TSG-RAN Working Group 2 (Radio layer 2 and Radio layer 3) *TSGR2#6(99)807*
Sophia Antipolis, August 16th to 20th 1999

Agenda Item: 9

Source: Ericsson

Title: **RRC protocol states**

Document for: Decision

1. Introduction

The number of RRC states in TS 25.303 is a result of the "principle" that more or less each valid transport channel combination becomes a separate state. To simplify the specification, it is desirable to reduce the number of states and also the number of levels of states (modes, states, substates etc). It is also proposed to move the states to TS 25.331.

The RRC states proposed in this contribution are a compromise of the following aspects:

- Which physical channels that are allocated to the UE, and thus which transport channels that can be used
- Which type of RRC connection mobility procedures that are used.
- The level of UE activity, e.g. whether it is known on cell or URA level and whether or not it uses DRX

We also propose to remove transient states as long as they can be hidden into the specification of the procedures.

2. RRC states

The figure below illustrates the RRC states and state transitions. Idle mode is not a state on the same level as the others.

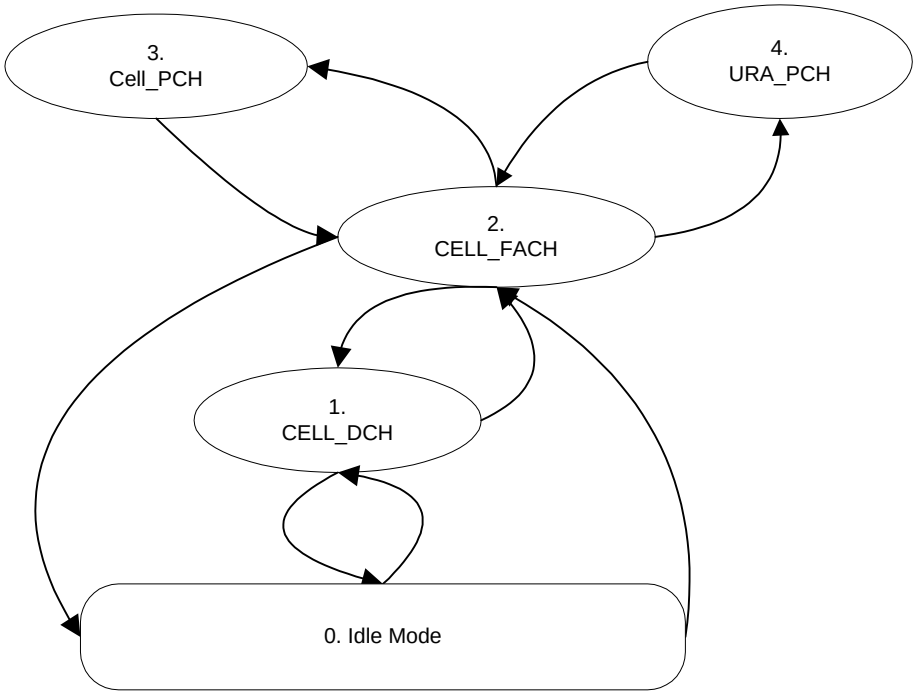


Figure 1. RRC states and state transitions (UTRA only)

A short specification of each RRC state in connected mode is given below.

2.1 CELL_DCH

The CELL_DCH state is characterised by:

- A dedicated physical channel is allocated to the UE in uplink and downlink.
- The UE is known on cell level according to its current active set.

In this state, the UE shall

- Use the connected mode measurement control information received in other states until new measurement control information has been assigned to the UE
- perform measurements and transmit measurement reports according to the measurement control information
- depending on UE capabilities, monitor the FACH to receive any broadcast messages
- monitor a DSCH in downlink for user data and signalling messages when instructed by UTRAN

2.2 CELL_FACH

The CELL_FACH state is characterised by:

- Neither an uplink nor a downlink dedicated physical channel is allocated to the UE.
- The UE the continuously monitors a FACH in the downlink
- The UE is assigned a default common or shared transport channel in the uplink (e.g. RACH) that it can use anytime according to the access procedure for that transport channel
- The UE is known on cell level according to the cell where the UE last made a cell update.

In this state, the UE shall

- Use C-RNTI assigned in the current cell as the UE identity on common transport channels unless when a new cell is selected
- monitor a FACH to receive signalling messages or user data addressed to the UE or any broadcast messages
- acquire system information on the BCH and use the common physical channel and transport channel configuration and measurement control information according to that system information when no UE dedicated common physical channel and transport channel configuration and measurement control information has been assigned to the UE
- by default, use RACH for transfer of signalling messages or user data in the uplink according to the random access procedure
- use transport channels of type CPCH or USCH (TDD only) for transfer of signalling messages or user data in the uplink accordong to the access procedures when instructed by the UTRAN
- perform cell reselection and upon selecting a new UTRA cell, initiate a cell update procedure
- upon selecting a new cell belonging to another radio access system than UTRA, enter idle mode and make an access to that system according to its specifications
- perform measurements and transmit measurement reports according to the measurement control information

2.3 CELL_PCH

The CELL_PCH state is characterised by:

- Neither an uplink nor a downlink dedicated physical channel is allocated to the UE
- The UE uses DRX for monitoring a PCH via an allocated PICH.
- No uplink activity is possible *[note: if the UE wants to make an uplink access it autonomously shall enter the CELL_FACH state]*.
- The UE is known on cell level according to the cell where the UE last made a cell update in CELL_FACH state.

In this state, the UE shall

- monitor the paging occasions according to the DRX cycle and receive paging information on the PCH
- acquire system information on the BCH and use the measurement control information according to that system information when no dedicated measurement control information has been assigned to the UE
- perform cell reselection and upon selecting a new UTRA cell, enter the CELL_FACH state and initiate a cell update procedure
- upon selecting a new cell belonging to another radio access system than UTRA, enter idle mode and make an access to that system according to its specifications
- perform measurements according to the measurement control information
- when needed according to the measurement control information, enter CELL_FACH state and transmit measurement reports

2.4 URA_PCH

The URA_PCH state is characterised by:

- Neither an uplink nor a downlink dedicated physical channel is allocated to the UE
- The UE uses DRX for monitoring a PCH via an allocated PICH.
- No uplink activity is possible *[note: if the UE wants to make an uplink access it autonomously enters the CELL_FACH state]*.
- The UE is known on URA level according to the URA assigned to the UE during the last URA update in CELL_FACH state.

In this state, the UE shall

- monitor the paging occasions according to the DRX cycle and receive paging information on the PCH
- acquire system information on the BCH and use the measurement control information according to that system information when no dedicated measurement control information has been assigned to the UE
- perform cell reselection and upon selecting a new UTRA cell that does not match the URA assigned to the UE, enter the CELL_FACH state and initiate a URA update procedure
- upon selecting a new cell belonging to another radio access system than UTRA, enter idle mode and make an access to that system according to its specifications (FFS)
- perform measurements according to the measurement control information

- when needed according to the measurement control information, enter CELL_FACH state and transmit measurement reports

2.5 Mobility procedures and channel combinations

The table below summarizes the mobility procedures, physical channels, transport channels and logical channels for each RRC state. Idle mode is also included for completeness.

