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–TDD, Physical Layer Procedures Description

Contents

1 Intellectual Property Rights

<ETSI text has been deleted. Text applicable to 3GPP has to be inserted>

2 Foreword

This document has been produced by 3 GPP organization.
It describes physical layer procedures for Physical Layer TDD mode.
ARIB text has been inserted with revision marks. In case a chapter is contained in ETSI and ARIB specifications, the chapter heading shows the origin and the ARIB text has been given the same number.
Furthermore, an editor's note has been added in <brackets> to differing section giving information on the differences. If the differences are more or less editorial, a recommendation for merging is given.

3 Scope

Document Status

The status of the chapters in this specification is as follows:
6.1 proposal
6.2 proposal
6.2.1 proposal
6.2.2 working assumption
6.3 working assumption
6.3.1 working assumption
6.3.2 working assumption
6.4 proposal
6.5 working assumption
6.6 working assumption

6.6.1 working assumptions
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6.7.3 working assumption

4 References

References may be made to:

a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply;
b) publications without mention of a specific version, in which case the latest version applies.

5 Definitions and abbreviations

<Editor's note: This section covers TDD relevant abbreviations only.>

BCCH	Broadcast Control Channel
BCH	Broadcast Channel
DCA	Dynamic Channel Allocation
FACH	Forward Access Channel
NRT	Non-Real Time
ODMA	Opportunity Division Multiple Access
TPC	Transmit Power Control
RACH	Random Access Channel
RT	Real Time
RU	Resource Unit
SCH	Synchronization Channel
UE	User Equipment
VBR	Variable Bit Rate

6 Physical layer procedures (TDD)

6.1 General

6.2 Synchronisation of NodeBs and ODMA Relays

6.2.1 Synchronisation of TDD NodeBs

<not explicitely covered by ARIB TDD spec., but also required for ARIB TDD in a similar way>

It is required that nodeB supporting the TDD mode are operated in synchronised mode, if the coverage areas of the cells are overlapping, i.e. we have contiguous coverage for a certain area. The nature of the TDD operation requires nodeB frame synchronisation, to achieve good spectral efficiency. The fact that UE and nodeB are receiving and transmitting on the same frequency makes it desirable, that in the reuse cell the same TX / RX timing is used.

The lack of a frame synchronisation could cause interference in several time slots, depending on the amount of time slip.

Frame synchronisation is used to minimise this effect. However, it will be necessary for a cost efficient solution to allow a certain amount of slip. The tolerance of the frame synchronisation shall be such, that the affected timeslots receive only a minor performance degradation. I.e. only some of the symbols shall be corrupted by the frame slip, rather than a full slot. Synchronisation on a chip level is not required.

6.2.2 Synchronisation of ODMA Relays

<not covered in ARIB TDD>

Due to the relatively short range of transmissions, the inclusion of ODMA does not impose any additional guard period or frame synchronisation requirements over those discussed above for standard TDD.

Any potential overlap caused by relay transmissions will be localised to a node and its neighbours by the ODMA protocol.

The inclusion of ODMA could relax the guard period requirements when relaying between nodes (not involving the BS) since neighbouring UEs are regarded as relay opportunities and any communications between neighbours (on an ODCH) could be synchronised further

6.3 Channel Allocation

<not covered in ARIB TDD>

For the UTRA-TDD mode a physical channel is characterised by a combination of its carrier frequency, time slot, and spreading code as explained in the chapter on the physical channel structure
Channel allocation covers both :

- resource allocation to cells (slow DCA)
- resource allocation to bearer services (fast DCA)

6.3.1 Resource allocation to cells (slow DCA)

<not covered in ARIB TDD>

Channel allocation to cells follows the rules below:

- A reuse one cluster is used in the frequency domain. In terms of an interference-free DCA strategy a timeslot-to-cell assignment is performed, resulting in a time slot clustering. A reuse one cluster in frequency domain does not need frequency planning. If there is more than one carrier available for a single operator also other frequency reuse patters >1 are possible.
- Any specific time slot within the TDD frame is available either for uplink or downlink transmission . UL/DL resources allocation is thus able to adapt itself to time varying asymmetric traffic.
- In order to accommodate the traffic load in the various cells the assignment of the timeslots (both UL and DL) to the cells is dynamically (on a coarse time scale) rearranged (slow DCA) taking into account that strongly interfering cells use different timeslots. Thus resources allocated to adjacent cells may also overlap depending on the interference situation.
- Due to idle periods between successive received and transmitted bursts, UEs can provide the network with interference measurements in time slots different from the one currently used. The availability of such information enables the operator to implement the DCA algorithm suited to the network.
- For instance, the prioritized assignment of time slots based on interference measurements results in a clustering in the time domain and in parallel takes into account the demands on locally different traffic loads within the network.

