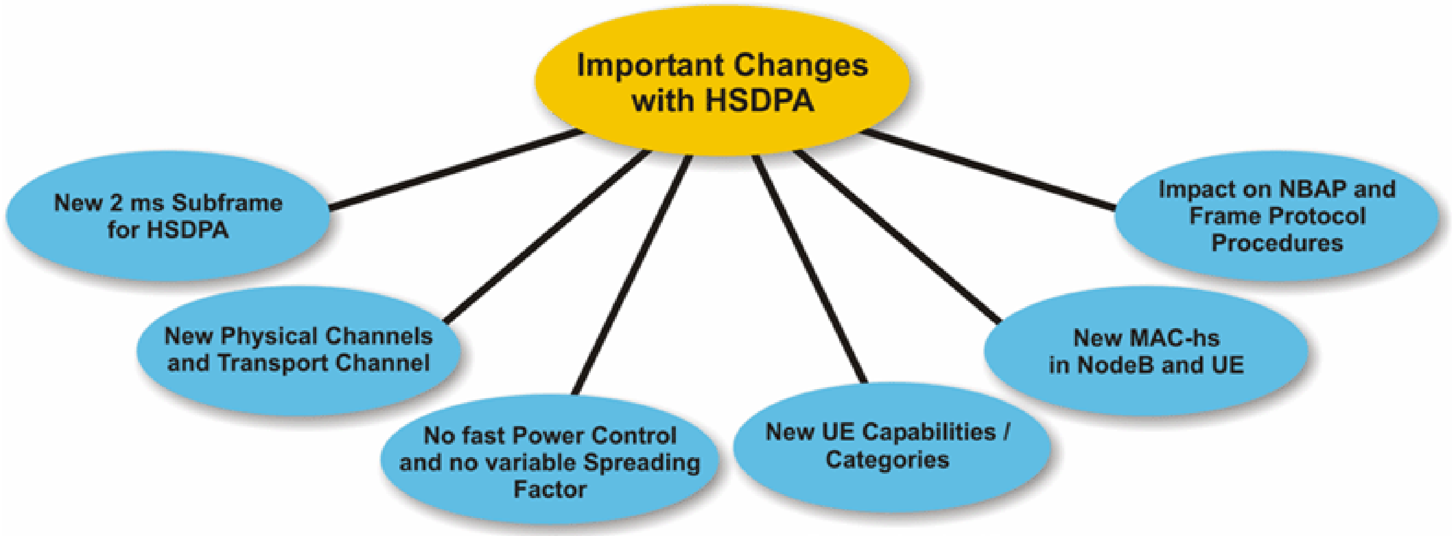
- ***HSDPA Principles***
- ***The Physical Layer of HSDPA***
- ***Forward and Backward Error Correction in HSDPA***
- ***HSDPA Protocol Enhancements and Extensions***
- ***HSDPA Mobility Procedures***

Objectives

After this Lecture the Student will be able to:

- **Describe the important changes and characteristics of HSDPA**
- **State the new channels of HSDPA and how they operate in principle**
- **Describe the extended UTRAN protocol stack with HSDPA**
- **State the advantages and disadvantages of HSDPA and future enhancements**
- **Describe the concept of HSUPA**

Important Changes with HSDPA



- Categories 1 – 12
- Multi-Code Operation
- Number of physical channels: 5, 10 or 15

HSDPA involves significant changes in the UTRAN providing a high flexibility to react upon changing air-interface conditions or variable user QoS.

New 2 ms Subframe for HSDPA

The TTI (transmission time interval) in HSDPA has been shortened to 2 ms in order to be faster in retransmitting erroneous data blocks compared to the minimum TTI of 10 ms in genuine UTRA-FDD. Another advantage of the shorter TTI in HSDPA is that NodeB can adapt literally every data block to fast changing radio conditions by the means of AMC. Thus it is possible to counteract the fading on the air-interface by adjusting modulation and coding almost every 2 ms depending on NodeB's processing delay and packet scheduling algorithm.

New Physical Channels and Transport Channel with HSDPA

New channels are introduced for HSDPA: HS-PDSCH, HS-SCCH, HS-DPCCH and HS-DSCH.

No Fast Power Control and variable Spreading Factor

With HSDPA, two of the most fundamental features of WCDMA, fast power control and variable spreading factor are disabled and replaced by AMC and HARQ. Note: AMC uses extensive multicode operation ((the UE can use more than one channelization code in parallel) in order to increase the data rate for a certain user and adapts the code rate to the air-interface quality. By these means AMC is able to improve the user throughput or at least keep it constant even the downlink channel quality deteriorates between subsequent transmissions.

New UE Capabilities / Categories

The HSDPA feature is optional for both UE and network in Rel. 5. The UE indicates its HSDPA support and its HS-DSCH physical layer category within the radio access capability parameter. The physical layer category defines among other parameters the maximum number of channelization codes the UE supports in parallel for multicode operation. A UE may support up to 5, 10 or at max. 15 channelization codes in parallel.

New MAC-hs in NodeB and UE

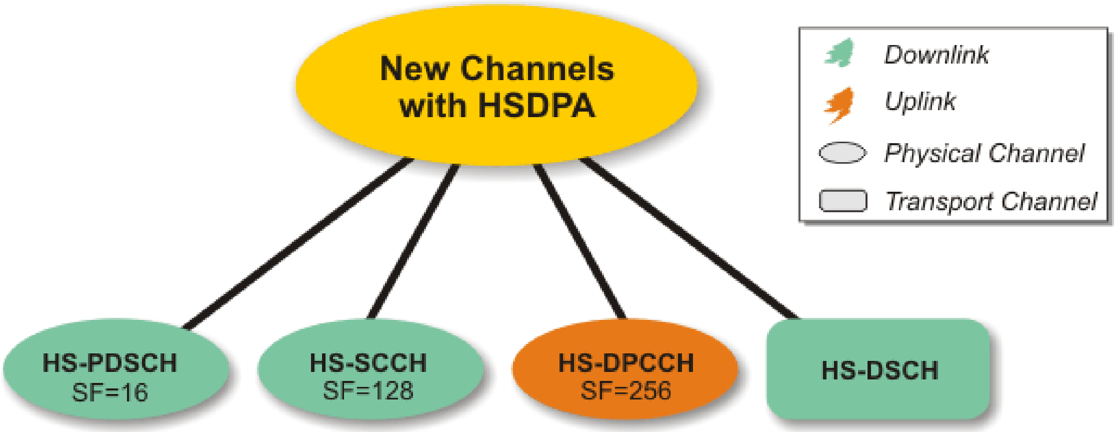
The implementation of MAC-hs (MAC high speed) in NodeB and UE is a pre-requisite for allowing the NodeB to schedule transmissions and retransmissions, to maintain the HSDPA specific channels and to operate with AMC and HARQ.

Impact on NBAP and Frame Protocol Procedure

NBAP procedures need to support HSDPA capability and HSDPA related IE's. The increased bandwidth needs to be supported by a new frame protocol. Among other parameters the frame protocol needs to cater for HSDPA flow control information, priority queue handling and UE capability information.

[3GTS 25.211 (7.1), 3GTS 25.306 (5.1), 3GTS 25.308 (5.1)]

New Channels with HSDPA



The support of HSDPA is based on several new physical channels and one new transport channel.

Physical Channels

HS-PDSCH (High Speed Physical Downlink Shared Channel)

The HS-PDSCH has a fixed spreading factor of value '16'. Thus, it provides for multicode operation using up to 15 channelization codes in parallel. Of course the UE must support the use of up to 15 channelization codes which depends on its category. The HS-PDSCH adopts the shortened TTI of 2 ms.

HS-SCCH (High Speed Shared Control Channel)

The HS-SCCH has a fixed spreading factor of value '128' and is configured only in the downlink direction. It also adopts the shortened TTI of 2 ms. In theory, up to 127 HS-SCCH's can be configured in a cell. However, the UE is required only to be able to listen to up to four HS-SCCH in parallel.

The HS-SCCH allows the efficient sharing of one or more HS-PDSCH's among different users. Nevertheless every UE needs to be informed on the DCCH via RRC messages about the specific HS-SCCH-set that it shall monitor in order to receive data via the HS-PDSCH's.

HS-DPCCH (High Speed Dedicated Physical Control Channel)

The HS-DPCCH has a fixed spreading factor of value '256' and is only configured in uplink direction. The HS-DPCCH also follows the shortened TTI of 2 ms. Its purpose is to provide feedback information about the downlink receive quality and whether the packet data received by the UE are error-free or need to be retransmitted. Thus the NodeB is quickly notified of unsuccessful transmissions and/or changing radio conditions in downlink direction.

Transport Channel

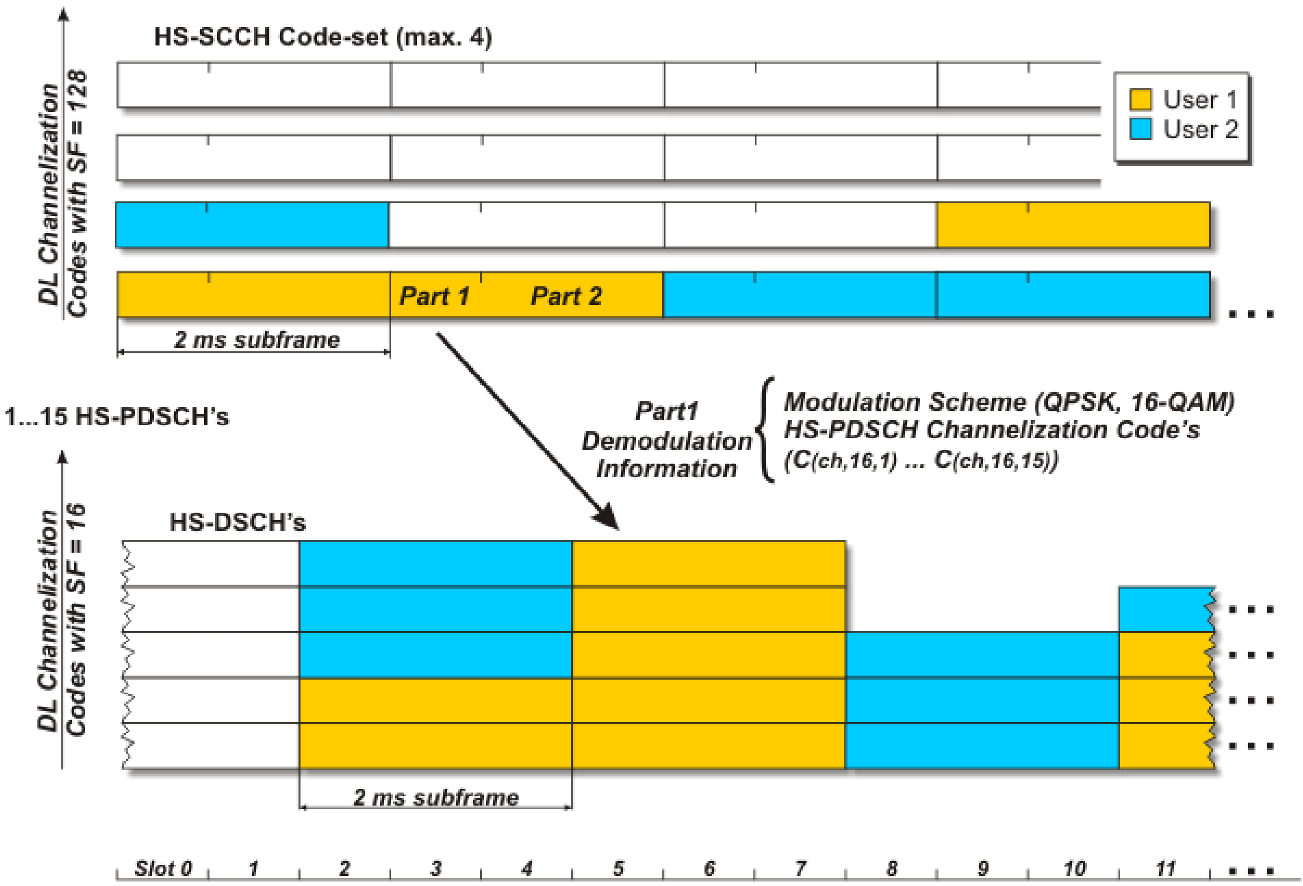
HS-DSCH (High Speed Downlink Shared Channel)

