(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) **World Intellectual Property Organization**
International Bureau

(43) **International Publication Date**
6 July 2006 (06.07.2006)

PCT

(10) **International Publication Number**
WO 2006/071162 A1

(51) **International Patent Classification:**
H04B 7/005 (2006.01) ***H04Q 7/38*** (2006.01)

(21) **International Application Number:** PCT/SE2004/002060

(22) **International Filing Date:** 30 December 2004 (30.12.2004)

(25) **Filing Language:** English

(26) **Publication Language:** English

(71) **Applicant** *(for all designated States except US)*: **TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)** [SE/SE]; S-164 83 Stockholm (SE).

(72) **Inventors; and**
(75) **Inventors/Applicants** *(for US only)*: **LINDHEIMER, Christofer** [SE/SE]; Köpenhamnsgatan 26, S-164 42 Kista (SE). **MILÉN, Anders** [SE/SE]; Diligensvägen 43, S-131 48 Nacka (SE). **BLOMBERG, Petter** [SE/SE]; Ågatan 18, S-172 62 Sundbyberg (SE). **KARLSSON, Patrik** [SE/SE]; Hasselnötsvägen 59, 1 tr, S-138 34 Älta (SE).

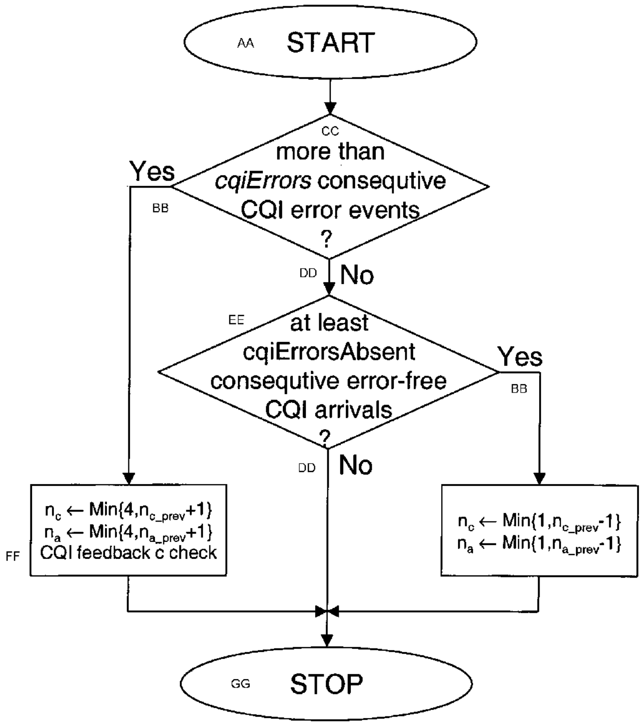
(74) **Agent: MAGNUSSON, Monica**; Ericsson AB, Patent Unit Radio Networks, S-164 80 Stockholm (SE).

(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,

[Continued on next page]

(54) **Title:** METHOD AND SYSTEM OF WIRELESS COMMUNICATIONS



AA...DEBUT
BB...OUI
CC...PLUS QUE NOMBRE D'EVENEMENTS D'ERREUR CQI CONSECUTIFS CQIERRORS ?
DD...NON
EE...AU MOINS LE NOMBRE D'ARRIVEES CQI SANS ERREUR CONSECUTIVES CQIERRORSABSENT ?
FF...VERIFICATION DE CYCLE DE RETOUR CQI
GG...ARRÊT

(57) **Abstract:** The present invention relates to wireless communications. More especially it relates to wireless high speed packet data communications. Particularly it relates to transmission power control of high speed packet data communications including adjustment of one or more transmission power control parameters of one or more wireless links not involved in soft handover in relation to wireless one or more links involved in soft handover or coordination of such parameters.

WO 2006/071162 A1

FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *of inventorship (Rule 4.17(iv))*

Published:
— *with international search report*

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.

Method and system of wireless communications

TECHNICAL FIELD OF THE INVENTION

The present invention relates to wireless communications. More especially it relates to wireless high speed packet data communications. Particularly it relates to transmission power control of high-speed packet data communications.

BACKGROUND AND DESCRIPTION OF RELATED ART

Transmission power control of dedicated and shared channels, such as DPDCH (Dedicated Physical Data Channel) and DPCCH (Dedicated Physical Control Channel) in UMTS (Universal Mobile Telecommunications System), is previously known.

Figure 1 shows schematically selected elements of a UMTS communications system according to prior art. Protocol Data Units, PDUs, are communicated downlink, DL, to user equipment «UE» and uplink from the user equipment «UE». Information disassembled/reassembled into appropriately sized protocol data units «PDU» are transferred to a presumed receiver. The communications path involves a radio base station, RBS, «BS1/Node B 1» and a radio network controller «RNC», the radio base station «BS1/Node B 1» is connected to the RNC over an Iub interface and to the UE over a radio interface. Also depicted is a second radio base station «BS2/Node B 2» not participating in the particular information transfer at the time instant depicted in the figure. Node B is a logical node responsible for radio transmission/reception in one or more cells to/from a User Equipment. A base station, BS, or radio base station is a physical entity representing Node B.

Figure 2 displays schematically selected elements involved in soft handover diversity in a UMTS communications system according to prior art. In uplink direction, PDUs, transmitted from UE are received over different radio links, illustrated by two radio base stations «BS 1/Node B 1» «BS 2/Node B 2» receiving transmitted protocol data units «PDU» over the radio interface. The protocol data units are forwarded to radio network controller «RNC». RNC combines received PDUs according to selection diversity combining. In downlink direction protocol data units are transferred to UE over the radio network controller «RNC» and the two radio base stations «BS 1/Node B 1» «BS 2/Node B 2». Identical PDUs transmitted over the radio interface from the radio base stations «BS 1/Node B 1» «BS 2/Node B 2» are combined in the receiver of UE.

Figure 3 shows a layered protocol structure, a protocol stack for HS-DSCH. The L2 MAC layer is divided into two sub-layers, an L2 MAC sub-layer and a MAC-hs sub-layer. The MAC-hs plus the MAC layer could be regarded as one single MAC layer extended to also include hybrid ARQ (Automatic Repeat Request), HARQ, functionality, allowing combining of successively received (re-)transmissions. However, for reasons of explanation they are preferably regarded as separate sub-layers. Further, on the network side, considering them as separate protocol sub-layers physically better corresponds to the physical entities where they reside. As illustrated in figure 3 on the UTRAN-side (or network side) L2 MAC sub-layer is preferably located in RNC, whereas L2 MAC-hs sub-layer is located in Node B. As the hybrid ARQ protocol combines successively received retransmissions it is a great advantage to have this protocol close to the physical layer and, particularly, in Node B. RLC/MAC control blocks are used to transport RLC/MAC control messages. In an RLC/MAC control block, all transported segments are of the same RLC/MAC control message. RLC/MAC control blocks are sent at a higher priority than RLC data blocks. RLC/MAC control blocks are sent on ADCH (Associated Dedicated Channel).

3rd Generation Partnership Project (3GPP): *Technical Specification Group Radio Access Network, Physical Layer Procedures, 3G TS 25.301 v3.6.0, France, September 2000,* specifies in chapter 5 Radio Interface Protocol Architecture of a UMTS system. There are three protocol layers:

- physical layer, layer 1 or L1,
- data link layer, layer 2 or L2, and
- network layer, layer 3 or L3.

Layer 2, L2, and layer 3, L3 are divided into Control and User Planes. Layer 2 consists of two sub-layers, RLC and MAC, for the Control Plane and four sub-layers, BMC, PDCP, RLC and MAC, for the User Plane. The acronyms BMC, PDCP, RLC and MAC denote Broadcast/Multicast Control, Packet Data Convergence Protocol, Radio Link Control and Medium Access Control respectively.

3rd Generation Partnership Project (3GPP): *Technical Specification Group Radio Access Network, Spreading and modulation (FDD) (Release 6), 3GPP TS 25.213 v6.0.0, France, December 2003,* describes spreading and modulation for UTRA (Universal Terrestrial Radio Access) Physical Layer FDD (Frequency Division Duplex) mode. Section 4.2 of the Technical Specification describes uplink spreading of, e.g., DPCCH, DPDCHs and HS-DPCCH (High Speed Dedicated Physical Control Channel). HS-DPCCH is a control channel (in uplink direction) for HSDPA (High Speed Downlink Packet Access) carrying feedback information. After channelization, the real-valued spread signals are weighted by gain factors, β_c for DPCCH, β_d for all DPDCHs and β_{hs} for HS-DPCCH (if one is active). The β_c and β_d values are signaled by higher layers or calculated. At every instant in time, at least one of the values β_c and β_d has the amplitude 1.0. The β_c and β_d values are quantized into 4-bit words corresponding to the nominator of a rational number with 15 in the denominator.