6.3.2 Resource allocation to bearer services (fast DCA)

<not covered in ARIB TDD>

Fast channel allocation refers to the allocation of one or multiple physical channels to any bearer service Resource units (RUs) are acquired (and released) according to a cell-related preference list derived from the slow DCA scheme.

1. The following principles hold for fast channel allocation:The basic RU used for channel allocation is one code / timeslot / (frequency).
2. Multirate services are achieved by pooling of resource units. This can be made both in the code domain (pooling of multiple codes within one timeslot = **multicode** operation) and time domain (pooling of multiple timeslots within one frame = **multislot** operation). Additionally, any combination of both is possible.
3. Since the maximal number of codes per time slot in UL/DL depends on several physical circumstances like , channel characteristics, environments, etc. (see description of physical layer) and whether additional techniques to further enhance capacity are applied (for example smart antennas),. the DCA algorithm has to be independent of this number. Additionally, time-hopping can be used to average inter-cell interference in case of low-medium bit rate users.
4. Channel allocation differentiates between RT and NRT bearer services:

  - RT services: Channels remain allocated for the whole duration the bearer service is established . The allocated resources may change because of a channel reallocation procedure (e.g. VBR).
  - NRT services: Channels are allocated for the period of the transmission of a dedicated data packet only UDD channel allocation is performed using ‘best effort strategy’, i.e. resources available for NRT services are distributed to all admitted NRT services with pending transmission requests. The number of channels allocated for any NRT service is variable and depends at least on the number of current available resources and the number of NRT services attempting for packet transmission simultaneously. Additionally, prioritisation of admitted NRT services is possible.

5. Channel reallocation procedures (intra-cell handover) can be triggered for many reasons:
   - To cope with varying interference conditions.
   - In case of high rate RT services (i.e. services requiring multiple resource units) a ‘channel reshuffling procedure’ is required to prevent a fragmentation of the allocated codes over to many timeslots. This is achieved by freeing the least loaded timeslots (timeslots with minimum used codes) by performing a channel reallocation procedure.
   - When using smart antennas, channel reallocation is useful to keep spatially separated the different users in the same timeslot.

6.3.3 Resource allocation for ODMA

<not covered in ARIB TDD>

<for further study>

6.4 Power Control (ETSI)

< editor’s note: the basic characteristics are the same for ETSI and ARIB. The description, however, is different and some section of ARIB TDD are for further study for ETSI TDD, like diversity handover>

Power control is applied for the TDD mode to limit the interference level within the system thus reducing the intercell interference level and to reduce the power consumption in the UE.

A slow C-level based power control scheme (similar to GSM) is mandatory for both up- and downlink. Open loop power control and the reference source for power measurements are under study. Power control is made, individually for each group of resource units (codes) in each slot which have a common TFCI, with the following characteristics:

Table -Error! Unknown switch argument.~~1~~**: TPC characteristics**

	Uplink	**Downlink**
Dynamic range	80 dB	30 dB
Power control rate	variable; 100-800 cycles / second	variable; 100-800 cycles / second
Step size	[0.25 ... 3] dB	[0.25 ... 3] dB
Remarks	A cycle rate of 100 means that every frame the power level is controlled	within one timeslot the powers of all active codes may be balanced to within a range of [20] dB

- All codes within one timeslot allocated to the same bearer service use the same transmission power.
- For RT services, in UL and DL a closed loop power control is used. UL open loop power control is under study
- For NRT services, both open loop power control and closed loop power control are used according to the UE state and the operators’ needs (similar to GPRS power control in GSM 03.64)
- The initial power value is based on the pathloss estimate to the serving BS
- In case of one user with simultaneous RT and NRT bearer service, the closed loop power control is used both for RT and NRT bearer service. However, depending on the current services different power levels are used.

Optional enhancements concerning power control for further study:

- Introduction of quality based power control

6.4.1 ODMA Power Control

<not covered in ARIB TDD>

<for further study>

6.4 Transmitter Power Control (ARIB 3.3.6.7)

<The text in the ARIB FDD section, which is referred to, is based on the specific physical structure and timing. It might not be applicable for other channel structures>

6.4.1 Reverse link Control (ARIB 3.3.6.7.1)

6.4.1.1 Common Physical Channel

Transmission power of perch channel and reverse link interference power are transmitted using BCCH. Mobile station decides transmission power of RACH by open loop power control based on the information and the signal power level of the Perch channel.