The HS-DSCH is the actual transport resource carrying the packet data of the user applications. As it also follows the shortened TTI of 2 ms, it allows for short round trip delay in the operation between NodeB and UE. The 2 ms TTI is short when compared to 10, 20, 40 or 80 ms TTI's supported by Rel. '99 and Rel. 4 transport channels. HS-DSCH describes the physical layer processing by MAC-hs of a HSDPA transport block.

- Dynamic part: TB size = TBS size {1 to 200 000 bits with 8 bit granularity}; modulation scheme {QPSK, 16-QAM}; redundancy / constellation version {1 … 8}.
- Static part: TTI {2 ms for FDD}; type of channel coding {turbo coding}; mother code rate {1/3}, CRC size {24 bits}
- No semi-static attributes are defined for HS-DSCH.

[3GTS 25.211 (4.1.2.7, 5.2.1, 5.3.3.12, 5.3.3.13), 3GTS 25.213 (4.2.1, 4.3.1.2), 3GTS 25.302 (7.1.6a)]

Multicode Operation in HSDPA



The figure shows two UE's operating in HSDPA.

HS-SCCH-set Decoding

The graphic demonstrates that both UE's have to decode their assigned HS-SCCH-set first, before they can attempt to decode the HS-PDSCH's. For simplicity reasons, both UE's have the same HS-SCCH-set assigned. A HS-SCCH-set consists of up to a maximum of four HS-SCCH channelization out of a possible range from codes C(ch,128,1) ... C(ch,128,127) under e.g. the primary scrambling code. As depicted, only one of the four HS-SCCH's contains valid information per UE per TTI. This is indicated by the appropriate color coding for each UE. All the information necessary for demodulating the related HS-DSCH subframe which follows always 2 slots later after HS-SCCH, is transmitted to the UE's within part 1. It can be seen that every HS-SCCH is (logically) divided into two parts. The second part contains the necessary information on how to decode the HS-DSCH. So part 1 and part 2 serve different purposes. Part 1 allows the demodulation of the HS-PDSCH subframe and part 2 is responsible for layer 2 decoding of the HS-DSCH.

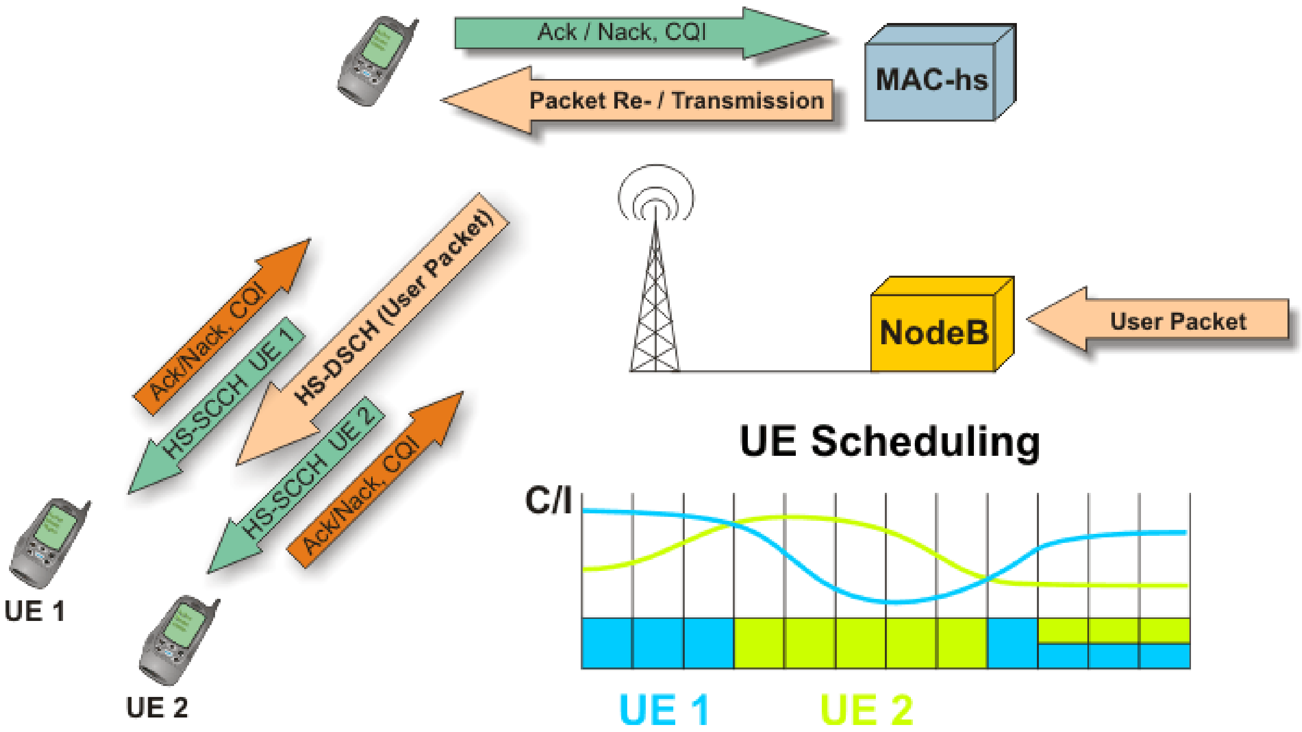
Note: The HS-SCCH is intended for the very UE once it recognizes its UE-id inside part 1 of the HS-SCCH subframe. If the UE detected consistent control information intended for it in the immediately preceding subframe, it is sufficient to only monitor the same HS-SCCH used in the immediate succeeding subframe. In the graph this is indicated by e. g. user 1 in slot 0 to slot 6 where user 1 gets two consecutive valid HS-SCCH's. Therefore UE 1 only needs to decode the same HS-SCCH from slot 3 onwards. From slot 8 onwards the complete HS-SCCH code-set has to be monitored again by UE 1 (only part 1).

HS-DSCH Demodulation

If a UE detects that one of the monitored HS-SCCH's contains its encoded UE-id (implicitly included) and consistent control information intended for this UE, the UE prepares to receive the HS-PDSCH's. Consistent control information hereby means that modulation scheme and HS-PDSCH channelization code-set info are valid according to the UE's capability. The UE has about one slot duration time after receiving part 1 to prepare for HS-PDSCH's reception. As already mentioned, the UE indicates via the category parameter if it supports up to 5, 10 or 15 HS-PDSCH channelization codes in parallel. The color coding used in the figure for the HS-SCCH and their related HS-DSCH shows that HSDPA allows for time multiplexing and code multiplexing of the HS-PDSCH's. Time multiplexing means that user 1 and user 2 get the HS-PDSCH's assigned one after the other in different subframes. Code multiplexing or multicode operation means that several user, here user 1 and user 2, use different HS-PDSCH's within the same subframe. The various HS-PDSCH's are separated by different channelization codes.

[3GTS 25.212 (4.6.2), 3GTS 25.213 (5.2.1)]

HSDPA Basic Operation



The figure consists of three functional parts. The upper part shows the basic communication between UE and NodeB via MAC-hs for packet transmission and retransmission. The lower left part depicts the Uu-interface together with the newly introduced physical channels and transport channel. Note for simplicity reasons the red colored arrows represent the individual HS-DPCCH's per UE.

In the lower right corner we sketched a basic scheduling principle how the HS-DSCH resources can be assigned among several UE's.

MAC-hs

MAC-hs located in NodeB receives user packets from the SRNC. MAC-hs is responsible for transmission and in case of erroneous reception also for retransmission of user packets. The retransmission of user packets is commanded by NodeB's MAC-hs which represents the fundamental change in HSDPA compared to Rel. '99 or Rel. 4. In legacy UMTS releases retransmissions are always performed between the RLC peers in UE and SRNC. With HSDPA the NodeB retransmits the user packets if the UE indicates a Nack on HS-DPCCH. Via this physical channel the UE also sends feedback information about the downlink channel quality in regular intervals to the NodeB.

