

Aggregation in 802.16j –Enhanced Concatenation and Packing

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Purpose:

Propose enhancements to the concatenation and packing mechanisms defined in current IEEE 802.16e for application on relay link.

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Aggregation in 802.16j

– *Enhanced Concatenation and Packing*

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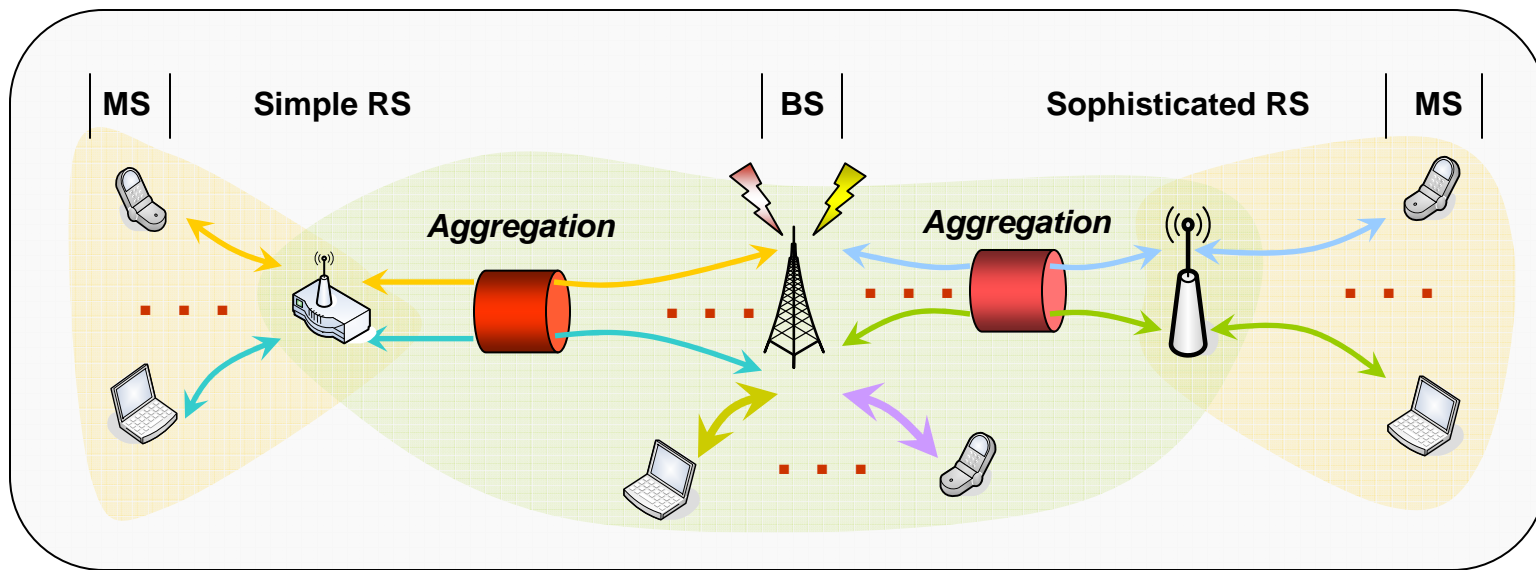
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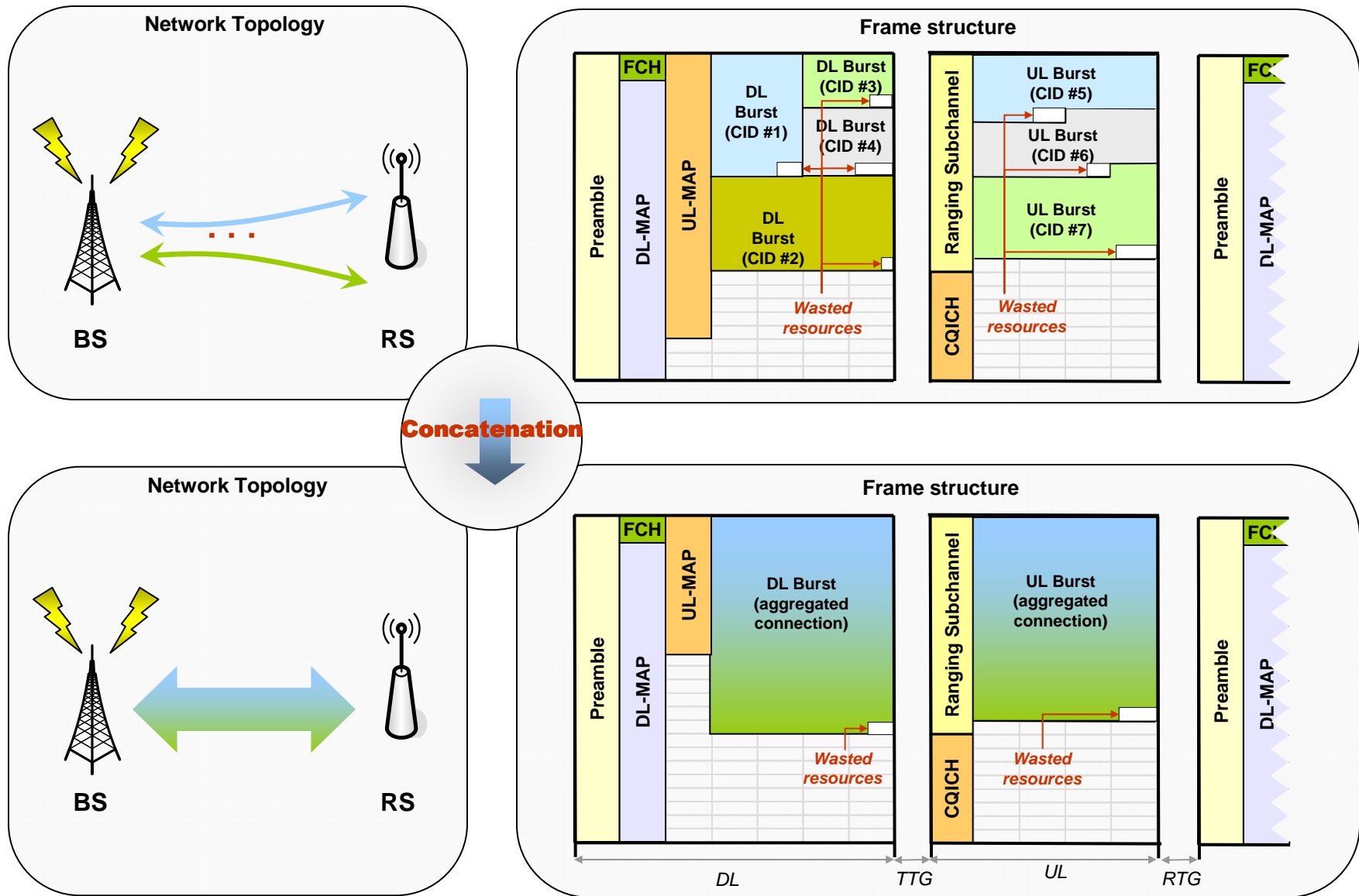
Aggregation