For the **physical channels**, a subset of those available in a given state may be used by a UE, depending on demands and the UE capability. For each **transport channel**, possibility to use it depends on whether the physical channel related to it is available. Also, transport channels that are not possible to use in a given state, may be allocated to the UE, for usage in other states when physical channels supporting those are available.

State	Mobility procedures	Uplink			Downlink		
		Physical channels	Transport channels	Logical channels	Physical channels	Transport channels	Logical channels
0. Idle Mode	Cell selection & reselection	PRACH	RACH	CCCH	PCCPCH	BCH	BCCH
					AICH		
					SCCPCH PICH	PCH	PCCH
					SCCPCH	FACH	CTCH
1. CELL_DCH	Active set update Hard handover Inter-system handover	DPCCH DPDCH	DCH	DCCH DTCH	DPCH	DCH	DCCH DTCH
					PDSCH	DSCH	
					SCCPCH	FACH	BCCH CTCH
2. CELL_FACH	Cell selection & reselection Cell update	PRACH	RACH FAUSCH	CCCH DCCH DTCH	PCCPCH	BCH	BCCH
					AICH		
		PCPCH	CPCH		SCCPCH	FACH	CCCH DCCH DTCH CTCH
3. CELL_PCH	Cell selection & reselection Cell update				PCCPCH	BCH	BCCH
					SCCPCH PICH	PCH	PCCH
4. URA_PCH	Cell selection & reselection URA update				PCCPCH	BCH	BCCH
					SCCPCH PICH	PCH	PCCH

Note: “Cell selection and reselection” includes also re-selection of cells belonging to another system (such as GSM).

3. Proposal

It is proposed that the chapter 5 of 25.303 is moved, with the changes below, to TS 25.331, chapter 13 “Protocol states”.

13 Protocol states

~~The proposed state diagram has been based on a few key assumptions. The set of states shall be comprehensive enough in order to satisfy the range of QoS requirements from very fast packet access to optimum saving of the resources (Node B h/w, UE power, air interface capacity). A comprehensive set of states between the two extremes is required for optimization purposes.~~

~~2.1~~13.1 ~~UE~~ RRC States and State Transitions including GSM ~~(PSTN / ISDN only)~~

Figure 2 shows the ~~main UE~~ RRC states ~~(Cell Connected State and URA Connected State)~~ in Connected Mode, including transitions between UTRAN connected mode and GSM connected mode for PSTN/ISDN domain services, and between UTRAN connected mode and GSM/GPRS packet modes for IP domain services. It also shows the transitions between Idle Mode and UTRAN Connected Mode and further the transitions ~~between Cell Connected and URA Connected States~~within UTRAN connected Mode.

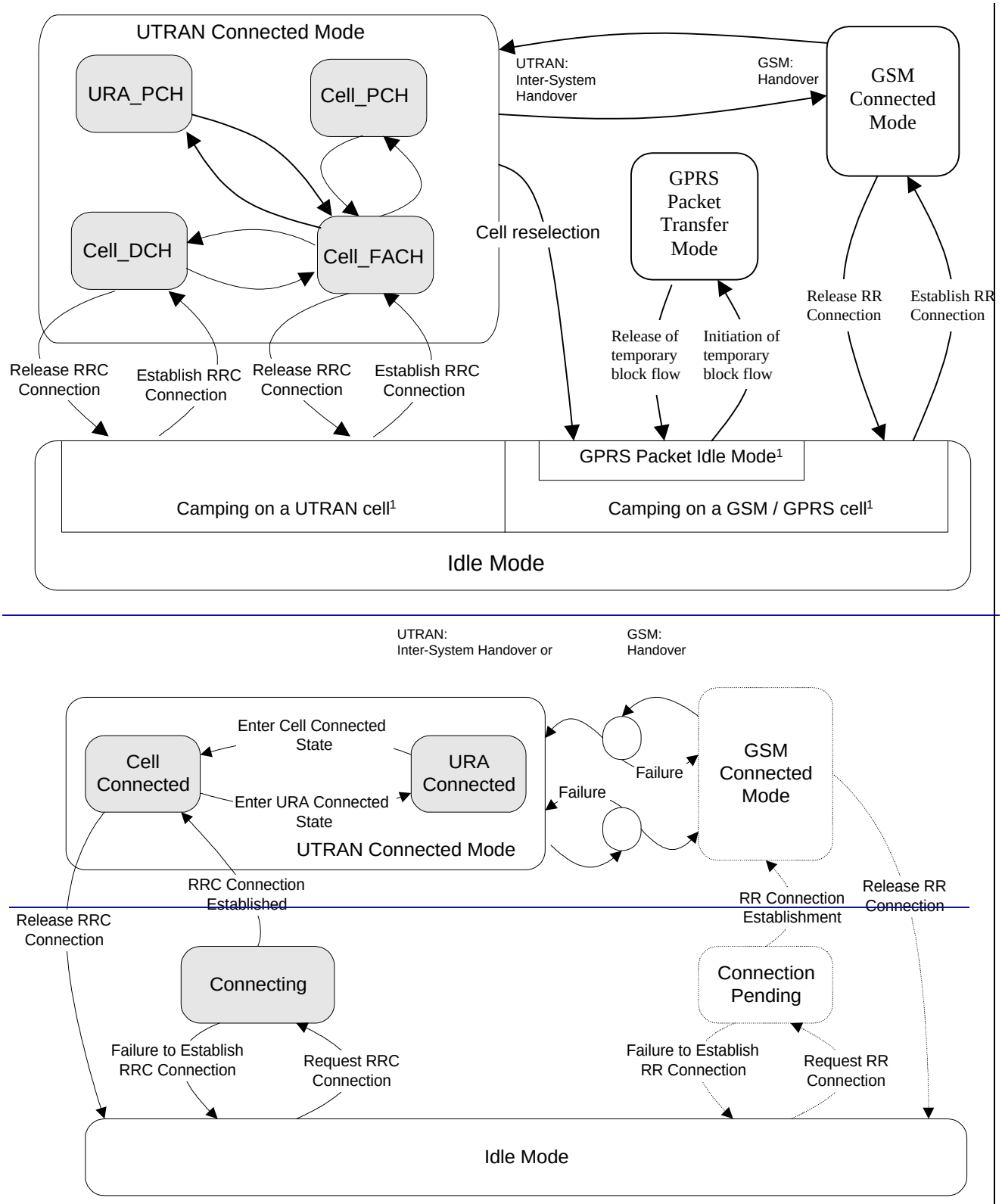


Figure 2: ~~UE~~ RRC States and State Transitions including GSM ~~(PSTN/ISDN only)~~

[[1]: The indicated division within Idle Mode is only included for clarification and shall not be interpreted as states.]

It shall be noted that not all states may be applicable for all UE connections. For a given QoS requirement on the UE connection, only a subset of the states may be relevant.

After power on, the UE stays in Idle Mode until it transmits a request to establish an RRC Connection. In Idle Mode the connection of the UE is closed on all layers of the UTRAN. In Idle Mode the UE is identified by non-access stratum identities such as IMSI, TMSI and P-TMSI. In addition, the UTRAN has no own information about the individual Idle Mode UE:s, and it can only address e.g. all UE:s in a cell or all UE:s ~~in a~~monitoring a paging ~~group~~occasion. The UE behaviour within this mode is described in /4/.