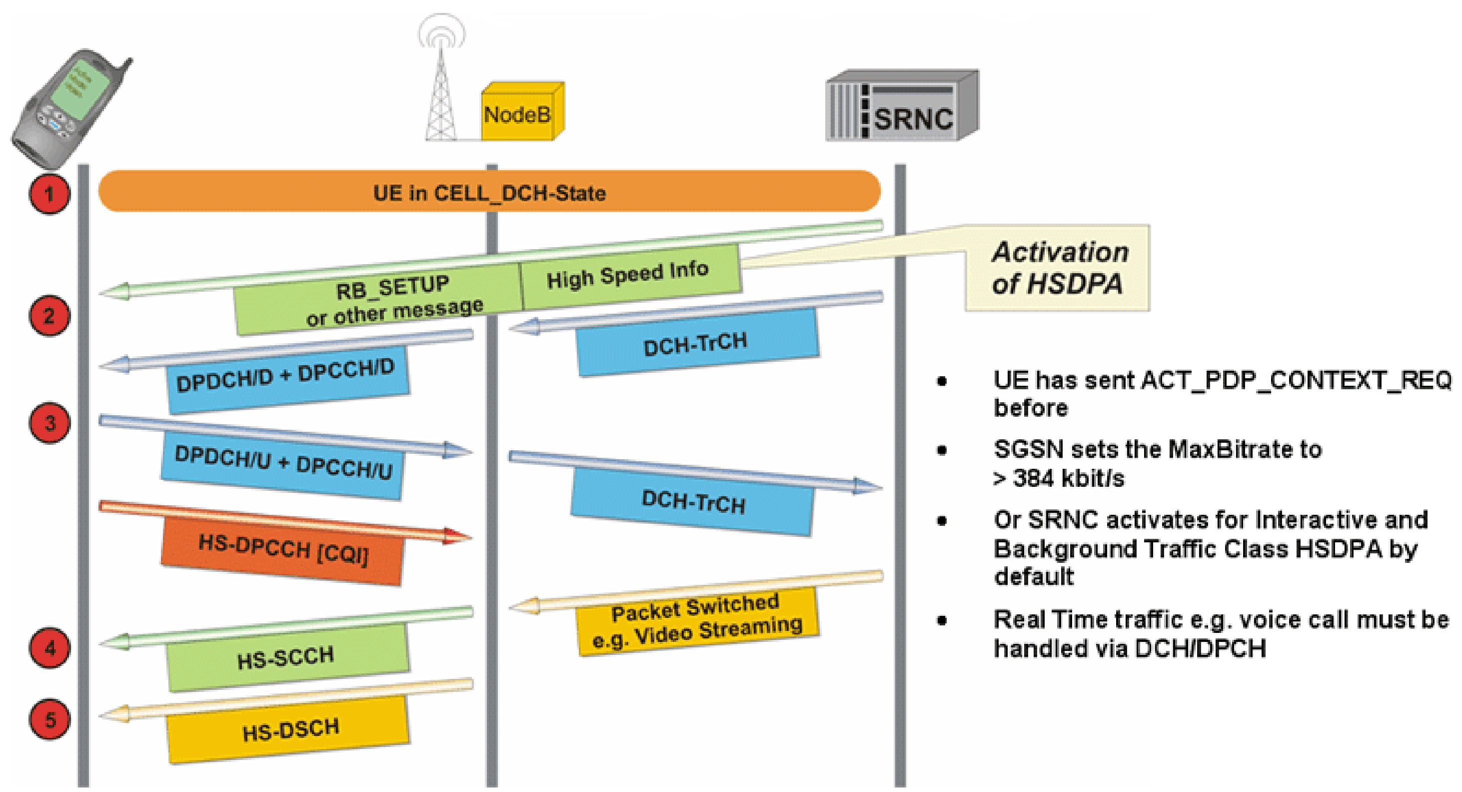
New Channels

Two UE's receiving user packets via the HS-DSCH. The physical channels in uplink and downlink are necessary to firstly signal which UE shall decode the very HS-DSCH. This is indicated by implicitly encoding the UE-id in the very HS-SCCH. Secondly after decoding of the user packet, the respective UE has to signal the successful or unsuccessful transmission to the MAC-hs entity in NodeB via the so called Ack/Nack description. Therefore HSDPA employs the uplink HS-DPCCH to signal the downlink reception quality and the Ack/Nack description. The downlink reception quality informs the NodeB about the current radio condition which serves as a vital input for the NodeB. The NodeB is therefore able to derive the proper modulation scheme and code rate for transmission and retransmission. This process is denoted as AMC in HSDPA.

UE Scheduling

The NodeB also contains a scheduling/priority handling function which determines whether a new transmission or retransmission shall be performed. The green and blue lines represent the changing downlink channel quality reported by UE in the uplink. One scheduling method which could be implemented in NodeB is to serve each UE according to the reported downlink channel quality and therefore always exploit best radio conditions. This method maximizes user throughput as it allows to use 16-QAM and an aggressive code rate if C/I is high. Another option is to serve each user proportionally fair despite unfavorable downlink radio conditions. This benefits especially UE 2 which indicates for several TTI's a bad radio quality, but this second method assures at least a minimum guaranteed throughput for UE 2.

HSDPA and DPCH Operation – HSDPA Setup



HSDPA Setup via DPCH

The resource allocation of HSDPA requires the previous setup of a DCCH mapped on DCH. The DCH transport channel runs on a Rel. '99 DPCH. This means, in order to setup and maintain HSDPA operation, there is always a DL DPCH and UL DPCH needed. Upon RRC connection request sent by UE, the SRNC may request the UE's HSDPA capabilities. The HSDPA related configuration supported in a cell is signaled to the UE via a DCCH mapped onto a DCH which is carried by DPDCH+DPCCH. By decoding the so called "High Speed Information" on the DCCH the UE obtains is informed about the physical layer configuration for HSDPA in the Cell. This physical layer configuration allows the UE to decode the HS-SCCH which informs the UE about available user data on the shared transport channel HS-DSCH.

Note: Note there are no parameters broadcast on BCCH about a cell's HSDPA capability.

The basic HSDPA setup is explained below:

1. Before moving in CELL_DCH state the UE is told by the RNC to reveal its HSDPA capabilities and category e.g. via RRC Connection Setup message.
2. Once the RNC has obtained the UE's HSDPA capabilities, the subsequent RRC configuration messages (e.g. Radio Bearer Setup) contain the high speed information telling the UE about the HSDPA configuration in the cell. High speed information contains e.g. the UE identity ((called H-RNTI) which is implicitly encoded on HS-SCCH to identify the very UE getting HS-DSCH resources allocated, the scrambling code to be applied for HS-PDSCH and HS-SCCH and the HS-SCCH channelization code-set. This is necessary to inform the UE about the decoding of the HS-SCCH which contains specific information about the HS-PDSCH's format carrying the HS-DSCH. From this moment on the UE is in a so called HSDPA "standby mode" ready to decode HS-SCCH's. Note: The UE might be told to monitor up to four HS-SCCH's.
3. A DPCH must always exist before a UE is able to operate in HSDPA as it carries the DCCH. The DPCH handles the real-time services, e.g. AMR 12.2 voice channel and the RRC signaling via SRB's. On SRB's the necessary RRC signaling messages are exchanged e.g. to reconfigure the physical link for HSDPA or prepare for HS-DSCH cell change. Please remember that HSDPA is not (yet) intended for services with real-time QoS requirements.
4. If there are packet data to be transferred to the UE in downlink, the NodeB will relay the necessary information for decoding the HS-DSCH to the UE on HS-SCCH's. The UE must be capable of decoding up to four HS-SCCH in parallel. This is a so called HS-SCCH-set. From the HS-SCCH's the UE obtains information how to decode the subsequent HS-PDSCH's and finally obtains the user data from the HS-DSCH.
5. If the UE detects consistent control information intended for it, the UE shall start receiving the HS-PDSCH's. Consistent control information means e.g. that the UE decodes its H-RNTI in one of the assigned HS-SCCH's of the HS-SCCH code-set.

[3GTS 25.302 (8.2), 3GTS 25.331 (8.6.3.1b, 8.6.6.32, 10.3.6.23a, 10.3.6.36a)]

- ***HSDPA Principles***
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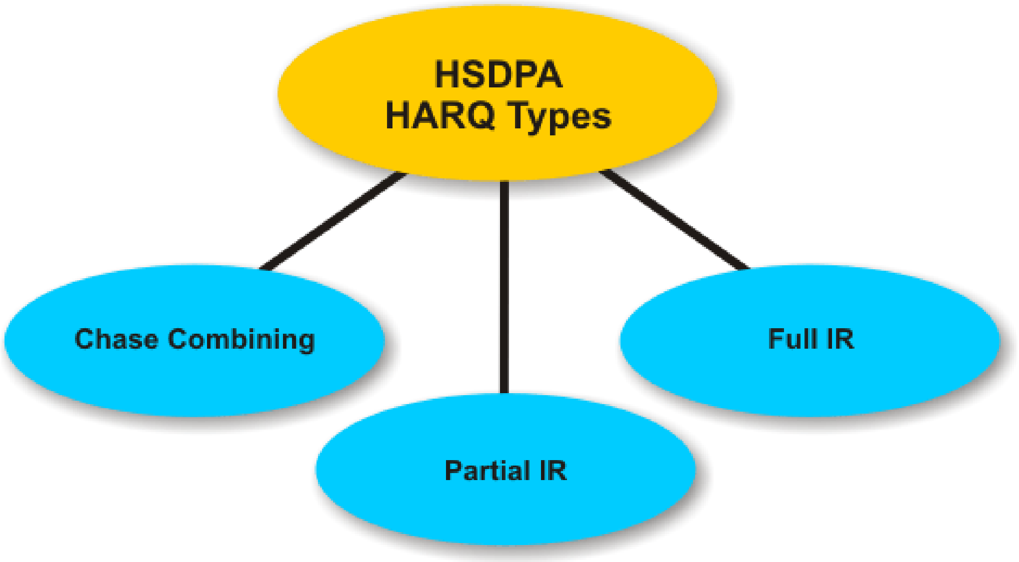
Objectives

After this Lecture the Student will be able to:

- **Describe the coding chains of HS-DSCH, HS-SCCH and HS-DPCCH**
- **State the timing relations between DPCH and HS-DSCH and HS-DPCCH**
- **Describe the implications of using 16-QAM**
- **State the advantages and liabilities of AMC in HSDPA**
- **Describe difference between chase combining, partial IR and full IR**

HSDPA HARQ Types



Hybrid Automatic Repeat reQuest (ARQ) is a protocol for error control in packet data transmission. When the receiver detects an error in a packet, it automatically requests the transmitter to resend the packet. This process is repeated until the packet is error free or the error continues beyond a predetermined number of transmissions and finally higher layers stop the retransmission. Possibly the erroneous packet is discarded. The user's application is then in charge of dealing with packet losses.

HARQ provides robustness through fast retransmissions at the physical layer controlled by NodeB's MAC-hs. Retransmitted copies are combined at the receiver and then decoding is attempted again.

There are three types of HARQ in HSDPA:

Chase Combining

Retransmission(s) of the same packet as that of the first attempt occur. The decoder combines multiple received copies of the coded packet weighted by their SNR prior to decoding. This method provides time diversity gain and is very simple to implement. Time diversity gain is simply the fact that the fast fading and interference changes between first transmission and multiple retransmissions thus not all (re-)transmissions are affected by the same (bad) radio channel conditions.

Partial IR

The retransmission takes place with a partially different packet from the first one. Each packet transmitted in the partial IR scheme is self-decodable because it has the systematic bits of turbo codes. Instead of sending simple repeats of the entire coded packet, additional redundant information is incrementally transmitted.

Note: The systematic bits of turbo encoded bits shall not be punctured; the other bits (parity bits p1 and parity bits p2) may be punctured.