- The concept of “relay” intrinsically implies a notion of *aggregation*.
- The logical aggregation on downlink and uplink between BS and RS leads to more efficient channel resource utilization.



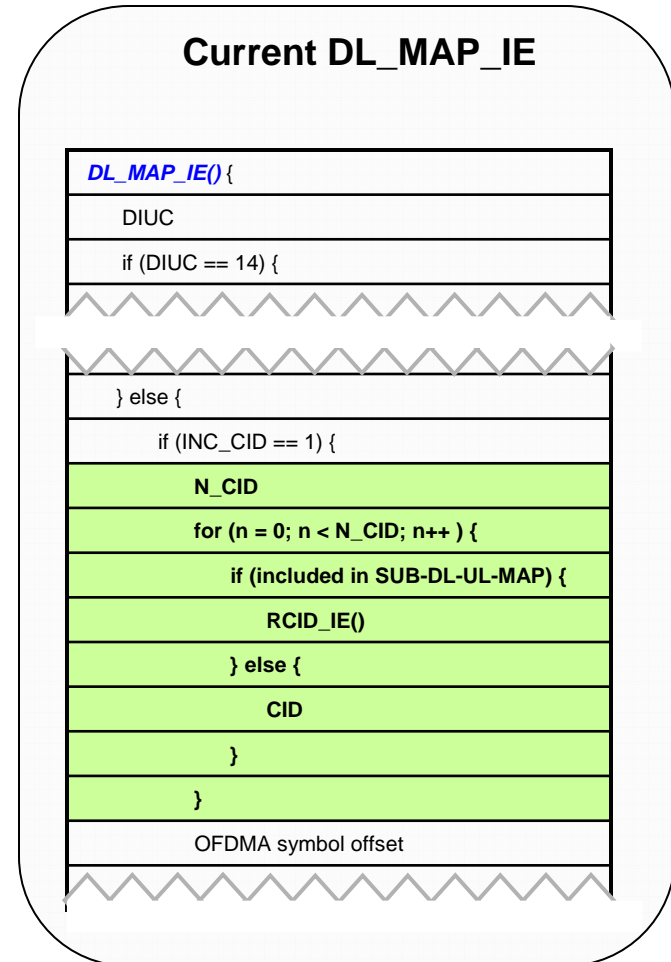
- Enhancements to 802.16e standard are needed to enable and leverage the inherent notion of “aggregation”.

