1.1 Restricted Protocol Description

E5776s-420 is a LTE CPE works on TDD 3.5GHz (3650~3675MHz). It provides LTE access for user device connected with Ethernet and Wi-Fi link. , E5776s-420 is a LTE client device. The transmitter and receiver works as LTE eNodeB required according to LTE TDD protocol 3GPP release 9.

The following synchronized TDD framing diagram is used to allow satisfactory sharing of the spectrum with similar systems.

As refer in <3GPP TS 36.211>, frame structure type 2 is applicable to TDD. Each radio frame of length $T_f = 307200 \cdot T_s = 10\ \text{ms}$ consists of two half-frames of length $153600 \cdot T_s = 5\ \text{ms}$ each. Each half-frame consists of five subframes of length $30720 \cdot T_s = 1\ \text{ms}$. The supported uplink-downlink configurations are listed in Table 1-1 where, for each subframe in a radio frame, "D" denotes the subframe is reserved for downlink transmissions, "U" denotes the subframe is reserved for uplink transmissions and "S" denotes a special subframe with the three fields DwPTS, GP and UpPTS. The length of DwPTS and UpPTS is given by Table 1-1 subject to the total length of DwPTS, GP and UpPTS being equal to $30720 \cdot T_s = 1\ \text{ms}$. Each subframe i is defined as two slots, $2i$ and $2i+1$ of length $T_{\text{slot}} = 15360 \cdot T_s = 0.5\ \text{ms}$ in each subframe.

Uplink-downlink configurations with both 5 ms and 10 ms downlink-to-uplink switch-point periodicity are supported.

In case of 5 ms downlink-to-uplink switch-point periodicity, the special subframe exists in both half-frames.

In case of 10 ms downlink-to-uplink switch-point periodicity, the special subframe exists in the first half-frame only.

Subframes 0 and 5 and DwPTS are always reserved for downlink transmission. UpPTS and the subframe immediately following the special subframe are always reserved for uplink transmission.

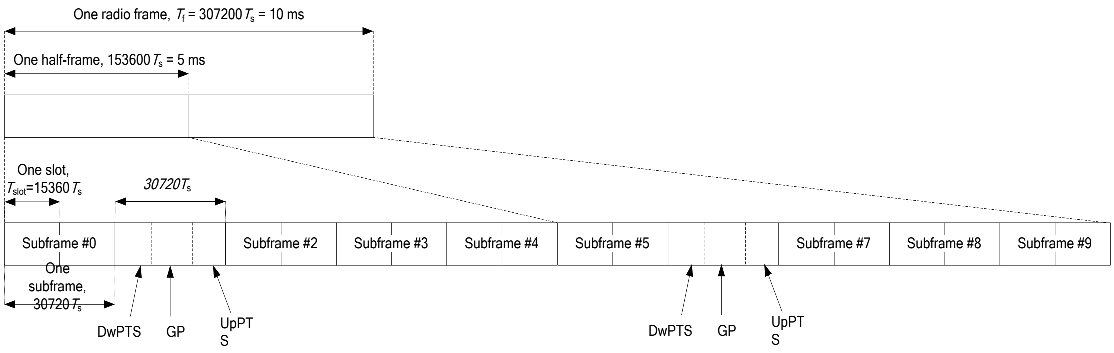

Figure 1-1 Frame structure type 2 (for 5 ms switch-point periodicity).

Special subframe configuration	**Normal cyclic prefix in downlink**			**Extended cyclic prefix in downlink**		
	DwPTS	**UpPTS**		**DwPTS**	**UpPTS**	
		Normal cyclic prefix in uplink	**Extended cyclic prefix in uplink**		**Normal cyclic prefix in uplink**	**Extended cyclic prefix in uplink**
0	$6592 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$	$7680 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$
1	$19760 \cdot T_s$			$20480 \cdot T_s$		
2	$21952 \cdot T_s$			$23040 \cdot T_s$		
3	$24144 \cdot T_s$			$25600 \cdot T_s$		
4	$26336 \cdot T_s$			$7680 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$
5	$6592 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$	$20480 \cdot T_s$		
6	$19760 \cdot T_s$			$23040 \cdot T_s$		
7	$21952 \cdot T_s$			-	-	-
8	$24144 \cdot T_s$			-	-	-

Table 1-1 Configuration of special subframe (lengths of DwPTS/GP/UpPTS)

The TDD system Uplink-downlink configuration is as follows:

Uplink-downlink configuration	**Downlink-to-Uplink Switch-point periodicity**	**Subframe number**									
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	**5 ms**	**D**	**S**	**U**	**U**	**U**	**D**	**S**	**U**	**U**	**U**
1	**5 ms**	**D**	**S**	**U**	**U**	**D**	**D**	**S**	**U**	**U**	**D**
2	**5 ms**	**D**	**S**	**U**	**D**	**D**	**D**	**S**	**U**	**D**	**D**
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

Table 1-2 Uplink-downlink configurations

E5776s-420 is TDD system and the supporting special subframe configuration is including 5 and 7. And the supporting Uplink-downlink configuration is including 0, 1 and 2. eA660 support the configuration in blue in above tables.

