

Long Term Evolution *IN BULLETS*

2nd Edition

Chris Johnson



Long Term Evolution

IN BULLETS

LONG TERM EVOLUTION (LTE)

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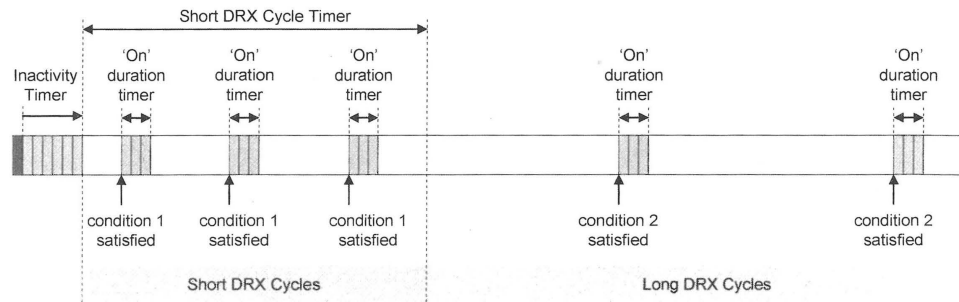
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24.6 DISCONTINUOUS RECEPTION (DRX)

- ★ Both UMTS and LTE networks use Discontinuous Reception (DRX) in RRC Idle mode when monitoring for paging messages. This avoids the UE having to receive all downlink subframes and helps to conserve UE battery power. The LTE paging occasions defined by the idle mode DRX cycle are described in section 23.7
- ★ UMTS networks use CELL_PCH and URA_PCH to help conserve UE battery power while the UE is in RRC Connected mode. Continuous Packet Connectivity (CPC) can also be used by UMTS networks to help conserve UE battery power while the UE is in CELL_DCH. These solutions can also help to conserve air-interface and BTS processing resources
- ★ LTE networks can use Discontinuous Reception (DRX) in RRC Connected mode to help conserve UE battery power. The DRX cycle determines the subframes during which the UE monitors for a PDCCH addressed using its C-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI or SPS C-RNTI. When DRX is used, the UE only has to monitor the PDCCH during specific subframes. When DRX is not used, the UE has to monitor the PDCCH during every subframe
- ★ The main drawback of using a DRX cycle is that it causes an increased delay when there is a requirement to transfer data. On average, this delay increases as the duration of the DRX cycle increases
- ★ The general concept of RRC Connected mode DRX for LTE is illustrated in Figure 227



Condition 1

$$[(SFN \times 10) + \text{subframe number}] \bmod (\text{shortDRX-Cycle}) = (\text{drxStartOffset}) \bmod (\text{shortDRX-Cycle})$$

Condition 2

$$[(SFN \times 10) + \text{subframe number}] \bmod (\text{longDRX-Cycle}) = \text{drxStartOffset}$$

Figure 227 – DRX pattern (both short and long DRX cycles configured)

- ★ An inactivity timer is started after each period of activity. This timer defines the number of consecutive inactive subframes which the UE must experience before using DRX mode. The timer is stopped and re-started if there is any activity while it is running. The UE monitors the PDCCH continuously while the inactivity timer is running
- ★ Assuming the inactivity timer expires, there is an optional period of short DRX cycles. Short DRX cycles can be used initially because in general, the probability of further activity is greater during the time window immediately after any previous activity. The probability of further activity tends to decrease as the period of inactivity increases
- ★ The eNode B instructs the UE whether or not it should use the period of short DRX cycles. If short DRX cycles are not used then the period of long DRX cycles starts directly
- ★ During the period of short DRX cycles, the UE triggers its 'on' periods when the following condition is satisfied:

$$[(SFN \times 10) + \text{subframe number}] \bmod (\text{shortDRX-Cycle}) = (\text{drxStartOffset}) \bmod (\text{shortDRX-Cycle})$$
 For example, shortDRX-Cycle = 20 subframes, and drxStartOffset = 25 leads to:

$$[(SFN \times 10) + \text{subframe number}] \bmod 20 = 25 \bmod 20 = 5$$
 i.e. the 'on' periods start during SFN 0 subframe 5, SFN 2 subframe 5, SFN 4 subframe 5, etc
 The eNode B signals the 'on' period duration to the UE. The UE monitors the PDCCH continuously during the 'on' period
- ★ The period of short DRX cycles continues for a specific number of short cycles before the mode of operation switches to long DRX cycles. During the period of long DRX cycles, the UE triggers its 'on' periods when the following condition is satisfied:

$$[(SFN \times 10) + \text{subframe number}] \bmod (\text{longDRX-Cycle}) = \text{drxStartOffset}$$
 For example, longDRX-Cycle = 40 subframes, and drxStartOffset = 25 leads to:

$$[(SFN \times 10) + \text{subframe number}] \bmod 40 = 25$$

i.e. the 'on' periods start during SFN 2 subframe 5, SFN 6 subframe 5, SFN 10 subframe 5, etc

- ★ DRX configuration information can be signalled to the UE within an RRC Connection Setup, RRC Connection Reconfiguration or RRC Connection Re-establishment message. The content of the DRX configuration information is presented in Table 279

Information Elements			
CHOICE			
Release			
Setup	onDurationTimer		
	drx-InactivityTimer		
	drx-RetransmissionTimer		
	longDRX-CycleStartOffset	CHOICE	
		longDRX-Cycle	drxStartOffset
	shortDRX	shortDRX-Cycle	
		drxShortCycleTimer	

Table 279 – Content of DRX configuration information

- ★ onDurationTimer can be configured with values of 1, 2, 3, 4, 5, 6, 8, 10, 20, 30, 40, 50, 60, 80, 100 and 200 subframes
- ★ drx-InactivityTimer can be configured with values of 0, 1, 2, 3, 4, 5, 6, 8, 10, 20, 30, 40, 50, 60, 80, 100, 200, 300, 500, 750, 1280, 1920, 2560 subframes
- ★ drx-RetransmissionTimer can be configured with values of 1, 2, 4, 6, 8, 16, 24 and 33 subframes
- ★ longDRX-Cycle can be configured with values of 10, 20, 32, 40, 64, 80, 128, 160, 256, 320, 512, 640, 1024, 1280, 2048 and 2560 subframes
- ★ drxStartOffset can be configured with any integer value between 0 and (longDRX-Cycle - 1)
- ★ shortDRX-Cycle is optional and can be configured with values of 2, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 256, 320, 512, 640 subframes
- ★ drxShortCycleTimer is optional and can be configured with any integer value between 1 and 16
- ★ The retransmission timer defines an additional 'on' period when a downlink retransmission is expected. This prevents the UE from missing a retransmission after entering DRX mode. The retransmission timer is started after the HARQ Round Trip Time (RTT) expires if the corresponding downlink transmission was not successfully decoded. The HARQ RTT is fixed at 8 subframes for FDD, and is given by $k + 4$ subframes for TDD, where 'k' is defined in Table 270 (section 24.3.4)
- ★ The eNode B can instruct the UE to enter DRX mode immediately using the DRX Command MAC control element. The DRX Command MAC control element does not have any payload. It is signalled simply by sending a DL-SCH MAC subheader with the Logical Channel Identity (LCID) set to 11110
- ★ DRX patterns should account for the end-user application. DRX can be applied to Voice over IP (VoIP) connections if the DRX pattern is designed to have 'on' periods which coincide with the periodic arrival of speech information
- ★ UE in RRC Connected mode are required to complete handovers when moving from one cell to another. UE must exit DRX to send an uplink RRC: Measurement Report message when the signal strength from a neighbouring cell becomes sufficiently strong to trigger a handover
- ★ 3GPP References: TS 36.321