Methods and arrangements in a mobile telecommunications network

Technical Field

The present invention relates to methods and arrangements in a mobile telecommunication network, and in particular to report transmit power headroom in conjunction with simultaneous transmission of physical uplink shared channels and physical uplink control channels.

Background

3GPP Long Term Evolution (LTE) is a project within the 3rd Generation Partnership Project (3GPP) to improve the UMTS standard with e.g. increased capacity and higher data rates towards the fourth generation of mobile telecommunication networks. Hence, the LTE specifications provide downlink peak rates up to 300 Mbps, an uplink of up to 75 Mbit/s and radio access network round-trip times of less than 10 ms. In addition, LTE supports scalable carrier bandwidths from 20 MHz down to 1.4 MHz and supports both FDD (Frequency Division Duplex) and TDD (Time Division Duplex).

LTE uses OFDM (Orthogonal Frequency Division Multiplex) in the downlink and DFT (Discrete Fourier Transform)-spread OFDM in the uplink. The basic LTE downlink physical resource can thus be seen as a time-frequency grid as illustrated in **figure 1**, where each resource element corresponds to one OFDM subcarrier during one OFDM symbol interval.

In the time domain, LTE downlink transmissions are organized into radio frames of 10 ms, each radio frame consisting of ten equally-sized subframes of length $T_{subframe} = 1$ ms as illustrated in **figure 2**.

Furthermore, the resource allocation in LTE is typically described in terms of *resource blocks*, where a resource block corresponds to one slot (0.5 ms) in the time domain and 12 contiguous subcarriers in the frequency domain. Resource blocks are numbered in the frequency domain, starting with 0 from one end of the system bandwidth.

Downlink transmissions are dynamically scheduled, i.e., in each subframe the

base station transmits control information about to which terminals data is transmitted and upon which resource blocks the data is transmitted, in the current downlink subframe. This control signaling is typically transmitted in the first 1, 2, 3 or 4 OFDM symbols in each subframe. A downlink system with 3 OFDM symbols as control is illustrated in **figure 3**.

LTE uses hybrid-ARQ, where, after receiving downlink data in a subframe, the terminal attempts to decode it and reports to the base station whether the decoding was successful (ACK) or not (NAK). In case of an unsuccessful decoding attempt, the base station can retransmit the erroneous data.

Uplink control signaling from the terminal to the base station consists of hybrid-ARQ acknowledgements for received downlink data; terminal reports related to the downlink channel conditions, used as assistance for the downlink scheduling; scheduling requests, indicating that a mobile terminal needs uplink resources for uplink data transmissions.

If the mobile terminal has not been assigned an uplink resource for data transmission, the L1/L2 control information (channel-status reports, hybrid-ARQ acknowledgments, and scheduling requests) is transmitted in uplink resources (resource blocks) specifically assigned for uplink L1/L2 control on *Physical Uplink Control Channel* (PUCCH). As illustrated in **figure 4**, these resources are located at the edges of the total available cell bandwidth. Each such resource consists of twelve "subcarriers" (one resource block) within each of the two slots of an uplink subframe. In order to provide frequency diversity, these frequency resources are frequency hopping on the slot boundary, i.e. one "resource" consists of 12 subcarriers at the upper part of the spectrum within the first slot of a subframe and an equally sized resource at the lower part of the spectrum during the second slot of the subframe or vice versa. If more resources are needed for the uplink L1/L2 control signaling, e.g. in case of very large overall transmission bandwidth supporting a large number of users, additional resources blocks can be assigned next to the previously assigned resource blocks.

To transmit data in the uplink the mobile terminal has to been assigned an

uplink resource for data transmission, on the *Physical Uplink Shared Channel* (PUSCH). In contrast to a data assignment in downlink, in uplink the assignment must always be consecutive in frequency, this to retain the signal carrier property of the uplink as illustrated in **figure 5**.

The middle SC(Single Carrier Frequency Division Multiple Access (FDMA))-symbol (also referred to as DFT-spread OFDM), in each slot is used to transmit a reference symbol. If the mobile terminal has been assigned an uplink resource for data transmission and at the same time instance has control information to transmit, it will transmit the control information together with the data on PUSCH.