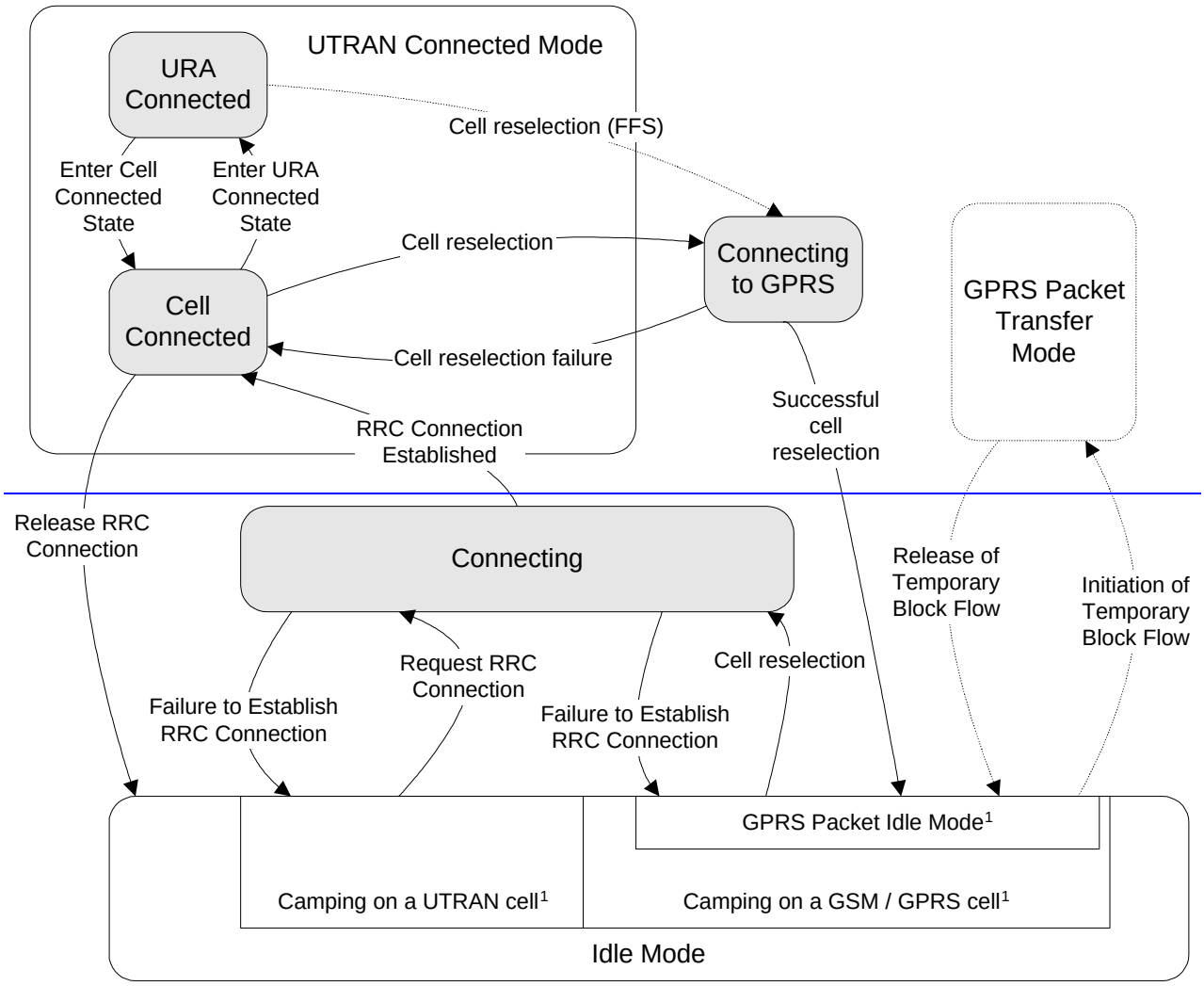
The UTRAN Connected Mode is entered when the RRC Connection is established. ~~This is done via the Connecting State.~~ The UE is assigned a radio network temporary identity (RNTI) to be used as UE identity on common transport channels. *[Note: The exact definition of RRC connection needs further refinement.]* The ~~main~~ RRC states within UTRAN Connected Mode reflect the level of UE connection and which transport channels that can be used by the UE.

For inactive stationary data users the UE may fall back to PCH ~~in~~ on both the Cell ~~Connected and~~ URA ~~Connected States~~levels. That is, upon the need for paging, the UTRAN shall check the current level of connection of the given UE, and decide whether the paging message shall be sent within the URA, or should it be sent via a specific cell.

~~The UE states indicated between UTRAN Connected Mode and GSM Connected Mode are transition states where the UE, in case of failure, has the possibility to re-establish the connection in the mode it originated from.~~

~~When using PSTN / ISDN domain services, UTRAN is using an Inter System Handover Procedure and GSM is using a Handover procedure for the transition from UTRAN Connected Mode to GSM Connected Mode.~~

~~5.2UE RRC States and State Transitions including GSM / GPRS (IP only)~~



~~Figure 3: UE RRC states and State Transitions including GSM/GPRS (IP only)~~

~~[1: The indicated "Radio access modes" in Idle Mode are only included for clarification and shall not be interpreted as states.]~~

~~The UE states "Connecting to GPRS" and "Connecting" indicated in figure 2 between UTRAN Connected Mode and Idle mode (GPRS Packet Idle Mode) are transition states where the UE, in case of failure, has the possibility to re-establish the connection in the mode it originated from.~~

~~When using IP domain services, The UE initiates cell reselection from GSM/GPRS to change from Idle Mode to "Connecting" state, from that state the UE is using the RRC Connection Establishment procedure for the transition from "Connecting" to Cell Connected state.~~

~~When the RRC Connection is established from Idle Mode (GPRS Packet Idle Mode) the RRC CONNECTION REQUEST message contains an indication, that UTRAN needs to continue an already established GPRS UE context from the CN. This indication allows UTRAN to e.g. prioritize the RRC CONNECTION REQUEST from the UE.~~

~~In Cell Connected or URA Connected (FFS) State UTRAN is using UE or Network initiated cell reselection to change from Cell Connected or URA Connected (FFS) state to "Connecting to GPRS" state. If the cell reselection was successful the UE enters Idle Mode (GPRS Packet Idle Mode). The UE sends a packet channel request from Idle Mode (GPRS Packet Idle mode) to establish a Temporary Block flow and enter GPRS Packet Transfer Mode. In the GPRS Packet Transfer Mode the UE sends a RA Update request message. The RA Update Request message sent from the UE contains an indication that GSM/GPRS need to continue an already established UTRAN UE context from the CN. This means that the RA Update request is always sent for the transition from UTRAN Connected Mode to GSM/GPRS regardless if the RA is changed or not.~~

[Note: The reason for using RA update instead of a new message is to reduce the impact on the existing GSM/GPRS specification.]

5.33.2 Transition from Idle Mode to Connecting StateUTRAN Connected Mode

The transition to the Connecting StateUTRAN Connected Mode from the Idle Mode can only be initiated by the UE by transmitting a request for an RRC Connection. The event is triggered either by a paging request from the network or by a request from upper layers in the UE.