3rd Generation Partnership Project (3GPP): *Technical Specification Group Radio Access Network, Physical layer procedures (FDD), (Release 6), 3GPP TS 25.214 v6.3.0, France, September 2004,* specifies and establishes the characteristics of the physicals layer procedures in the FDD mode of UTRA. Paragraph 5.1.2.5A defines setting of uplink DPCCH/HS-DPCCH power difference. When an HS-DPCCH is active, the power offset $\Delta_{HS\text{-}DPCCH}$ for each HS-DPCCH slot shall be set as follows. For HS-DPCCH slots carrying HARQ Acknowledgement:

- $\Delta_{HS\text{-}DPCCH} = \Delta_{ACK}$ if the corresponding HARQ Acknowledgement is equal to 1.
- $\Delta_{HS\text{-}DPCCH} = \Delta_{NACK}$ if the corresponding HARQ Acknowledgement is equal to 0.

For HS-DPCCH slots carrying CQI:

- $\Delta_{HS\text{-}DPCCH} = \Delta_{CQI}$

The values for Δ_{ACK}, Δ_{NACK} and Δ_{CQI} are set by higher layers. Then, in non-compressed frames, the gain factor β_{hs} is calculated according to

$$\beta_{hs} = \beta_c \cdot 10^{\Delta_{HS\text{-}DPCCH}/20} ,$$

where β_c value is signaled by higher-layer or calculated as described in the technical specification. During the period between the start and end of a compressed DPCCH frame, when HS-DPCCH is transmitted, β_{hs} is calculated according to

$$\beta_{hs} = \beta_{c,C,j} \cdot 10^{\Delta_{HS\text{-}DPCCH}/20} \cdot \sqrt{\frac{N_{pilot,C}}{N_{pilot,N}}} \quad ,$$

where $\beta_{c,C,j}$ is calculated as described in the technical specification, $N_{pilot,C}$ is the number of pilot bits per slot on the DPCCH in compressed frames, and $N_{pilot,N}$ is the number of pilot bits per slot in non-compressed frames.

Thus the gain factor β_{hs} varies depending on the current power offset $\Delta_{HS\text{-}DPCCH}$ and on whether the uplink DPCCH is currently in a compressed frame.

3rd Generation Partnership Project (3GPP): *Technical Specification Group Radio Access Network, UTRAN Iub interface NBAP signalling (Release 6), 3GPP TS 25.433 v6.3.0, France, September 2004,* specifies the radio network layer signaling protocol called Node B Application Part, NBAP, specification to be used for Control Plane over Iub Interface. A number of information elements, IEs, are explained:

- The CQI Power Offset, Δ_{CQI}, IE indicates Power offset used in the UL between the HS-DPCCH slots carrying CQI (Channel Quality Indication) information and the associated DPCCH.
- The NACK Power Offset, Δ_{NACK}, IE indicates Power offset used in the UL between the HS-DPCCH slot carrying HARQ NACK information and the associated DPCCH.
- The ACK Power Offset, Δ_{ACK}, IE indicates Power offset used in the UL between the HS-DPCCH slot carrying HARQ ACK information and the associated DPCCH.

- The CQI Repetition Factor IE indicates the number of consecutive repetitions of the CQI.
- The CQI Feedback Cycle k IE provides the duration of the CQI feedback cycle.
- The ACK-NACK Repetition Factor IE indicates the number of consecutive repetitions of the ACK and NACK.

According to 3GPP TS 25.433 it shall be possible to initiate changes to CQI repetition factor and feedback cycle, as well as ACK-NACK repetition factors from Radio Link Parameter update. The Radio Link Parameter Update procedure is executed by the Node B when the update of HS-DSCH related radio link parameter values are needed on the Node B side. With this procedure, Node B can suggest some HS-DSCH related Radio Link Parameter values to RNC. In FDD (Frequency Division Duplex) mode, if Node B needs to update the CQI Feedback Cycle k, CQI Repetition Factor, ACK-NACK Repetition Factor, CQI Power Offset, ACK Power Offset and/or NACK Power Offset, the Node B shall initiate RADIO LINK PARAMETER UPDATE INDICATION message including *CQI Feedback Cycle k* IE, *CQI Repetition Factor* IE, *ACK-NACK Repetition Factor* IE, *CQI Power Offset* IE, *ACK Power Offset* IE and/or *NACK Power Offset* IE.

European Telecommunications Standards Institute 2004: *ETSI TS 125 401 V5.9.0, Universal Mobile Telecommunications System (UMTS); UTRAN overall description (3GPP TS 25.401 version 5.9.0 Release 5), France, September 2004,* lists in section 3 a number of definitions and abbreviations, and defines a radio link as a logical association between a single User Equipment and a single UTRAN access point. Its physical realization comprises one or more radio bearer transmissions. A Radio Link Set, RLS, is a set of one or more Radio Links that has a common generation of Transmit Power Control, TPC, commands in the DL. A UTRAN Access Point is a conceptual point within the UTRAN performing radio transmission and reception. A UTRAN access point is associated with one specific cell, i.e. there exists one UTRAN access point for each cell. It is the UTRAN-side end point of a radio link.

None of the cited documents above discloses a method and system of adjusting transmission power control parameters of one or more wireless links not involved in soft handover in relation to wireless one or more links involved in soft handover or coordination of such parameters.

SUMMARY OF THE INVENTION

Setting of transmission power control offsets for HS-DPCCH as an example from the UMTS specification, when the number of links involved for HS-DPCCH coincides with the number of links for the channel, typically DPCCH, or channels, such as DPCCH and DPDCH, to which the power offset relates is straight forward, at least as long as the links are served by the same base station. However, in soft handover situations or in situations where the links are served by different base station, prior art solution imposes problems.

The ADCH can be in soft handover, like any other ordinary DCH. HSDPA and HS-DSCH cannot. When the ADCH is communicating with more than one cell in a soft handover situation it is power controlled by outer loop and inner loop power control. The reference for β_{hs} is either DPDCH or DPCCH, or both. In the uplink DPDCH and DPCCH are power controlled by the outer and inner loop. During soft handover, the fact that DPDCH and DPCCH perceive a diversity effect is considered in the inner and outer loop power control. The information on DPDCH concerning outer loop power control is terminated in RNC. HS-DPCCH is terminated in Node B serving a present user equipment entity. Consequently, according to prior art it is power controlled as if it would enjoy a diversity effect corresponding to DPCCH or DPDCH when in soft handover, when it actually perceives no diversity gain, since it communicates over a single diversity branch. During soft handover there is consequently a great risk that channel quality of HS-DPCCH can seriously degrade, which jeopardizes both ARQ feedback and CQI information to the HS scheduling entity.

Consequently, there is a need of providing uplink transmission power control compensating for diversity mismatch between various links, sharing control parameters.

An object of the invention is to compensate transmission power control of uplink physical channels sharing one or more power control parameters, in relation to the number of radio links involved in a connection.

Another object is to provide transmission power control by means of a limited number of transmission power control parameters, for uplink physical channels of different diversity order.

It is also an object of the invention to provide a method and system for efficient, signaling of transmission power control.

Finally, it is an object to provide a method and system for signaling of transmission power control optimized for parameter matching.

These objects are met by a method and system of updating uplink power offset parameters, determining a transmission power offset of different uplink physical channels depending on the cardinality of Radio Link Set or number of radio base stations, RBSes, in an active set.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows schematically selected elements of a UMTS communications system according to prior art.

Figure 2 displays schematically selected elements involved in soft handover diversity in a UMTS communications system according to prior art.

Figure 3 shows a layered protocol structure, a protocol stack for HS-DSCH according to prior art.

Figure 4 illustrates an active set comprising three radio links involving user equipment «UE» and three radio base stations «BS 2», «BS 3», «BS 4» during a soft handover.

Figure 5 shows uplink channel structure of ADCH. For high-speed communications an HS-DPCCH is included.

Figure 6 depicts signaling triggered by RBS according to a first mode of the invention.

Figure 7 monitors signaling triggered by RNC according to a second mode of the invention.

Figure 8 illustrates schematically in a flow chart parameter updating according to the first mode of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Setting of transmission power control offsets for HS-DPCCH as an example from the UMTS specification, when the number of links involved for HS-DPCCH coincides with the number of links for the channel, typically DPCCH, or channels, such as DPCCH and DPDCH, to which the power offset relates is straight forward, at least as long as the links are served by the same base station. However, in soft handover situations or in situations where the links are served by different base station, prior art solution imposes problems.