Uplink power control is used both on the PUSCH and on PUCCH. The purpose is to ensure that the mobile terminal transmits with sufficient power, but at the same time not be too high, since that would only increase the interference to other users in the network. In both cases, a parameterized open loop combined with a closed loop mechanism is used. Roughly, the open loop part is used to set a point of operation, around which the closed loop component operates. Different parameters such as targets and partial compensation factors for user and control plane are used.

In more detail, for PUSCH the mobile terminal sets the output power according to

$$P_{\mathrm{PUSCH}}(i) = \min\{P_{\mathrm{CMAX}}, 10\log_{10}(M_{\mathrm{PUSCH}}(i)) + P_{\mathrm{O_PUSCH}}(j) + \alpha \cdot PL + \Delta_{\mathrm{TF}}(i) + f(i)\}$$

[dBm],

where P_{CMAX} is the configured maximum transmit power for the mobile terminal, $M_{\mathrm{PUSCH}}(i)$ is the number resource blocks assigned, $P_{\mathrm{O_PUSCH}}(j)$ and α control the target received power, PL is the estimated pathloss, $\Delta_{\mathrm{TF}}(i)$ is transport format compensator and $f(i)$ is the a UE (User Equipment) specific offset or 'closed loop correction' . The function f may represent either absolute or accumulative offsets. The closed loop power control can be operated in two

different modes either accumulated or absolute. Both modes are based on a TPC (Transmit power command) which is part of the downlink control signaling. When absolute power control is used, the closed loop correction function is reset every time a new power control command is received. When accumulated power control is used, the power control command is a delta correction with regard to the previously accumulated closed loop correction. The base station can filter the mobile terminals power in both time and frequency to provide an accurate power control operating point for the mobile terminal. The accumulated power control command is defined as $f(i) = f(i-1) + \delta_{PUSCH}(i - K_{PUSCH})$, where δ_{PUSCH} is the TPC command received in K_{PUSCH} subframe before the current subframe i and $f(i-1)$ is the accumulated power control value.

The accumulated power control command is reset when changing cell, entering/leaving RRC active state, an absolute TPC command is received, P_{O_PUCCH} is received and when the mobile terminal (re)synchronizes.

In the case of reset the power control command is reset to $f(0) = \Delta P_{rampup} + \delta_{msg2}$, where δ_{msg2} is the TPC command indicated in the random access response and ΔP_{rampup} corresponds to the total power ramp-up form the first to the last random access preamble.

The PUCCH power control has in principle the same configurable parameters with the exception that PUCCH only has full pathloss compensation, i.e. does only cover the case of $\alpha = 1$.

In existing LTE systems, the base station has the possibility to request a power headroom report from the UE for PUSCH transmissions. The power headroom reports inform the base station how much transmission power the UE had left for the subframe i. The reported value is within the range of 40 to -23 dB, where a negative value indicates that the UE did not have enough amount of transmit power to fully conduct the transmission of data, or control information.

The UE PUSCH power headroom PH for subframe i is defined as

$$PH\ (i) = P_{CMAX} - \left\{10\log_{10}(M_{PUSCH}(i)) + P_{O_PUSCH}(j) + \alpha(j)\cdot PL + \Delta_{TF}(i) + f(i)\right\}$$

where P_{CMAX}, $M_{PUSCH}(i)$, $P_{O_PUSCH}(j)$, $\alpha(j)$, PL, $\Delta_{TF}(i)$ and $f(i)$ is defined above.

In future LTE releases it will be possible to transmit PUCCH and PUSCH at the same occasion and to transmit/receive on multiple component carriers. With the added possibility for the UE to transmit PUSCH and PUCCH at the same occasion, the scenario of power limitation, i.e. when the UE has reached the maximum transmit power, becomes more likely.

Summary

In order for the base station to schedule PUSCH effectively, the base station needs to be aware of the available transmission power of the UE. In the prior art, the base station requests a power headroom report from the UE, which indicates how much transmission power that is used in the UE based on a PUSCH transmission in subframe i.

Future LTE releases, will give the possibility for the UE to transmit PUSCH (Physical uplink shared channel) and PUCCH (Physical uplink control channel) simultaneously. As both the PUCCH and the PUSCH can be transmitted simultaneously the transmit power in the UE needs to be shared among the two channels.

It is therefore desired to be able to achieve an improved solution for predicting the available transmission power.

