Agenda Item: 6.3, 7.9

Source: Siemens AG

Title: A Proposal for RLC Protocol States

Document for: Decision

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1.   Introduction

This paper proposes a set of protocol states and transitions between states for use in the description of the RLC protocol(s). It is similar to that made in [1] but includes some extensions.

2.   Discussion

The states that have been included in the state model given in this document are those listed in [2] with the addition of new states to cover recovery and transparent mode operation. The recovery state has been included in anticipation of one being required by the RLC protocols. It is suggested that the recovery state would encompass both error recovery and resynchronisation. Unacknowledged mode operation and Acknowledged mode operation before the acknowledged data link has been established are merged into the single Idle state.

Furthermore, in the following state model, the primitives RLC-Establish.req and RLC-Release.req have been introduced to enable a higher layer to trigger the acknowledged mode to move from/to a state where no acknowledged transfer is permitted to/ from a state where acknowledged data transfer is permitted.

3.   RLC States

The following states are proposed:-

Null: In the null state the RLC entity does not exist. A transition to another state is made when an MRLC-CONFIGURE.req is received. A return to the null state is made in response to an RLC-RELEASE.req primitive.

Transparent: In the transparent state the RLC operates in transparent mode. The RLC can complete segmentation/ re-assembly but does not add RLC headers. From transparent state the RLC can only transit to the null state.

Idle: This state is the initial state for acknowledged mode operation and the operating state for unacknowledged mode operation. When in this state the RLC may only send and receive unacknowledged (UMD) PDUs. The state can be entered from the Null state and from the Outgoing Connection Pending, Data Transfer Ready, Outgoing Disconnection Pending and Incoming Connection Pending states. Transitions to the Outgoing Connection Pending and Data Transfer Ready states are possible. When in Idle state an initial protocol parameter negotiation may be performed.

Outgoing Connection Pending: In this state, the RLC attempts to establish the acknowledged mode data service through an exchange of BGN and BGNAK signals with its peer. The state can be entered from the Idle state and transitions to the Outgoing Disconnection Pending and Data Transfer Ready states can be made.

Incoming Connection Pending: This state is entered when the RLC receives a BGN PDU when in the Idle state. The RLC requests from a higher layer whether the link should be established or not. Transfer is to the Data Transfer Ready state if establishment of the link is agreed and to the Null state if release is indicated.

Outgoing Disconnection Pending   In this state, the RLC attempts to release acknowledge mode operation through the exchange of END and ENDAK PDUs with its peer. A transition is made to the Null state whether the exchange completes satisfactorily or is timed out. The state is entered from the Data Transfer Ready, the Outgoing Link Setup Pending or the Outgoing Recovery Pending state should an RLC- RELEASE primitive be received. It is also entered from the Outgoing Link Setup Pending state should the link establish protocol fail or from the Outgoing Recovery Pending state should the recovery protocol fail.

Outgoing Recovery Pending   In this state the RLC attempts to recover from an error condition which is assumed here to encompass re-synchronising the data link should this be required. The state is entered from the Data Transfer Ready state should an error condition occur. Re-synchronising could be selected after a period where no data transfers have taken place or after handover, for example. This topic is proposed as ffs. The RLC will transit to the Data Transfer Ready state should the recovery protocol complete, it will transit to the Outgoing Disconnection Pending state should the recovery protocol fail.

Data Transfer Ready This is the normal operating state for acknowledged mode operation. The data link has been established and the RLC may transfer SD, STAT and USTAT PDUs. The RLC transits to the Outgoing Disconnection Pending state if an RLC-RELEASE primitive is received, it transits to the Outgoing Recovery Pending state if an error condition or resynchronisation occurs and to the Idle state if an END PDU is received. Protocol parameter changes for acknowledged mode operation are possible.