Figure 5 shows uplink channel structure of ADCH (Associated Downlink Control Channel). For high-speed communications an HS-DPCCH (High-Speed Dedicated Physical Control Channel) is included. HS-DPCCH carries, e.g., feedback information requesting retransmission or (positively) acknowledging successfully received transmissions «HARQ-ACK» and channel quality information «CQI» destined for MAC-hs protocol layer. In UMTS the HARQ-ACK field of an HS-DSCH sub-frame comprises 10 bits, and the CQI field 20 bits, the sub-frame being transmitted over three time slots. The HS-DPCCH is multiplexed with other channels on ADCH. DPCCH and DPDCH are examples of ordinary channels multiplexed on ADCH, together with HS-DPCCH. The ADCH can be in soft handover, like any ordinary DCH.

Since downlink scheduling of HS-DSCH relies on CQI feedback information, transmitted on HS-DPCCH, downlink transmissions could be substantially deteriorated if transmission power of HS-DPCCH is not appropriately adjusted in relation to other physical channels, such as DPDCH and DPCCH, multiplexed on ADCH.

When the ADCH is communicating with more than one cell in a soft handover situation it is power controlled by outer loop and inner loop power control. The reference for β_{hs} is either DPDCH or DPCCH, or both. In the uplink DPDCH and DPCCH are power controlled by the outer and inner loop. During soft handover, the fact that DPDCH and DPCCH perceive a diversity effect is considered in the inner and outer loop power control. The information on DPDCH concerning outer loop power control is terminated in RNC. HS-

DPCCH is terminated in Node B serving an entity of user equipment for consideration. Consequently, according to prior art it is power controlled as if it would enjoy a diversity effect of multiple communications links corresponding to DPCCH or DPDCH when in soft handover, when it actually perceives no diversity gain, since it communicates over a single communications link. During soft handover there is consequently a great risk that channel quality of HS-DPCCH seriously degrade, which jeopardizes both ARQ feedback and CQI information to the HS (high speed) scheduling entity and there is a great risk that no feedback information reaches Node B for downlink scheduling and ARQ acknowledgments, which risks to deteriorate downlink performance substantially.

An active set of a connection including an entity of user equipment comprises all radio base stations, RBSes, involved in the connection, whereas a radio link set is a set of one or more Radio Links that has a common generation of TPC commands in the DL. Often the Active Set and the Radio Link Set are identical. In softer handover they are not. In softer handover there are a plurality of radio links of one single radio base station.

Figure 4 illustrates an active set comprising three radio links involving user equipment «UE» and three radio base stations «BS 2», «BS 3», «BS 4» during a soft handover. The radio base stations are controlled by different radio network controllers «SRNC» «DRNC» over Iub interfaces. The serving RNC «SRNC» is the RNC responsible for interconnecting to a core network over an Iu interface. The drift RNC «DRNC» assists the SRNC during the soft handover as it controls two of the base stations «BS 3», «BS 4» involved. The RNCs «SRNC», «DRNC» are interconnected over an Iur interface.

According to a first embodiment of the invention, for a connection the discriminating number of diversity branches for ADCH/DPCCH/DPDCH and HS-DPCCH is considered when determining gain factor β_{hs}, and β_{hs} is updated whenever there is an increase in number of links in the active set or radio link set of the connection. When updating β_{hs}, this is preferably made by increasing the constant power offset for the HS-DPCCH during the time at which the DPDCH relies on gains from macro-diversity.

According to a second embodiment of the invention, repetition factors for HS-DPCCH transmissions (CQI and ACK-NACK repetition factors) are updated. Of course, increased repetition factors implies increased load of control signaling. Preferably the repetition factors are not updated until uplink performance has deteriorated below a threshold. The uplink performance degradation is preferably detected from number of repeated transmission failures and retransmissions in the base station/Node B. Either common or disjoint one or more triggers are used for updating of different repetition factors.

The repetition factors may interfere with CQI feedback cycle (the frequency with which a UE reports CQI). Therefore the repetition factor updating is preferably coordinated with the CQI feedback cycle according to the invention.

According to the first embodiment of the invention, parameters for ADCH are signaled to RBS in Radio Link Reconfiguration and Radio Bearer Setup messages in the radio bearer setup procedure. Parameters related to CQI, such as Δ_{CQI}, CQI repetition factor and CQI feedback cycle, are signaled to UE in *downlink HS-PDSCH information* message as *Measurement Feedback info*. Parameters related to ACK/NACK, such as Δ_{ACK}, Δ_{NACK} and ACK-NACK repetition factor, are included as *Uplink DPCH power control info fields.*

There are two modes of signaling according to the invention. The first mode adopts a synchronized procedure for parameter updating, and the second an unsynchronized procedure. According to the invention, a particular mode is preferably selected conditionally depending on the particular parameters.

The first mode is required when CQI repetition factor, CQI feedback cycle or ACK-NACK repetition factors are to be changed, whereas both modes are applicable for changing of power offsets. Preferably, parameter updating according to the second embodiment triggered from RBS will be signaled according to the first mode of signaling and parameter updating according to the first embodiment related to radio link set size updates will be signaled according to the second mode of signaling.

Figure 6 depicts signaling triggered by RBS according to the first mode. Parameter update, e.g. of CQI repetition factor, CQI feedback cycle and ACK-NACK repetition factor are triggered by radio base station «RBS» by sending of an RL Parameter Update Indication «R1» to the controlling RNC. At RL Reconfiguration Prepare «R2» new values of repetition factors are sent to the RBS with the serving HS-DSCH connection. With RL Reconfiguration Ready signal «R3», new values are stored in RBS. Activation time, in terms of CFN (Connection Frame Number), is then calculated in RNC and sent to RBS «R4» in an RL Reconfiguration Commit signal. (Node B, RNC and UE uses CFN for DCH and Common Transport Channels frame transport references.) RNC sends «R5» the new one or more parameters, including activation time, in terms of CFN, to UE over RBS. At activation time «R6» the new parameters are in effect. A Physical Channel Reconfiguration Complete signal confirms/completes the physical channel reconfiguration.

Figure 7 monitors signaling triggered by RNC according to the second mode. Subsequent to triggering «C1» of updating of one or more transmission power control related parameters Δ_{ACK}, Δ_{NACK} and Δ_{CQI}, new parameters are sent to UE over RBS in Physical Channel Reconfiguration signaling «C2». UE confirms reception and parameter updating in Physical Channel Reconfiguration complete signaling.

According to the first mode, Node B initiates parameter update preferably when detecting particular CQI error patterns of received CQI, each non-reliable CQI being logged as a CQI error event, if at least one updated parameter (CQI repetition factor or ACK-NACK repetition factor) differs from the existing parameters. During soft handover or diversity combining, if CQI repetition factor is greater than 1 errors in CQI after combining of diversity branches is considered for logging, not errors in individual CQIs of the various diversity branches or repetitions of particular one or more CQIs. Preferred error patterns for triggering of HS-DPCCH parameter change are listed in table 1 together with preferred parameter settings. In the table *cqiErrors* refers to a predefined number of consecutive CQI error events, and *cqiErrorsAbsent* a predefined number of received consecutive one or more CQIs in absence of CQI error event.

Error Pattern	**CQI repetition factor, n_c**	**ACK-NACK repetition factor, n_a**	**CQI feedback cycle [ms]**
more than *cqiErrors* consecutive CQI error events	$Min\{4, n_{c\_prev}+1\}$	$Min\{4, n_{a\_prev}+1\}$	>2·*CQI repetition factor**
at least *cqiErrorsAbsent* consecutive CQI arrivals in absence of CQI error events	$Min\{1, n_{c\_prev}-1\}$	$Min\{1, n_{a\_prev}-1\}$	no change

Table 1

---

* repetition factor - feedback cycle consistency check

n_{c_prev} and n_{a_prev} in table 1 refer to the (existing) CQI repetition factor the (existing) ACK-NACK repetition factor, respectively, applied when the parameter update was triggered by a detected error pattern in the first column of table 1. If there are more than *cqiErrors* consecutive CQI error events and if n_c, the updated CQI repetition factor, differs from n_{c_prev}, the CQI feedback cycle is updated if a repetition factor - feedback cycle consistency check indicates a conflict of the updated CQI repetition factor and existing CQI feedback cycle. In case the consistency check indicates a conflict, CQI feedback cycle is increased. Preferably the updated CQI feedback cycle, measured in milliseconds, is set to 2 times the CQI repetition factor. Preferably there is no corresponding decrease of CQI feedback cycle when CQI repetition factor is decreased as a CQI repetition factor decrease will generally not cause any CQI feedback cycle consistency problem. The invention, however, does not exclude a corresponding decrease of CQI feedback cycle. The procedure is illustrated schematically in a flow chart in figure 8.