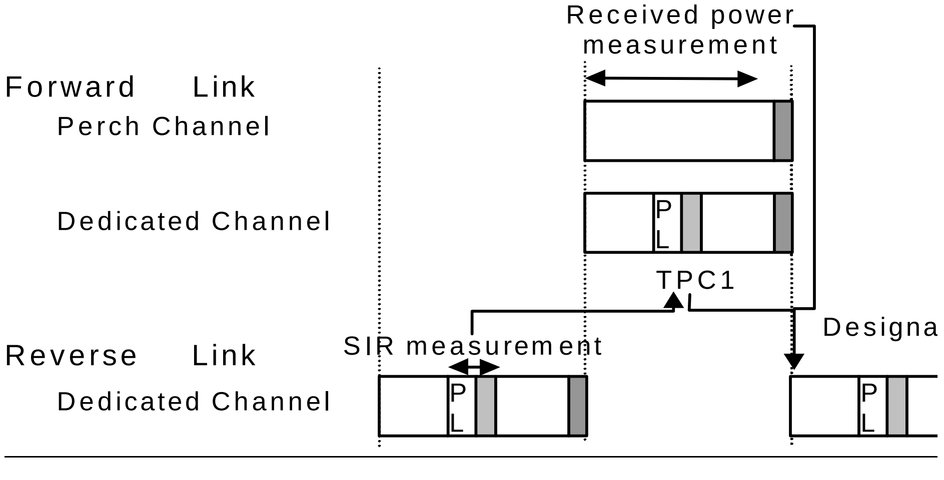
6.4.1.2 Dedicated Physical Channel

The initial transmission power is decided in a similar manner as RACH. After the synchronization between BTS and MS is established, MS transits into a combination scheme of open-loop and fast closed-loop transmitter power control (TPC). Fast closed-loop TPC is based on SIR, and the TPC processing procedures are the same as the FDD mode. During this power control process, the BTS periodically makes a comparison between the received SIR measurement value and the target SIR value. When the measured value is higher than the target SIR value, TPC bit = „0“. When this is lower than the target SIR value, TPC bit = „1“. The TPC bits shall be transmitted continuously to the MS. At the MS, soft decision on the TPC bits is performed, and when it is judged as „0“, the target received power at the BTS (P_{BTS}) shall be reduced by P_{TPC2}dB, whereas if it is judged as „1“, P_{BTS} shall be raised by P_{TPC2}dB. The MS measures the received signal power of the perch channel, which is code multiplexed with the dedicated channel, at the previous forward link time slot. After this, the transmitter power is decided by the combination of open-loop and closed-loop transmitter power control based on the equation below:

$T_{MS} = (P_{BTS} + P_{TPC2}) + (T_{BTS} - R_{MS})$
T_{MS}: Transmission power of MS
T_{BTS}: Transmitted signal power level of perch channel on BTS, which is broadcasted on BCH
P_{BTS}: Target received power on BTS
R_{MS}: Received power of Perch channel on MS

When the TPC bit cannot be received due to out-of-synchronization, T_{MS} shall be kept at a constant value. When SIR measurement cannot be performed for being out-of-synchronization, the TPC bit shall always be = „1“ during the period of being out-of-synchronization.
Fig.3.3.6-3 shows reverse link transmitter power control timing. The combination power control of open loop with 1-slot control delay and closed loop with 2-slots control delay can be realized.

Fig.3.3.6-3 Reverse link transmitter power control timing



6.4.1.2.1Outer Loop

This is the same as FDD mode.

6.4.1.2.2 Transmitter power control upon Inter-sector Diversity Handover

This is the same as FDD mode.

6.4.1.3 Transmitter power control upon Inter-cell Diversity Handover

(a)BTS operations

This is the same as FDD mode.

(b)MS operations

Receives the TPC bits independently in BTS units(inter-sector handover is performed). At the same time, measures the reliability of the TPC bits(received SIR) for each BTS. If there is even one „0“ among the soft decision majority result of TPC bits that satisfy the required reliability, the target received power on BTS(P_{BTS}) shall be reduced by P_{TPC}dB. If the TPC bits are all „1“, P_{BTS} shall be raised by P_{TPC}dB.

6.4.2 Forward link Control (ARIB 3.3.6.7.2)

6.4.2.1 Perch Channel

This is the same as FDD mode.

6.4.2.2 Common Physical Channel

This is the same as FDD mode.

6.4.2.3 Dedicated Physical Channel

In principle, there is no restrictions on the initial transmission power of the forward link Dedicated Physical Channel. After the initial transmission, the BTS transits into SIR-based fast closed-loop TPC as similar to the FDD mode.

The measurement of received SIR shall be carried out periodically at the MS. When the measured value is higher than the target SIR value, TPC bit = „0“. When this is lower than the target SIR value, TPC bit = „1“. 2bits are transmitted continuously to the BTS. At the BTS, soft decision on the TPC bits is performed, and when it is judged as „0“, the transmission power shall be reduced by P_{TPC1}dB, whereas if it is judged as „1“, the transmission power shall be raised by P_{TPC1}dB.

When the TPC bit cannot be received due to out-of-synchronization, the transmission power value shall be kept at a constant value. When SIR measurement cannot be performed due to out-of-synchronization, the TPC bit shall always be = „1“ during the period of being out-of-synchronization.

