-H over DVB-T, DVB-H is beginning to make inroads into the mobile station market. At the time of writing of this patent application, pilot projects using DVB-H technology to bring television like
25 services to mobile devices have been started. While DVB-H is an improvement over DVB-T, DVB-H also causes certain problems. For instance, a mobile station typically will contain at least one transmitter that transmits using one or more frequency bands. The DVB-H receiver typically receives in a frequency band that is different than the one or more frequency bands used by any
30 transmitter in the mobile station. For instance, certain mobile stations can support the global system for mobile communications (GSM) standard, and the frequency bands used by a GSM transmitter are different than the frequency band used by a DVB-H receiver. Nonetheless, transmitting using one frequency band can still cause interference in the frequency band used by the
35 DVB-H receiver in the same device.

In the European Union DVB-H version, the reception band is on the lower side of the GSM frequency band (GSM900, which has a transmission frequency

band of 880 – 915 MHz) and the reception frequency band is far enough that transmissions on the 900 MHz frequency band are not band-blocking the DVB-H receiver. Nonetheless, the wide band noise may be a problem also in European DVB-H reception.

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In terms of the U.S. standards, transmissions on the 850 MHz frequency band may generate a second harmonic, which will be at least partially on top of the U.S. DVB-H reception frequency band of 1670-1675 MHz. Also, the 850 MHz frequency band transmission will generate wide band noise to the U.S. DVB-H
10 frequency band. The most difficult frequencies are 835.0 – 837.5 MHz in transmission, since these frequencies generate harmonics directly on top of the U.S. DVB-H frequency band.

There will shortly be also other than DVB-H based digital TV services available
15 in US. One known system in development is known as MediaFlo, which is a digital TV service driven by Qualcomm Inc. The centre frequency of transmission in the MediaFlo system is 719 MHz. This digital TV system will use OFDM based modulation method, which is similar than used in DVB-H system. Thus similar interoperability problems can be assumed with MediaFlo
20 system than with DVB-H system. The wideband noise from 850 MHz band cellular system may generate interfering noise to the MediaFlo reception channel.

Summary of the invention

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Embodiments of the present invention aim to overcome one or several of the above problems.

According to one aspect of the invention, a method for mobile station of a
30 wireless communication network is provided. The method can be used in a mobile station having a first receiver and a first transmitter for communicating with the wireless communication network on at least a first frequency band, and a second receiver for receiving transmissions on at least a second frequency band. The method comprises the steps of

35 determining if changing of a transmission parameter of the mobile station would cause less interference to reception by the second receiver by transmissions of the mobile station, and if it is so determined,

transmitting a message to the wireless communication network indicating a communication parameter.

5 The message can indicate a channel, a frequency band, a second wireless communication network, a modulation method, timing information, or for example a type of service received by the second receiver or location information of the mobile terminal. The message can also indicate timing information of a second wireless communication network, or for example timing information of a signal interfering reception by the second receiver. The
10 message can also indicate a power level of an interfering signal, a transmission power level of a second wireless communication network, a reception power level of a signal received from a second wireless communication network, or for example a frequency of an interfering signal.

15 The message can be a handover request message.

The method can further comprise the step of transmitting an indication of more than one transmission channel, frequency band, or wireless communication network, and an indication of order of preference of the more than one
20 transmission channel, frequency band, or wireless communication network.

The method can further comprise the step of transmitting an indication to the wireless communication network that reception by the second receiver has ended.
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In an embodiment, the message can indicate a transmission parameter to be used in transmissions from the mobile station to the wireless communication network.

30 In a further embodiment, the message can indicate a transmission parameter to be avoided in transmissions from the mobile station to the wireless communication network.

35 According to a second aspect of the invention, a method in a wireless communication system is provided. The method comprises the steps of receiving a message from a mobile station, extracting indication of a communication parameter from the received message, and

changing a communication parameter of the radio link between the wireless communication system and the mobile station as a response to receiving the message.

- 5 The method can comprise the steps of receiving an indication from a mobile station that reception by a second receiver in the mobile station has finished, and initiating a handover as a response to receiving the indication.

10 The method can comprise the steps of receiving information from the mobile station about timing of reception by a second receiver in the mobile station, and adjusting a communication parameter on the basis of the received timing information.

15 The method can comprise the steps of receiving information from the mobile station about a frequency band received by a second receiver in the mobile station, selecting a handover target at least in part on the basis of the received information about the frequency band, and initiating a handover to the selected handover target.

