R2-060124 HARQ Considerations

Motorola

Agenda Item 8.2

HARQ Schemes

- **Incremental Redundancy (Chase, Partial Chase included)**
- **N channel SAW**
  - **N = 6 can be supported with TTI=0.5 ms**
    - RTT and processing requirements can be met
    - Support of Higher N allows for pre-emption and advanced schemes
- **Synchronous**
  - **Conventional synchronous scheme**
    - Mobile assigned a process
    - Retransmissions use corresponding frame in following cycle of N sub-frames
      - Process identity need not be sent – it is implicitly determined
      - Still beneficial to include UE id in control channel assignment signaling to handle missed assignment
    - Works best for case where TTI is fixed/semi-static

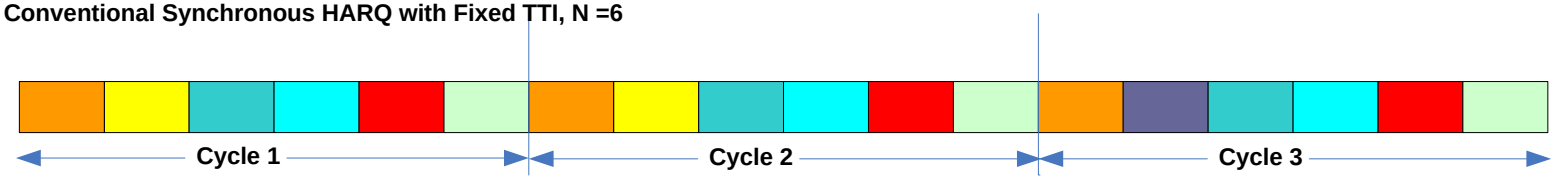
HARQ Schemes (2)

- **Modified synchronous scheme**
  - Mobile assigned a process and this is tied to the frame currently in use for transport channel
  - Process could be tied to the first sub-frame when a Long frame first transmission is assigned in order to define the synchronicity relationship
  - Retransmissions <u>may</u> use corresponding frame in following cycle;
    - UE Identity always sent in control signaling;
    - TTI also indicated *along with redundancy version;*
    - *Resource allocation can also be different from that used for initial transmission.*
  - Can be applied to Variable TTI
  - Possible to interrupt retransmission with another transmission for same or different UE

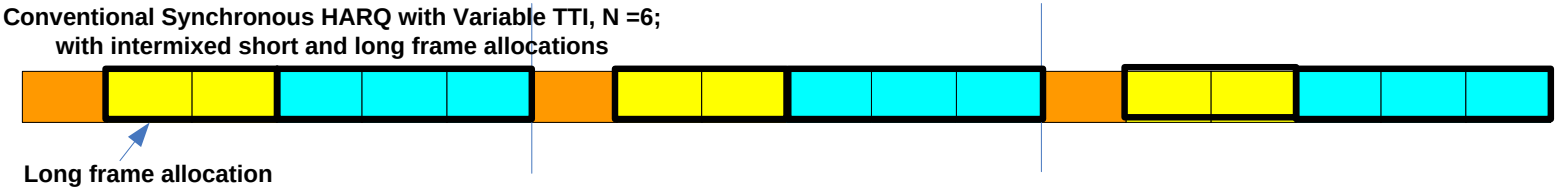
- **Asynchronous**
  - **Similar to current HSDPA scheme**
  - **Mobile is assigned a Short or Long frame; Process identity and UE identity are explicitly sent through the shared control channel using shared control channel**
    - No implicit tying of sub-frame to process identity

Synchronous HARQ with Short and Long frame allocations for one UE

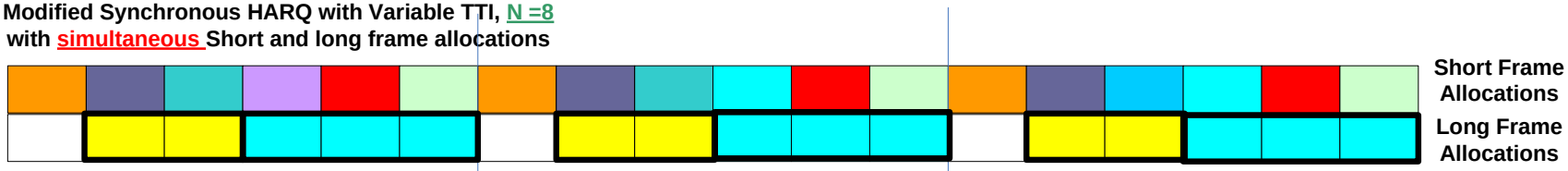
Conventional Synchronous HARQ with Fixed TTI, N =6



Conventional Synchronous HARQ with Variable TTI, N =6;
with intermixed short and long frame allocations



Modified Synchronous HARQ with Variable TTI, N =8
with simultaneous Short and long frame allocations



Here each one of such blocks (length conforms to short/long frame allocation) refers to a particular Resource Block Assignment in one sub-frame that is mapped to a HARQ process to one UE. Block indicates time instance when process is active; buffer size can be distinct for each process/block. It is assumed that every process requires three retransmissions at least (illustrative purposes only).