Fig.3.3.6-4 shows forward link transmitter power control timing. The transmitter power control of closed loop with 2-slots control delay can be realized.

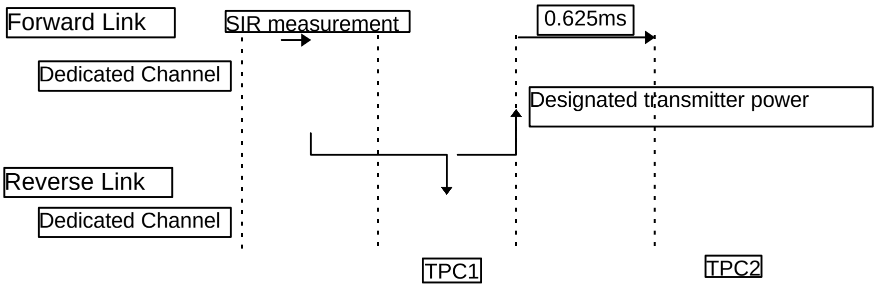


Fig.3.3.6-4 Forward link transmitter power control timing

6.4.3 Transmitter power control for Packet Data Transmission

Packet data transmission using the dedicated physical channels is always handled as a pair of reverse link and forward link as similar to the FDD mode.

Uplink common physical channel (RACH):
  Open-loop transmitter power control is adopted.
Downlink common physical channel (FACH):
  Transmission power is determined by the information transmitted on RACH, or fixed power.
Uplink dedicated physical channel (DCH):
  Open-loop transmitter power control is applied basically. Fast closed-loop transmitter power control is combined with open loop control. TPC bits in downlink dedicated physical channel are used for power control.
Downlink dedicated physical channel (DCH):
  Fast closed-loop transmitter power control is adopted. TPC bits in the uplink dedicated physical channel are used.

6.5 Timing Advance

<not covered in ARIB TDD>

The timing of transmissions from the UE will be advanced with respect to the timing of signals received from the serving nodeB to compensate for round trip propagation delay. The initial value for timing advance (TA) will be determined in the serving nodeB by measurement of the timing of a specific transmission from the UE [FFS].
The required timing advance will be represented as a [7] bit number, n [(0-127)] being the multiple of [1.953 µs (= 8 chips)] which is nearest to the required timing advance. The maximum allowed value may be limited by the operator to a value lower than [127], if required or the function may be disabled. A UE cannot operate beyond the range set by the maximum value of TA.
The serving nodeB will measure the timing of a transmission from the UE and signal the necessary timing advance (TA). On receipt of the TA the UE will adjust the timing of its transmissions accordingly.
As the UE moves within the cell, the serving nodeB will signal whether to advance, retard or maintain UE timing when the error in the timing of the signal received from the UE reaches a significant value. The UE shall respond by adjusting its timing advance by [±8] chips accordingly.
When TDD to TDD handover takes place the UE shall measure the timing difference (Δ_{TA}) between the new and old cells, double it and add it to the current timing advance value to provide the new timing advance. The new value is adopted on completion of handover.

$$TA_{new} = TA_{old} + 2.\Delta_{TA}$$

6.6 Synchronisation and Cell Search Procedures

6.6.1~~ Initial Mode~~ Cell Search (ETSI)

<editor's note: Though the physical structure of the Perch channel in ARIB is different from the Synchronization Channel in ETSI TDD, the procedure for obtaining synchronization itself is very similar. The chapter for idle and active mode cell search have been moved to S1.25>

During the initial cell search, the UE searches for a~~the~~ cell~~ with the highest receive power level~~ . It then determines the midamble, the downlink spreading code and frame synchronisation of that cell. The initial cell search uses the synchronisation channel (SCH) described in S1.21~~,~~ ~~shown in Figure 1 below (repeated from UMTS XX.09).~~

<editors note: the figure about the SCH was removed because it was redundant>

This initial cell search is carried out in three steps:

Step 1: Slot synchronisation

During the first step of the initial cell search procedure the UE uses the primary synchronization code to acquire slot synchronisation to the strongest cell. Furthermore, frame synchronization with the uncertainty of 1 out of 2 is obtained in this step. A single matched filter (or any similar device) is used for this purpose, that is matched to the primary synchronisation code c_p which is common to all cells. The procedure is according to the description for the FDD mode in S1.14~~XX.07~~.

Step 2: Frame synchronisation and code-group identification

During the second step of the initial cell search procedure, the UE uses the secondary synchronization code to find frame synchronisation and identify the code and midamble group of the cell as well as the BCH structure and the time offset t_{offset}(see S1.21~~XX.09~~). This is done by correlating the received signal at the positions of the Secondary Synchronisation Code with all possible Secondary Synchronisation Codes. After four frames a sequence of eight codes is available providing all necessary informations described above. The same Secondary Synchronisation Codes as in FDD are used for this purpose.