When the signaling message Radio Link Parameter Update Indication has been sent to the RNC, counters of number of continuous CQI error events and number of continuous error free CQI arrivals are reset. Subsequent to the reset of the counters, there is preferably an interrupt time duration during which the counters are not updated in order to provide some time for RNC to issue updates, without having to transmit several triggers. The interrupt time duration is controlled by a timer. Updating of the counters is preferably continued at expiry of the interrupt time duration or at a CFN specified for the update. The counters are preferably reset at HS-DSCH cell change, when the serving HS-DSCH cell is changed. Potential changes of ACK-NACK repetition factor is communicated with the entity scheduling the repetitions, facilitating future scheduling, as an increase of ACK-NACK repetition factor limits scheduling opportunities.

According to the second mode, new power-offset factors are applied if the number of radio link sets is changed. Preferably there are two different sets of power control related parameters (Δ_{ACK}, Δ_{NACK} and Δ_{CQI},) applied depending on the number of radio link sets. During softer handover of HS-DPCCH involving only one RBS, there is no need to trigger power offset factor update, since HS-DPCCH of different radio links are combined according to Maximum Ratio Combining.

In summary, the second mode of the invention does not require coordination between UE and Node B, but UE is updated and Node B can then be informed thereof unsynchronized, whereas the first mode of the invention requires coordination/synchronization of UE and Node B updates.

In this patent application acronyms such as UE, RBS, RNC, HSDPA, HS-DPCCH, HS-DPDCH, HS-DSCH, ADCH, are applied. However, the invention is not limited to systems with entities with these acronyms, but holds for all communications systems operating analogously.

The invention is not intended to be limited only to the embodiments described in detail above. Changes and modifications may be made without departing from the invention. It covers all modifications within the scope of the following claims.

CLAIMS

1. A method of wireless uplink transmission control characterized in that one or more transmission parameters of one or more wireless links not involved in soft handover is adjusted in relation to one or more wireless links involved in soft handover or coordination of such parameters.

2. The method according to claim 1 characterized in that one or more wireless links not involved in soft handover subject to adjustment of one or more transmission parameters carries high speed uplink packet data communications.

3. The method according to claim 2 characterized in that at least one of the one or more wireless links involved in soft handover carries uplink data communications transferred at lower speed than the high speed uplink packet data communications.

4. The method according to claim 1 characterized in that at least one of the one or more wireless links not involved in soft handover being subject to adjustment of one or more transmission parameters is an HS-DPCCH or HS-DPDCH of a WCDMA system.

5. The method according to claim 2 characterized in that at least one of the one or more wireless links involved in soft handover is a DPDCH or DPCCH of a WCDMA system.

6. The method according to any of claims 1-5 characterized in that at least one of one or more transmission parameters is a transmission power control parameter.

7. The method according to claim 6 c h a r a c t e r i z e d i n that at least one of one or more transmission power control parameters is a transmission power offset parameter.

8. The method according to of claim 7 c h a r a c t e r i z e d i n that the transmission power offset parameter indicates an offset between different uplink physical channels.

9. The method according to claim 7 c h a r a c t e r i z e d i n that the transmission power offset parameter update is initiated by a radio network controller.

10. The method according to of claim 7 c h a r a c t e r i z e d i n that transmission power offset parameter update is communicated according to an unsynchronized procedure.

11. The method according to claim 6 c h a r a c t e r i z e d i n that at least one of one or more transmission power control parameters is a gain factor parameter.

12. The method according to claim 11 c h a r a c t e r i z e d i n that the gain factor parameter is β_{hs}.

13. The method according to any of claims 1-5 c h a r a c t e r i z e d i n that at least one of one or more transmission parameters is one or more parameters of hybrid ARQ.

14. The method according to any of claims 1-5 c h a r a c t e r i z e d i n that at least one of one or more transmission parameters is a repetition factor parameter.

15. The method according to claim 14 c h a r a c t e r - i z e d i n that the repetition factor parameter is CQI repetition factor.

16. The method according to claim 14 c h a r a c t e r - i z e d i n that the repetition factor parameter is ACK-NACK repetition factor.

17. The method according to any of claims 1-5 c h a r - a c t e r i z e d i n that at least one of one or more transmission parameters is a CQI feedback cycle parameter.

18. The method according to any of claims 1-5 c h a r - a c t e r i z e d i n that updating of CQI repetition factor and ACK-NACK repetition factor are inititated by first predefined distinct numbers of received consecutive CQI arrivals in error, or second predefined distinct numbers of received consecutive CQI arrivals indicated to be error-free, the first and second predefined distinct numbers being distinct for updating of CQI repetition factor and ACK-NACK repetition factor.

19. The method according to any of claims 1-5 c h a r - a c t e r i z e d i n that updating of at least one of CQI repetition factor, ACK-NACK repetition factor and CQI feedback cycle is initiated if the base station either receives more than a first predefined number of consecutive CQI arrivals in error, or a second predefined number of consecutive CQI arrivals indicated to be error-free.

20. The method according to claim 19 c h a r a c t e r - i z e d i n that the second predefined number is greater than the first predefined number.

21. The method according to claim 19 c h a r a c t e r - i z e d i n that in case of the first predefined number of consecutive CQI arrivals are in error, CQI repetition

factor is increased unless the CQI repetition factor equals a maximum value CQI repetition factor.

22. The method according to claim 21 characterized in that the CQI repetition factor increase is an increase by one.

23. The method according to claim 21 characterized in that the maximum value CQI repetition factor equals four.

24. The method according to claim 19 characterized in that in case of the second predefined number of consecutive CQI arrivals are error-free, CQI repetition factor is decreased by one unless the CQI repetition factor equals a minimum value CQI repetition factor.

25. The method according to claim 24 characterized in that the minimum value CQI repetition factor equals 1.

26. The method according to claim 19 characterized in that in case of the first predefined number of consecutive CQI arrivals are in error, ACK-NACK repetition factor is increased by one unless the ACK-NACK repetition factor equals a maximum value ACK-NACK repetition factor.

27. The method according to claim 28 characterized in that the maximum value ACK-NACK repetition factor equals four.

28. The method according to claim 19 characterized in that in case of the second predefined number of consecutive CQI arrivals are error-free, ACK-NACK repetition factor is decreased by one unless the ACK-NACK repe-

tition factor equals a minimum value ACK-NACK repetition factor.

29. The method according to claim 28 characterized in that the minimum value ACK-NACK repetition factor equals 1.

30. The method according to claim 19 characterized in that in case of the first predefined number of consecutive CQI arrivals are in error, CQI feedback cycle factor is increased such that the resulting CQI feedback cycle factor is greater than a predefined time interval times CQI repetition factor.

31. The method according to claim 30 characterized in that the predefined time interval equals 2 milliseconds.

32. The method according to of claim 14, 17 or 19 characterized in that the transmission parameter update is initiated by a radio base station.

33. The method according to of claim 14, 17 or 19 characterized in that the transmission parameter update is communicated in a synchronized procedure.

34. An apparatus of wireless uplink transmission control characterized by communication means for communicating updating of one or more transmission parameters of one or more wireless links not involved in soft handover, the updating being adjusted in relation to one or more wireless links involved in soft handover or coordination of such parameters.

35. The apparatus according to claim 34 characterized in that the communications means are transmitting means.

36. The apparatus according to claim 34 c h a r a c - t e r i z e d i n that the communications means are receiving means.

37. The apparatus according to claim 34 c h a r a c - t e r i z e d b y processing means for initiating updating of one or more transmission parameters of one or more wireless links not involved in soft handover, the updating being adjusted in relation to wireless one or more links involved in soft handover or coordination of such parameters.

38. The apparatus according to claim 34 c h a r a c - t e r i z e d b y processing means for coordinating parameter updating in a first and a second apparatus.

39. The apparatus according to claim 38 c h a r a c - t e r i z e d i n that the first and second apparatuses are a base station and an entity of user equipment, respectively.

40. The apparatus according to claim 34 c h a r a c - t e r i z e d i n that one or more wireless links not involved in soft handover subject to adjustment of one or more transmission parameters carries high speed uplink packet data communications.

41. The apparatus according to claim 40 c h a r a c - t e r i z e d i n that at least one of the one or more wireless links involved in soft handover carries uplink data communications transferred at lower speed than the high speed uplink packet data communications.

42. The apparatus according to claim 34 c h a r a c - t e r i z e d i n that at least one of the one or more wireless links not involved in soft handover being subject

to adjustment of one or more transmission parameters is an HS-DPCCH or HS-DPDCH of a WCDMA system.

43. The apparatus according to claim 40 characterized in that at least one of the one or more wireless links involved in soft handover is a DPDCH or DPCCH of a WCDMA system.

44. The apparatus according to any of claims 34-43 characterized in that at least one of one or more transmission parameters is a transmission power control parameter.

45. The apparatus according to claim 44 characterized in that at least one of one or more transmission power control parameters is a transmission power offset parameter.

