3GPP Joint Meeting on GSM-UTRAN handover and SRNS relocation ***Tdoc WHS-99016***

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Agenda Item:

Source: **NTT DoCoMo**

Title: **Necessity of L3CE Multiplexing function in terms of the required RLC buffer size in UE**

Document for: Discussion

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1 INTRODUCTION

In this contribution, We studied the necessity of L3CE Multiplexing function in terms of the required RLC buffer size in UE.

2 DISCUSSION

2.1 Assumptions

We estimate how much RLC buffer size must be carried in UE based on the following assumptions of RLC and L3CE parameters.

(1) Number of Payload unit (PU) per 1 radio frame (10 msec)

DTCH 32 kbps = 1 PU/frame

DTCH 64 kbps = 2 PUs/frame

DTCH 128 kbps = 4 PUs/frame

DTCH 384 kbps = 12 PUs/frame

(2) PU length

RLC entity uses about 64 Bytes in buffers to manage 1 PU. The details are below.

(2-1) Data

PU data = 42 Octets, RLC header = 2 Octets, CRC = 2 Octets

(2-2) Management information

MUI = 2 Octets, PU data address management = 8 Octets, PU data status = 8 Octets

(3) RLC parameters

Timer_Poll_Periodic = 10 sec, Timer_Poll = 1 sec, MaxDAT = 3,

the SN field of AMD PDU is 12 bits.

(4) L3CE maximum frame length

1520 Octets (= 37 PUs (1520 / 42))

2.2 Transmission buffer size

RLC transmission buffer size required in a UE depends on either the maximum value of SN (Sequence Number) or Poll trigger period (smaller value of them).

(A) required buffer size due to the maximum value of SN

The maximum SN value is 4096(dec), because the SN field of AMD PDU is 12 bits. Therefore, the maximum number of PUs that a UE can send to the peer entity without receiving acknowledgement is 4096. In other words, the UE must be able to hold 4096 PUs. Then the required transmission buffer size is 263 kBytes (= 64 octets * 4096 PUs)

(B) required buffers due to Poll trigger period

RLC parameters (Poll timer etc.) used by UE are assigned by RRC layer from RAN. So UE must support the whole range of the parameter valued provided in 3GPP specification.

UE must be able to hold all PUs transmitted during Timer_Poll_Periodic + Timer_Poll * (MaxDAT +1) (i.e., the maximum time until a PU is either acknowledged or abandoned), 14 sec (= 10 sec + 1 sec * (3 + 1)). Number of PUs that can be transmitted during the 14 sec is dependent on the transmission speed as follows.

32 kbps : 1400 PUs (= 1 PU/10 msec * 14000 msec)
→ 89.6 kBytes (= 64 Bytes * 1400 PUs)

64 kbps : 2800 PUs (= 2 PUs/10 msec * 14000 msec)
→ 179.2 kBytes (64 kBytes * 2800 PUs)

128 kbps : 5600 PUs (= 4 PUs/10msec * 14000 msec)
→ 358.4 kBytes (64 kBytes * 5600 PUs)

384 kbps : 16800 PUs (= 12 PUs/10 msec * 14000 msec)
→ 1.0752MBytes (64 kBytes * 16800 PUs)

RLC transmission buffer size needed in a UE is the smaller value among (A) and (B). In addition, buffer size of about 32kBytes is necessary for the entire management of RLC.

Transfer speed	(A)	(B)	Transmission buffer size in UE
32 kbps	263 kBytes	89.6 kBytes	121.6 kBytes (89.6 kbytes + 32 kBytes)
64 kbps	263 kBytes	179.2 kBytes	211.2 kBytes (179.2 kBytes + 32 kBytes)
128 kbps	263 kBytes	358.4 kBytes	295 kBytes (263 kBytes + 32 kBytes)
384 kbps	263 kBytes	1.0752 MBytes	295 kBytes (263 kBytes + 32 kBytes)

2.3 Reception buffer size

RLC reception buffer size required in a UE depends on either the maximum value of SN (Sequence Number) or L3CE frame assembly (smaller value of them).