Step 3: Spreading-code identification

During the third and last step of the initial cell-search procedure, the UE determines the exact midamble and the accompanying spreading code used by the found cell. They are identified through correlation over the BCH with all midambles of the group identified in the second step.

6.6.1 Cell Detection Control (ARIB 3.3.6.1)

<editor’s note: The text in the ARIB FDD section, which is referred to in 6.6.1 and 6.6.2, is based on the specific physical structure of the Perch Channel and Search Codes. It might not be applicable for other Synchronization and common Control channel structures>

For TDD mode, smooth and fast cell acquisition can be realized by the specific structure of the perch channel as similar to the FDD mode. Like the FDD mode, a fast cell search scheme using three step cell search method is adopted. The basic scheme is almost the same as the inter-cell asynchronous operation of the FDD mode, because the structure of the Search Code symbols is the same. The scrambling code phase does not coincide with the frame phase as shown in Fig.3.3.6-1, which is different from the FDD mode. Therefore, one more step is added to the FDD mode for the cell search scheme of TDD. After identifying the scrambling code timing and scrambling code group from 2nd Search Code, scrambling code detection and frame synchronization processes are performed in parallel. During this step, frame synchronization can be detected by using the Frame Synchronization Word of pilot symbols.

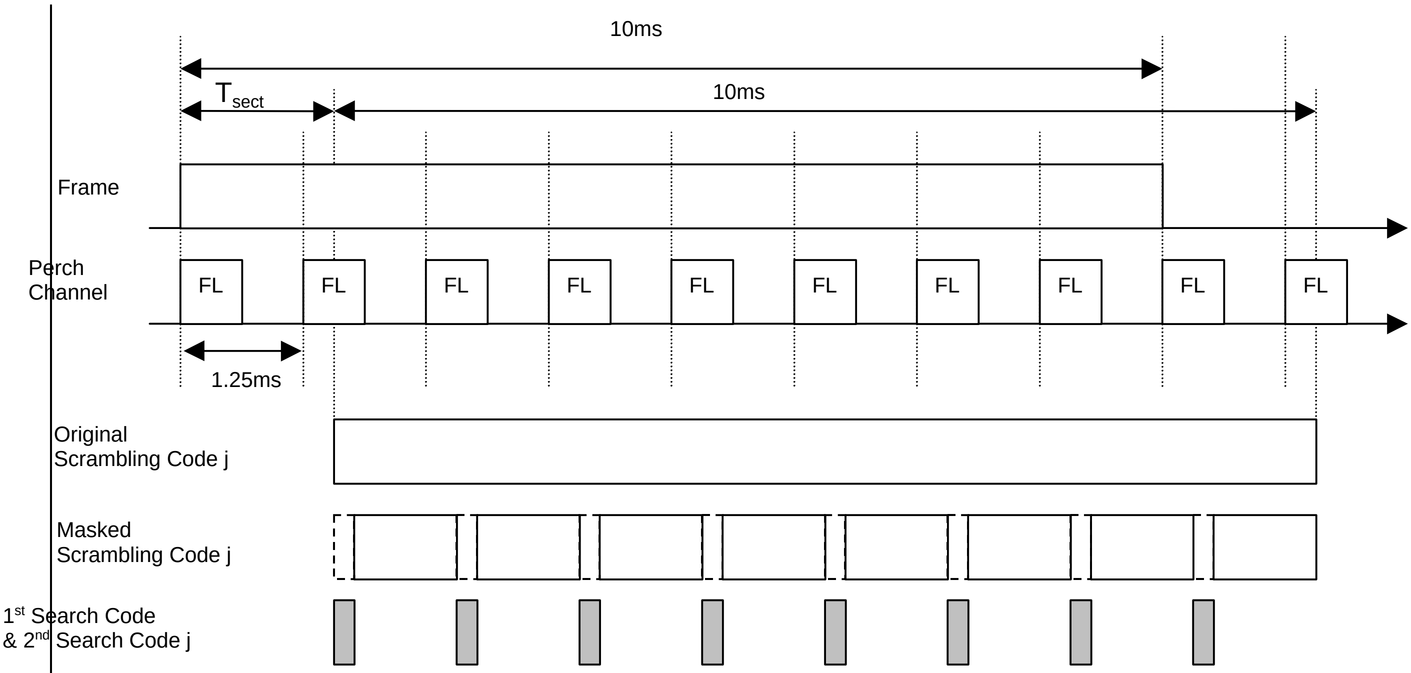


Fig.3.3.6-1 Search Code Symbols in Perch Channel

6.6.2 Synchronization Procedure (ARIB 3.3.6.2)

<see editor's note for 6.6.1>

This is the same as FDD mode.

Perch Channel
See 6.6.1.

Common Physical Channel
This is the same as FDD mode.
Dedicated Physical Channel
This is the same as FDD mode.