3.4Connecting State

In the Connecting State (Figure 3) the UE has transmitted a request for an RRC connection and it waits for a response. No mobility procedures take place in this state.

In this state, the UE transmits on RACH transport channel in the uplink and receives the FACH transport channel in the downlink. Only the logical channel CCCH can be used, since no RNTI is assigned. Connecting state is shown in Figure 3.

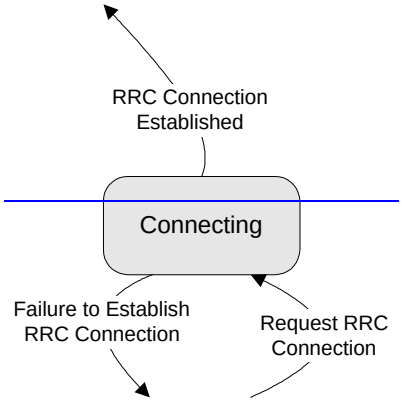


Figure 4: Connecting State

3.4.1Transition to Connected Mode

When the UE receives a message from the network that confirms the RRC connection establishment, the UE enters the cell connectedCELL_FACH or CELL_DCH state of UTRAN Connected Mode.

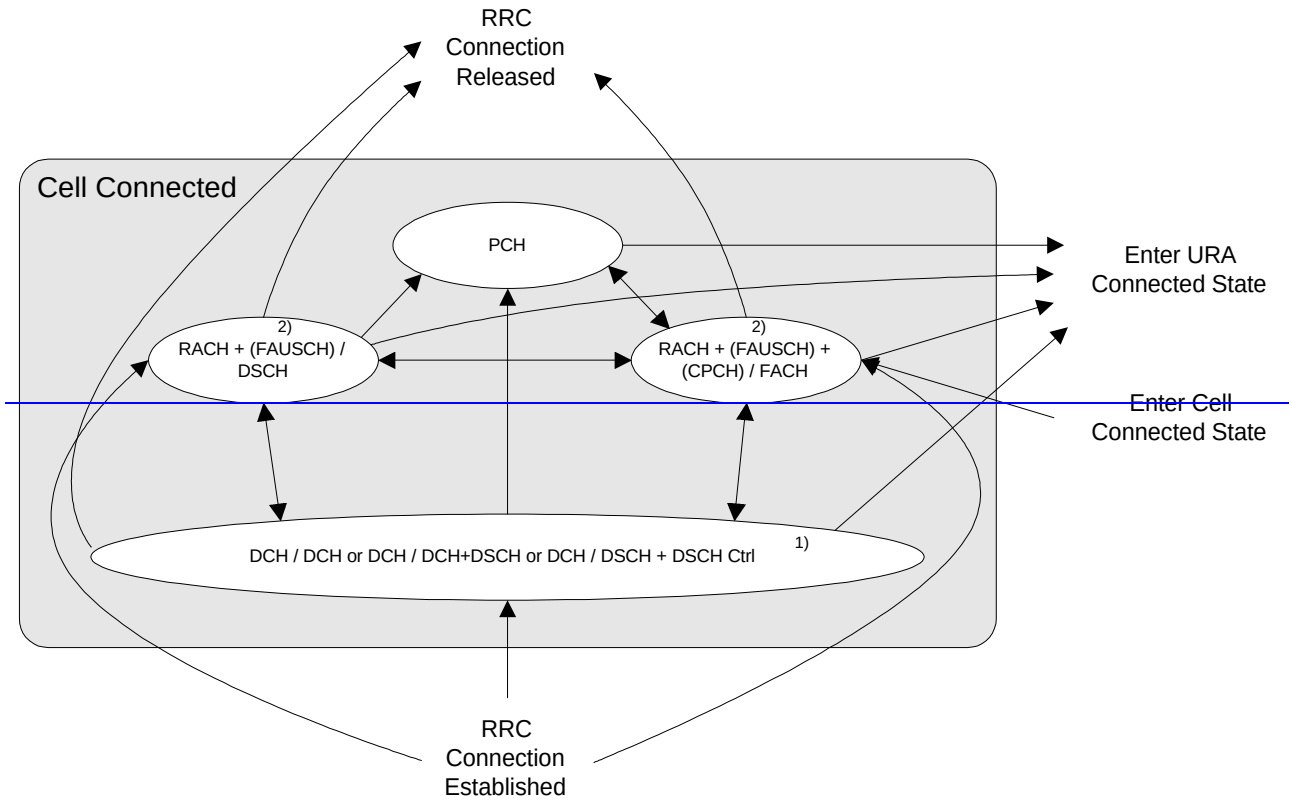
5.4.2Transition to Idle Mode

In the case of a failure to establish the RRC Connection the UE goes back to Idle Mode. Possible causes are radio link failure, a received reject response from the network or lack of response from the network (timeout).

5.53.3 UTRAN Connected Mode States and Transitions

2.5.1Cell Connected State

In this state, the position of the UE is known on cell level. The RRC Connection mobility is handled by handover procedures including soft handover, hard handover and cell updates. Both uplink and downlink data transfer is possible.



~~Figure 5: Substates within Cell Connected State~~

~~[1): Inclusion of the DCH / DSCH + DSCH Ctrl substate is based on the assumption that DSCH Ctrl contains power control bits. If these PC bits don't exist, this substate is not needed.]~~

~~[1): The channels shown in parenthesis (FAUSCH and CPCH) are available in these substates after allocation to the UE.]~~

~~5.5.1.13~~3.3.1 ~~DCH / DCH, DCH / DCH + DSCH and DCH / DSCH + DSCH Ctrl substates~~CELL_DCH state

~~These substates~~ The CELL_DCH state is ~~are~~ characterized by

- A dedicated physical channel is allocated to the UE in uplink and downlink.
- The UE is known on cell level according to its current active set.
- ~~the allocation of a d~~Dedicated transport channels can be used ~~to~~ by the UE.

The CELL_DCH ~~-states are~~ is entered from the ~~Connecting State~~Idle Mode through the setup of an RRC connection, or by establishing a dedicated channel (DCH) from the ~~RACH / FACH, RACH + FAUSCH / FACH, RACH + FAUSCH / DSCH or RACH / DSCH substates~~CELL_FACH state.

A PDSCH may be assigned to the UE in this state, to be used for a DSCH.

These ~~substates~~ CELL_DCH state is ~~are~~ further divided depending on the type of information that is allowed to be transmitted on the dedicated channel(s) and the downlink shared channel. The substates are shown in Figure 6.