(A) required buffers due to the maximum value of SN

The required reception buffer size is 263 kBytes (= 64 octets * 4096 PUs) for the same reason as sub-clause 2.2

(B) required buffers due to L3CE frame assembly

The RLC entity on the receiving side must be able to hold PUs until a L3CE frame is assembled from them. Thus, the receiving RLC entity at least needs to have a buffer that can hold a L3CE frame of the maximum length (Here, the maximum length is assumed to be 1520 Bytes, i.e., 37 PUs.). In addition, the UE needs to have buffer size for the reception of other PUs while RLC retransmission is executed for the L3CE frame. When a certain PU is not received, it takes about 5 sec at the maximum to receive the retransmitted PU. Then, the required buffer size in the receiving RLC entity is as follows.

32 kbps : 500 PUs (= 1 PU/10 msec * 5000 msec) + 37 PUs
→ 35 kBytes (= 64 Bytes * (37 PUs + 500 PUs))

64 kbps : 1000 PUs (= 2 PUs/10 msec * 5000 msec) + 37 PUs
→ 67 kBytes (64 kBytes * (37 PUs + 1000 PUs))

128 kbps : 2000 PUs (= 4 PUs/10 msec * 5000 msec) + 37 PUs
→ 131 kBytes (64 kBytes * 5600 PUs)

384 kbps : 6000 PUs (= 12 PUs/10 msec * 5000 msec) + 37 PUs
→ 387 kBytes (64 kBytes * (37 PUs + 6000 PUs))

RLC reception buffer size needed by a UE is the smaller value among (A) and (B). In addition, buffer size of about 32kBytes is necessary for the entire management of RLC.

Transfer speed	(A)	(B)	Transmission buffer size in UE
32 kbps	263 kBytes	35 kBytes	67 kBytes (35 kbytes + 32 kBytes)
64 kbps	263 kBytes	67 kBytes	99 kBytes (67 kBytes + 32 kBytes)
128 kbps	263 kBytes	131 kBytes	295 kBytes (263 kBytes + 32 kBytes)
384 kbps	263 kBytes	387 kBytes	295 kBytes (263 kBytes + 32 kBytes)

2.4 Total RLC buffer size necessary for a UE

Total RLC buffer size necessary for UE is transmission buffer size plus reception buffer size in order to offer one RLC link.

2.5 Comparison MAC multiplexing with L3CE Multiplexing

Total RLC buffer size which is necessary in order to treat several PDP contexts simultaneously is as follows.
In this example, QoSs of every PDP context are the same best effort. Backward transmission speed and Forward transmission speed are each 64 kbps and 384 kbps.

Number of PDP contexts	MAC multiplexing	L3CE multiplexing
1	506.2 kBytes (211.2 kBytes + 295 kBytes) * 1 → 4Mbit RAM	506.2 kBytes (211.2 kBytes + 295 kBytes) * 1 → 4Mbit RAM
2	1012.4 kBytes (211.2 kBytes + 295 kBytes) * 2 → 8Mbit RAM	506.2 kBytes (211.2 kBytes + 295 kBytes) * 1 → 4Mbit RAM
3	1518.6 kBytes (211.2 kBytes + 295 kBytes) * 3 → 12Mbit RAM	506.2 kBytes (211.2 kBytes + 295 kBytes) * 1 → 4Mbit RAM
…	…	…
N	506.2 kBytes * N (211.2 kBytes + 295 kBytes) * N → (4 * N) Mbit RAM	506.2 kBytes (211.2 kBytes + 295 kBytes) * 1 → 4Mbit RAM

As above example, multi-call of best effort is the service that may share the radio bandwidth with each PDP context. But, when suppose that a multiplexing function of L3CE does not exist, it is impossible to offer the multi-call service of packet communication with the very compact UE that only 4 Mbit RAM can carry.

3 CONCLUSION

Multiplex function of L3CE is necessary because it should be possible to offer the multi-call service of packet communication shared the radio resource with a very compact UE that can have only 4 Mbit RAM.

4 NOTE

A quantity of buffer use is different by implementation of UE, and values mentioned above is not absolute.