This is achieved by taking account of the PUCCH transmission power in a power headroom report. Hence, the UE is requested to either report an individual power headroom report for PUCCH or a combined power headroom report for PUCCH and PUSCH according to embodiments. For example the combined power headroom report may be transmitted with the individual power headroom report for the PUSCH. The individual power headroom report and the combined power headroom reports may be valid for only one component carrier, e.g. for each individual component carrier, or for the sum of the component

carriers.

By using the embodiments of the present invention, the base station is now able to know how much power that the PUCCH will take from the total available transmission power and correspondingly how much power which is left for the scheduled PUSCH transmission.

According to a first aspect of embodiments of the present invention a method in a UE for distributing available transmit power between PUCCH and PUSCH. In the method, available power for transmission on at least the PUCCH is determined, and at least one power headroom report indicating the available power for transmission on at least the PUCCH is transmitted to a base station.

According to a second aspect of embodiments of the present invention a method in a base station for distributing available transmit power of a UE between PUCCH and PUSCH is provided. In the method, at least one power headroom report indicating available power for transmission on at least the PUCCH is received from a UE and the UE is scheduled based on information of the at least one received power headroom report.

According to a third aspect of embodiments of the present invention a UE for distributing available transmit power between PUCCH and PUSCH is provided. The UE comprises a processor configured to determine available power for transmission on at least the PUCCH, and a transmitter configured to transmit to a base station at least one power headroom report indicating the available power for transmission on at least the PUCCH.

A base station for distributing available transmit power of a UE between PUCCH and PUSCH is provided. The base station comprises a receiver configured to receive from the UE at least one power headroom report indicating the available power for transmission on at least the PUCCH, and a processor configured to schedule the UE based on information of the at least one received power headroom report.

An advantage with embodiments of the present invention is that the base station can predict the available remaining transmission power when the PUSCH and PUCCH are simultaneously transmitted.

Brief Description of the drawings

Figure 1 illustrates the LTE downlink physical resources according to prior art.

Figure 2 illustrates the LTE time-domain structure according to prior art.

Figure 3 illustrates the downlink subframes according to prior art.

Figure 4 illustrates uplink L1/L2 control signaling transmission on PUCCH according to prior art.

Figure 5 illustrates the PUSCH resource assignment according to prior art.

Figures 6 and **7** are flowcharts of the methods according to embodiments of the present invention.

Figure 8 illustrates the UE and the base station according to embodiments of the present invention.

Detailed description

Although the embodiments of the present invention will be described in the context of an LTE network, the embodiments can also be implemented in other networks enabling simultaneous transmission of different physical channels.

In accordance with embodiments, the base station configures 601 the UE whether or not simultaneous transmission of PUCCH and PUSCH is possible as illustrated in the flowchart of **figure 6**. The base station then signals 602 a parameter to the UE indicating whether simultaneous transmission of PUSCH and PUCCH is possible. The parameter may be signaled via RRC (Radio Resource Control) protocol or as part of the broadcasted system information. Hence, as illustrated in the flowchart of **figure 7**, the UE receives 701 the

parameter indicating whether simultaneous transmission of PUSCH and PUCCH is possible, and configures 702 the uplink transmission based on the received parameter according to an embodiment.

As a UE has a limited available transmit power, it would be desired to schedule the UE such that the available transmission power can be taken into account. Hence in situations when simultaneous transmission of PUCCH and PUSCH is possible, it would be desired to be able to take the PUSCH and the PUCCH transmission into account when determining the available UE transmit power.

This is achieved according to embodiments of the present invention by introducing power headroom reports indicating the available power for transmission on at least the PUCCH. This implies that a method in a UE for distributing the available transmit power to avoid violation of UE power limitations on the PUCCH and the PUSCH is provided. The method is illustrated in the flowchart of **figure 7** which shows that the method comprises determining 703 available power for transmission on at least the PUCCH, and transmitting 704 to a base station at least one power headroom report indicating the available power for transmission on at least the PUCCH.

Accordingly, a corresponding method in a base station for distributing available transmit power of a UE between PUCCH, and Physical Uplink Shared Channel, PUSCH is provided. The base station receives 603 from the UE at least one power headroom report indicating the available power for transmission on at least the PUCCH, and schedules 604 the UE based on information of the at least one received power headroom report.

The power headroom reports can be created in different ways according to the embodiments which are further described below.