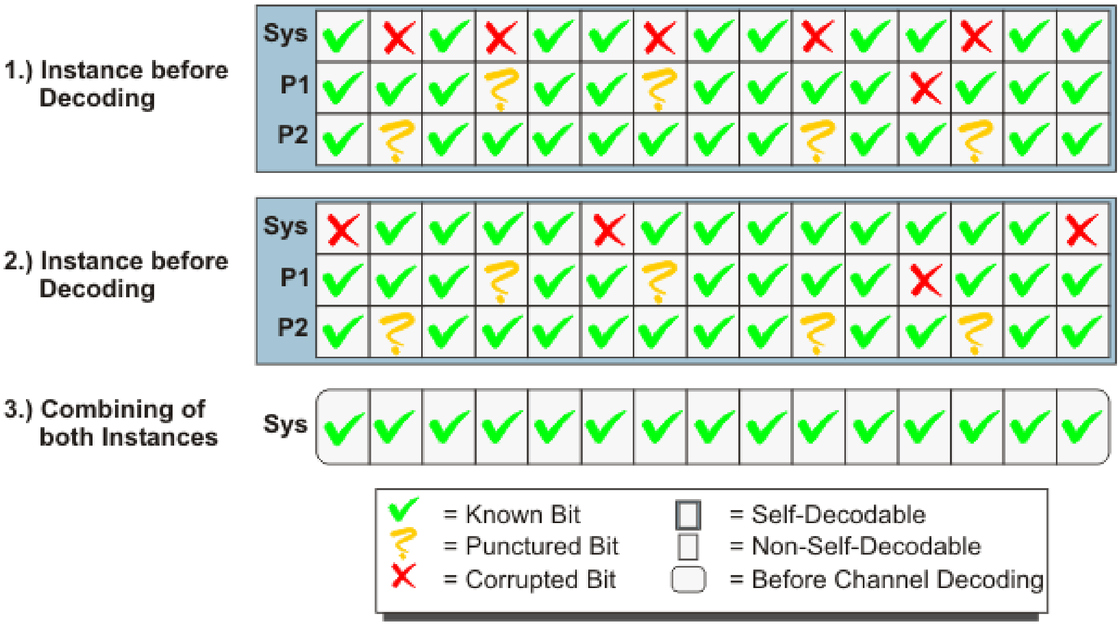
Full IR

The retransmission of an entirely different packet from the first one occurs. The retransmissions of packets are not self-decodable, thus they may contain only the parity bits of the turbo code output. This means also that the first transmission of a packet must at least contain the systematic bits of a packet.

IR usually yields better performance compared to chase combining. However, it requires more implementation complexity and may not result in good performance unless the link adaptation errors are very small. Chase combining yields reasonable performance with lower implementation complexity and cost. Note: HARQ is controlled by MAC-hs scheduler.

[3GTR 25.858 (7.1)]

Operation of Chase Combining



The receiver comprises a demodulator and a channel decoder. The demodulator generates soft decision bits for every received bit. The soft decision bits represent likelihood of the real bit value. Thus the demodulator tries to find out all possible combinations of bit values for unknown bits targeting the maximum probability of the bit sequence. The demodulator stores, therefore after each packet has been demodulated, the highest probability values for each bit in soft decision bits. When the channel decoder performs the decoding and the CRC check indicates a block error, retransmission is requested from the sender.

Note: The HS-DSCH is turbo encoded with a rate of 1/3. The turbo coder delivers 3 output bit streams.

- Systematic bits
- Parity P1 bits
- Parity P2 bits

The systematic bits are always needed to decode the original transport block. Transmission or retransmissions containing the systematic bits are therefore also called self-decodable transmissions. The parity bits add redundancy to the encoded block and are not sufficient to decode the transport block without systematic bits.

Chase Combining Performance – Hybrid ARQ type III

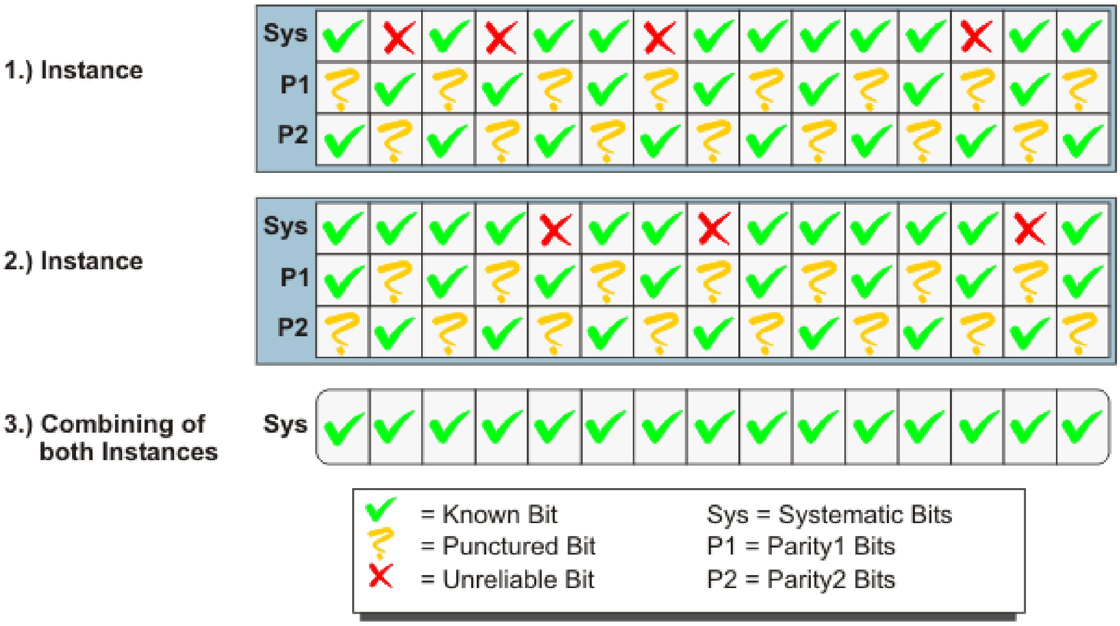
The retransmission of the same packet occurs always with the same puncturing scheme. Every transmission and retransmission contains systematic bits. The same puncturing scheme is indicated by the same two question marks in each packet. Thus chase combining makes use of time diversity gain. Not every transmission or re-transmission is affected by the same interference or fading. Thus errors occur on different bit positions as indicated by the red 'cross'. After the first instance of a packet has been received the demodulator keeps the soft decision values in a buffer as the CRC check indicated block error and a second instance of the same packet is requested.

Once the second instance has been received, the demodulator can add up the soft decision values of each transmission based on their SNR value and so achieve a more reliable demodulation result. By adding up the soft decision values after every instance of a retransmission, the buffer capacity for the soft decision bits is modest compared to IR.

> **Note:** In chase combining, multiple retransmissions, so called full retransmissions, are sent with the same puncturing scheme. Every transmission is self-decodable as it contains the systematic bits. The amount of data in the receiver buffer remains the same.

[3GTR 25.848 (6.8.1.1)]

Operation of Partial IR



With partial IR, every transmission and retransmission is still self-decodable however the puncturing scheme varies between retransmissions. Thus the retransmissions become more effective compared to chase combing where the puncturing scheme stays the same for every retransmission instance.

As multiple retransmissions vary in their punctured bits, the demodulator can benefit from several instances of the same packet by reducing the code rate.

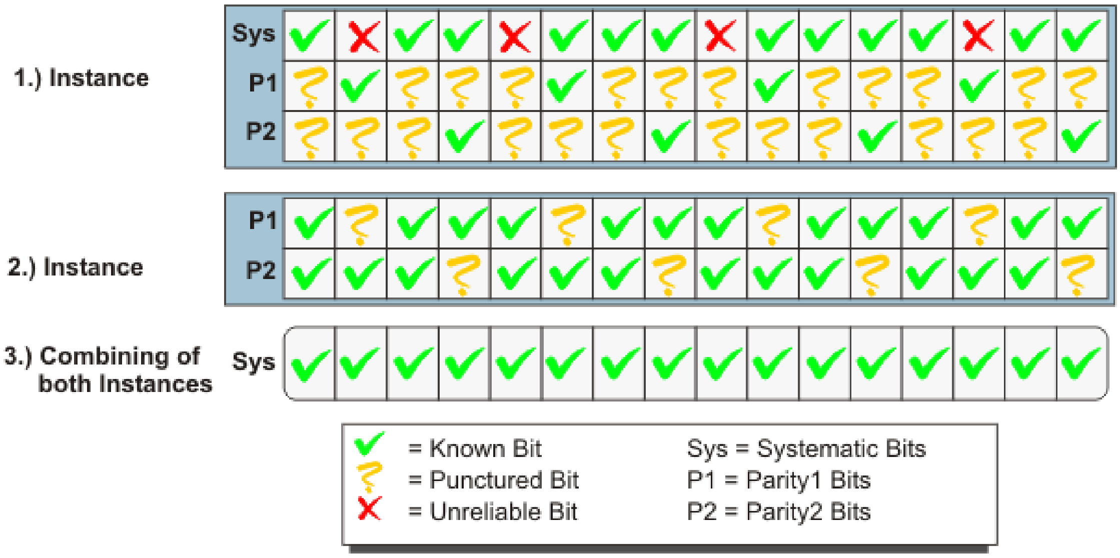
After each retransmission the demodulator can re-calculate the maximum likelihood by either taking the soft decision values of the transmission and retransmission into account or their added sum weighted by their individual SNR's. The buffer requirements are still modest compared to full IR.

Note: IR is another Hybrid ARQ technique wherein instead of sending simple repeats of the entire coded packet; additional redundant information is incrementally transmitted if the decoding fails on the first attempt. Partial IR is called Hybrid ARQ type-III as each retransmission is restricted to be self-decodable.

In the IR schemes the receiver buffers coded symbols, which introduce new information to the HSDPA TTI transmitted first. Therefore the amount of data to be buffered increases with consecutive retransmissions. Prior to decoding these symbols are soft-valued, i.e. each symbol is represented by two or more bits.

[3GTR 25.848 (6.8.1.1)]

Operation of Full IR



Using full IR, the first transmission of a packet must be self-decodable thus the systematic bits need to be inside. However with every retransmission instance of the same packet only the parity bits may be transmitted. Every retransmission reduces therefore the code rate and increases the decoding probability. However the likelihood calculation makes it necessary to buffer each transmission instance. The soft decision values cannot be added up as the retransmissions containing the parity bits only are not self decodable.

The full IR requires the biggest memory size and thus may not be useable for maximum data rate transmissions.

Note: Full IR is called Hybrid ARQ type II as each retransmission is not self-decodable.

In case of HARQ type II or type III with multiple redundancy versions, additional redundancy bits are sent during each retransmission yielding potentially more coding gain than simple type III with single redundancy version.

Note: All three figures (chase combining, partial IR and full IR) always show at the end the status of the demodulator. A green “ok-sign” means that the demodulator could reliably predict whether the received bits are determined as logical “0” or “1”. This information is used as input for the turbo decoder which decodes the HS-DSCH TB. Only the CRC check after turbo decoding ensures if the HS-DSCH TB was successfully received. Here we just wanted to demonstrate the differences in transmission and retransmissions by using chase combining, partial and full IR.

[3GTR 25.848 (6.8.1.1)]

HARQ Transmissions / Retransmissions

HARQ Types	Original transmission	Re-transmissions	Code Rate Reduction considering Transmissions & Retransmission	Layer 1
type I	*self-decodable*	*self-decodable*	*Combining Impossible ==> No Reduction*	*n. a.*
type II	*self-decodable*	*non-self-decodeable (only Parity bits)*	*==> Fast Reduction of Code Rate*	*Soft Combining*
type III	*self-decodable*	*self-decodeable (Code Word + Parity bits)*	*- Chase Combining: ==> No Reduction - Partial IR: ==> Yes (but slow for high initial Code Rate)*	

Here we would like to summarize the vital differences between the various ARQ types. The reason why those ARQ types are called hybrid is because of layer 1 combining based on higher layer retransmission request. HARQ type I actually only provides for a ARQ functionality as there is no layer 1 combining with previous transmission instances of the same PDU. HARQ type II and III are entirely based on layer 1 and do not even involve higher layer processing, e.g. generating retransmission requests. Thus HSDPA is built on a fast and very robust ARQ scheme which is a pre-requisite for supporting with huge data rates over the air interface.