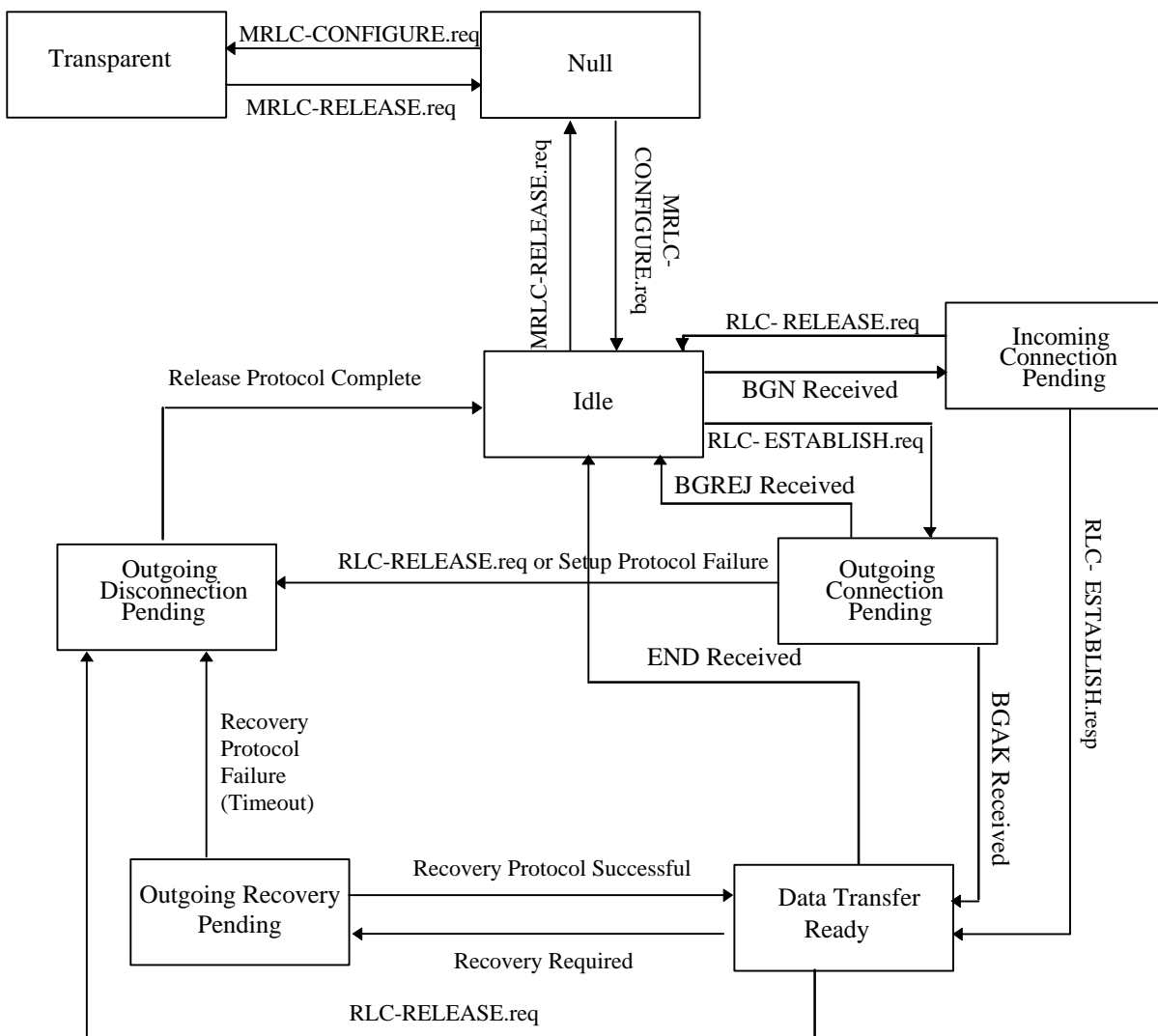The following diagram illustrates the states and the connections between them.

Figure 1. Proposed RLC State Model

4.   Conclusions

It is proposed that the state diagram contained in Figure 1 should be adopted as an initial state model for document 3GPP S2.22 v0.0.1. Consideration should be given as to whether the RLC-Establish.req and RLC-Release.req primitives are required and whether a data link recovery procedure should be implemented.

5. References

1. ETSI SMG2 UMTS Technical Document Tdoc SMG2 UMTS-L23 555/98

2. 3GPP Technical Document 3GPP S2.22 v0.0.1 Description of the RLC protocol