20 The method can comprise the steps of receiving information from the mobile station about a type of service received by a second receiver in the mobile station, selecting a handover target at least in part on the basis of the received information about a type of service, and initiating a handover to the selected handover target.

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The handover target is a channel, a frequency band, or for example a wireless communication network.

30 According to a third aspect of the invention, a mobile station having a first transmitter and a first receiver for communicating with a wireless communication network on at least a first frequency band and a second receiver for receiving transmissions on at least a second frequency band is provided. The mobile station comprises

35 a controller for determining if changing of a transmission parameter of the mobile station would cause less interference to reception by the second receiver by transmissions of the mobile station, and

a transmitter for transmitting, as a response to a positive determination by the controller, a message to the wireless communication network indicating a communication parameter.

5 The mobile station can comprise a controller for transmitting information to the wireless communication network about timing of reception by the second receiver.

10 The mobile station can comprise a controller for transmitting information to the wireless communication network about a second frequency band.

The mobile station can comprise a controller for transmitting information to the wireless communication network about the type of service received by the second receiver.

15 The mobile station can comprise a controller for transmitting an indication of more than one transmission channel, frequency band, or wireless communication network, and an indication of order of preference of the more than one transmission channel, frequency band, or wireless communication network.

20 The mobile station can comprise a controller for transmitting, as a response to ending of reception by the second receiver, an indication to the wireless communication network that reception by the second receiver has ended.

25 According to a fourth aspect of the invention, a network element for a wireless communication system is provided. The network element comprises a controller for extracting an indication of a communication parameter from a message received from a mobile station, and

30 a controller for changing a transmission parameter of the radio link between the wireless communication system and the mobile station as a response to extracting a communication parameter from a message received from a mobile station.

35 According to a fifth aspect of the invention, a system in a wireless communication network is provided. The system comprises a controller for extracting an indication of a communication parameter from a message received from a mobile station, and

a controller for changing a transmission parameter of the radio link between the wireless communication system and the mobile station as a response to extracting a communication parameter from a message received from a mobile station.

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According to a sixth aspect of the invention, a software program product for carrying out the steps of the method for a mobile station is provided. The software program product can be executed in a processing unit of a mobile station for carrying out the specified method steps. The software program product can be provided in different types of media, such as in a memory means such as random access memory, rewritable memory such as FLASH memory, or read only memory. The software program product can also be provided on a magnetic, magneto-optical, or optical carrier such as a CD-ROM.

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According to a seventh aspect of the invention, a software program product for carrying out the steps of the method in a wireless communication system is provided. The software program product can be executed in a processing unit of a network element of the wireless communication system for carrying out the specified method steps. The software program product can be provided in different types of media, such as in a memory means such as random access memory, rewritable memory such as FLASH memory, or read only memory. The software program product can also be provided on a magnetic, magneto-optical, or optical carrier such as a CD-ROM.

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The invention can also be provided as an integrated circuit, for example as a circuit having a processor unit and a memory means, or for example as a dedicated ASIC circuit. According to an eighth aspect of the invention, an integrated circuit for a mobile station of a wireless communication network is provided, the mobile station having a first transmitter, a first receiver, and at least a second receiver. The integrated circuit comprises a controller for determining if changing of a transmission parameter of the mobile station would cause less interference to reception by the second receiver by transmissions of the mobile station, and a message transmitter for initiating, as a response to a positive determination by the controller, transmission of a message to the wireless communication network indicating a communication parameter.

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The integrated circuit can further comprise an information structure containing information about at least one transmission parameter for the first transmitter causing interference to reception on a channel or a frequency band by the second receiver.

5

The integrated circuit can further comprise a calculator for calculating harmonic frequencies of transmissions of the first transmitter, and a controller for determining whether a harmonic frequency of a transmission by the first transmitter falls within a reception channel or a frequency band of the second receiver.

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Brief description of the drawings

15 Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 illustrates a mobile station with a first wireless part and a second wireless part and a network element,

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Figure 2 illustrates a method in a mobile station, and

Figure 3 illustrates a method in a network element of a wireless communication system.