6.7 ODMA Relay Probing

<not covered in ARIB TDD>

This section describes the probe-response procedure used by ODMA nodes to detect neighbours which may be used as relays during a call.

6.7.1 Initial Mode Probing

<not covered in ARIB TDD>

The initial mode probing procedure is activated by a UE when it is switched on and has no information about its surroundings. In this case the UE will synchronise with the ODMA Random Access Channel (ORACH) which is used by all UEs to receive and broadcast system routing control information and data. The UE begins a probing session by periodically broadcasting a probe packet on the ORACH. The broadcast probe includes the current neighbour list for the UE which will initially be empty. If a neighbouring UE, UE*a*, receives the broadcast packet it will register the UE as a neighbour and send an addressed response probe. The response probe is transmitted at random to avoid contention with other UEs and typically one response is sent for every *n* broadcast probes received from a particular UE.

The next time the UE transmits a broadcast probe the neighbour list will have one new entry, *UEa*, and an associated quality indicator (a weighted factor based on the received signal strength of the response probe). It is through this basic mechanism that each UE builds a neighbour list.

6.7.2 Idle Mode Probing

<not covered in ARIB TDD>

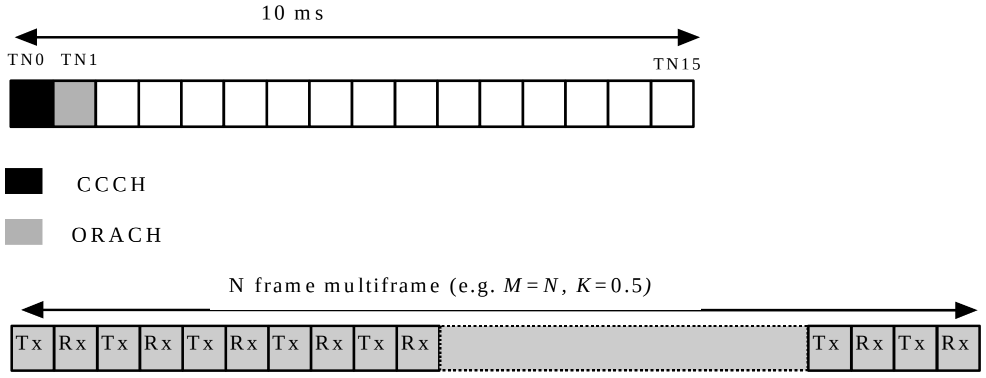
The Idle Mode Probing procedure is activated when the UE has synchronised with the ORACH but is not transmitting data. This procedure is the same as that described above after ORACH synchronisation.
The ODMA Idle Mode Probing procedure controls the rate of probing on the ORACH to reduce interference levels and regulate power consumption. The procedure is governed by a state machine, which consists of the following states: full probing, duty maintained probing, and relay prohibited. Each state defines the number of probing opportunities within one N multiframe, and a probing activity parameter K which is the ratio of probe transmission time to probe monitoring time.

Full probing
Full probing is the case where probing is allowed on every ORACH timeslot within an N multiframe. The UE$_R$ will probe on the ORACH at a rate defined by the probing activity parameter K.

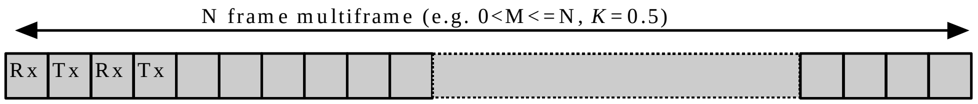
Duty Maintained probing
The duty maintained probing is the case where probing is allowed on M slots of an N multiframe. The UE$_R$ will probe on the M ORACH slots in an N multiframe at a rate defined by the probing activity parameter K.

Relay Prohibited
In this mode the UE$_R$ would cease all of its ODMA probing activities and will fall into standard TDD or FDD operation.

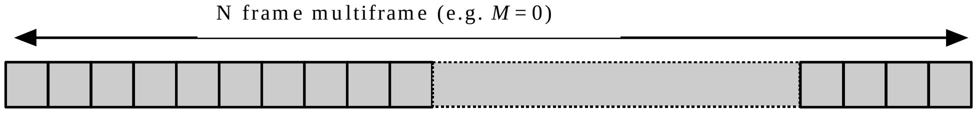
The probing activity levels for given state machines are illustrated in Figure 2 for a system with an ORACH for M slots per N × 16 multiframe.
Note that the distribution of probing opportunities within a multiframe may not necessarily be consecutive and located at the beginning of a multiframe.



(a) Full probing



(b) Duty maintained probing - example



(c) Relay prohibited

Figure 3: Probing state machines and mechanism.

