

- Support for dynamic and semi-static resource allocation

**Random Access Channel (RACH)**

- Supports transmission of limited control information
- Possible risk of collision

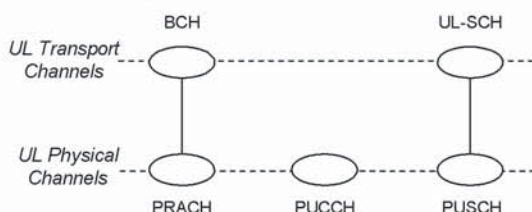
**3.2.6 Mapping Uplink Physical Channels to Transport Channels**

Transport channels are mapped to physical channels as shown in Figure 3.2.6-1.

**3.2.7 Coding**

The UL-SCH uses the same rate 1/3 turbo encoding scheme (two 8-state constituent encoders and one internal interleaver) as the DL-SCH.

**Figure 3.2.6-1 Mapping of UL Transport Channels to UL Physical Channels**



**3.3 MB-SFN**

Multimedia Broadcast Multicast Services (MBMS) are performed either in a single cell or multi-cell mode. In single cell transmissions, MBMS traffic is mapped to the DL-SCH. In multi-cell mode, transmissions from cells are carefully synchronized to form a Multicast/Broadcast – Single Frequency Network (MB-SFN).

MB-SFN is an elegant application of OFDM for cellular broadcast. The principle of operation is quite simple. Identical transmissions are broadcast from closely coordinated cells simultaneously on a common frequency. Signals from adjacent cells arrive at the receiver and are dealt with in the same manner as multipath delayed signals. In this manner, UE can combine the energy from multiple transmitters with no additional receiver complexity.

If the UE is at a cell boundary, the relative delay between the two signals is quite small. However, if the UE is close to one base station and relatively distant from a second base station, the amount of delay between the two signals can be quite large. For this reason, MB-SFN transmissions are supported using a 7.5 kHz subcarrier spacing and a longer CP. MB-SFN networks also use a common reference signal from all transmitters within the network to facilitate channel estimation.

As a consequence of the MB-SFN transmission scheme, UE can roam between cells with no handoff procedure required. Signals from various cells will vary in strength and in relative delay, but in aggregate the received signal is still dealt with in the same manner as a conventional single channel OFDM transmission.

**4 Conclusions**

Although incomplete, the LTE specifications do contain a great deal of useful information. It is entirely possible to construct a reasonably accurate picture of the LTE physical layer at this time. This discussion has hopefully provided the reader with a reasonably complete description of the LTE PHY. In some cases, material has been omitted for the sake of brevity. In other instances, the LTE specifications do not contain much detail at this time. As mentioned above, work on the 3GPP LTE specification is on going at this time and will not be complete before late this year or possibly early 2008.

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## 6 Acronyms and Abbreviations

16QAM	16 point quadrature amplitude modulation	MBMS	Multimedia broadcast multicast service
3GPP	Third Generation Partnership Project	MB-SFN	Multicast/broadcast – single frequency network
64QAM	64 point quadrature amplitude modulation	MCH	Multicast channel
ACK	Acknowledgement	MIMO	Multiple Input Multiple Output
AGC	Automatic gain control	MRC	Maximal ratio combining
AP	Access point	NACK	Not acknowledgement
ARQ	Automatic repeat request	OFDM	Orthogonal Frequency Division Multiplexing
BCH	Broadcast channel	PAPR	Peak-to-average power ratio
BPSK	Binary phase shift keying	PCH	Paging channel
BW	Bandwidth	PDCCH	Physical downlink control channel
CCPCH	Common control physical channel	PDSCH	Physical downlink shared channel
CDD	Cyclic delay diversity	PHY	Physical layer
CDMA	Code Division Multiple Access	PRACH	Physical random access channel
CIR	Channel impulse response	PRB	Physical resource block
CP	Cyclic prefix	PRN	Pseudo random numerical sequence
CQI	Channel quality indication	PSK	Phase shift keying
CSMA	Carrier sense multiple access	PUCCH	Physical uplink control channel
DC	Direct current	PUSCH	Physical uplink shared channel
DFT	Discrete Fourier transform	QAM	Quadrature amplitude modulation
DL	Downlink	QPSK	Quadrature phase shift keying
DL-SCH	Downlink-shared channel	RACH	Random access channel
DRX	Discontinuous receive	RFE	Radio front end
eNodeB	Enhanced Node B (enhanced base station)	RFPA	Radio frequency power amplifier
FDD	Frequency division duplexing	S/P	Serial-to-parallel
FFT	Fast Fourier transform	SAP	Service access point
GMSK	Gaussian minimum shift keying	SC-FDMA	Single Carrier – Frequency Division Multiple Access
GT	Guard time	SNR	Signal-to-noise ratio
HARQ	Hybrid automatic repeat request	STA	Station
HSDPA	High Speed Downlink Packet Access	TDD	Time Division Duplexing
HSUPA	High Speed Uplink Packet Access	UE	User equipment
ICI	Inter carrier interface	UL	Uplink
IDFT	Inverse discrete Fourier transform	UL-SCH	Uplink – shared channel
IEEE	Institute of Electrical and Electronics Engineers	XCVR	Transceiver
IFFT	Inverse fast Fourier transform		
ISI	Inter symbol interface		
LO	Local oscillator		
LTE	Long Term Evolution		

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