46. The apparatus according to of claim 45 characterized in that the transmission power offset parameter indicates an offset between different uplink physical channels.

47. The apparatus according to claim 45 characterized in that the transmission power offset parameter update is initiated by a radio network controller.

48. The apparatus according to of claim 45 characterized in that transmission power offset parameter update is communicated according to an unsynchronized procedure.

49. The apparatus according to claim 44 characterized in that at least one of one or more transmission power control parameters is a gain factor parameter.

50. The apparatus according to claim 49 characterized in that the gain factor parameter is β_{hs}.

51. The apparatus according to any of claims 34-43 characterized in that at least one of one or more transmission parameters is one or more parameters of hybrid ARQ.

52. The apparatus according to any of claims 34-43 characterized in that at least one of one or more transmission parameters is a repetition factor parameter.

53. The apparatus according to claim 52 characterized in that the repetition factor parameter is CQI repetition factor.

54. The apparatus according to claim 52 characterized in that the repetition factor parameter is ACK-NACK repetition factor.

55. The apparatus according to any of claims 34-43 characterized in that at least one of one or more transmission parameters is a CQI feedback cycle parameter.

56. The apparatus according to any of claims 34-43 characterized in processing means determining whether received CQI is considered error free or in error and in response thereupon increasing number of error-free CQI arrivals and resetting number of consecutive CQI arrivals in error, and increasing number of CQI arrivals in error and resetting number of consecutive CQI arrivals in error, respectively, and CQI processing means conditionally initiating updating of at least one of CQI repetition factor and ACK-NACK repetition factor if the base station either receives more than first predefined distinct numbers

of consecutive CQI arrivals in error, or second predefined distinct numbers of consecutive CQI arrivals indicated to be error-free, the first and second predefined distinct numbers being distinct for updating of CQI repetition factor and ACK-NACK repetition factor.

57. The apparatus according to any of claims 34-43 characterized in processing means determining whether received CQI is considered error free or in error and in response thereupon increasing number of error-free CQI arrivals and resetting number of consecutive CQI arrivals in error, and increasing number of CQI arrivals in error and resetting number of consecutive CQI arrivals in error, respectively, and CQI processing means conditionally initiating updating of at least one of CQI repetition factor, ACK-NACK repetition factor and CQI feedback cycle if the base station either receives more than a first predefined number of consecutive CQI arrivals in error, or a second predefined number of consecutive CQI arrivals indicated to be error-free.

58. The apparatus according to claim 57 characterized in that the second predefined number is greater than the first predefined number.

59. The apparatus according to claim 57 characterized in that in case of the first predefined number of consecutive CQI arrivals are in error, CQI repetition factor is increased unless the CQI repetition factor equals a maximum value CQI repetition factor.

60. The apparatus according to claim 59 characterized in that the CQI repetition factor increase is an increase by one.

61. The apparatus according to claim 59 c h a r a c - t e r i z e d i n that the maximum value CQI repetition factor equals four.

62. The apparatus according to claim 57 c h a r a c - t e r i z e d i n that in case of the second predefined number of consecutive CQI arrivals are error-free, CQI repetition factor is decreased by one, unless the CQI repetition factor equals a minimum value CQI repetition factor.

63. The apparatus according to claim 62 c h a r a c - t e r i z e d i n that the minimum value CQI repetition factor equals 1.

64. The apparatus according to claim 57 c h a r a c - t e r i z e d i n that in case of the first predefined number of consecutive CQI arrivals are in error, ACK-NACK repetition factor is increased by one unless the ACK-NACK repetition factor equals a maximum value ACK-NACK repetition factor.

65. The apparatus according to claim 64 c h a r a c - t e r i z e d i n that the maximum value ACK-NACK repetition factor equals four.

66. The apparatus according to claim 57 c h a r a c - t e r i z e d i n that in case of the second predefined number of consecutive CQI arrivals are error-free, ACK-NACK repetition factor is decreased by one unless the ACK-NACK repetition factor equals a minimum value ACK-NACK repetition factor.

67. The apparatus according to claim 66 c h a r a c - t e r i z e d i n that the minimum value ACK-NACK repetition factor equals 1.

68. The apparatus according to claim 57 c h a r a c - t e r i z e d i n that in case of the first predefined number of consecutive CQI arrivals are in error, CQI feedback cycle factor is increased such that the resulting CQI feedback cycle factor is greater than a predefined time interval times CQI repetition factor.

69. The apparatus according to claim 68 c h a r a c - t e r i z e d i n that the predefined time interval equals 2 milliseconds.

70. The apparatus according to any of claims 34-69 c h a r a c t e r i z e d i n that the apparatus is a radio network controller.

71. The apparatus according to any of claims 34-69 c h a r a c t e r i z e d i n that the apparatus is a radio base station.

72. The apparatus according to any of claims 34-69 c h a r a c t e r i z e d i n that the apparatus is a user equipment.

73. A communications system c h a r a c t e r i z e d b y processing and storage means arranged for carrying out the method in any of claims 1-33.

74. A communications system c h a r a c t e r i z e d b y the communications system comprising a plurality of apparatuses in any of claims 34-72.