Note, a transmission is called self-decodable whenever the code word of the TB is contained. That expression stems from turbo coding as turbo coding generates two parity streams out of the TB bits, but the original TB bits are transmitted unmodified. The code word also known as the systematic bits.

- HARQ type I: Original transmission and retransmissions must always be self-decodable but no combining on layer 1 is possible, e. g. due to the different ciphering mask between transmission and retransmission instances.
- HARQ type II: Retransmissions only contain parity bits (non-self-decodable transmission) thus the receiver must perform soft-combining with previous transmissions (e.g. original transmission) in order to decode systematic bits of a TB successfully. The systematic bits are only transmitted within the original transmission. The code rate (amount of redundancy/parity bits being incrementally added) gets reduced fast as retransmission(s) entirely only contain parity information.
- HARQ type: Retransmissions contain like the original transmission the systematic code (code word) and additionally parity bits for enhanced decoding. However the amount of redundancy/parity bits being incrementally added with sub-sequent retransmissions is less compared to HARQ type II as the code word always occupies significant space of the physical transmission capacity.

HARQ Type III – Partial IR and Chase Combing

Two sub-cases of hybrid ARQ type III can be distinguished:

- Partial IR (with multiple redundancy versions): Different versions of a PDU are transmitted. Different puncture bits are used in each version. If a transmission fails then the a second version is sent. Transmission of further versions or repeated transmissions of the already transmitted versions may be made and can also be soft combined.
- Chase combining (only one redundancy version): In this sub-case of HARQ type III, the same FEC coding is used for each retransmission, similar to the operation of HARQ type I. However, the erroneous packets are stored in the receiver and combined with retransmissions of the packet. This is a kind of incremental redundancy coding scheme in the form of a code repetition where each transmission instance of the same PDU is combined taking the SNR into consideration.
- Note: In both cases, chase combining and partial IR, each transmission instance of the same PDU is self-decodable and thus contains the CRC. This allows for both cases an independent (without taking previous transmission instances into account) or combined decoding (taking previous transmission instances into account). The latter case is more applicable as a combined decoding is from statistical point of view always more reliable.
- [3GTR 25.835 (5.1)]

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Objectives

After this Lecture the Student will be able to:

- **Describe the Turbo Coding and Decoding Principle**
- **State the reason for Hybrid ARQ in HSDPA**
- **Describe the HARQ Functionality**
- **State the different purpose of Rate Matching**
- **Describe different performance of Partial IR and Full IR**

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Objectives

After this Lecture the Student will be able to:

- **Describe the aim and task of packet scheduler in NodeB**
- **State the interworking between MAC-hs in NodeB and MAC-d in RNC**
- **Describe the various functions and components of MAC-hs**
- **State the new HS-DSCH FP Control and Data Frame**
- **Describe the protocol extensions of NBAP**
- **State the basic HSDPA Data Transfer**

Objectives

After this Lecture the Student will be able to:

- **Describe the serving HS-DSCH cell change**
- **State the various HSDPA mobility procedures**
- **Describe the measurement event 1D**
- **State intra and inter NodeB serving HS-DSCH cell change**

Table of Contents

Index

R

S

T

Glossary

Term	Explanation
16-QAM	16 symbols Quadrature Amplitude Modulation ((3GTS 25.213)
2B1Q	Two Binary One Quaternary ((Line Coding used on the ISDN U-Interface)
3G ...	3rd Generation ...
3GPP	Third Generation Partnership Project (Collaboration between different standardization organizations (e.g. ARIB, ETSI) to define advanced mobile communications standards, responsible for UMTS)
3GPP2	Third Generation Partnership Project 2 (similar to 3GPP, but consisting of ANSI, TIA and EIA-41, responsible for cdma2000, EvDO and EVDV)
8-PSK	8 Symbol Phase Shift Keying
AA	Anonymous Access
AAL-2	ATM Adaptation Layer 2 (for real-time services) ((ITU-T I.363.2)
AAL-5	ATM-Adaptation Layer 5 (non-real time) ((ITU-T I.363.5)
A-Bit	Acknowledgement Request Bit ((used in LLC-protocol (Logical Link Control)
ABM	Asynchronous Balanced Mode
ACC	Access Control Class ((3GTS 22.011)
ACCH	Associated Control Channel (GSM / can be an SACCH or an FACCH)
ACK	Acknowledgement ((3GTS 25.214)
ACS	Active Codec Set
ADM	Asynchronous Disconnected Mode
ADPCM	Adaptive Differential Pulse Code Modulation
AES	Advanced Encryption Standard
AESA	ATM End System Address
AG	Absolute Grant ((3GTS 25.309)
AGCH	Access Grant Channel (GSM)
AH	Authentication Header ((RFC 2402)
AI	Acquisition Indicator
AICH	Acquisition Indicator Channel (UMTS Physical Channel)
AK	Anonymity Key ((3GTS 33.102)
AKA	Authentication and key agreement ((3GTS 33.102)
ALCAP	Access Link Control Application Part ((ITU-T Q.2630.1 / Q.2630.2)
AM	Acknowledged Mode operation ((e.g. in UMTS-RLC)
AM	Amplitude Modulation
AMC	Adaptive Modulation and Coding ((3GTS 25.858)
AMD	Acknowledged Mode Data ((UMTS RLC PDU-type)
AMF	Authentication management field ((3GTS 33.102)
AMI	Alternate Mark Inversion ((Line Coding)
AMPS	Advanced Mobile Phone System
AMR	Adaptive Multirate Encoding ((3GTS 26.090)
ANSI	American National Standards Institute
AP	Access Preamble
AP-AICH	CPCH Access Preamble Acquisition Indicator Channel ((UMTS Physical Channel)
API	Access Preamble Acquisition Indicator
APN	Access Point Name ((Reference to a GGSN)
APP	A Posteriori Probability ((Turbo Decoding)
ARFCN	Absolute Radio Frequency Channel Number
ARIB	Association of Radio Industries and Businesses (Japanese)
ARP	Address Resolution Protocol ((RFC 826)
ARQ	Automatic Repeat Request
AS	Application Server
AS	Access Stratum ((UMTS)
ASC	Access Service Class
ASCI	Advanced Speech Call Items ((GSM-R)
ASCII	American Standard Code for Information Interchange
ASIC	Application Specific Integrated Circuit
AS-ILCM	Application Server - Incoming Leg Control Model
ASN.1	Abstract Syntax Notation 1 ((ITU-T X.680 / X.681)
AS-OLCM	Application Server - Outgoing Leg Control Model
AT-Command	Attention-Command
ATM	Asynchronous Transfer Mode ((ITU-T I.361)
AuC	Authentication Center
AUTN	Authentication Token ((3GTS 33.102)
AV	Authentication Vector ((3GTS 33.102)

B8ZS	Bipolar with Eight-Zero Substitution ((Line Code used at the T1-Rate (1.544 Mbit/s))
BB	Base Band module
BC	Broadcast
BCC	Base Station Color Code
BCCH	Broadcast Control Channel (UMTS Logical Cannel)
BCCH	Broadcast Control Channel ((GSM Logical Channel)
BCH	Broadcast Channel (UMTS Transport Channel)
BCTP	Bearer Control Tunneling Protocol ((ITU-T Q.1990)
BEC	Backward Error Correction
BEG	BEGin Message ((TCAP)
BER	Bit Error Rate
BFI	Bad Frame Indication
BG	Border Gateway
BGCF	Breakout Gateway Control Function
BIB	Backward Indicator Bit
BICC	Bearer Independent Call Control ((ITU-T Q.1902.1 – Q.1902.6)
BLER	Block Error Rate
BMC	Broadcast / Multicast Control ((3GTS 25.324)
BM-IWF	Broadcast Multicast Interworking Function
BQA	Bluetooth Qualification Administer
BQB	Bluetooth Qualification Body
BQRB	Bluetooth Qualification Review Board
BQTF	Bluetooth Qualification Test Facility
BS	Base Station
BS_CV_MAX	Maximum Countdown Value to be used by the mobile station ((Countdown Procedure)
BSC	Base Station Controller
BSIC	Base Station Identity Code
BSN	Block Sequence Number ((RLC) / Backward Sequence Number ((SS7)
BSS	Base Station Subsystem
BSSAP	Base Station Subsystem Application Part
BSSGP	Base Station System GPRS Protocol
BSSMAP	Base Station Subsystem Mobile Application Part ((3GTS 48.008)
BTAB	Bluetooth Technical Advisory Board
BTS	Base Transceiver Station
BVCI	BSSGP Virtual Connection Identifier
C/R-Bit	Command / Response Bit
C/T-Field	logical Channel / Transport channel identification Field
CAI	Channel Assignment Indicator
CAP	CAMEL Application Part ((CCS7)
CBC	Cell Broadcast Center
CBCH	Cell Broadcast Channel (GSM)
CC	Call Control
CCC	CPCH Control Command
CCCH	Common Control Channel (UMTS Logical Channel)
CCCH	Common Control Channel (GSM Logical Channel)
CCH	Control Channel
CCITT	Comité Consultatif International Télégraphique et Téléphonique (International Telegraph and Telephone Consultative Committee)
CCM	Common Channel Management (Protocol Part on the GSM Abis-Interface / 3GTS 48.058)
CCN	Cell Change Notification (related to Network Assisted Cell Change / 3GTS 44.060)
CCPCH	Common Control Physical Channel (see also P-CCPCH and S-CCPCH)
CCS7	Common Channel Signaling System No. 7 ((ITU-T Q-series of specifications, in particular Q.700 – Q.703)
CCTrCH	Coded Composite Transport Channel (UMTS)
CCTrCH	Coded Composite Transport Channel (UMTS)
CCU	Channel Codec Unit
CD/CA-ICH	Collision Detection / Channel Assignment Indicator Channel (UMTS Physical Channel)
CDI	Collision Detection Indicator
CDMA	Code Division Multiple Access
CDR	Call Detail Record
CEPT	Conférence Européenne des Postes et Télécommunications
CFN	Connection Frame Number
CG	Charging Gateway
CGF	Charging Gateway Function
CGI	Cell Global Identification
CHAP	Challenge Handshake Authentication Protocol ((RFC 1334)
CIC	Circuit Identity Code ((ISUP)
CIC	Call Instance Code ((BICC)
CID	Channel Identity ((ATM)
CIDR	Classless Inter-Domain Routing ((RFC 1519)