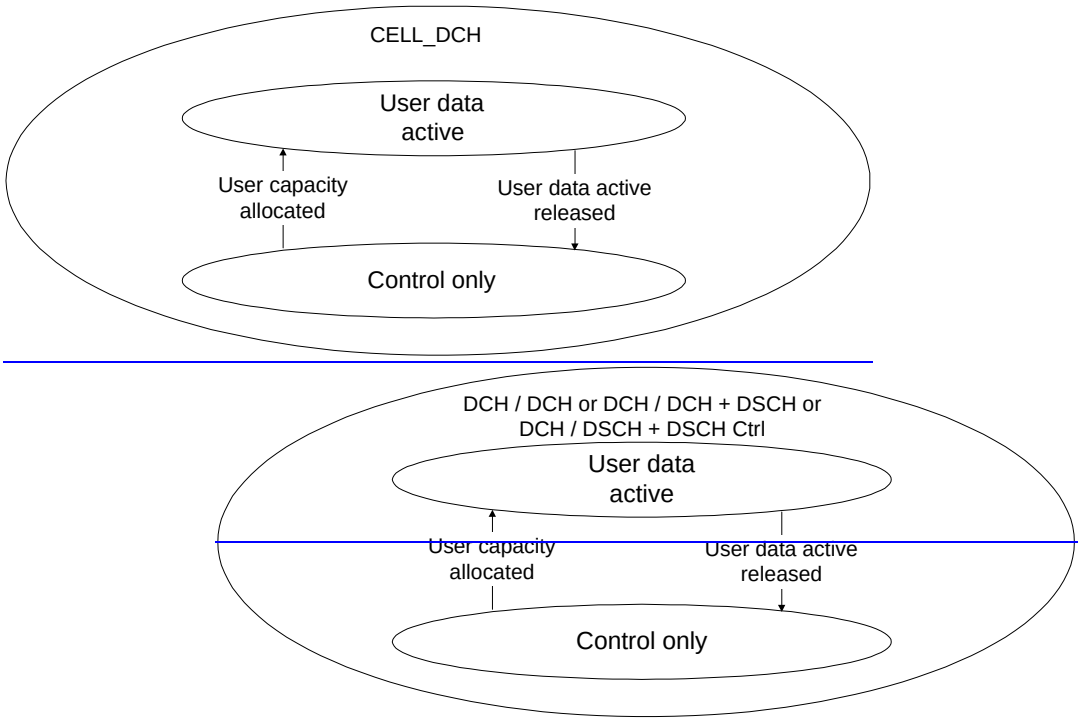


Figure 6: Substates in ~~DCH / DCH, DCH / DCH + DSCH and DCH / DSCH + DSCH Ctrl substates~~CELL_DCH state

~~2.5.1.1.1~~3.3.1.1 Control only substate

[Editor's note: The applicability of the control only substate to the TDD-mode is FFS.]

In Control only substate, the uplink and downlink DCHs are allocated, but no user data frames can be exchanged with the exception of data that uses the signalling connection e.g. SMS. Signalling in this substate includes link maintenance and higher layer signalling.

The Control only substate is provided to save air interface capacity and provide efficient packet transfer capacity allocation.

~~5.5.1.1.2~~3.3.1.2 User data active substate

In this substate UTRAN has allocated transmission resources for the UE and it may transmit data without a prior request up to the peak capacity that is currently granted to that UE.

~~In DCH/DCH+DSCH state s~~Some part or all of the DTCH resources can be allocated from the DSCH.

~~5.5.1.1.3Transition from DCH/DCH to DCH/DCH+DSCH substate~~

~~FFS.~~

~~5.5.1.1.4Transition from DCH/DCH+DSCH to DCH/DCH substate~~

~~FFS.~~

~~5.5.1.1.5Transition from DCH/DCH to DCH/DSCH+DSCH Ctrl substate~~

~~FFS.~~

~~5.5.1.1.6Transition from DCH/DSCH+DSCH Ctrl to DCH/DCH substate~~

~~FFS.~~

~~5.5.1.1.7~~3.3.1.3 Transition from ~~DCH/DCH or DCH/DCH+DSCH or DCH / DSCH + DSCH Ctrl~~CELL_DCH to Idle Mode

Transition to Idle Mode is realised through the release of the RRC connection.

~~5.5.1.1.8~~3.3.1.4 Transition from ~~DCH/DCH or DCH/DCH+DSCH~~CELL_DCH to ~~RACH / FACH sub~~CELL_FACH state

Transition to ~~RACH/~~CELL_FACH ~~sub~~state can occur either

a) through the expiration of an inactivity timer (T_{DCH}),

b) at the end of the time period for which the dedicated / shared channel was allocated or

c) via explicit signalling.

~~2.5.1.1.9Transition from DCH/DCH or DCH/DCH+DSCH to RACH+FAUSCH/FACH substate~~

~~Similar to 3.4.1.1.8, differences FFS.~~

~~5.5.1.1.10Transition from DCH/DCH or DCH/DCH+DSCH to RACH/DSCH or RACH+FAUSCH/DSCH substates~~

~~FFS.~~

~~5.5.1.1.11Transition from DCH/DCH or DCH/DCH+DSCH to PCH substate~~

~~FFS.~~

~~5.5.1.1.12Transition from DCH/DCH or DCH/DCH+DSCH to URA Connected state~~

~~FFS.~~

~~5.5.1.1.13~~3.3.1.5 Radio Resource Allocation tasks (~~DCH/DCH and DCH/DCH+DSCH~~CELL_DCH)

For the DCH, several physical channel allocation strategies may be applied. The allocations can be either permanent (needing a DCH release message) or based on time or amount-of-data.

Resource allocation can be done separately for each packet burst with fast signalling on the DCH. Transition out of the Control only state is either triggered by user capacity allocation or by timeout (no data transaction requests received within a specified time period).

For each radio frame the UE and the network indicate the current data rate (in uplink and downlink respectively) using the transport format combination indicator (TFCI). If the configured set of combinations (i.e. transport format set for one transport channel) are found to be insufficient to retain the QoS requirements for a transport channel, the network initiates a reconfiguration of the transport format set (TFS) for that transport channel. This reconfiguration can be done during or in between data transmission. Further, the network can reconfigure the physical channel allowing an increase or decrease of the peak data rate.

For the uplink data transmission, the UE reports the observed traffic volume to the network in order for the network to re-evaluate the current allocation of resources. This report contains e.g. the amount of data to be transmitted or the buffer status in the UE.

If during data transfer the UE is unable to transmit at the requested output power when using the peak allocated capacity, the UE shall reduce transmission rate within the current 10 ms radio frame in order to maintain the closed-loop power control.

~~5.5.1.1.14~~3.3.1.6 RRC Connection mobility tasks (~~DCH/DCH and DCH/DCH+DSCH~~CELL_DCH)

Depending on the amount and frequency of data macrodiversity (soft handover) may or may not be applied.

The RRC Connection mobility is handled by measurement reporting, soft handover and hard handover procedures.

~~1.1.1.1.1.1~~3.3.1.6.1 Localised Service Area (LSA) support

[Editor's note: A liaison statement to SMG12 has been sent to receive guidance on the functionalities that would need to be defined in UTRAN to support SoLSA-like (Support of LSA, GSM) services.]

In case of a network-controlled handover procedure, UTRAN shall take into account the local support of LSA service and the enventual subscription information of the UE to those LSA regarding the provision of service to the UE.

Regarding soft handover, the following principles are applied by UTRAN:

- For "LSA only" UE, the RRC connection shall be maintained by UTRAN as long as at least one cell of the active set belongs to a UE subscribed LSA.
- For "LSA exclusive access" cells, UTRAN shall prevent such cell from being part of the active set if the UE has not subscribed to the corresponding LSA

Regarding network controlled hard handover, the following principles are applied by UTRAN:

- For "LSA only" UE, UTRAN shall prevent the UE from being handed over a cell which does not belong to a UE subscribed LSA.
- For "LSA exclusive access" cells, UTRAN shall prevent the UE from being handed over such a cell if the UE has not subscribed to the corresponding LSA

3.3.1.7 UE Measurements (CELL_DCH)

The UE shall perform measurements and transmit measurement reports according to the measurement control information.