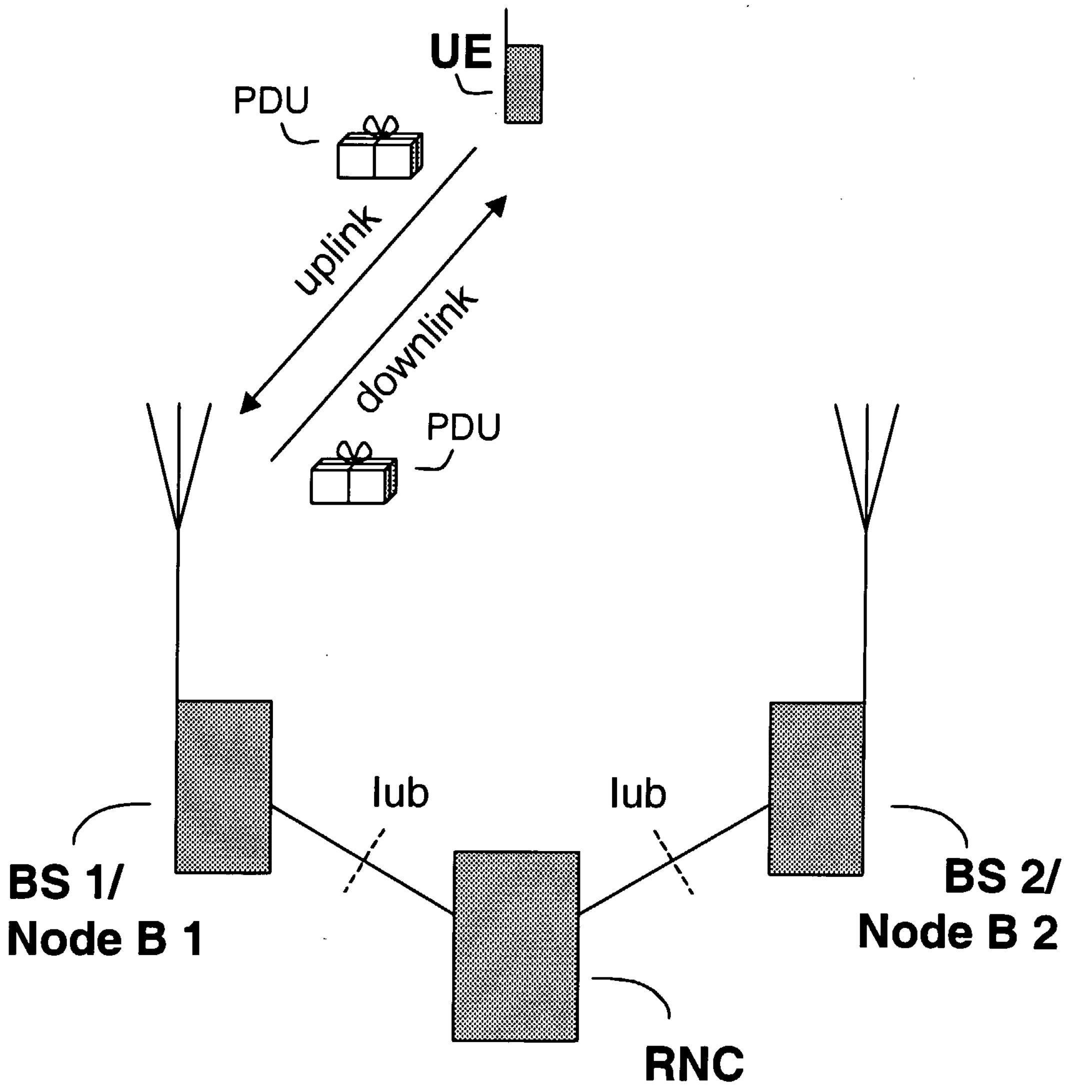


Fig. 1

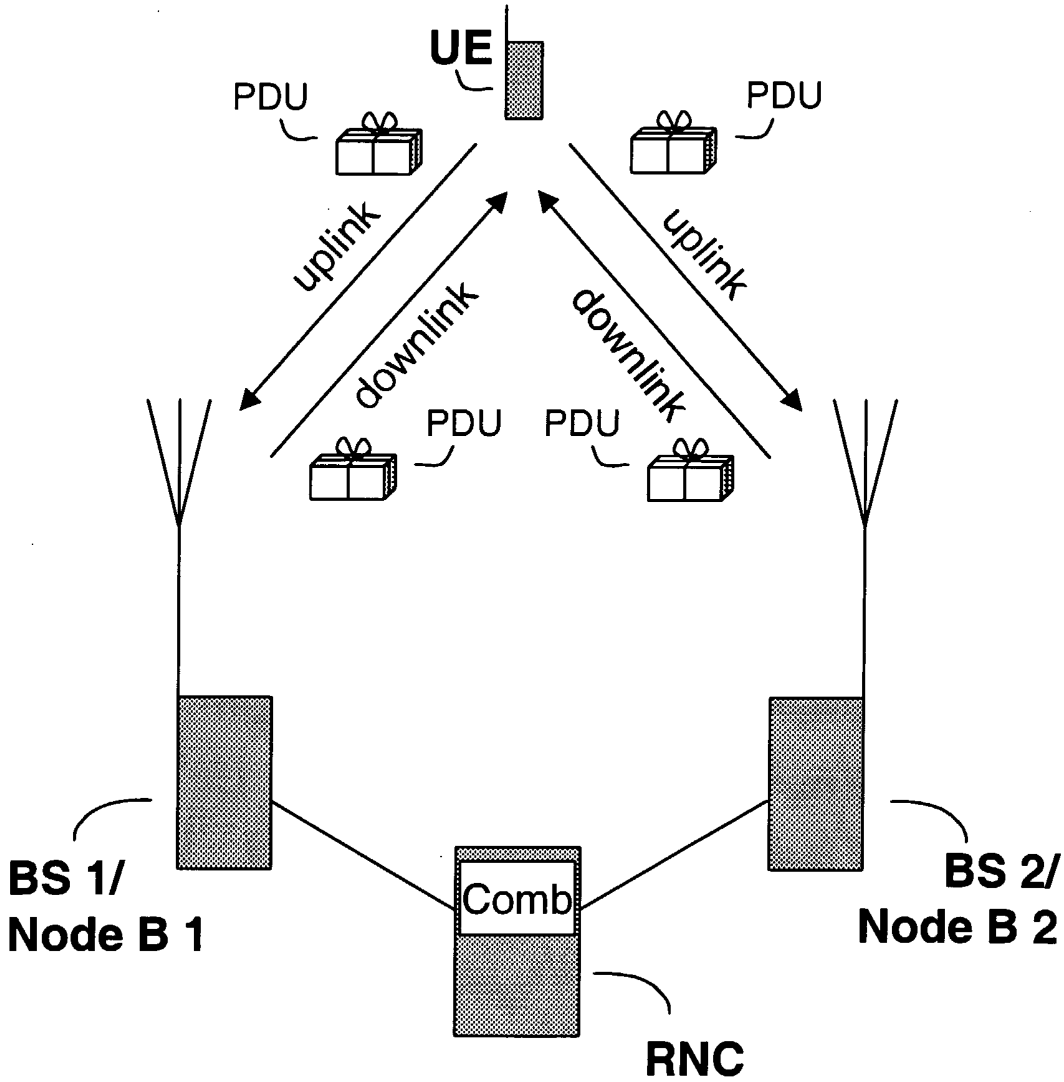

UE
PDU
PDU
uplink
uplink
downlink
downlink
PDU
PDU
BS 1/
Node B 1
Comb
BS 2/
Node B 2
RNC

Fig. 2

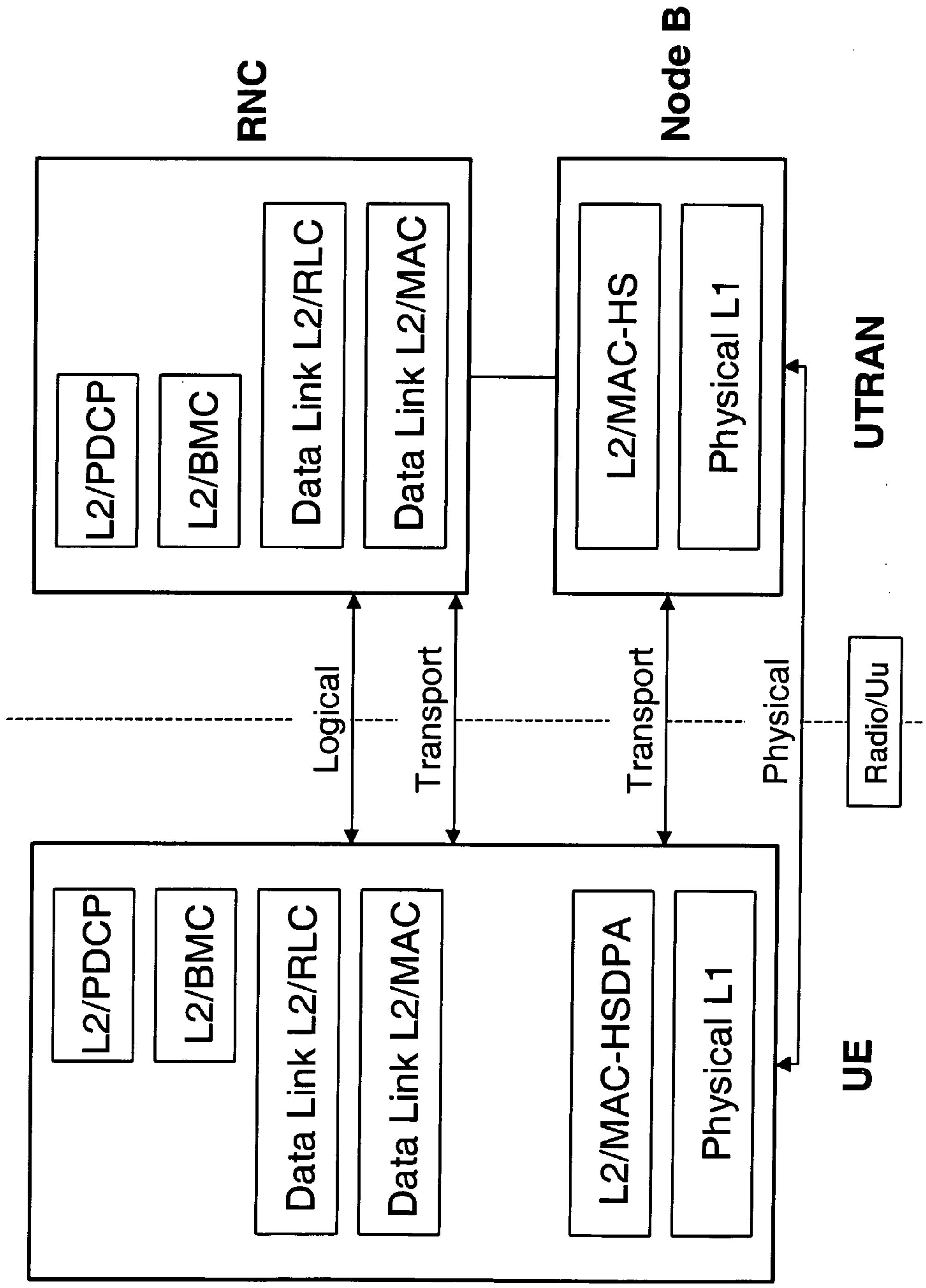

RNC
L2/PDCP
L2/BMC
Data Link L2/RLC
Data Link L2/MAC
Node B
L2/MAC-HS
Physical L1
UTRAN
Logical
Transport
Transport
Physical
Radio/Uu
UE
L2/PDCP
L2/BMC
Data Link L2/RLC
Data Link L2/MAC
L2/MAC-HSDPA
Physical L1