25

Detailed description of embodiments

Figure 1 illustrates a mobile station 10 comprising a first wireless part 50 with a first transmitter 52 and a first receiver 54, and a second wireless part 60 with at least a second receiver 64. The mobile station has also an user interface 12 comprising for example a display and a keyboard. The mobile station also comprises at least one processor 30 for controlling the operations of the mobile station and performing many of the functions of the mobile station. A mobile station typically comprises many other components as well, but for clarity, other components are not illustrated in figure 1.

30
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Figure 1 also illustrates a wireless communication network 70 having a base station 72, with which the mobile station 10 communicates. The wireless communication network can be for example a cellular communication network such as a GSM, UMTS, or a CDMA network, or a WLAN network.

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Figure 1 also illustrates several other types of wireless services that the second wireless part 60 of the mobile station can utilize. For example, the second wireless part can be a satellite location receiver such as a GPS receiver receiving location signals from a satellite 82. The second wireless part 10 60 can also be a television receiver, such as a DVB-H receiver, for receiving transmissions from television broadcast transmitters 80. The second wireless part can also comprise a receiver 64 and a transmitter for a second wireless communication system on a different frequency band or bands than the first wireless part 50. For example, the second wireless part can be a WLAN 15 transceiver in a mobile station having a GSM transceiver as the first wireless part, the second wireless part communicating with a base station 85 of a WLAN network 84.

Figure 1 also illustrates a network element 74 of the wireless communication 20 network. The network element 74 comprises means 75 for extracting an indication of a communication parameter from a message received from a mobile station, and means 76 for changing a transmission parameter of the radio link between the wireless communication system and the mobile station as a response to extracting a communication parameter from a message 25 received from a mobile station. These means can be realized in the form of controllers, or for example as software code executed in a processor of the network element.

In an embodiment of the invention, the inventive method is implemented in an 30 integrated circuit 32. In the example of figure 1, the integrated circuit comprises a controller 33. The controller can determine whether changing of a transmission parameter of the mobile station would cause less interference to reception by the second receiver by transmissions of the mobile station. The integrated circuit also comprises a message transmitter 34 for initiating 35 transmission of a message to the wireless communication network indicating a communication parameter.

In the example of figure 1, the integrated circuit also comprises an information structure 35 containing information about at least one transmission parameter for the first transmitter causing interference to reception on a channel or a frequency band by the second receiver. For example, the information structure
5 can indicate that GSM transmissions in certain channels cause interference to reception in certain WLAN channels. In the example of figure 1, the integrated circuit also comprises a calculator 36 for calculating harmonic frequencies of transmissions of the first transmitter, and a controller 33 for determining whether a harmonic frequency of a transmission by the first transmitter falls
10 within a reception channel or a frequency band of the second receiver.

The invention is based on the insight that a mobile station which has a first transmitter and a first receiver for communicating with a wireless network and a second receiver for receiving transmissions from another service has
15 information about the frequency band (or bands) of the second receiver. If the mobile station observes that a channel on which the mobile station transmits or is going to transmit causes interference to reception of service by the second receiver, the mobile station can send an indication about this to the wireless communication network. The indication can be for example in the form of a
20 message indicating a channel which would cause less interference. Upon receiving such an indication, the network can change the transmission channel used for communication between the mobile station and the network for example by initiating a handover to a different channel, to a different cell, or for example to a different frequency band. The network can also initiate a
25 handover to a different wireless communication network if the mobile station is able to communicate in two different networks, such as in a GSM and a CDMA network.

The communication between the mobile station and the network can also
30 change the modulation method in order to reduce interference. For example, in a GPRS/EDGE system the communication can change between EDGE modulation which is used for higher bitrate communications and GMSK modulation which is used for lower bitrate communications.

35 The method can further comprise the step of changing the operating method of the transmission. This can be done for example in WCDMA/GSM network where WCDMA operation is used for higher bitrate communications and GSM operation is used for lower bitrate communications.

The mobile station can advantageously indicate also more than one channel, frequency band, or wireless communication network. The mobile station may also specify an order of preference, which the wireless communication network
5 can take into account in decision about initiating a handover.

The mobile station can advantageously send a message indicating a more suitable transmission channel in a variety of situations. For example, the mobile station can send such a message upon observing that the second
10 receiver is active during transmissions by the first transmitter of the mobile station. As another example, the mobile station can send such a message upon receiving a command from the user of the station to start reception using the second receiver.