Enhanced Concatenation (EC)



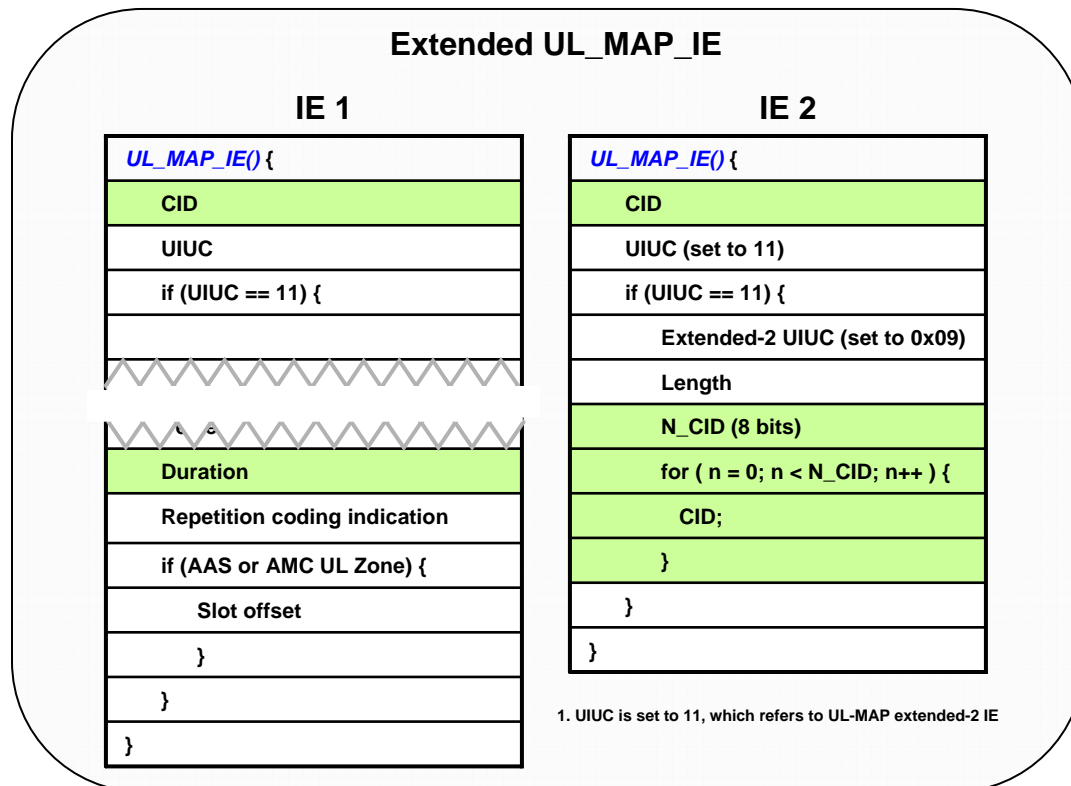
Enhanced Concatenation: the Detail

- Data plane
 - The concatenation defined in current 802.16 standard can support this operation.
 - Concatenation essentially is an MPDU level aggregation.
- Management plane
 - Downlink: The DL-MAP IE for OFDMA-PHY defined in current 802.16 standard can accommodate multiple CIDs, and thus could be used to support downlink concatenation.