The UE shall use the connected mode measurement control information received in other states until new measurement control information has been assigned to the UE.

3.3.1.8 Transfer and update of system information (CELL_DCH)

UEs with certain capabilities shall read system information broadcast on FACH. *[Editors note: Currently it is only UEs having DRAC capabilities that need to read system information on FACH.]*

~~1.5.1.2~~3.3.2 CELL_FACH ~~RACH + (FAUSCH) + (CPCH) / FACH substates~~state

~~*[Note: Channels in parenthesis available after allocation.]*~~

The CELL_FACH state is characterised by:

- No dedicated physical channel is allocated to the UE.
- The UE the continuously monitors a FACH in the downlink
- The UE is assigned a default common or shared transport channel in the uplink (e.g. RACH) that it can use anytime according to the access procedure for that transport channel

- The position of the UE is known by UTRAN on cell level according to the cell where the UE last made a cell update.

In the ~~RACH /~~ CELL_FACH substate the UE shall perform~~s~~ the following actions:

- listens to an FACH
- listens to the BCH transport channel of the serving cell for the decoding of system information messages ~~(FFS)~~
- initiates a cell update procedure on cell change of another UTRA cell
- Use C-RNTI assigned in the current cell as the UE identity on common transport channels unless when a new cell is selected
- transmits uplink control signals and small data packets on the RACH.
- transmits uplink control signals and larger data packets on CPCH when resources are allocated to cell and UE is assigned use of those CPCH resources.

Furthermore, the UE ~~can~~ may use the FAUSCH to trigger the allocation of a new DCH by ~~RNC~~UTRAN. Further rate adaptation can be done via the DCCH of the new DCH.

~~1.1.1.1.1Transition from RACH/FACH to RACH+FAUSCH/FACH substate~~

~~FFS.~~

~~1.1.1.1.2Transition from RACH+FAUSCH/FACH to RACH/FACH substate~~

~~FFS.~~

~~1.1.1.1.3~~3.3.2.1 Transition from ~~RACH/~~CELL_FACH to CELL_DCH ~~/DCH or DCH/DCH+DSCH sub~~state~~s~~

A transition occurs, when a dedicated ~~transport~~ physical channel is established via explicit signalling. ~~Examples of these procedures are given in section **Error! Reference source not found.**~~

~~Details of the transition to DCH/DCH+DSCH FFS.~~

~~5.5.1.2.4Transition from RACH+FAUSCH/FACH to DCH/DCH or DCH/DCH+DSCH substates~~

The state transition ~~is~~ may also be done by using the FAUSCH.

~~5.5.1.2.5~~3.3.2.2 Transition from ~~RACH/~~CELL_FACH ~~or RACH+FAUSCH/FACH~~ to CELL_PCH ~~sub~~state

Since the UE performs continuous reception of FACH in this ~~sub~~state, it should be moved to the CELL_PCH ~~sub~~state if the data service has not been active for a while. When an inactivity timer (T_{rf}) expires, the UE state is changed to CELL_PCH in order to decrease power consumption. Also, when coming from CELL_PCH ~~sub~~state, and after the cell update procedure has been performed, the UE state is changed back to CELL_PCH ~~sub~~state if neither the UE nor the network has any data to transmit.

When coming from the ~~RACH+FAUSCH/~~CELL_FACH substate, the FAUSCH is still available in the CELL_PCH ~~sub~~state after the transition.

~~5.5.1.2.6~~3.3.2.3 Transition from ~~RACH/~~CELL_FACH ~~or RACH+FAUSCH/FACH~~ to Idle Mode

The release of the RRC connection moves the UE to the idle mode.

~~5.5.1.2.7Transition from RACH/FACH or RACH+FAUSCH/FACH to RACH / DSCH state~~

~~FFS.~~

~~5.5.1.2.8~~3.3.2.4 Transition from ~~RACH/~~CELL_FACH ~~or RACH+FAUSCH/FACH~~ to URA_PCH ~~Connected~~ State

To perform the URA update procedure, UE is moved temporarily from URA_PCH ~~Connected~~ to ~~RACH /~~CELL_FACH ~~or RACH + FAUSCH / FACH sub~~state. After the URA update is completed, UE state is changed back to URA_PCH~~Connected~~.

If FAUSCH is intended to be used in URA ~~Connected~~ _PCH State, a FAUSCH transport channel needs to be allocated for the intended cells in the URA prior to this transition.

~~5.5.1.2.9~~3.3.2.5 Radio Resource Allocation Tasks (~~RACH/~~CELL_FACH ~~and RACH+FAUSCH/FACH~~)

In the ~~RACH /~~CELL_FACH ~~sub~~state the UE will monitor an FACH. It is enabled to transmit uplink control signals and it may be able to transmit small data packets on the RACH. The network can assign the UE ~~s~~transport channel parameters (e.g. transport format sets) in advance, to be used when a DCH is used. When the physical channel for DCH is assigned, the ~~transport channel type~~UE state is changed to CELL_DCH ~~is switched to DCH~~ and the assigned TFS for the DCH can be used.

The UE shall use the common physical channel and transport channel configuration according to the system information when no UE dedicated common physical channel or transport channel channel configuration has been assigned.

For the uplink data transmission, the UE reports the observed traffic volume to the network in order for the network to re-evaluate the current allocation of resources. This report contains e.g. the amount of data to be transmitted or the buffer status in the UE.

~~When there is either user or control data to transmit, a selection procedure determines whether the data should be transmitted on a common transport channel, or if a dedicated transport channel should be allocated. The selection should be dynamic and depend on traffic parameters (amount of data, packet burst frequency).~~

~~5.5.1.2.10Radio Resource Allocation Tasks (RACH+CPCH/FACH)~~

The UTRAN can assign CPCH resources to the UE in ~~RACH/~~CELL_FACH ~~sub~~state. When CPCH resources are assigned, the UE will continue to monitor FACHs. The UE may use the RACH to transmit uplink control signals and small data packets. The UE also may choose to transmit data packets, larger than those carried on the RACH, on the CPCH channel. The UE selects either the RACH or one of the CPCH channels to make maximum use of the capacity available on that channel.

The UE provides the UTRAN with CPCH measurement data which includes data queue depth (current size of data buffers), average access time for each CPCH channel used, and average traffic volume on each CPCH channel used. With these measurands and the UTRAN MAC-d measurement reports, the UTRAN can reallocate network resources on a periodic basis. The UTRAN allocates CPCH Sets to each cell and assigns UEs to one of the cell's CPCH Sets. The UEs can dynamically access the CPCH resources without further UTRAN control.

~~5.5.1.2.11~~3.3.2.6 RRC Connection mobility tasks (~~RACH + (FAUSCH) + (CPCH) /~~CELL_FACH)

~~*[Note: Channels in parenthesis available after allocation.]*~~

In this ~~sub~~state the location of the UE is known on cell level. A cell update procedure is used to report to the UTRAN, when the UE selects a new cell to observe the common downlink channels of a new ~~Node B~~cell. ~~In this substate measurement reporting and hard handover procedures can be used.~~ Downlink data transmission on the FACH can be started without prior paging.