CIO	Cell Individual Offset ((3GTS 25.331)
CK	Ciphering Key
CKSN	Ciphering Key Sequence Number
CMC	Codec Mode Command
CMI	Codec Mode Indication
CMR	Codec Mode Request
CN	Core Network
CON	CONtinue Message ((TCAP)
COPS	Common Open Policy Service Protocol ((RFC 2748)
CPCH	Common Packet Channel (UMTS Transport Channel)(FDD only
CPCS	Common Part Convergence Sublayer
CPICH	Common Pilot Channel (UMTS Physical Channel / see also P-CPICH and S-CPICH)
CPS	Coding and Puncturing Scheme
CQI	Channel Quality Indicator ((3GTS 25.214)
CRNC	Controlling RNC
CS	Coding Scheme
C-SAP	Control Service Access Point
CSCF	Call Session Control Function ((SIP)
CSD	Circuit Switched Data
CSICH	CPCH Status Indicator Channel (UMTS Physical Channel)
CSMA-CA	Carrier-Sense Multiple Access – Collision Avoidance
CSPDN	Circuit Switched Public Data Network
CS-X	Coding Scheme (1 – 4)
CTCH	Common Traffic Channel (Logical) (PTM
CTFC	Calculated Transport Format Combination ((3GTS 25.331)
CV	Countdown Value
CW	Code Word
cwnd	Congestion window
dBm	X [dBm] = 10 x log10(X [W] / 0.001 [W])
DBP	Diameter Base Protocol ((RFC 3588)
DCCH	Dedicated Control Channel (UMTS Logical Channel)
DCH	Dedicated Channel (Transport)
DCM	Dedicated Channel Management (Protocol Part on the GSM Abis-Interface / 3GTS 48.058)
DCS	Digital Communication System
DDI	Data Description Indicator ((3GTS 25.309, 25.331)
DES	Data Encryption Standard
DHCP	Dynamic Host Configuration Protocol ((RFC 2131)
Digit	4 bit
DL	Downlink
DLR	Destination Local Reference ((SCCP term)
DNS	Domain Name System
DPC	Destination Point Code
DPCCH	Dedicated Physical Control Channel (UMTS Physical Channel)
DPCH	Dedicated Physical Channel (UMTS / Term to combine DPDCH and DPCCH)
DPDCH	Dedicated Physical Data Channel (UMTS Physical Channel)
DRNC	Drift Radio Network Controller
DRX	Discontinuous Reception
DS-CDMA	Direct Sequence Code Division Multiple Access
DSCH	Downlink Shared Channel (UMTS Transport Channel)
DSL	Digital Subscriber Line
DSN	Digital Switching Network
DSS1	Digital Subscriber Signaling System No.1 ((also referred to as LAPD-signaling / ITU-T Q.931)
DTAP	Direct Transfer Application Part
DTCH	Dedicated Traffic Channel (UMTS Logical Channel)
DTM	Dual Transfer Mode ((3GTS 43.055)
DTX	Discontinuous Transmission
E-AGCH	E-DCH Absolute Grant Channel ((3GTS 25.211)
Ec/No	Received energy per chip / power density in the band
ECSD	Enhanced Circuit Switched Data ((HSCSD + EDGE)
E-DCH	Enhanced Uplink Dedicated Transport Channel ((3GTS 25.211, 25.309)
EDGE	Enhanced Data Rates for Global Evolution
E-DPCCH	E-DCH Dedicated Physical Control Channel((3GTS 25.211)
E-DPDCH	E-DCH Dedicated Physical Data Channel((3GTS 25.211)
EDR	Enhanced Data Rate ((more speed with Bluetooth 2.0 ((2.0 – 3.0 Mbit/s)
EFR	Enhanced Full Rate speech codec
EGPRS	Enhanced General Packet Radio Service
E-GSM	Extended GSM (GSM 900 in the Extended Band)
E-HICH	E-DCH HARQ Acknowledgement Indicator Channel ((3GTS 25.211)
EIA	Electronic Industries Alliance (US-organization to support US industry)

EIR	Equipment Identity Register
EIRENE	European Integrated Railway Radio Enhanced Network ((GSM-R)
eMLPP	enhanced Multi-Level Precedence and Pre-emption ((3GTS 23.067)
END	END Message ((TCAP)
E-RGCH	E-DCH Relative Grant Channel ((3GTS 25.211)
E-RNTI	E-DCH Radio Network Temporary Identifier ((3GTS 25.401)
ESN	Electronic Serial Number (North American Market)
ESP	Encapsulating Security Payload ((RFC 2406)
E-TFC	E-DCH Transport Format Combination ((3GTS 25.309)
Ethernet	Layer 2 Protocol for IP ((IEEE 802.3)
ETSI	European Telecommunications Standard Institute
EvDO	Evolution Data Only or Evolution Data Optimized ((cdma2000)
EVDV	Evolution Data/Voice ((cdma2000)
EVM	Error Vector Magnitude
FACCH	Fast Associated Control Channel (GSM)
FACH	Forward Access Channel (UMTS Transport Channel)
FBI	Feedback Information (UMTS
FBI	Final Block Indicator
FCC	Federal Communications Commission
FCCH	Frequency Correction Channel (GSM)
FCS	Frame Check Sequence (CRC-Check)
FDD	Frequency Division Duplex
FDDI	Fiber Distributed Data Interconnect (optical Layer 2)
FDMA	Frequency Division Multiple Access
FEC	Forward Error Correction
FER	Frame Error Rate
FFH	Fast Frequency Hopping
FH-CDMA	Frequency Hopping Code Division Multiple Access
FIB	Forward Indicator Bit
FISU	Fill In Signal Unit
FMC	Fixed Mobile Convergence
FN	Frame Number
FPB	First Partial Bitmap
FR	Fullrate or Frame Relay
FRMR	Frame Reject
FSN	Forward Sequence Number
FTP	File Transfer Protocol ((RFC 959)
GCC	Generic Call Control
GCF	General Certification Forum
GEA	GPRS Encryption Algorithm
GERAN	GSM EDGE Radio Access Network
GGSN	Gateway GPRS Support Node
GIF	Graphics Interchange Format
GK	Gatekeeper
GMM	GPRS Mobility Management
G-MSC	Gateway MSC
GMSC-S	Gateway MSC Server
GMSK	Gaussian Minimum Shift Keying
G-PDU	T-PDU + GTP-Header
GPRS	General Packet Radio Service
GPRS-CSI	GPRS CAMEL Subscription Information
GPRS-SSF	GPRS Service Switching Function ((CAMEL)
GPS	Global Positioning System
GSM	Global System for Mobile Communication
GSM-R	GSM for Railways
GSN	GPRS Support Node
GTP	GPRS Tunneling Protocol ((3GTS 29.060)
GTP-C	GTP Control Plane
GTP-U	GTP User Plane
GTT	Global Text Telephony ((3GTS 23.226)
GTTP	GPRS Transparent Transport Protocol ((3GTS 44.018)
HARQ	Hybrid ARQ ((3GTS 25.212)
HCS	Hierarchical Cell Structure
HDB3	High Density Bipolar Three ((Line Coding used for E1 (PCM 30))
HDLC	High level Data Link Control
HLR	Home Location Register
HMAC	Keyed Hashing for Message Authentication ((RFC 2104)
H-PLMN	Home PLMN
HR	Halfrate

H-RNTI	HS-DSCH Radio Network Transaction Identifier ((3GTS 25.331, 25.433)
HSCSD	High Speed Circuit Switched Data
HSDPA	High Speed Downlink Packet Access ((3GTS 25.301, 25.308, 25.401, 3GTR 25.848)
HS-DPCCH	High Speed Dedicated Physical Control Channel ((3GTS 25.211)
HS-DSCH	High Speed Downlink Shared Transport Channel ((3GTS 25.211, 25.212, 25.308)
HS-PDSCH	High Speed Physical Downlink Shared Channel ((3GTS 25.211)
HSS	Home Subscriber Server ((3GTS 23.002). HSS replaces the HLR with 3GPP Rel. 5
HS-SCCH	High Speed Shared Control Channel ((3GTS 25.211, 25.214)
HSUPA	High Speed Uplink Packet Access ((3GTS 25.301, 25.309, 25.401, 3GTR 25.896)
HTTP	HyperText Transfer Protocol ((RFC 2616)
HUMAN	High-speed Unlicensed Metropolitan Area Network
I+S	Information + Supervisory
IAM	Initial Address Message (ISUP (ISDN User Part)
IANA	Internet Assigned Numbers Authority
ICANN	Internet Corporation for Assigned Names and Numbers
ICH	Indicator Channel (UMTS Physical Channel / see also PICH, AICH, CD/CA-ICH)
ICH	Indicator Channel
ICM	Initial Codec Mode
ICMP	Internet Control Message Protocol ((RFC 792)
ICS	Implementation Conformance Statement
I-CSCF	Interrogating Call Session Control Function ((SIP)
IE	Information Element
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force (www.ietf.org)
IHOSS	Internet Hosted Octet Stream Service
IK	Integrity Key
IKE	Internet Key Exchange ((RFC 2409)
IKMP	Internet Key Management Protocol
ILCM	Incoming Leg Control Model
IMEI	International Mobile Equipment Identity
IMPI	IP Multimedia Private Identity
IMPU	IP Multimedia Public Identity
IMS	Internet Protocol Multimedia Core Network Subsystem ((Rel. 5 onwards)
IMSI	International Mobile Subscriber Identity
IMT-2000	International Mobile Telecommunications for the year 2000
INAP	Intelligent Network Application Part ((CCS7)
IOV-I / IOV-UI	Input Offset Variable for I+S and UI-Frames ((for ciphering in GPRS)
IP	Internet Protocol ((RFC 791)
IPBCP	IP Bearer Control Protocol ((ITU-T Q.1970)
IPCP	Internet Protocol Control Protocol ((RFC 1332)
IPsec	Internet Protocol / secure ((RFC 2401)
IPv4	Internet Protocol (version 4)
IPv6	Internet Protocol (version 6)
IR	Incremental Redundancy ((ARQ II)
ISAKMP	Internet Security Association and Key Management Protocol ((RFC 2408)
ISC	IP multimedia Subsystem Service Control-Interface
ISCP	Interference Signal Code Power ((3GTS 25.215 / 3GTS 25.102)
ISDN	Integrated Services Digital Network
I-SIM	IMS capable SIM
ISO	International Standardization Organization
ISP	Internet Service Provider
ISPC	International Signaling Point Code ((ITU-T Q.708)
ISUP	ISDN User Part ((ITU-T Q.761 – Q.765)
ITU-T	International Telecommunication Union – Telecommunication Sector
Iub-FP	Iub-Frame Protocol ((3GTS 25.427 / 25.435)
Iu-FP	Iu-Frame Protocol ((3GTS 25.415)
Iur-FP	Iur-Frame Protocol ((3GTS 25.424, 3GTS 25.425, 25.426, 25.435)
JPEG	Joint Picture Expert Group
kbps	kilo-bits per second
L1	Layer 1 (physical layer)
L2	Layer 2 (data link layer)
L2TP	Layer 2 Tunneling Protocol ((RFC 2661)
L3	Layer 3 (network layer)
LA	Location Area
LAC	Location Area Code
LAI	Location Area Identification (LAI = MCC + MNC + LAC)
LAPB	Link Access Procedure Balanced
LAPD	Link Access Protocol for the ISDN D-Channel