OFDM has been adopted as the downlink transmission scheme for the 3GPP Long-Term Evolution (LTE). As TDD LTE system, E5776s-420 downlink transmission scheme is also based on OFDM. Transmission by means of OFDM can be seen as a kind of multi-carrier transmission. The ‘physical resource’ in case of OFDM transmission is often illustrated as a time-frequency grid according to Figure 1-2 where each ‘column’ corresponds to one OFDM symbol and each ‘row’ corresponds to one OFDM subcarrier.

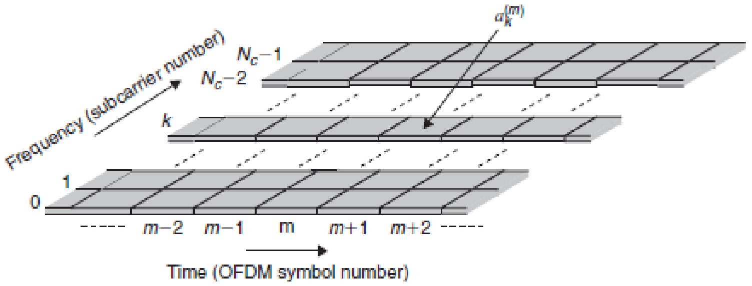

Figure 1-2 OFDM time-frequency grids

In contrast to the kind of multi-carrier transmission, any corruption of the frequency-domain structure of the OFDM subcarriers, e.g. due to a frequency selective radio channel, may lead to a loss of inter-subcarrier orthogonality and thus to interference between subcarriers. To handle this and to make an OFDM signal truly robust to radio-channel frequency selectivity, cyclic-prefix insertion is typically used.

To deal with this problem and to make an OFDM signal truly insensitive to time dispersion on the radio channel, so-called cyclic-prefix insertion is typically used in case of OFDM transmission. As illustrated in Figure 1-3, cyclic-prefix insertion implies that the last part of the OFDM symbol is copied and inserted at the beginning of the OFDM symbol. Cyclic-prefix insertion thus increases the length of the OFDM symbol from Tu to Tu +Tcp, where Tcp is the length of the cyclic prefix, with a corresponding reduction in the OFDM symbol rate as a consequence.

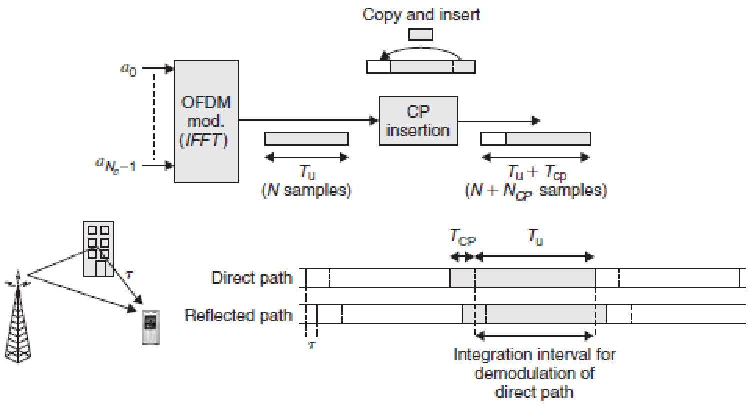

Figure 1-1 Cyclic-prefix insertion

Cyclic-prefix insertion is beneficial in the sense that it makes an OFDM signal insensitive to time dispersion as long as the span of the time dispersion does not exceed the length of the cyclic prefix. In general, there is a trade-off between the power loss due to the cyclic prefix and the signal corruption (inter-symbol and inter-subcarrier interference) due to residual time dispersion not covered by the cyclic prefix and, at a certain point, further reduction of the signal corruption due to further increase of the cyclic-prefix length will not justify the corresponding additional power loss. This also means that, although the amount of time dispersion typically increases with the cell size, beyond a certain cell size there is often no reason to increase the cyclic prefix further as the corresponding power loss due to a further increase of the cyclic prefix would have a larger negative impact, compared to the signal corruption due to the residual time dispersion not covered by the cyclic prefix

Due to the relatively long OFDM symbol time in combination with a cyclic prefix, OFDM provides a high degree of robustness against channel frequency selectivity. Although signal corruption due to a frequency-selective channel can, in principle, be handled by equalization at the receiver side, the complexity of the equalization starts to become unattractively high for implementation in a mobile terminal at bandwidths above 5 MHz. Therefore, OFDM with its inherent robustness to frequency-selective fading is attractive for the downlink, especially when combined with spatial multiplexing.