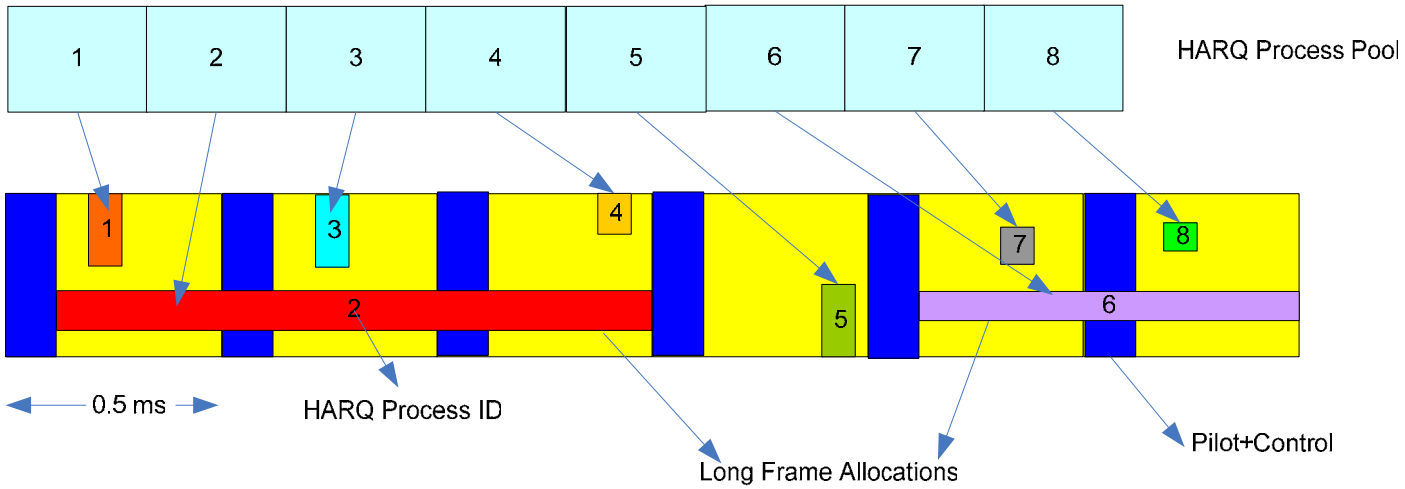
HARQ Scheme – Process Pool

- Configure N processes where N is larger than the number M prescribed by RTT and processing time considerations
- Pool of processes can then be shared among short and long frame allocations

Asynchronous HARQ scheme – Simul. Short and Long Frame Alloc

- **Resource Assignments may span multiple subframes**
  - Resource Assignment is effectively a short or long frame and can be achieved through simple signaling means
- **For fast retransmission scheduling and flexibility asynchronous HARQ scheme is used**
- **A pool of processes is used (as defined in previous slide)**
- **Permits assignment of simultaneous processes to multiple Resource Assignments to one UE where the resource allocations reside in same subframe**
  - Resource allocations may be mapped to either short or long frames
- **HARQ process memory requirement is dependent on whether process is mapped to long or short frame**
  - total maximum process memory capability defined for a UE class

Asynchronous HARQ scheme – Simul. Short+Long (2)



- **Figure illustrates a single cycle (6 subframes long) of a N=8, M=6 Asynchronous HARQ scheme that permits multiplexing of short and long frame allocations to one UE.**
  - **Can be seen as applicable for case with multiple transport channel assignments within a sub-frame**
  - **the Mth (here M = 6) sub-frame after the end of the transmission can be used for retransmissions**

HARQ Considerations

- **RAN WG1 has agreed on synchronous HARQ for uplink as a working assumption**
  - **Primary considerations seem to be stemming from saving control bits to identify HARQ process**
  - **Could be (re)considered in light of potential performance improvement to be demonstrated with more advanced mechanisms such as simultaneous short+long frame allocations, etc.**
  - **We should study overall performance gains with different schemes – Synchronous, Asynchronous, etc.**