6.7.3 Active Mode Probing

<not covered in ARIB TDD>

The Active Mode Probing procedure is activated when the UE has synchronised with the ORACH and is transmitting data.
With ODMA, data may be relayed on either the ODMA Random Access Channel (ORACH) or the ODMA dedicated transport channel (ODCH), depending on the volume of data to be sent. When a UE has small amounts of data to send it may transmit an addressed probe response packet on the ORACH at an interval proportional to air interface modem rate, R_{CCH}, and is defined by *Probe_timer_1*. This interval also defines the broadcast probe interval, *Probe_timer_2*, which is typically five times longer than *Probe_timer_1*. Every time an UE transmits a response probe containing data on the ORACH, it may be received, but not acknowledged, by third party neighbour UEs, and provides an implicit indication of activity. In this instance broadcast probes are not necessary and *Probe_timer_2* is reset after every addressed probe transmission. Only when an UE has no data to send is it necessary to transmit a broadcast probe every *Probe_timer_2* seconds to register its active status with its neighbours.

In order to avoid overlapping packet transmissions the length of the packet may not exceed the probe timer interval, *Probe_timer_1*. The relationship between the different probe timers is illustrated in Figure 3.

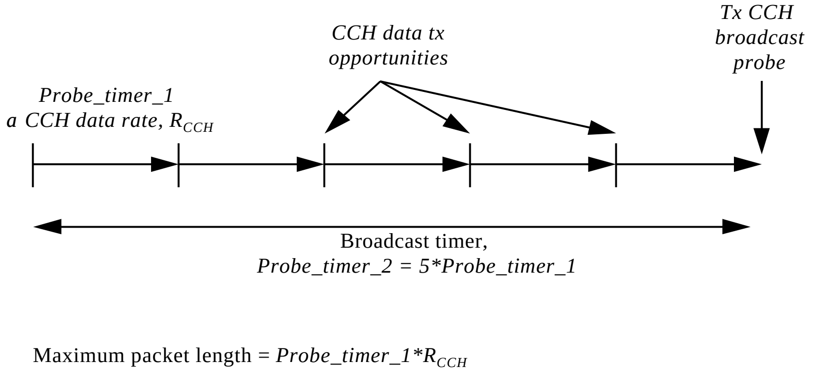


Figure 3: Probe timer relationships.

6.8 Idling Operation (ARIB 3.3.6.3)

<editor's note: not covered in ETSI TDD. The text in the ARIB FDD section, which is referred to, is based on the specific physical structure of the Paging Channel. It might not be applicable for other Paging channel structures>

This is the same as FDD mode.

Paging Control

This is the same as FDD mode.

6.9 Handover (ARIB 3.3.6.6)

< not covered in ETSI TDD. TDD handover measurements are covered in S1.25. Slotzted mode for inter-frequency handover is described in S1.22.

The description of the FDD mode, that is referred to, describes Diversity Handover, Hard Handover and Inter-Frequency Handover. Diversity Handover was for further study for ETSI TDD. The description for Interfrequency handover describes mainly describes compression techniques for slotted mode, which is based on the specific transmission characteristic of ARIB TDD and might not be applicable to ETSI TDD.>.

same as FDD mode.

6.10 Discontinuous transmission (DTX) of Radio Frames (ARIB 3.3.6.9)

<This is not covered in ETSI TDD. The scheme for ETSI TDD could be different to the one for ARIB TDD. The description of DTX within a frame is included in S1.22>

When a DPDCH carries a DCH to which a DTCH for packet data is mapped, and if there is no data, the transmission of radio frames can be paused. After sending each packet, the dedicated physical channel may be kept for a certain period, without switching into common physical channels, to restart transmission as soon as possible. During this reservation period, we can stop transmitting not only DPDCH but also DPCCH not to waste the channel capacity. Fig. 3.2.6-16 and Fig. 3.2.6-17 show examples when applying this DTX control. BTS and MS perform the normal fast closed-loop transmitter power control when possible

6.10.1 Transmission Stop Control

BTS Control Procedure
The necessity of transmission is judged in each radio frame. When there is no DCH data, the BTS stops DPDCH transmission, but continues to transmit DPCCH as far as both Conditions 1 and 2 are satisfied.
Condition 1: More than Fkp-f radio frames have passed after DCH data paused.
Condition 2: More than Fcrc-b radio frames are detected consecutively as to CRC NG in reverse link .
MS Control Procedure
The necessity of transmission is judged in each radio frame. When there is no DCH data, the MS stops DPDCH transmission, but continues to transmit DPCCH as far as both Conditions 3 and 4 are satisfied.
Condition 3: More than Fkp-b radio frames have passed after DCH data paused.
Condition 4: Forward link is out of synchronization.

Parameters: Fkp-f = 2, Fcrc-b = 2, Fkp-b = 2. (Expected gap length between packets)
These values shall be set by Layer 3 procedures.