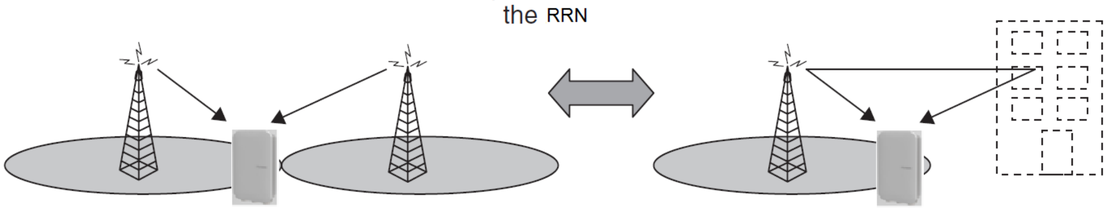

Figure 1-4 Equivalence between simulcast transmission and multi-path propagation

One way to improve the provisioning of broadcast/multicast services in a network is to ensure that the broadcast transmissions from different cells are truly identical and transmitted mutually time aligned. In this case, the transmissions received from multiple cells will appear as a single transmission subject to severe multi-path propagation as illustrated in Figure 1-4.

In case of such identical time-aligned transmissions from multiple cells, the 'intercell interference' due to transmissions in neighboring cells will, from a terminal point of view, be replaced by signal corruption due to time dispersion. If the broadcast transmission is based on OFDM with a cyclic prefix that covers the main part of this 'time dispersion', the achievable broadcast data rates are thus only limited by noise, implying that, especially in smaller cells, very high broadcast data rates can be achieved. The OFDM receiver does not need to explicitly identify the cells to be soft combined. Rather, all transmissions that fall within the cyclic prefix will 'automatically' be captured by the receiver.

Moreover，the LTE system uses the orthogonal frequency division multiple access (OFDMA) technology in the downlink (DL) and the single carrier frequency division multiple access (SC-FDMA) technology in the uplink (UL). OFDMA and SC-FDMA have a common characteristic: All physical resource blocks (PRBs) occupied by UEs(User Equipment） in a cell are mutually orthogonal in the frequency domain. Therefore, intra-cell interference is very low. However, inter-cell interference is relatively high because the frequency reuse factor is 1 and every cell can provide services over the entire system band. For cell edge users (CEUs), the impact of the inter-cell interference is especially severe. Therefore, to increase the CEU throughput, inter-cell interference must be mitigated. Two basic interference mitigation solutions would be provided: interference rejection combining (IRC) and ICIC.

IRC is a technology that combines receive (RX) antennas to combat high colored interference between cells. It is implemented at the physical layer. IRC achieves diversity gains, array gains, and interference suppression gains. PUCCH IRC keeps the scheduling request indicator (SRI) false alarm probability low when there is interference. This prevents the eNodeB from allocating unnecessary uplink resources to user equipment (UE) and increases cell uplink capacity. PRACH IRC keeps the PRACH false alarm probability low when there is interference. This prevents the eNodeB from allocating unnecessary uplink resources to UEs and increases cell uplink capacity.

ICIC is a technology that collaborates with power control and media access control (MAC) scheduling technologies to mitigate inter-cell interference. ICIC divides the entire system band into three frequency bands and uses different frequency bands at the edge of neighboring cells. CEUs, which cause high interference or may be sensitive to interference, are preferentially scheduled in the cell edge bands to mitigate inter-cell interference. The interference mitigation enhances the network coverage and improves the CEU throughput.

With the development of LTE technology, the more interference mitigation solutions would be proposed, such as UL/DL CoMP(Coordinated Multi-Point transmission/reception) technology.

1.2 Describe the method to permit occupancy.

As a client device, the occupancy of traffic requirement brought up by client device and the time slots are arranged by eNodeB (the master).

1.3 Describe the action taken if two or more transmitters simultaneously access the same channel by the master and the client devices.

E5776s-420 is LTE client device, two or more transmitters simultaneously access the channel will occur at the access stage. LTE PHY level random access procedure is used to solve the conflict. When there are conflicts between client devices. The client devices will make a random back-off for another access.

1.4 Describe opportunities for other similar systems to operate - address how, or if, a different system operator using the same technology can operate in the same band.

The radio interference to other LTE devices connected to the eNodeBs in the same system cased by E5776s-420 is avoided by eNodeBs side with TDD synchronisation mechanism. The radio interference mitigation to the LTE devices connected to the eNodeBs not in the same system (inter-system) cased by E5776s-420 should be designed and deployed by the eNodeBs in different systems.

Normally eNodeB avoid inter-system interference by synchronization, ATPC, RNP (Radio network planning), space isolation etc. methods.