Enhanced Concatenation: the Detail

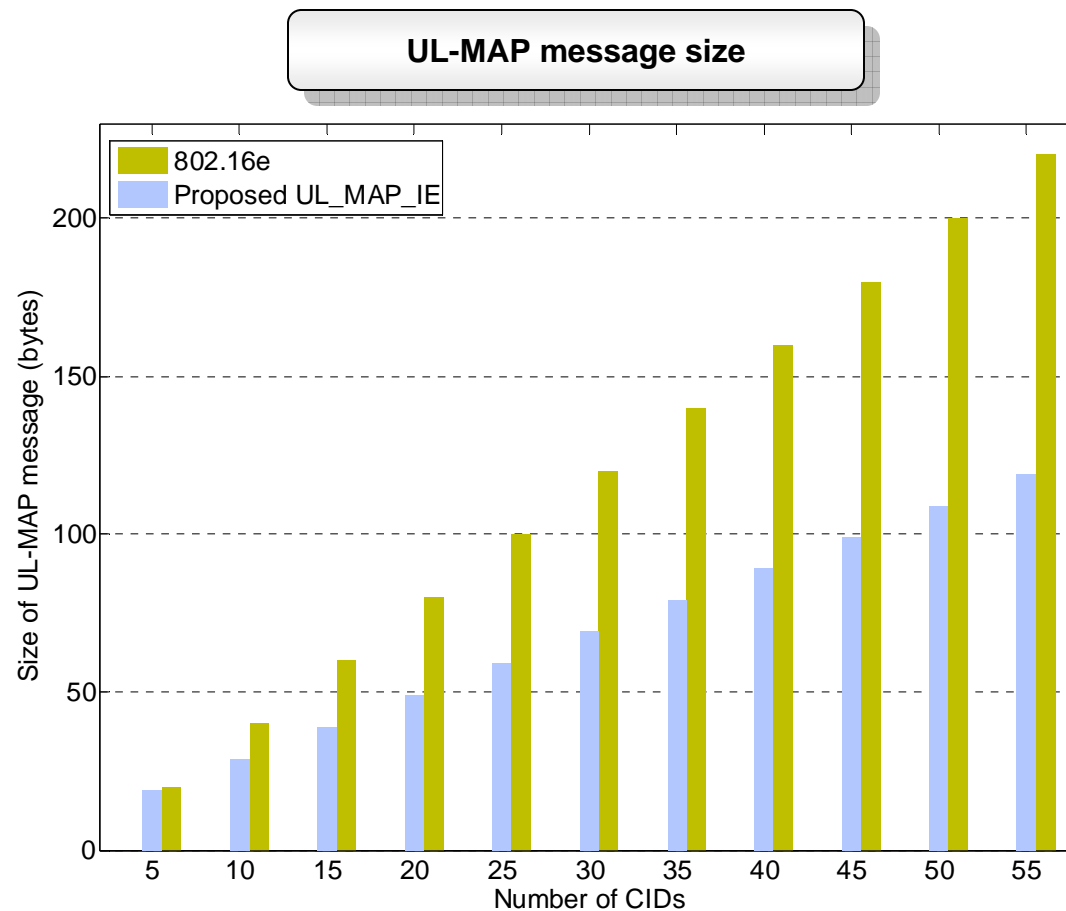
- Uplink (management plane):
 - Current standard supports one CID per UL-MAP IE.
 - An extension of current UL-MAP IE format is needed.
 - Provide support for uplink concatenation,
 - Reduce overhead in the management plane.
 - Maintain backward compatibility with legacy MSs/SSs.
 - The duration field may need to be lengthened.
 - Current size is only 10 bits.