LBS	Location Based Service
LCP	Link Control Protocol ((PPP)
LCS	LoCation Service
LI	Length Indicator
LLC	Logical Link Control-Protocol
LPD	Link Protocol Discriminator
LSB	Least Significant Bit
LSSU	Link Status Signal Unit
M3UA	MTP-3 User Adaptation Layer ((RFC 3332 / 3GPP 29.202 (Annex A))
MAC	Medium Access Control (UMTS (3GTS 25.321)
MAC	Medium Access Control ((E)GPRS (3GTS 04.60 / 3GTS 44.060)
MAC	Message Authentication Code ((3GTS 33.102)
MAC-e	MAC-E-DCH ((3GTS 25.321)
MAC-es	MAC-E-DCH SRNC ((3GTS 25.321)
MAC-hs	MAC-High Speed ((3GTS 25.321)
MAN	Metropolitan Area Network
MAP	Mobile Application Part
MASF	Minimum Available Spreading Factor
Max [X, Y]	The value shall be the maximum of X or Y, which ever is bigger
MBZ	Must Be Zero
MCC	Mobile Country Code
Mcps	Mega Chip Per Second
MCS-X	Modulation and Coding Scheme (1 – 9) and for HSDPA / HSUPA
MCU	Multipoint Control Unit ((H.323 equipment)
MD-X	Message Digest Algorithm (MD-2, 4, 5 are defined) (MD-5 (RFC 1321)
ME	Mobile Equipment (ME + SIM = MS)
MEGACO	Media Gateway Control Protocol ((ITU-T H.248 incl. Annex F – H and IETF RFC 3015)
MExE	Mobile Station Application Execution Environment
MGC	Media Gateway Controller
MGCF	Media Gateway Control Function
MGCP	Media Gateway Control Protocol ((RFC 2705)
MGW	Media Gateway
MIDI	Musical Instrument Digital Interface
MIME	Multipurpose Internet Mail Extensions
MIMO	Multiple In, Multiple Out ((3GTR 25.848)
MIN	Mobile Identity Number (North American Market)
Min [X, Y]	The value shall be the minimum of X or Y, which ever is smaller
MLP	MAC Logical Channel Priority
MLPP	Multi-Level Precedence and Pre-emption ((ITU-T Q.85 / Clause 3)
MM	Mobility Management
MMCC	Multimedia Call Control
MMS	Multimedia Messaging Service ((3GTS 22.140, 3GTS 23.140]
MNC	Mobile Network Code
MNRG	Mobile Not Reachable for GPRS flag
MOC	Mobile Originating Call
MPCC	Multiparty Call Control
MPEG	Motion Picture Expert Group
MRFC	Multimedia Resource Function Controller
MRFP	Multimedia Resource Function Processor
MRU	Maximum Receive Unit ((PPP)
MRW	Move Receiving Window
MS	Mobile Station
MSB	Most Significant Bit
MSC	Mobile Services Switching Center
MSC-S	MSC-Server
MS-ISDN	Mobile Subscriber – International Service Directory Number
MSS	Maximum Segment Size ((TCP)
MSU	Message Signal Unit
MT	Mobile Terminal or Mobile Terminating
MTC	Mobile Terminating Call
MTP	Message Transfer Part ((ITU-T Q.701 – Q.709)
MTP-3b	Message Transfer Part level 3 / broadband ((ITU-T Q.2210)
MTU	Maximum Transmit Unit ((IP)
NACC	Network Assisted Cell Change ((3GTS 44.060)
NACK	Negative Acknowledgement ((3GTS 25.308, 25.309))
NAS	Non-Access-Stratum ((UMTS)
NAT	Network Address Translation ((RFC 1631)
NBAP	NodeB Application Part ((3GTS 25.433)

NBNS	NetBios Name Service
NC	Neighbor Cell
NCC	Network Color Code
NCP	Network Control Protocol ((PPP)
NGN	Next Generation Networks
NI	Network Indicator
NIC	Network Interface Card
NPB	Next Partial Bitmap
N-PDU	Network-Protocol Data Unit ((IP-Packet, X.25-Frame)
NS	Network Service
NSAPI	Network Service Access Point Identifier
N-SAW	N-Channel Stop and Wait ((3GTS 25.309, 3GTR 25.848)
NSE	Network Service Entity
NSPC	National Signaling Point Code
NSS	Network Switching Subsystem
NS-VC	Network Service – Virtual Connection
NS-VCG	Network Service – Virtual Connection Group
NS-VL	Network Service – Virtual Link
NT	Network Termination
O&M	Operation and Maintenance
Octet	8 bit
OLCM	Outgoing Leg Control Model
OMA	Open Mobile Alliance ((http://www.openmobilealliance.org/)
OMC	Operation and Maintenance Center
OoBTC	Out of Band Transcoder Control ((3GTS 23.153)
OPC	Originating Point Code
OPWA	One Pass With Advertising ((Term in RSVP)
OSA	Open Service Access
OSA-SCS	Open Service Access – Service Capability Server
OSI	Open System Interconnection
OSP	Octet Stream Protocol
OTDOA	Observed Time Difference Of Arrival
OVSF	Orthogonal Variable Spreading Factor
P/F-Bit	Polling/Final - Bit
PABX	Private Automatic Branch Exchange
PACCH	Packet Associated Control Channel ((E)GPRS)
PAD	Packet Assembly Disassembly
PAGCH	Packet Access Grant Channel ((E)GPRS)
PAP	Password Authentication Protocol ((RFC 1334)
PBCCH	Packet Broadcast Control Channel ((E)GPRS)
PCCCH	Packet Common Control Channel ((E)GPRS)
PCCH	Paging Control Channel (UMTS Logical Channel)
P-CCPCH	Primary Common Control Physical Channel (UMTS / used as bearer for the BCH TrCH)
PCH	Paging Channel (UMTS / Transport Channel)
PCH	Paging Channel (GSM / Logical Channel)
PCM	Pulse Code Modulation
PCN	Personal Communication Network
PCPCH	Physical Common Packet Channel (UMTS Physical Channel)
P-CPICH	Primary Common Pilot Channel (UMTS Physical Channel)
PCS	Personal Communication System
P-CSCF	Proxy Call Session Control Function ((SIP)
PCU	Packet Control Unit
PD	Protocol Discriminator
PDCH	Packet Data Channel ((E)GPRS)
PDCP	Packet Data Convergence Protocol ((3GTS 25.323)
PDF	Policy Decision Function ((Part of the IP Multimedia Subsystem)
PDH	Plesiochronous Digital Hierarchy
PDN	Packet Data Network
PDP	Packet Data Protocol
PDSCH	Physical Downlink Shared Channel (UMTS Physical Channel)
PDTCH	Packet Data Traffic Channel ((E)GPRS)
PDU	Protocol Data Unit or Packet Data Unit
PER	Packed Encoding Rules ((ITU-T X.691)
PFC	Packet Flow Context
PFI	Packet Flow Identifier
PHY	Physical Layer
PICH	Page Indicator Channel (UMTS Physical Channel)
PLC	Power Line Communications

PLMN	Public Land Mobile Network
PMM	Packet Mobility Management
PN	Pseudo Noise
PNCH	Packet Notification Channel ((E)GPRS)
PoC	Push to talk over Cellular ((3GTR 29.979 and various OMA-specifications)
POP	Post Office Protocol ((RFC 1939)
POTS	Plain Old Telephone Service
PPCH	Packet Paging Channel ((E)GPRS)
PPP	Point-to-Point Protocol ((RFC 1661)
PRA	PCPCH Resource Availability
PRACH	Physical Random Access Channel (UMTS
PRACH	Packet Random Access Channel ((E)GPRS)
PRD	Bluetooth Qualification Program Reference Document
PRI	Primary rate access ISDN-user interface for PABX's (23 or 30 B-channels plus one D-Channel)
PS	Puncturing Scheme
PSC	Primary Synchronization Code or Primary Scrambling Code (both used in UMTS)
P-SCH	Primary Synchronization Channel (physical)
PSD	Power Spectral Density ((3GTS 25.215 / 3GTS 25.102)
PSK	Phase Shift Keying
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
PT	Protocol Type ((GTP or GTP')
PTCCH	Packet Timing Advance Control Channel ((E)GPRS)
PTCCH/D	Packet Timing Advance Control Channel / Downlink Direction ((E)GPRS)
PTCCH/U	Packet Timing Advance Control Channel / Uplink Direction ((E)GPRS)
PTM	Point to Multipoint
P-TMSI	Packet TMSI
PTP	Point to Point
PVC	Permanent Virtual Circuit
QE	Quality Estimate
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying ((3GTS 25.213)
RA	Routing Area
RAB	Radio Access Bearer
RAC	Routing Area Code
RACH	Random Access Channel (UMTS Transport Channel)
RACH	Random Access Channel (GSM)
RADIUS	Remote Authentication Dial In User Service ((RFC 2865)
RAI	Routing Area Identification
RANAP	Radio Access Network Application Part ((3GTS 25.413)
RAND	Random Number
RAT	Radio Access Technology (e.g. GERAN, UTRAN, ...)
RATSCCH	Robust AMR Traffic Synchronized Control CHannel
RB	Receive Block Bitmap ((EGPRS)
RB	Radio Bearer
RBB	Receive Block Bitmap ((GPRS)
REJ	Reject
RF	Radio Frequency
RFC	Request for Comments ((Internet Standards)
RFID	Radio Frequency Identification
RG	Relative Grant ((3GTS 25.309)
R-GSM	Railways-GSM
RL	Radio Link
RLC	Radio Link Control (UMTS (3GTS 25.322)
RLC	Radio Link Control ((E)GPRS / 3GTS 04.60 / 3GTS 44.060)
RLM	Radio Link Management (Protocol Part on the GSM Abis-Interface / 3GTS 48.058)
RLP	Radio Link Protocol ((3GTS 24.022)
RLS	Radio Link Set ((3GTS 25.309, 25.433)
RNC	Radio Network Controller
RNL	Radio Network Layer
RNR	Receive Not Ready
RNS	Radio Network Subsystem
RNSAP	Radio Network Subsystem Application Part ((3GTS 25.423)
RNTI	Radio Network Temporary Identifier
RPLMN	Registered PLMN
RPR	Resilient Packet Ring ((IEEE 802.17)
RR	Radio Resource Management
RR	Receive Ready (LAPD/LLC/RLP-Frame Type)