15 In an embodiment, the system sends a message to the mobile station before a handover procedure indicating the candidate handover target. In such an embodiment, the mobile station can determine whether transmissions after the handover would generate more interference than transmissions before the handover. If the handover would cause an increase in interference, the mobile
20 station can then send a message to the network indicating a transmission parameter such as another handover target.

The mobile station can determine which channels or frequency bands tend to cause interference to reception by the second receiver in a variety of ways. For
25 example, the mobile station can comprise a table or another information structure containing information about conflicts between different transmission channels and/or transmission frequency bands and different reception channels and/or frequency bands. For example, the table can indicate that GSM transmissions in certain channels cause interference to reception in
30 certain WLAN channels.

In an embodiment a mobile station can calculate interfering mixing products and/or harmonics internally when it knows operating frequencies of the radio
35 interfaces of the first and second wireless parts. Based on those calculations and knowledge of the operation frequencies a terminal may find suitable radio frequencies for proposing to the network communicating with the first wireless part.

In an embodiment a mobile station can measure interference situations directly. For example, interference measurements can be done in a GSM/WLAN/Bluetooth system between transmission and reception slots, during periods when terminal would otherwise be in idle mode. The
5 interference measurement results can be reported to the different radio networks.

The mobile station can also indicate timing information related to the reception of signals by the second receiver in a message to the wireless network. The
10 wireless network can use this information to adjust one or more communication parameters, such as timing of communication between the mobile station and the network so as to reduce the simultaneous occurrence of transmission by the first transmitter in the mobile station and reception by the second receiver.

15 The mobile station can also indicate other kinds of information related to reception by the second receiver. Such information can be for example information about the frequency band or bands on which the receiver will operate, or for example type of service received by the receiver. The wireless network can use this information in determination of whether or not and to
20 which channel or frequency band to perform a handover.

Such other kinds of information that a mobile station can indicate to the network are for example timing information of transmission and reception periods, which may help avoid interference if transmission and reception
25 periods can be arranged so as to at least reduce interference.

In an embodiment, the mobile station can indicate the timing information in the form of channel and timing tables of a wireless part in the mobile station. The mobile station can for example send to the network the channel allocation
30 table of a Bluetooth device in the mobile station.

The mobile station can also indicate to the network that another modulation method could also be used. This is an advantageous approach, if the interference can be reduced by changing the modulation method.
35

The mobile station can also indicate to the network the location of the mobile terminal. The location information can aid in determination of a more advantageous radio link for example to a nearer base station, which would

allow reduction of transmission power of the first wireless part, and consequently reduce interference observed by the second wireless part. The mobile station can obtain the location information for example from the second wireless part, if the second wireless part is a location system receiver such as
5 a GPS receiver.

Another way of using the location information to reduce interference is that as a result of reporting by the mobile stations the network will continuously have up-dated information about the interference situation. This information can be
10 used for spectrum usage optimisation and data throughput optimisation by avoiding the use of interfered radio channels for the data transmission, thus reducing the need for re-transmissions of data. This will achieve a better user experience for the end user better and for the operator more delivered data bits, which can be charged from the user.

15 The mobile station can also comprise a second transmitter for communicating with the network providing the transmissions received by the second receiver. For example, a mobile station can comprise a transmitter and a receiver for communicating with a GSM network and a transmitter and a receiver for
20 communicating with a WLAN network. In such an example, the mobile station can observe if simultaneous use of both the GSM network and the WLAN network occurs, and whether transmission to one of the networks disturbs reception from the other; and send a message to one of the networks to request a change of a transmission channel.

25 In an embodiment, the mobile station can send an indication to the network after the second transmitter is no longer used, in order to indicate that the original transmission channel can again be used.

30 Figure 2 illustrates a method in a mobile station of a wireless communication system. The method comprises the steps of determining 210 if changing of a transmission parameter of the mobile station would cause less interference to reception by the second receiver by transmissions of the mobile station. If the determination is positive, a message is transmitted in step 220 to the wireless
35 communication network indicating a communication parameter.

Figure 3 illustrates a method in a network element of a wireless communication system. The method comprises the steps of receiving 310 a message from a

mobile station, extracting 320 a communication parameter from the received message, selecting 330 a communication parameter for the radio link between the mobile station and the wireless communication system, and changing 340 a communication parameter of the radio link between the wireless
5 communication system and the mobile station as a response to receiving the message.

The step of selection can comprise for example selection of a handover target, and the step of changing a communication parameter can comprise a
10 handover to the selected handover target.