In ~~RACH /~~CELL_FACH ~~sub~~state an ~~RACH /~~CELL_FACH cell set comparable to the active set of a dedicated channel in SHO is maintained both in the UE and in the network. The ~~RACH /~~CELL_FACH cell set representes a list of cells which have the potential to serve the UE from radio signal strength perspective. The UE performs measurements and

reporting for the ~~RACH /~~CELL_FACH cell set using the same procedures as in ~~DCH/DCH+DSCH substates~~CELL_DCH state. The thresholds required for triggering a measurement report may be different from those in ~~DCH based substates~~CELL_DCH state.

The ~~RACH/~~CELL_FACH cell set information is used by the network to decide whether the user data can be routed directly via a cell to a specific UE or soft handover would be required when resuming the DCH operation. In addition, the ~~RACH/~~CELL_FACH cell set information provides the means for the network to evaluate potential interference conditions and select a suitable amount of capacity when moving the UE in the DCH active substate, for both uplink and downlink data transfer.

The UE monitors the broadcast channel and system information on BCCH of its own and neighbour cells and from this the need for the updating of cell location is identified.

The UE shall perform cell reselection and upon selecting a new UTRA cell, it shall initiate a cell update procedure. Upon selecting a new cell belonging to another radio access system than UTRA, the UE shall enter idle mode and make an access to that system according to its specifications.

3.3.2.7 UE Measurements (CELL_FACH)

The UE shall perform measurements and transmit measurement reports according to the measurement control information.

The UE shall use the measurement control information according to the system information when no UE dedicated measurement control information has been assigned.

~~1.1.1.1.12~~3.3.2.8 Transfer and update of system information (CELL_FACH)

The UE shall read the BCH to acquire valid system information. For each acquisition, the UE may need different combinations of system information broadcast on BCH. The scheduling on the broadcast channel is done in such way that the UE knows when the requested information can be found.

When the system information is modified, the scheduling information is updated to reflect the changes in system information transmitted on BCH. The new scheduling information is broadcast on FACH in order to inform UEs about the changes. If the changes are applicable for the UE, the modified system information is read on BCH.

~~5.5.1.3RACH/DSCH and RACH+FAUSCH/DSCH substates~~

~~FFS.~~

~~5.5.1.4~~3.3.3 CELL_PCH ~~sub~~state

The CELL_PCH state is characterised by:

- No dedicated physical channel is allocated to the UE
- The UE uses DRX for monitoring a PCH via an allocated PICH.
- No uplink activity is possible.
- The position of the UE is known by UTRAN on cell level according to the cell where the UE last made a cell update in CELL_FACH state.

In this ~~sub~~state the UE performs the following actions:

- ~~listens to the PCH transport channel for the decoding of paging and notification messages sent by the network~~monitor the paging occasions according to the DRX cycle and receive paging information on the PCH

- listens to the BCH transport channel of the serving cell for the decoding of system information messages

- initiates a cell update procedure on cell change.

The DCCH logical channel cannot be used in this substate. If the network wants to initiate any activity, it needs to make a paging request on the PCCH logical channel in the known cell to initiate any downlink activity.

5.5.1.4.13.3.3.1 Transition from CELL_PCH to URA Connected _PCH State

The only overhead in keeping a UE in the CELL_PCH substate is the potential possibility of cell updating, when the UE moves to other cells.

To reduce this overhead, the UE is moved to the URA Connected _PCH State when low activity is observed. This can be controlled with an inactivity timer, and optionally, with a counter, which counts the number of cell updates. When the number of cell updates has exceeded certain limits (a network parameter), then UTRAN orders the UE changes to the URA Connected _PCH State. This transition is made via the CELL_FACH state.

[Editor's note: If the coverage area of FAUSCH is expanded from one cell to several cells in the URA in relation to the execution of this transition, the new FAUSCH allocation information for each new cell in the URA needs to be exchanged either in RACH+FAUSCH/FACH the CELL_FACH or a CELL_DCH-based substate prior to a transition from CELL_PCH to URA connected _PCH state. For proper operation, this shouldn't be observed as increased activity.]

5.5.1.4.23.3.3.2 Transition from CELL_PCH to RACH/CELL_FACH substate

The UE is transferred to RACH/>CELL_FACH substate either by a command (packet paging) from UTRAN or through any uplink access.

5.5.1.4.3Transition from PCH to RACH+FAUSCH/FACH substate

If a valid FAUSCH transport channel is allocated for the current cell, the UE changes to RACH+FAUSCH/CELL_FACH substate as soon as it uses the FAUSCH to allocate a DCH.

5.5.1.4.4Transition from PCH to RACH/DSCH or RACH+FAUSCH/DSCH substates

FFS.

5.5.1.4.53.3.3.3 Radio Resource Allocation Tasks (CELL_PCH)

In CELL_PCH substate no resources have been granted for data transmission. For this purpose, a transition to another substate has to be executed.

The UE may use Discontinuous Reception (DRX) in order to reduce power consumption. When DRX is used the UE needs only to receive at one paging occasion per DRX cycle. The UE may be instructed to use a specific DRX cycle length by the network. The UE shall determine its paging occasions in the same way as for Idle Mode, see TS 25.304.

5.5.1.4.63.3.3.4 RRC Connection mobility tasks (CELL_PCH)

In the CELL_PCH substate, the UE mobility is performed through cell reselection procedures, which may differ from the one defined in S2.04TS 25.304.

The UE shall perform cell reselection and upon selecting a new UTRA cell, it shall Cell updating is initiated by the UE which, upon the detection of the new cell, moves to RACH/CELL_FACH substate and initiates a cell update procedure in the new cell. After the cell update procedure has been performed, the UE shall change its state is changed back to CELL_PCH substate if neither the UE nor the network has any more data to transmit.

Upon selecting a new cell belonging to another radio access system than UTRA, the UE shall enter idle mode and make an access to that system according to its specifications.

3.3.3.4.7 UE Measurements (CELL_PCH)

The UE shall perform measurements and transmit measurement reports according to the measurement control information.

The UE shall use the measurement control information according to the system information when no UE dedicated measurement control information has been assigned.

~~1.1.1.1.7~~3.3.3.4.8 Transfer and update of system information (CELL_PCH)

The UE shall read the BCH to acquire valid system information. For each acquisition, the UE may need different combinations of system information broadcast on BCH. The scheduling on the broadcast channel is done in such way that the UE knows when the requested information can be found.

~~5.5.2~~3.3.4 URA ~~Connected~~ _PCH State

The URA_PCH state is characterised by:

- Neither an uplink nor a downlink dedicated physical channel is allocated to the UE
- The UE uses DRX for monitoring a PCH via an allocated PICH.
- No uplink activity is possible
- ~~In URA Connected State () T~~the location of ~~a~~ the UE is known on UTRAN Registration area level according to the URA assigned to the UE during the last URA update in CELL_FACH state.

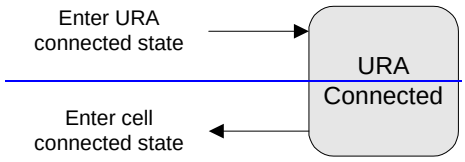
In this ~~sub~~state the UE performs the following actions:

- monitor the paging occasions according to the DRX cycle and receive paging information on the PCH
- ~~listens to the PCH transport channel for the decoding of paging and notification messages sent by the network~~
- listens to the BCH transport channel of the serving cell for the decoding of system information messages
- initiates a URA updating procedure on URA change.

