

Agenda item: 5.2.2
Source: Motorola
Title: Flow Control
Document for: Discussion and Approval

1 Introduction

This contribution addresses the issue of flow control in LTE and the location of this functionality.

2 Discussion

In Rel-5, a flow control mechanism has been specified for application on the Iub interface. This was required partly due to the different locations of the RLC and MAC-hs protocol entities in the network. The window mechanism in RLC provided the UE with the ability to control the transmit window at the Node B. With the move of the RLC layer to the eNodeB, it is worthwhile to revisit this feature.

Firstly, a decision needs to be taken as to whether there is flow control mechanism in EUTRA. Consider the scenario where the UE is used as a modem with the UE being connected to accessory device using Bluetooth, WiFi or any other suitable radio interface. It is possible that while the UE is in very good channel conditions from the EUTRA radio interface perspective, the peripheral interface periodically suffers from poor link speeds. Given that EUTRA supports high peak data rates of 100 Mb/s in the downlink and 50 Mb/s in the uplink, it is likely that flow control will be useful to ensure that the network does not transmit more data to the UE than the UE is able to consume even though the network is scheduling data according to the UE capability class from a EUTRA perspective.

Previously during the design of Rel-5 in particular, various approaches have been considered including CQI reporting and RLC window re-sizing.

The following analyses the applicability and desirability of these approaches for EUTRA.

1. Sending CQI reports reflecting poor channel conditions even when the radio interface indicates high channel quality. This is essentially a L1 approach to the problem. However, this is not a preferred approach since in normal cases the UE is expected to ensure accurate CQI reporting and will be so tested.

2. RRC could send a modified UE capability message indicating a lower memory size applicable for a temporary duration. However such techniques have too much overhead overall and seem too heavy handed in terms of how many layers get impacted.

3. The RLC layer can use the window mechanism to reduce the transmit window size. However, the following should be noted in this context:

- given the flexible PDU size in EUTRA, window size per se does not provide the necessary functionality unless the window is redefined in terms of "bytes"

- without a redefinition of window as stated above the buffer size and window size are no longer related; the slow peripheral link will cause buffer overflow in the UE but a window movement can still be ambiguous unless additional (different) definitions are provided for the window size.

- using RLC window mechanism would imply that the receiver would be instructing the peer entity at the transmitter which in turn would need to indicate this to the MAC scheduler; it would be desirable however to avoid such cross layer interactions where possible. It is noted that in principle some of this information is needed anyway at the MAC layer for scheduling purposes.

4. A fourth approach is the use of PDCP control PDUs – the receiver PDCP can send a control message to the PDCP entity at the sender requesting to slow down the rate of PDU forwarding. However, use of PDCP would be quite overhead intensive and does not really resolve the problem directly since PDCP at the sender eventually needs to provide this indication to MAC so that the scheduler can account for it when making scheduling decisions.

An alternative and more efficient approach would be for the MAC entity at the receiver to indicate to the MAC entity at the transmitter to temporarily lower the data rate or cease transmission. Typical implementations in a UE would leverage a single buffer usable by both RLC and PDCP layers. A mechanism wherein the MAC entity at the receiver instructs the MAC entity at the transmitter of a temporary block requiring a slow-down of data transmission would provide the necessary tools for avoiding buffer overflow in the UE. Such a mechanism would be enabled through a MAC Control message with the additional advantage of low overhead.

3 Conclusions

It is proposed to support flow control mechanism in EUTRA which is triggered by the UE transmitting a MAC control message to the network indicating to lower the rate of data transmission irrespective of the CQI indicating good channel conditions. The MAC control message could additionally include remaining buffer size or similar information fields.