Fig. 3

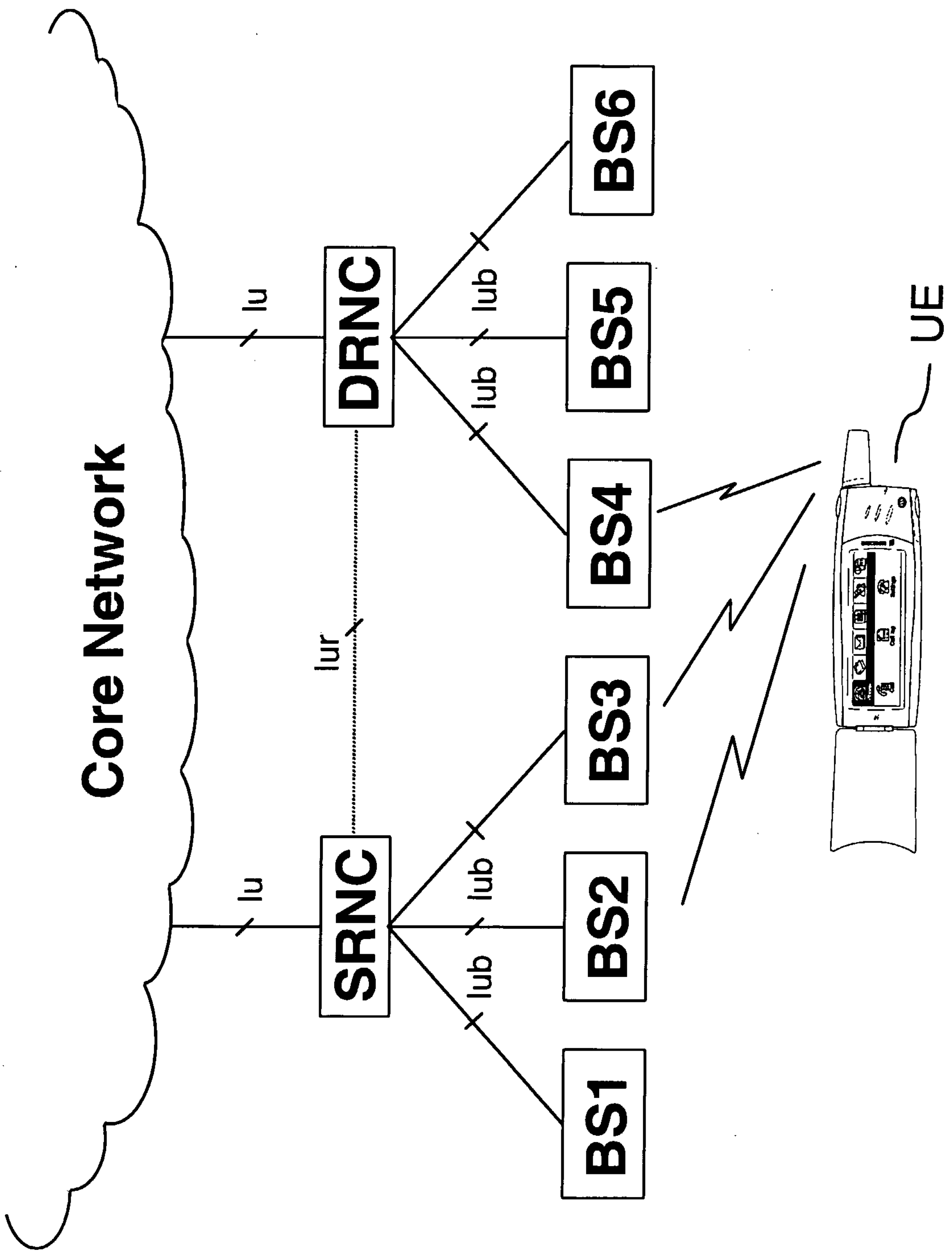

Core Network
Iu
Iu
SRNC
DRNC
Iur
Iub
Iub
Iub
Iub
Iub
Iub
BS1
BS2
BS3
BS4
BS5
BS6
UE

Fig. 4

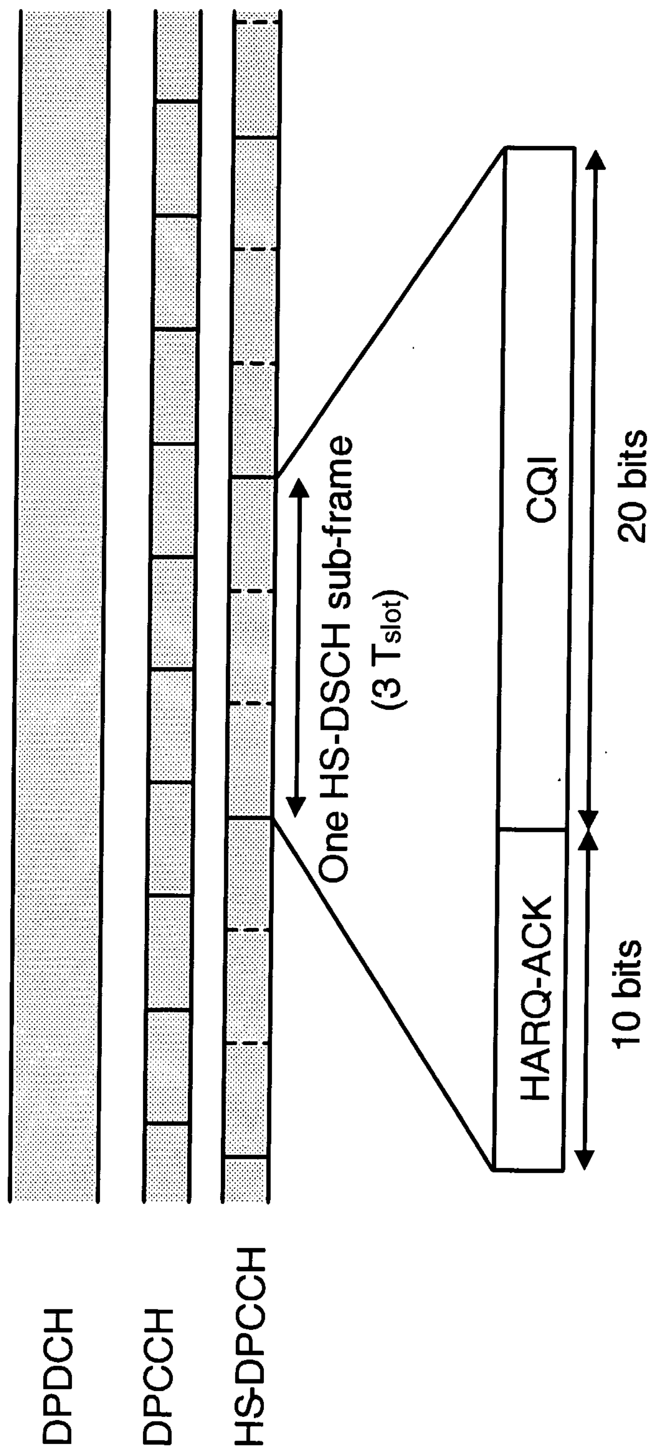

DPDCH
DPCCH
HS-DPCCH
One HS-DSCH sub-frame
(3 T_{slot})
HARQ-ACK
CQI
10 bits
20 bits

Fig. 5

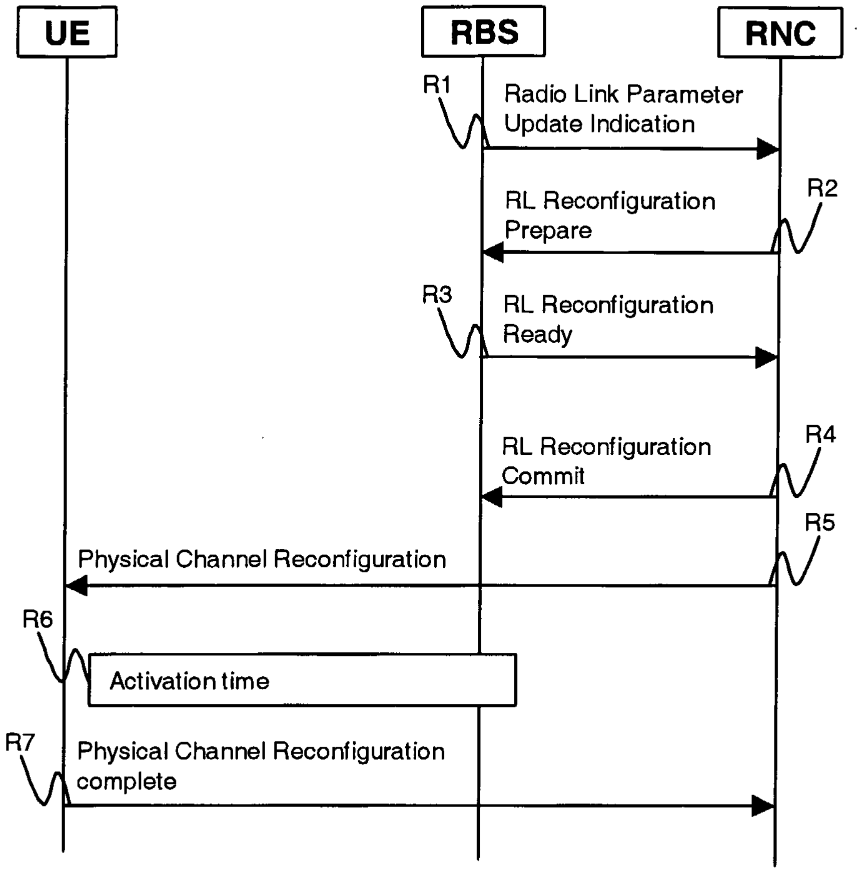

UE
RBS
RNC
R1
Radio Link Parameter Update Indication
R2
RL Reconfiguration Prepare
R3
RL Reconfiguration Ready
R4
RL Reconfiguration Commit
R5
Physical Channel Reconfiguration
R6
Activation time
R7
Physical Channel Reconfiguration complete