The DCCH logical channel cannot be used in this ~~sub~~state. If the network wants to initiate any activity, it needs to make a paging request on the PCCH logical channel within the URA where the location of the UE is known. If the UE needs to transmit anything to the network, it goes to the ~~RACH/~~CELL_FACH ~~sub~~state ~~of the Cell Connected State~~. In addition, the UE can also use the FAUSCH for requesting a DCH in the whole URA or parts of it, if the UE has been allocated - on entering the connected mode or via explicit signalling later on - a FAUSCH channel for the cell, which the UE is currently camping on.

The transition to URA ~~Connected~~ _PCH State can be controlled with an inactivity timer, and optionally, with a counter which counts the number of cell updates. When the number of cell updates has exceeded certain limits (a network parameter), then the UE changes to the URA ~~Connected~~ _PCH State.

URA updating is initiated by the UE which, upon the detection of the Registration area, sends the network the Registration area update information on the RACH of the new cell.



~~Figure 7: URA Connected State~~

~~5.5.2.1~~3.3.4.1 Transition from URA ~~Connected~~ _PCH State to Cell ~~Connected~~ _FACH State

Any activity causes the UE to be transferred to ~~RACH / FACH or RACH + FAUSCH /~~CELL_FACH ~~substate of the Cell Connected~~ State. Uplink access is performed by either RACH or FAUSCH, if a FAUSCH transport channel for the current cell has been allocated.

Note that the release of an RRC connection is not possible in the URA ~~Connected~~ PCH State. The UE will first move to Cell ~~Connected~~ FACH State to perform the release signalling.

~~5.5.2.2~~3.3.4.2 Radio Resource Allocation Tasks (URA ~~Connected~~ PCH)

In URA ~~Connected~~ PCH State no resources have been granted for data transmission. For this purpose, a transition to ~~a suitable substate of~~ CellFACH ~~Connected~~ State has to be executed.

The UE may use Discontinuous Reception (DRX) in order to reduce power consumption. When DRX is used the UE needs only to receive at one paging occasion per DRX cycle. The UE may be instructed to use a specific DRX cycle length by the network. The UE shall determine its paging occasions in the same way as for Idle Mode, see TS 25.304.

~~5.5.2.3~~3.3.4.3 RRC Connection mobility tasks (URA ~~Connected~~ PCH)

In URA ~~Connected~~ PCH State the location of a UE is known on UTRAN Registration area level.

In this state, the UE mobility is performed through URA reselection procedures, which may differ from the definitions in S2.04. The UE shall perform cell reselection and upon selecting a ~~If the~~ new UTRA cell belong~~s~~ing to an ~~different~~ URA which does not match the URA used by the UE, the UE shall move~~s~~ to ~~RACH/~~CELL_FACH ~~substate of the cell connected~~ state and initiates a URA update towards the network. After the URA update procedure has been performed, the UE shall change its state ~~is changed~~ back to URA ~~connected~~ PCH state if neither the UE nor the network has any more data to transmit.

Upon selecting a new cell belonging to another radio access system than UTRA, the UE shall enter idle mode and make an access to that system according to its specifications (FFS).

3.3.4.4 UE Measurements

The UE shall perform measurements and transmit measurement reports according to the measurement control information.

The UE shall use the measurement control information according to the system information when no UE dedicated measurement control information has been assigned.

~~3.4.3.4~~3.3.4.5 Transfer and update of system information (URA_PCH)

The same mechanisms to transfer and update system information as for state CELL_PCH are applicable for UEs in URA_PCH state, see section 3.3.3.4.7.

3.4 Inter-system handover with PSTN/ISDN domain services

When using PSTN / ISDN domain services, UTRAN is using an Inter-System Handover Procedure and GSM is using a Handover procedure for the transition from UTRAN Connected Mode to GSM Connected Mode.

3.5 Inter-system handover with IP domain services

When using IP domain services, the UE initiates cell reselection from a GSM/GPRS cell to a UTRAN cell and then uses the RRC Connection Establishment procedure for the transition to UTRAN Connected mode.

When the RRC Connection is established from Idle Mode (GPRS Packet Idle Mode) the RRC CONNECTION REQUEST message contains an indication, that UTRAN needs to continue an already established GPRS UE context from the CN. This indication allows UTRAN to e.g. prioritize the RRC CONNECTION REQUEST from the UE.

In UTRAN connected mode UTRAN is using UE or network initiated cell reselection to change from a UTRAN cell to a GSM/GPRS cell. If the cell reselection was successful the UE enters Idle Mode (GPRS Packet Idle Mode). The UE sends a packet channel request from Idle Mode (GPRS Packet Idle mode) to establish a Temporary Block flow and enter GPRS Packet Transfer Mode. In the GPRS Packet Transfer Mode the UE sends a RA Update request message. The RA Update Request message sent from the UE contains an indication that GSM/GPRS need to continue an already established UTRAN UE context from the CN. This means that the RA Update request is always sent for the transition from UTRAN Connected Mode to GSM/GPRS regardless if the RA is changed or not.

[Note: The reason for using RA update instead of a new message is to reduce the impact on the existing GSM/GPRS specification.]

~~5.6~~3.6 Inter-system handover with simultaneous IP and PSTN/ISD~~G~~N domain services

[Note: This is an initial assumption that needs to be seen by SMG2 and requiring checking by SMG2, when the work on this item has progressed.]

~~2.6.1~~3.6.1 Inter-system handover UTRAN to GSM / BSS

For a UE in CELL ~~Connected~~ DCH state ~~on a dedicated channel~~ using both PSTN / ISDN and IP Domain services the Inter-system handover procedure is based on measurement reports from the UE but initiated from UTRAN.

The UE performs the Inter-system handover from UTRAN Connected Mode to GSM Connected Mode first. When the UE has sent handover complete message to GSM / BSS the UE initiates a temporary block flow towards GPRS and sends a RA update request.

If the Inter-system handover from UTRAN Connected Mode to GSM Connected Mode was successful the handover is considered as successful regardless if the UE was able to establish a temporary block flow or not towards GPRS.

In case of Inter-system handover failure the UE has the possibility to go back to UTRAN Connected Mode and re-establish the connection in the state it originated from without attempting to establish a temporary block flow. If the UE has the option to try to establish a temporary block flow towards GSM / GPRS after Inter-system handover failure is FFS.

~~5.6.2~~3.6.2 Inter-system handover GSM / BSS to UTRAN

For a UE in GSM Connected Mode using both PSTN / ISDN and IP domain services the Inter-system handover procedure is based on measurement reports from the UE but initiated from GSM / BSS.

The UE performs the Inter-system handover from GSM Connected Mode to UTRAN Connected Mode.

In UTRAN Connected Mode both services are established in parallel.

If the Inter-System handover from GSM Connected mode to UTRAN Connected Mode was successful the handover is considered as successful.

In case of Inter-system handover failure the UE has the possibility to go back to GSM Connected Mode and re-establish the connection in the state it originated from.