Proposal for IEEE 802.16m ARQ Protocol

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Re: IEEE 802.16m-08/033 – Call for Contributions and Comments on Project 802.16m System Description Document (SDD), on the topic of "MAC: Data Plane"

Purpose: Adopt the proposal into the IEEE 802.16m System Description Document

Introduction

- This contribution proposes ARQ protocol that address the following TGm SRD (IEEE 802.16m-07/002r4) requirements:
  - User plane latency
  - System overhead

Issues with Legacy ARQ Protocol

- The legacy ARQ uses ACK-based protocol. As the residual error after HARQ is typically 1% or less, ACK-based protocol incurs unnecessary overhead

- There is no coordination between HARQ and ARQ, ARQ may generate unnecessary retransmission before HARQ complete the error recovery process.

Proposed ARQ Protocol for 16m

- NAK-based protocol should be used, i.e. the receiver sends NAK on un-received ARQ blocks. As the probability of HARQ failure is 1% or lower, the occurrence of NAK transmission is low

- ARQ block construction and sequence numbering same as in the legacy system

- At the receiver, a timer is set for each missing ARQ block. A NAK is sent when the timer expires.

HARQ and ARQ Interaction

- On the transmitter side:
  - The HARQ state machine can indicate to the ARQ state machine when a PHY packet has failed after maximum HARQ retrials. The ARQ state machine will generate the corresponding ARQ blocks retransmission
  - Most HARQ failure can be fixed by the above transmitter-initiated retransmission. However, in the case of HARQ NAK-to-ACK error, the transmitter side won't be able to trigger the ARQ retransmission. Note that the probability of HARQ NAK-to-ACK error is typically around 0.1%. Although this is a low probability, it would cause a residual packet error of 0.1% which is still too high for TCP type of application which required packet error rate of ~10e-5.
- On the receiver side:
  - The receiver side ARQ can be used to safe-guard against the HARQ NAK-to-ACK error
  - The HARQ state machine detects the occurrence of NAK-to-ACK error by the following:
    - For async HARQ, the receiver keeps a timer, if after timeout and no retrx received, it declares that an NAK-to-ACK error has occured
    - For sync HARQ, if at the predetermined retransmission time, there is no retransmission, it declares that an NAK-to-ACK error has occurred
  - When the HARQ state machine detects that there is a HARQ failure due to NAK-to-ACK error, it informs the ARQ state machine
  - The ARQ state machine will keep a timer which can start after the HARQ informs of a missing PHY PDU. When timer expires, the ARQ sends a message to the transmitter ARQ to indicate the missing ARQ blocks and last ARQ block received.

Proposed Text for SDD

[Add the following section and text to page 30, after line 4]

10.x ARQ

- *[include proposed text in slides 4 -5 here]*