The indication of a communication parameter resulting in reduced interference to the second wireless part can be performed in many different ways. The mobile station can indicate to the network a parameter or a plurality of
15 parameters, which would be a better choice or choices than a currently used parameter. For example, the mobile station can indicate a plurality of channels for transmissions, the use of which would cause less interference than the use of a current transmission channel.

20 In a further embodiment, the mobile station can indicate to the network a parameter or a plurality of parameters, which should be avoided. For example, if transmissions on a current transmission channel interfere with the reception by the second wireless part in the mobile station, the mobile station can indicate the current transmission channel to the network, which in this
25 embodiment would be a factor for the network to consider in changing the transmission to another channel.

In a further embodiment, the mobile station can indicate to the network a communication parameter or a plurality of parameters related to reception by
30 the second wireless part. The network can then use the received parameters to determine suitable transmission parameters for the first wireless part of the mobile station. For example, the mobile station can indicate to the network the reception frequencies of the second receiver, and the network can then use this information to determine which transmission parameters would be suitable
35 for the first wireless part in order to reduce possible interference observed by the second wireless part.

It is noted that while the preceding description illustrates various embodiments of the invention within a 3G cellular telecommunications system, the invention is not limited to a so called 3G cellular system, but can be implemented in different types of cellular telecommunication systems as well.

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It is also noted herein that while the above describes exemplifying embodiments of the invention, there are several variations and modifications which may be made to the disclosed solution without departing from the scope of the present invention as defined in the appended claims.

10

Claims

1. Method in a mobile station of a wireless communication network, the mobile station having a first receiver and a first transmitter for communicating with the wireless communication network on at least a first frequency band, the mobile station having a second receiver for receiving transmissions on at least a second frequency band, comprising the steps of
- 5 determining if changing of a transmission parameter of the mobile station would cause less interference to reception by the second receiver by transmissions of the mobile station, and if it is so determined,
- 10 transmitting a message to the wireless communication network indicating a communication parameter.
2. A method according to claim 1, wherein
- 15 the message indicates a handover target radio channel.
3. A method according to claim 1, wherein
- the message indicates a radio frequency of a second wireless communication network.
- 20
4. A method according to claim 1, wherein
- the message indicates a a handover target frequency band.
5. A method according to claim 1, wherein
- 25 the message indicates a second wireless communication network.
6. A method according to claim 1, wherein
- the message indicates a a handover target system modulation method.
7. A method according to claim 1, wherein
- 30 the message indicates timing information of a second wireless communication network.
8. A method according to claim 1, wherein
- 35 the message indicates timing information of a signal interfering reception by the second receiver.
9. A method according to claim 1, wherein

the message indicates a type of service received by the second receiver.

10. A method according to claim 1, wherein the message is a handover request message.

5

11. A method according to claim 1, wherein the message indicates a power level of an interfering signal.

12. A method according to claim 1, wherein the message indicates a transmission or reception power level of a second
10 wireless communication network.

13. A method according to claim 1, wherein the message indicates a frequency of an interfering signal.

15 14. A method according to claim 1, wherein the message indicates location information of the mobile terminal.

15 A method according to claim 1, comprising the step of
transmitting an indication of more than one transmission channel,
20 frequency band, or wireless communication network, and an indication of order
of preference of the more than one transmission channel, frequency band, or
wireless communication network.

16. A method according to claim 1, comprising the step of
25 transmitting an indication to the wireless communication network that
reception by the second receiver has ended.

17. A method according to claim 1, wherein the message
indicates a transmission parameter to be used in transmissions from the
30 mobile station to the wireless communication network.

18. A method according to claim 1, wherein the message
indicates a transmission parameter to be avoided in transmissions from the
mobile station to the wireless communication network.

35

19. A method in a wireless communication system,
comprising the steps of
receiving a message from a mobile station,

extracting indication of a communication parameter from the received message, and

changing a communication parameter of the radio link between the wireless communication system and the mobile station as a response to receiving the message.

20. A method according to claim 19, comprising the step of initiating handover to a channel, frequency band, or a wireless communication system indicated in the message.

21. A method according to claim 19, comprising the steps of receiving an indication from a mobile station that reception by a second receiver in the mobile station has finished, and initiating a handover as a response to receiving the indication.