RRBP	Relative Reserved Block Period
RRC	Radio Resource Control ((3GTS 25.331)
RRC-Filter	Root Raised Cosine Filter
RSC	Recursive Systematic Convolutional Coder((Turbo Coding, 25.212)
RSCP	Received Signal Code Power ((3GTS 25.215)
RSN	Retransmission Sequence Number ((3GTS 25.309)
RSSI	Received Signal Strength Indicator
RSVP	Resource Reservation Protocol ((RFC 2205)
RTO	Retransmission Time Out
RTP	Real-time Transport Protocol ((RFC 3550)
RTT	RoundTrip Time ((RFC 793)
RV	Redundancy and Constellation Version ((3GTS 25.212)
RX	Receive
SA	Service Area
SAAL-NNI	Signaling ATM Adaptation Layer – Network Node Interface
SAB	Service Area Broadcast
SABM(E)	Set Asynchronous Balanced Mode (Extended for Modulo 128 operation) (LAPD/LLC/RLP-Frame Type)
SABP	Service Area Broadcast Protocol ((3GTS 25.419)
SACCH	Slow Associated Control Channel (GSM)
SACCH/MD	SACCH Multislot Downlink (related control channel of TCH/FD / GSM)
SAI	Service Area Identifier
SAIC	Single Antenna Interference Cancellation
SANC	Signaling Area Network Code ((ITU-T Q.708)
SAP	Service Access Point
SAPI	Service Access Point Identifier
SAR	Segmentation And Reassembly (ATM-sublayer)
SC	Serving Cell
SCCP	Signaling Connection Control Part ((ITU-T Q.711 – Q.714)
S-CCPCH	Secondary Common Control Physical Channel (used as bearer for the FACH and PCH TrCH's / UMTS Physical Channel)
SCH	Synchronization Channel (UMTS Physical Channel / see also P-SCH and S-SCH)
SCH	Synchronization Channel (GSM)
S-CPICH	Secondary Common Pilot Channel (UMTS Physical Channel)
SCR	Source Controlled Rate
S-CSCF	Serving Call Session Control Function ((SIP)
SCTP	Stream Control Transmission Protocol ((RFC 2960)
SDCCH	Stand Alone Dedicated Control Channel
SDH	Synchronous Digital Hierarchy
SDMA	Space Division Multiple Access
SDU	Service Data Unit ((the payload of a PDU)
SF	Spreading Factor
SFH	Slow Frequency Hopping
SFN	System Frame Number
SG	Security Gateway (IPsec / (RFC 2401)
SGSN	Serving GPRS Support Node
SGW	Signaling Gateway (SS7 (IP)
SHA	Secure Hash Algorithm
SHCCH	Shared Channel Control Channel (UMTS Logical Channel / (TDD only)
SI	Service Indicator
SIB	System Information Block
SID	Silence Insertion Descriptor
SID	Size InDex ((3GPP 25.321)
SIF	Signaling Information Field
SIG	Special Interest Group ((e.g. Bluetooth)
SIM	Subscriber Identity Module
SIO	Service Information Octet
SIP	Session Initiation Protocol ((RFC 3261)
SIR	Signal to Interference Ratio
SLC	Signaling Link Code
SLF	Subscriber Locator Function
SLR	Source Local Reference
SLS	Signaling Link Selection
SLTA	Signaling Link Test Acknowledge
SLTM	Signaling Link Test Message
SM	Session Management ((3GTS 23.060, 3GTS 24.008)
SMS	Short Message Service ((3GTS 24.011, 3GTS 23.040)
SM-SC	Short Message Service Center
SMSCB	Short Message Services Cell Broadcast
SMS-G-MSC	SMS Gateway MSC (for Short Messages destined to Mobile Station)

SMS-IW-MSC	SMS Interworking MSC (for Short Messages coming from Mobile Station)
SMTP	Simple Mail Transfer Protocol ((RFC 2821)
SN	Sequence Number
SND	Sequence Number Downlink ((GTP)
SNDCP	Subnetwork Dependent Convergence Protocol
SNM	Signaling Network Management Protocol ((ITU-T Q.704 (3))
SNN	SNDCP N-PDU Number Flag
SN-PDU	Segmented N-PDU (SN-PDU is the payload of SNDCP)
SNR	Signal to Noise Ratio
SNTM	Signaling Network Test & Maintenance ((ITU-T Q.707)
SNU	Sequence Number Uplink ((GTP)
SOAP	Simple Object Access Protocol ((http://www.w3.org/TR/2000/NOTE-SOAP-20000508)
SPC	Signaling Point Code
SPI	Security Parameter Index ((RFC 2401)
SQN	Sequence number (used in UMTS-security architecture / 3GTS 33.102)
SRB	Signaling Radio Bearer
SRES	Signed Response
SRNC	Serving Radio Network Controller
SRNS	Serving Radio Network Subsystem
SRTT	Smoothed RoundTrip Time ((RFC 793)
SSC	Secondary Synchronization Code
SSCF	Service Specific Co-ordination Function
SSCF/NNI	Service Specific Coordination Function – Network Node Interface Protocol ((ITU-T Q.2140)
SSCF/UNI	Service Specific Coordination Function – User Network Interface Protocol ((ITU-T Q.2130)
S-SCH	Secondary Synchronization Channel (physical)
SSCOP	Service Specific Connection Oriented Protocol ((ITU-T Q.2110)
SSCOPMCE	Service Specific Connection Oriented Protocol in a Multi-link or Connectionless Environment ((ITUT Q.2111)
SSCS	Service Specific Convergence Sublayer
SSDT	Site Selection Diversity Transmission
SSN	Start Sequence Number ((related to ARQ-Bitmap in GPRS / EGPRS)
SSN	Send Sequence Number ((GSM MM and CC-Protocols)
SSSAR	Service Specific Segmentation And Reassembly ((ITU-T I.366.1)
ssthresh	Slow start threshold ((RFC 2001)
STC	Signaling Transport Converter on MTP-3 and MTP-3b ((ITU-T Q.2150.1) / Signaling Transport Converter on SSCOP and SSCOPMCE ((ITU-T Q.2150.2)
STTD	Space Time block coding based Transmission Diversity
SUERM	Signal Unit Error Rate Monitor ((ITU-T Q.703 (10))
SUFI	Super Field (RLC-Protocol)
SVC	Switched Virtual Circuit
SWAP	Shared Wireless Access Protocol ((Home RF)
TA	Terminal Adapter ((ISDN)
TA	Timing Advance
TACS	Total Access Communication System
TAF	Terminal Adopter Function ((3GTS 27.001)
TAI	Timing Advance Index
TB	Transport Block
TBF	Temporary Block Flow
TBS	Transport Block Set
TCAP	Transaction Capabilities Application Part ((Q.771 – Q.773)
TCH	Traffic Channel
TCH/FD	Traffic Channel / Fullrate Downlink
TCH-AFS	Traffic CHannel Adaptive Full rate Speech
TCH-AHS	Traffic Channel Adaptive Half rate Speech
TCP	Transmission Control Protocol
TCTF	Target Channel Type Field
TCTV	Transport Channel Traffic Volume
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
TE	Terminal Equipment
TEID	Tunnel Endpoint Identifier ((GTP / 3GTS 29.060)
TF	Transport Format
TFC	Transport Format Combination
TFCI	Transport Format Combination Identifier
TFCS	Transport Format Combination Set
TFI	Transport Format Indication ((UMTS)
TFI	Temporary Flow Identity (((E)GPRS)
TFO	Tandem Free Operation ((3GTS 22.053)
TFRC	Transport Format and Resource Combination ((3GTS 25.308)
TFRI	Transport Format and Resource Indicator (<=> 3GTS 25.308, 25.321)

TFS	Transport Format Set
TGD	Transmission Gap start Distance ((3GTS 25.215)
TGL	Transmission Gap Length ((3GTS 25.215)
TGPRC	Transmission Gap Pattern Repetition Count ((3GTS 25.215)
TGSN	Transmission Gap Starting Slot Number ((3GTS 25.215)
TH-CDMA	Time Hopping Code Division Multiple Access
THIG	Topology Hiding Inter Network Gateway
TI	Transaction Identifier
TIA	Telecommunications Industry Association
TID	Tunnel Identifier
TLLI	Temporary Logical Link Identifier
TLS	Transport Layer Security ((RFC 2246 / RFC 3546 / formerly known as SSL or Secure Socket Layer)
TLV	Tag / Length / Value Notation
TM	Transparent Mode operation ((UMTS-RLC)
TM	Transmission Modules
TMD	Transparent Mode Data ((UMTS RLC PDU-type)
TMSI	Temporary Mobile Subscriber Identity
TNL	Transport Network Layer ((3GTS 25.401)
TPC	Transmit Power Command
T-PDU	Payload of a G-PDU which can be user data, i.e. possibly segmented IP-frames, or GTP signaling information ((GTP)
TQI	Temporary Queuing Identifier
TRAU	Transcoder and Rate Adaption Unit
TrCH	Transport Channel (UMTS)
TrFO	Transcoder Free Operation
TrGW	Transition Gateway (IPv4 (IPv6)
TRX	Transmitter / Receiver
TS	Timeslot
TSC	Training Sequence Code
TSN	Transmission Sequence Number ((3GTS 25.321)
TSTD	Time Switched Transmit Diversity
TTI	Transmission Time Interval
TTL	Time To Live ((IP-Header / RFC 791)
TX	Transmit
UA	User Agent
UA	Unnumbered Acknowledgement (LAPD/LLC/RLP-Frame Type)
UAC	User Agent Client
UARFCN	UMTS Absolute Radio Frequency Channel Number
UART	Universal Asynchronous Receiver and Transmitter
UAS	User Agent Server
UDP	User Datagram Protocol ((RFC 768)
UE	User Equipment
UEA	UMTS Encryption Algorithm ((3GTS 33.102)
UI	Unnumbered Information ((LAPD) / Unconfirmed Information ((LLC) / Frame Type
UIA	UMTS Integrity Algorithm ((3GTS 33.102)
UICC	Universal Integrated Circuit Card ((3GTS 22.101 / Bearer card of SIM / USIM)
UL	Uplink
UM	Unacknowledged Mode operation ((UMTS-RLC)
UMD	Unacknowledged Mode Data ((UMTS RLC PDU-type)
UMTS	Universal Mobile Telecommunication System
URA	UTRAN Registration Area
URI	Uniform Resource Identifier
URL	Uniform Resource Locator ((RFC 1738)
USAT	USIM Application Toolkit
USB	Universal Serial Bus
USCH	Uplink Shared Channel (UMTS Transport Channel (TDD only
USF	Uplink State Flag
USIM	Universal Subscriber Identity Module ((3GTS 31.102)
UTF-8	Unicode Transformation Format-X (Is an X-bit) lossless encoding of Unicode characters)
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network
UUI	User to User Information
UUS	User-User-Signaling ((3GTS 23.087)
UWB	Ultra-Wide Band
UWC	Universal Wireless Convergence (Merge IS-136 with GSM)
VAD	Voice Activity Detector
VBS	Voice Broadcast Service ((GSM-R)
VC	Virtual Circuit
VCI	Virtual Circuit Identifier ((ATM)
VGCS	Voice Group Call Service ((GSM-R)

VHE	Virtual Home Environment ((3GTS 22.121, 3GTS 23.127)
VLR	Visitor Location Register
VPI	Virtual Path Identifier ((ATM)
V-PLMN	Visited PLMN
VPN	Virtual Private Network
WAP	Wireless Application Protocol
WCDMA	Wide-band Code Division Multiple Access
WIMAX	Worldwide Interoperability for Microwave Access ((IEEE 802.16)
WINS	Windows Internet Name Service
W-LAN	Wireless Local Area Network ((IEEE 802.11)
WMAN	Wireless Metropolitan Area Network
WSN	Window Size Number
XID	Exchange Identification (LAPD/LLC-Frame Type)
XOR	Exclusive-Or Logical Combination

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