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Fig. 3.2.6-16 Transmission stop control for dedicated physical channels

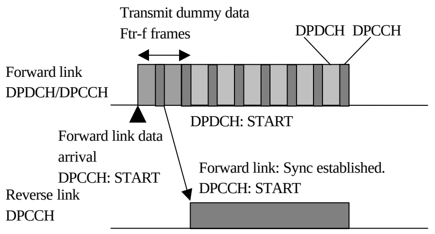
6.10.2. Transmission Resumption Control

The DPDCH/DPCCH transmission suspended is resumed if either of condition 5 or 6 is detected.
Condition 5: DCH data has arrived.
Condition 6: The synchronization of the opposite link has been established.
When resuming DPDCH transmission, the station transmits dummy frames prior to radio frames with real DCH data. In the dummy frames, all of the CRC coding field shall be set to 0, and the TPC commands on DPCCHs are set to a predetermined pattern, for example, indicating transmission power increase. The power control at the resuming transmission is as follows;

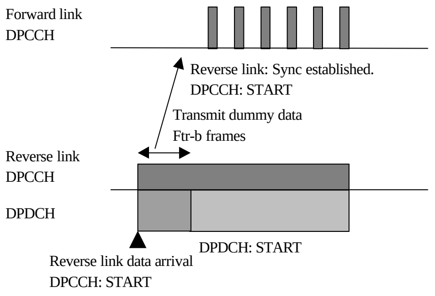
- There is no regulation about the initial transmission power of the forward link. The initial transmission power of the BTS may be set to a fixed value or the value of Padd dB added to the transmission power just before the DPDCH suspension.)
- The initial transmission power of the MS is set based on the open-loop transmitter power control described in 3.2.6.7.1(where the constant value may be set differently).
- To acquire chip/frame synchronization, the station transmits dummy frames. The number of dummy frame is Ftr. The station increases its transmission power by Pup dB in each Sup slots until receiving the DPCCH in the opposite link, but the maximum transmission power is limitted to Pmax dBm. If the number of frames after pausing transmission is less than Fgap, where the chip/frame synchronization is expected to be kept, the transmission of the dummy data can be omitted, and only DPCCH (Pilot and TPC) is transmitted in the last Str slots of the dummy frame.
- After establishing the synchronization, the opposite station shall transmit DPCCH, and enters the normal fast closed-loop transmitter power control. The sending station also enters the normal fast closed-loop transmitter power control after sending dummy frames.

Parameters:
Padd = 0
Fgap = 2, Str = 4 (training slot)
Ftr =2, Sup =4, Pup = 1 (synchronization demand)
Pmax = the maximum transmission power in the link.

The values of Ftr, Sup, Pup, Fgap, and Str may be set differently between BTS and MS. All values shall be via Layer 3 messages.



(a) Resumption control when forward link data is arrived



(b) Resumption control when reverse link data is arrived

Fig. 3.2.6-17 Transmission resumption control for dedicated physical channels

6.11 Encryption Control (ARIB 3.3.6.11)

<editor's note: not defined for ARIB FDD, no text for ETSI TDD>

This is the same as FDD mode.

6.12 Forward Link Transmit Diversity (ARIB 3.3.6.12)

<editor's note: not covered in ETSI TDD>

Transmit diversity in the forward link provides means to achieve similar performance gains as the mobile-station receiver diversity without the complexity of a second mobile-station receiver. Furthermore, transmit diversity improves the SIR and increases the system capacity. Depending on the mobile station's distance to the base station, its speed, and the asymmetry ratio, selective transmit diversity (STD) or parallel transmit diversity (PTD) can be employed. These techniques are described herewith.
With STD, the received signal power of reverse link is measured for each of the antennas at the BTS over every single reverse link interval (1 slot). The antenna with the highest signal level is used to transmit the forward link information for that link during the next interval over which the carrier is used for the forward link (1 or more slots). The basis for the gains from this type of diversity is the availability of information on the channel due to the use of the same frequency for reverse link and forward link. STD is applied only to dedicated physical channels.

For perch channel and common physical channels such as PCH, PTD can be applied optionally. PTD can be implemented as follows. Coded bits are copied into two data streams in parallel and transmitted via two separate antennas each with half power. Different orthogonal spreading codes are used for each antenna. This maintains the orthogonality between the two output streams, and hence self-interference is negligible. The introduction of PTD can improve the received performance of the forward link due to diversity gains. Furthermore, it can improve the reverse link performance of the dedicated channel. Open-loop transmitter power control can be controlled by using the combing received power of perch channel from both antennas with different spreading codes. The structure mentioned above is highly flexible. It may be easily extended to more antennas (3,4, etc.). PTD may be an optional feature that can be turned on only when needed. There is little additional processing required for PTD at the mobile station.

7 History

Document history		
v0.0.1	1998-02-09	Document is a merged version of documents XX.13 V 0.5.0 of ETSI and Vol.3 V1.0 of ARIB. The merging is editorial and based on XX.13. Some sections of the corresponding ARIB text in chapter 3.3.6 of Vol 3 have been moved partly or completely to other specifications.
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