22. A method according to claim 19, comprising the steps of receiving information from the mobile station about timing of reception by a second receiver in the mobile station, and adjusting a communication parameter on the basis of the received timing information.

23. A method according to claim 19, comprising the steps of receiving information from the mobile station about a frequency band received by a second receiver in the mobile station, selecting a handover target at least in part on the basis of the received information about the frequency band, and initiating a handover to the selected handover target.

24. A method according to claim 19, comprising the steps of receiving information from the mobile station about a type of service received by a second receiver in the mobile station, selecting a handover target at least in part on the basis of the received information about a type of service, and initiating a handover to the selected handover target.

25. A method according to claim 23 or 24, wherein the handover target is a channel.

26. A method according to claim 23 or 24, wherein the handover target is a frequency band.

27. A method according to claim 23 or 24, wherein the handover target is a
5 wireless communication network.

28. A mobile station having a first transmitter and a first receiver for communicating with a wireless communication network on at least a first frequency band and a second receiver for receiving transmissions on at least a
10 second frequency band, comprising

a controller for determining if changing of a transmission parameter of the mobile station would cause less interference to reception by the second receiver by transmissions of the mobile station, and

15 a transmitter for transmitting, as a response to a positive determination by the controller, a message to the wireless communication network indicating a communication parameter.

29. A mobile station according to claim 28, comprising

20 a controller for transmitting information to the wireless communication network about timing of reception by the second receiver.

30. A mobile station according to claim 28, comprising

a controller for transmitting information to the wireless communication network about a second frequency band.

25

31. A mobile station according to claim 28, comprising

a controller for transmitting information to the wireless communication network about the type of service received by the second receiver.

30 32. A mobile station according to claim 28, comprising

a controller for transmitting an indication of more than one transmission channel, frequency band, or wireless communication network, and an indication of order of preference of the more than one transmission channel, frequency band, or wireless communication network.

35

33. A mobile station according to claim 28, comprising

a controller for transmitting, as a response to ending of reception by the second receiver, an indication to the wireless communication network that reception by the second receiver has ended.

5 34. A network element for a wireless communication system, comprising
a controller for extracting an indication of a communication parameter
from a message received from a mobile station, and
a controller for changing a transmission parameter of the radio link
between the wireless communication system and the mobile station as a
10 response to extracting a communication parameter from a message received
from a mobile station.

35. A system in a wireless communication network, comprising
a controller for extracting an indication of a communication parameter
15 from a message received from a mobile station, and
a controller for changing a transmission parameter of the radio link
between the wireless communication system and the mobile station as a
response to extracting a communication parameter from a message received
from a mobile station.

20 36. A software program product comprising computer software code means for
carrying out the method according to claim 1.

25 37. A software program product comprising computer software code means for
carrying out the method according to claim 19.

38. An integrated circuit for a mobile station of a wireless communication
network, the mobile station having a first transmitter, a first receiver, and at
least a second receiver, comprising
30 a controller for determining if changing of a transmission parameter of
the mobile station would cause less interference to reception by the second
receiver by transmissions of the mobile station, and
a message transmitter for initiating, as a response to a positive
determination by the controller, transmission of a message to the wireless
35 communication network indicating a communication parameter.

39. An integrated circuit according to claim 38, further comprising

an information structure containing information about at least one transmission parameter for the first transmitter causing interference to reception on a channel or a frequency band by the second receiver.

- 5 40. An integrated circuit according to claim 38, further comprising
a calculator for calculating harmonic frequencies of transmissions of the
first transmitter, and
a controller for determining whether a harmonic frequency of a
transmission by the first transmitter falls within a reception channel or a
10 frequency band of the second receiver.