In a first embodiment the power headroom report indicates the available power for transmission on the PUCCH, i.e. $PH_{PUCCH} = P_{CMAX}$ - PUCCH power where P_{CMAX} is the maximum power for the UE and PUCCH power is the power of PUCCH. It should be noted that the existing power headroom report for PUSCH (PH_{PUSCH})

also may be available. An example how the power headroom report for PUCCH (PH_{PUCCH}), among many possible implementations, can be determined, is shown below:

$$PH_{PUCCH}(i) = P_{CMAX} - \{P_{0_PUCCH} + PL + h(n_{CQI}, n_{HARQ}) + \Delta_{F_PUCCH}(F) + g(i)\}$$

where P_{CMAX} is the configured maximum transmit power for the mobile terminal, $P_{O_PUSCH}(j)$, PL is the estimated pathloss, $\Delta_{F_PUCCH}(F)$ is provided by higher layers. Each $\Delta_{F_PUCCH}(F)$ value is dependent on the PUCCH format. h(n) is also a PUCCH format dependent value, where n_{CQI} corresponds to the number of information bits for the channel quality information and n_{HARQ} is the number of HARQ bits. g(i) is the current PUCCH power adjustment state and *i* is the current subframe.

In a second alternative embodiment the existing power headroom report for PUSCH is extended to also include PUCCH which is implies that the power headroom is reported for both PUSCH and PUCCH in the same report referred to as $PH_{PUCCH+PUSCH}$, where $PH_{PUCCH+PUSCH}$=Pcmax-(the PUSCH power + the PUCCH power). An example among many possible implementations is shown below:

$$PH_{PUSCH_and_PUCCH}(i) = P_{CMAX} - \{P_{0_PUCCH} + PL + h(n_{CQI}, n_{HARQ}) + \Delta_{F_PUCCH}(F) + g(i)\} - \{10\log_{10}(M_{PUSCH}(i)) + P_{O_PUSCH}(j) + \alpha(j) \cdot PL + \Delta_{TF}(i) + f(i)\}$$

where the parameter definitions are specified above. It should also be noted that the power headroom can be expressed in dB in the mW or W domain. For the power headroom report indicating the available power for transmission on PUSCH and PUCCH, the power headroom report can be defined as:

$$PH_{PUSCH_and_PUCCH}(i) = P_{CMAX,c} - 10\log_{10}\left(\begin{matrix} 10^{\left(10\log_{10}(M_{PUSCH,c}(i)) + P_{O_PUSCH,c}(j) + \alpha_c(j)\cdot PL + \Delta_{TF,c}(i) + f_c(i)\right)/10} \\ + \ 10^{\left(P_{0_PUCCH} + PL + h(n_{CQI}, n_{HARQ}) + \Delta_{F_PUCCH}(F) + g(i)\right)/10} \end{matrix}\right) \text{дБ}$$

It should be noted that all PH reports can be defined in the mW or W domain

and expressed in dB in this way.

According to a third embodiment, the power headroom report for PUSCH and PUCCH can also be used in combination with the existing power headroom report for PUSCH. Thus, the power headroom report indicating the available power for transmission on the PUCCH and the PUSCH is transmitted in combination with a power headroom report indicating the available power for transmission on PUSCH. In this way it is possible to determine the available power on both PUCCH and PUSCH.

According to a fourth embodiment, the power headroom report for PUSCH and PUCCH can also be used in combination with the power headroom report for PUCCH. Thus, the power headroom report indicating the available power for transmission on the PUCCH and the PUSCH is transmitted in combination with a power headroom report indicating the available power for transmission on PUCCH. In this way it is possible to determine the available power on both PUCCH and PUSCH.

According to further embodiments, the power headroom report indicates the available transmission power for a given component carrier c. In the example below the power headroom report indicates the available power for transmission on the PUCCH for a given component carrier c, $PH_{PUCCH}(c)=P_{CMAX}$-PUCCH power(c) in addition to an existing power headroom report for PUSCH, e.g. defined for a specific component carrier. An example among many possible implementations is shown below:

$$PH_{PUCCH}(i,c) = P_{\mathrm{CMAX}} - \left\{P_{0_\mathrm{PUCCH},c} + PL_c + h\left(n_{CQI}, n_{HARQ}, c\right) + \Delta_{\mathrm{F_PUCCH}}\left(F,c\right) + g\left(i,c\right)\right\}$$

where the parameters follow the definitions specified above.