Fig. 6

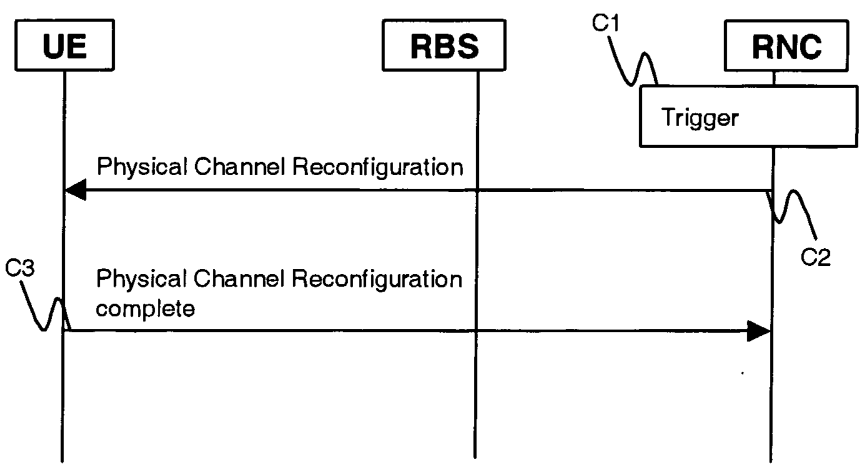

UE
RBS
C1
RNC
Trigger
Physical Channel Reconfiguration
C2
C3
Physical Channel Reconfiguration complete

Fig. 7

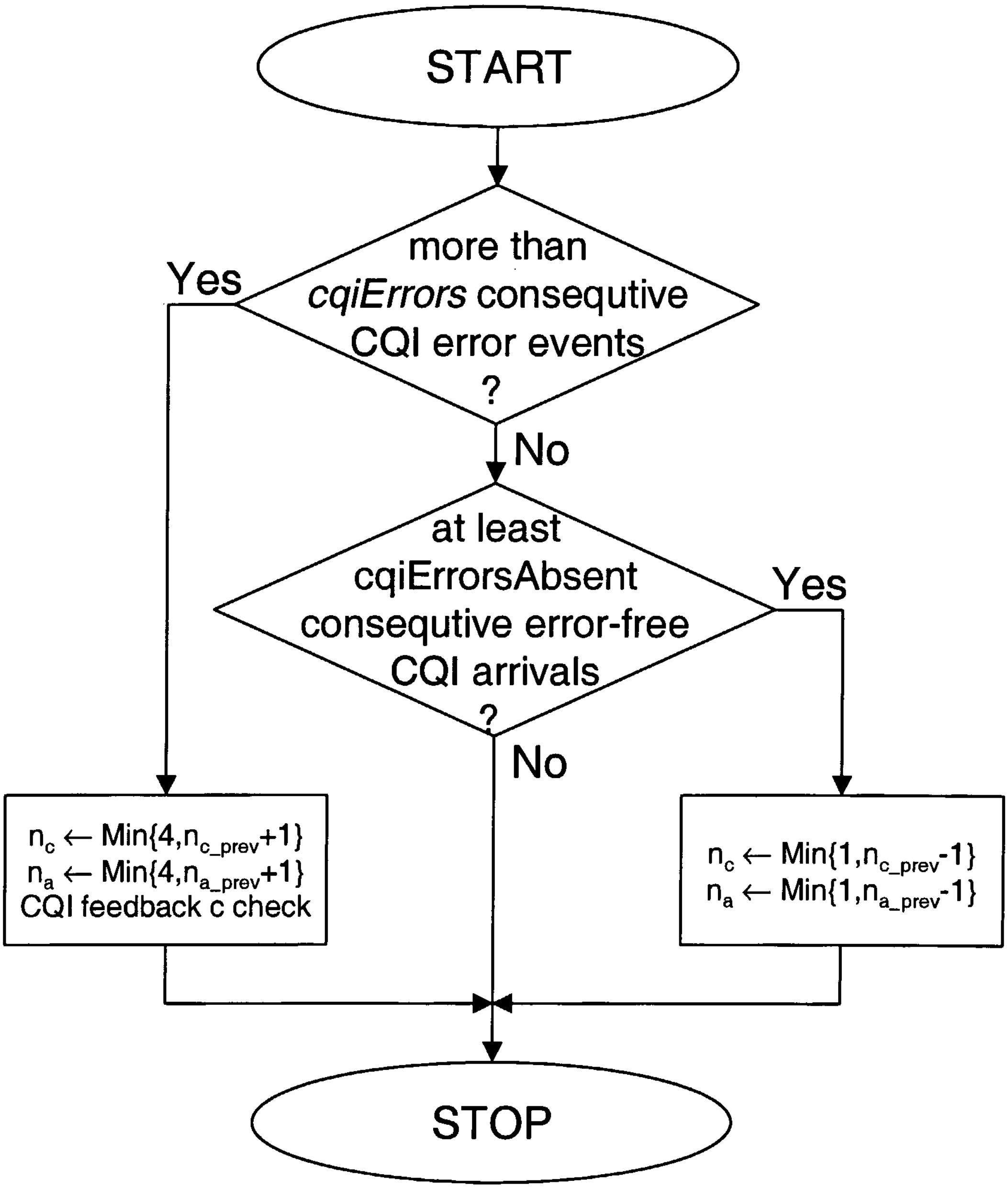

START
more than
cqiErrors consequtive
CQI error events
?
Yes
No
at least
cqiErrorsAbsent
consequtive error-free
CQI arrivals
?
Yes
No
n_c ← Min{4,n_c_prev+1}
n_a ← Min{4,n_a_prev+1}
CQI feedback c check
n_c ← Min{1,n_c_prev-1}
n_a ← Min{1,n_a_prev-1}
STOP

Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2004/002060

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04B 7/005, H04Q 7/38
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)

IPC7: 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, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	3GPP TS 25.433 V6.3.0: 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; UTRAN lub interface NBAP signalling (Release 6), September 2004, see section 8.3.19 --	1-74
A	EP 1341318 A2 (SAMSUNG ELECTRONICS CO., LTD), 3 Sept 2003 (03.09.2003), paragraphs 0028-0036 --	1-74
A	EP 1313334 A2 (LG ELECTRONICS INC.), 21 May 2003 (21.05.2003), paragraphs 0029-0056 --	1-74

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

* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "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)
- "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
- "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
- "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
- "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
- "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 Sept 2005	06-09-2005

Name and mailing address of the ISA/	Authorized officer
Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Fredrik Blomqvist /OGU Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2004/002060

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1313231 A1 (LG ELECTRONICS INC.), 21 May 2003 (21.05.2003), paragraphs 0015-0035	1-74
	--	

INTERNATIONAL SEARCH REPORT

Information on patent family members

08/07/2005

International application No.
PCT/SE 2004/002060

EP	1341318	A2	03/09/2003	AU	2003200543	A	00/00/0000
				CA	2419005	A	17/08/2003
				CN	1455607	A	12/11/2003
				JP	2003298509	A	17/10/2003
				US	20030232622	A	18/12/2003
EP	1313334	A2	21/05/2003	CN	1420696	A	28/05/2003
				CN	1420704	A	28/05/2003
				EP	1313231	A	21/05/2003
				JP	2003283424	A	03/10/2003
				JP	2003298508	A	17/10/2003
				KR	2003039850	A	22/05/2003
				US	20030112773	A	19/06/2003
				US	20030114181	A	19/06/2003
				WO	03043228	A	22/05/2003
				KR	2003041056	A	23/05/2003
EP	1313231	A1	21/05/2003	CN	1420696	A	28/05/2003
				CN	1420704	A	28/05/2003
				EP	1313334	A	21/05/2003
				JP	2003283424	A	03/10/2003
				JP	2003298508	A	17/10/2003
				KR	2003039850	A	22/05/2003
				US	20030112773	A	19/06/2003
				US	20030114181	A	19/06/2003
				WO	03043228	A	22/05/2003