1 / 2

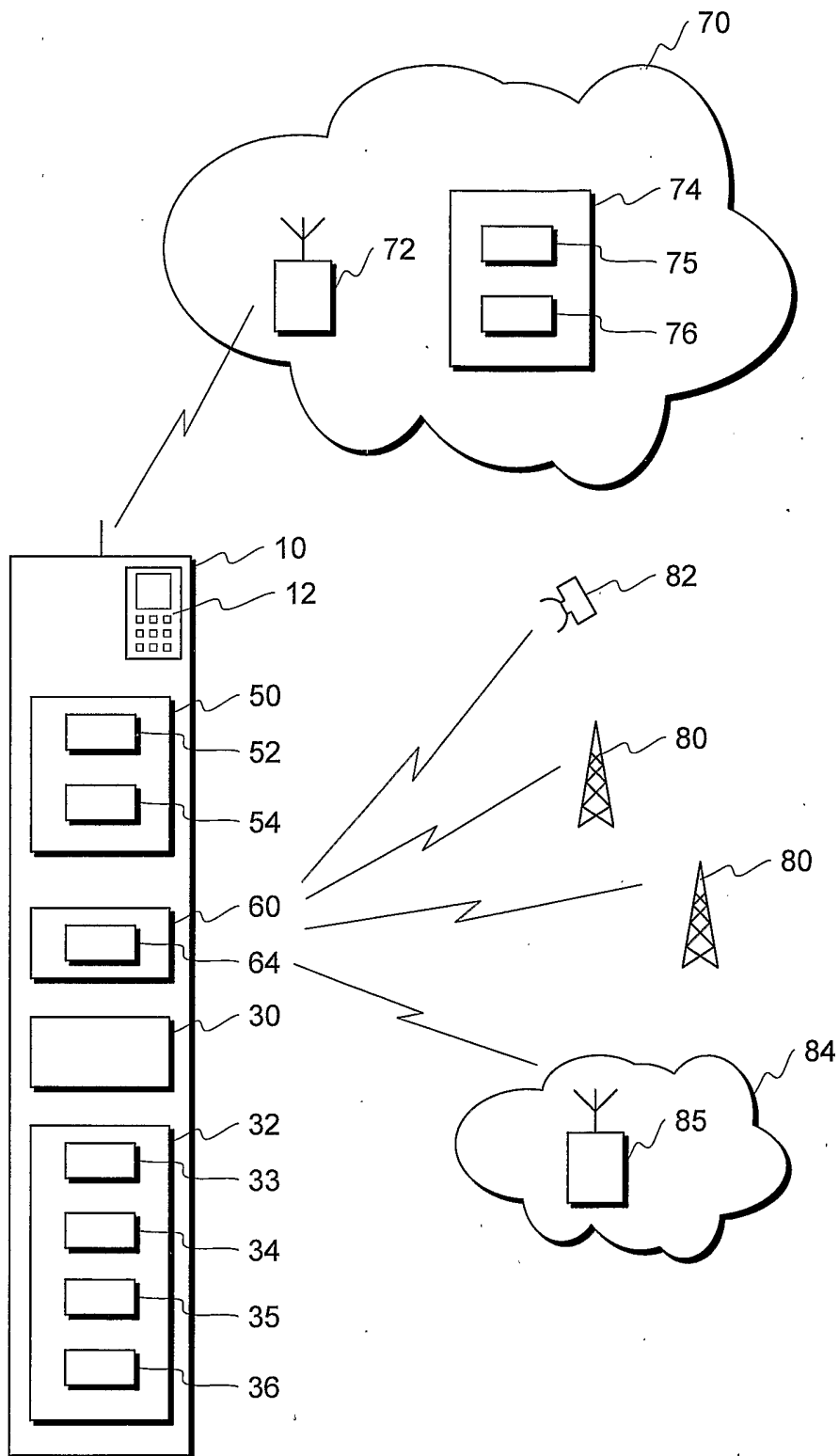


Fig. 1

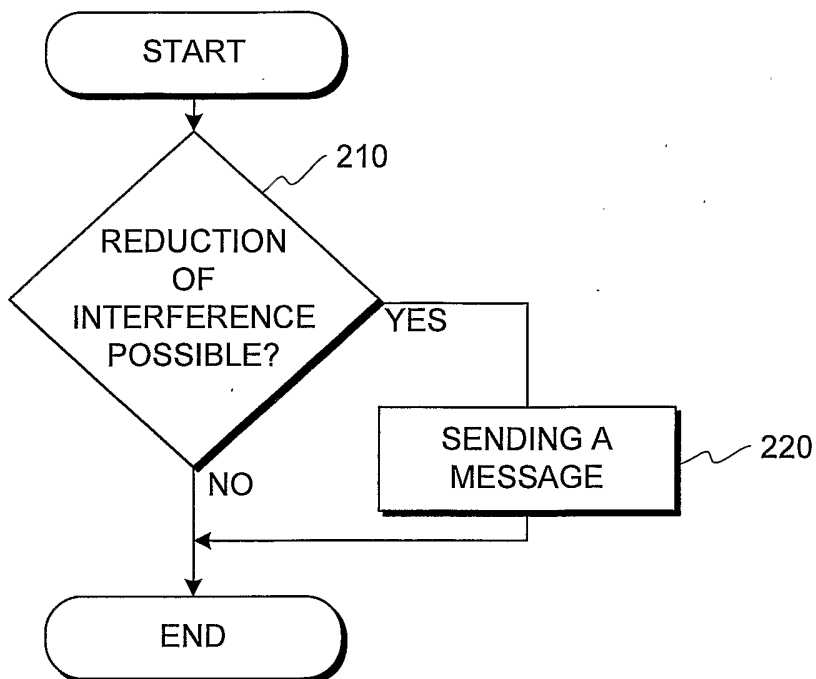


Fig. 2

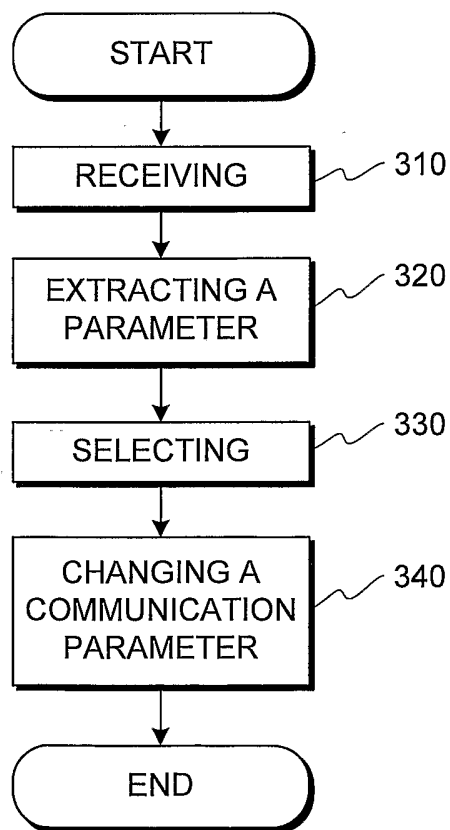


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 2005/000246

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet
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)

IPC: H04B, H04Q, H04L

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

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 20030228892 A1 (JUHA MAALISMAA ET AL), 11 December 2003 (11.12.2003), abstract, [7-10],[13-14],[32],[40] --	1-40
A	US 20020012381 A1 (SVEN MATTISSON ET AL), 31 January 2002 (31.01.2002), abstract, [6-12],[30] --	1-40
A	US 20040028003 A1 (NEIL R. DIENER ET AL), 12 February 2004 (12.02.2004), abstract, [19-22],[28],[59],[69-73] -- -----	1-40

Further documents are listed in the continuation of Box C. See patent family annex.

- | | |
|---|--|
| * Special categories of cited documents: | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
| "A" document defining the general state of the art which is not considered to be of particular relevance | "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone |
| "E" earlier application or patent but published on or after the international filing date | "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | "&" document member of the same patent family |
| "O" document referring to an oral disclosure, use, exhibition or other means | |
| "P" document published prior to the international filing date but later than the priority date claimed | |

Date of the actual completion of the international search 6 February 2006	Date of mailing of the international search report 09 -02- 2006
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Åsa Rydenius/MN Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2005/000246

INTERNATIONAL PATENT CLASSIFICATION (IPC):

H04B 15/00 (2006.01)
H04Q 7/32 (2006.01)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2005/000246

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.: 19-27, 34-35 and 37 in part
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

See next page

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2005/000246

Box No. IV Text of the abstract (Continuation of item 5 of the first sheet)

Claims Nos.: 19-27, 34-35 and 37 in part

From the description it is clear that the single general inventive concept of the invention refers to a solution of the problem of interference between a colocated transceiver and receiver in a mobile station. The problem is solved by determining in the mobile station if the change of a transmission parameter of the mobile station would cause less interference to reception by the receiver, and if so, transmitting a message to the wireless communication network indicating a communication parameter.

The search concerning claims 19-27, 34-35 and 37 has therefore been restricted to messages generated by the method and mobile station of claims 1 and 28. (The scope of claims 19-27, 34-35 and 37 in their present form covers all messages received by a network from a mobile station including conventional power control or handover requests.)

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established will not be the subject of an international preliminary examination (Rule 66.1(e) PCT). This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

26/11/2005

PCT/FI 2005/000246

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