In a further example, the power headroom report indicating the available power for transmission on the PUCCH and the PUSCH can be defined for a given component carrier. I.e. $PH_{PUCCH+PUSCH}$ (c)=Pcmax-(PUSCH power(c)+PUCCH power(c)) can be exemplified as:

$$PH_{PUSCH_and_PUCCH}(i,c) = P_{\mathrm{CMAX}} - \{P_{0_\mathrm{PUCCH},c} + PL_c + h(n_{CQI}, n_{HARQ}, c) + \Delta_{\mathrm{F_PUCCH}}(F,c) + g(i,c)\} - \{10\log_{10}(M_{\mathrm{PUSCH}}(i,c)) + P_{\mathrm{O_PUSCH}}(j,c) + \alpha(j)\cdot PL_c + \Delta_{\mathrm{TF}}(i,c) + f(i,c)\}$$

where the parameters follow the definitions specified above.

In a yet further example, the power headroom report indicating the available power for transmission on the PUCCH and the PUSCH can transmitted in combination with a power headroom report indicating the available power for transmission on PUSCH. These power headroom reports can be defined for a given component carrier c. The transmission of the different reports may occur simultaneously or at separate instances.

In a yet further example, the power headroom report indicating the available power for transmission on the PUCCH and the PUSCH can transmitted in combination with a power headroom report indicating the available power for transmission on PUCCH. These power headroom reports can be defined for a given component carrier c. The transmission of the different reports may occur simultaneously or at separate instances.

The power headroom report on a given component carrier may be triggered by a pathloss change on the same or on another component carrier. The UE may send a power headroom report for a carrier where the pathloss is changed beyond a certain threshold. Alternatively, a pathloss change on one component carrier may trigger a full power headroom report including reports for all component carriers.

The power headroom reports indicating the available power for transmission on PUCCH, PUSCH and on PUCCH and PUSCH can be defined as a sum for all component carriers used by one UE.

It should be noted that the principles described for PUSCH may also be applied for the sounding reference signals (SRS). I.e., when simultaneous transmission of SRS and PUCCH occurs, the embodiments of the present invention are also

applicable if PUSCH or PUCCH is replaced by SRS.

The present invention is also directed to a UE (User Equipment) and a base station, also referred to as an eNB in LTE. The UE is configured to wirelessly communicate with a mobile telecommunication network via base stations. Hence, the UE and the base station comprise antennas, power amplifiers and other software means and electronic circuitry enabling the wireless communication. **Figure 8** illustrates schematically a UE and a base station according to embodiments of the present invention.

Accordingly, the UE 806 is adapted to distribute the available transmit power of a UE between PUCCH and PUSCH. The UE comprises a processor 804 configured to determine available power for transmission on at least the PUCCH and a transmitter 805 configured to transmit to a base station at least one power headroom report 821 indicating the available power for transmission on at least the PUCCH. As indicated in **figure 8**, the transmitter is configured to transmit data on PUSCH and control information on PUCCH. Further, the UE comprises a receiver 803 configured to receive a parameter 825 indicating whether simultaneous transmission of PUSCH and PUCCH is possible and to e.g. receive scheduling information 820. The processor 804 is further configured to configure the uplink transmission based on the received parameter.

Hence, the base station 800 is adapted to distribute the available transmit power of a UE between PUCCH and PUSCH. The base station comprises a receiver 807 for receiving at least one power headroom report 821 indicating the available power for transmission on at least the PUCCH and a processor 801 configured to schedule the UE based on information of the at least one received power headroom report. Furthermore, the base station comprises a transmitter 802 for transmitting scheduling information 820 regarding how to schedule future uplink transmission in the UE, wherein the scheduling information 820 is based on the headroom reports 821.
In addition the processor 801 may be configured to configure the UE whether or not simultaneous transmission of PUCCH and PUSCH is possible, and the

transmitter 802 may be configured to signal a parameter 825 to the UE indicating whether simultaneous transmission of PUSCH and PUCCH is possible.

It should be noted that the respective processor 804, 801 of the UE and the base station may be one processor or a plurality of processors configured to perform the different tasks assigned to the respective above mentioned processor of the UE and the base station.

It should also be noted that the available power for transmission in the different embodiment is the available remaining power that can be used for transmission on the relevant physical channel such as PUCCH and PUSCH when the power allocated for the respective channel(s) is reduced from the configured maximum transmit power for the mobile terminal.

Modifications and other embodiments of the disclosed invention will come to mind to one skilled in the art having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of this disclosure. Although specific terms may be employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

CLAIMS

1. A method in a User Equipment, UE, for distributing available transmit power between Physical Uplink Control Channel, PUCCH, and Physical Uplink Shared Channel, PUSCH , the method comprises:

-determining (703) available power for transmission on at least the PUCCH, and

-transmitting (704) to a base station at least one power headroom report indicating the available power for transmission on at least the PUCCH.

2. The method according to claim 1, wherein the available power is determined for transmission on the PUCCH and the PUSCH and the at least one power headroom report indicates the available power for transmission on the PUCCH and the PUSCH.

3. The method according to claim 2, wherein the at least one power headroom report indicating the available power for transmission on the PUCCH and the PUSCH is transmitted in combination with a power headroom report indicating the available power for transmission on PUSCH.

4. The method according to claim 2, wherein the at least one power headroom report indicating the available power for transmission on the PUCCH and the PUSCH is transmitted in combination with a power headroom report indicating the available power for transmission on PUCCH.

5. The method according to claim 1, wherein the available power is determined for transmission on the PUCCH and the at least one power headroom report indicates the available power for transmission on the PUCCH.

6. The method according to any of claims 1-5, wherein the at least one power headroom report is valid for a given component carrier c.

7. The method according to any of claims 1-5, wherein the at least one power headroom report is defined as a sum for all component carriers.

8. The method according to claim 4, wherein the at least one power headroom report indicating the available power for transmission on the PUCCH and the PUSCH is transmitted simultaneously with the power headroom report indicating the available power for transmission on PUSCH.

9. The method according to claim 4, wherein the at least one power headroom report indicating the available power for transmission on the PUCCH and the PUSCH is transmitted at a separate instance compared with the power headroom report indicating the available power for transmission on PUSCH.

10. The method according to any of claims 1-9, further comprising :
-receiving (701) a parameter indicating whether simultaneous transmission of PUSCH and PUCCH is possible, and
-configuring (702) the uplink transmission based on the received parameter.

11. A method in a base station for distributing available transmit power of a User Equipment, UE, between Physical Uplink Control Channel, PUCCH, and Physical Uplink Shared Channel, PUSCH , the method comprises:
-receiving (603) from the UE at least one power headroom report indicating available power for transmission on at least the PUCCH, and
-scheduling (604) the UE based on information of the at least one received power headroom report.

12. The method according to claim 11, wherein the at least one power headroom report indicates the available power for transmission on the PUCCH and the PUSCH.

13. The method according to claim 12, wherein the at least one power headroom report indicating the available power for transmission on the PUCCH and the PUSCH is received in combination with a power headroom report indicating the available power for transmission on PUSCH.

14. The method according to claim 12, wherein the at least one power headroom report indicating the available power for transmission on the PUCCH and the PUSCH is received in combination with a power headroom report indicating the available power for transmission on PUCCH.

15. The method according to claim 11, wherein the at least one power headroom report indicates the available power for transmission on the PUCCH.

16. The method according to any of claims 11-15, further comprises:

-configuring (601) the UE whether or not simultaneous transmission of Physical Uplink Control Channel, PUCCH, and Physical Uplink Shared Channel, PUSCH is possible, and

-signalling (602) a parameter to the UE indicating whether simultaneous transmission of PUSCH and PUCCH is possible.

17. A User Equipment, UE, (806) for distributing available transmit between Physical Uplink Control Channel, PUCCH, and Physical Uplink Shared Channel, PUSCH, the UE (806) comprises a processor (804) configured to determine available power for transmission on at least the PUCCH, and a transmitter (805) configured to transmit to a base station at least one power headroom report indicating the available power for transmission on at least the PUCCH.

18. A base station (800) for distributing available transmit power of a User Equipment, UE, (806) between Physical Uplink Control Channel, PUCCH, and Physical Uplink Shared Channel, PUSCH, the base station comprises a receiver (807) configured to receive from the UE at least one power headroom report indicating the available power for transmission on at least the PUCCH, and a processor (801) configured to schedule the UE based on information of the at least one received power headroom report.