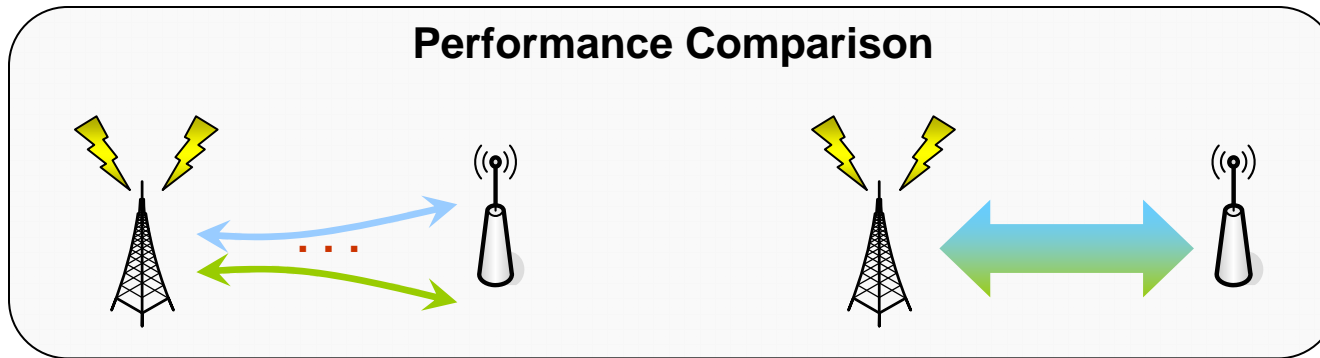
Management Message Overhead

- **Major findings:**

- The proposed simple scheme can reduce management plane overhead by more than 50%.



EC: Performance Evaluation

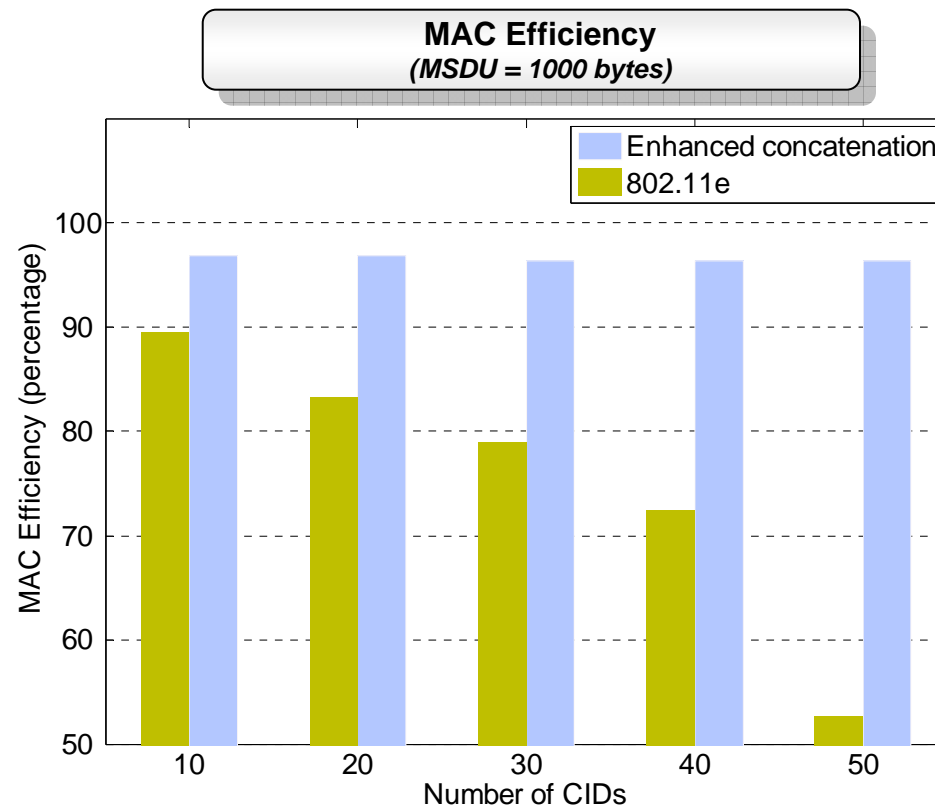


Parameter			
DL	<i>PUSC (2 symbols per slot)</i>	Number of subchannels (DL PUSC)	30
UL	<i>PUSC (3 symbols per slot)</i>	Number of data subcarriers per subchannel (DL PUSC)	24
FFT size	1024	Number of subchannels (UL PUSC)	24
Channel bandwidth (BW)	20 MHz	Number of data subcarriers per subchannel (UL PUSC)	35
MCS for data	64 QAM with $\frac{3}{4}$ coding rate	Number of UL BW/RNG subchannels	6
MCS for preamble and MAP	QPSK with $\frac{1}{2}$ coding rate	RTG	10 us
Cyclic prefix (G)	1/32	TTG	10 us
Sampling factor (n)	28/25	MSDU size	Variable
Period for DCD/UCD	Every 10 frames	Number of CIDs	Variable
Frame size	20 ms		

EC: Performance Evaluation

- Major findings:

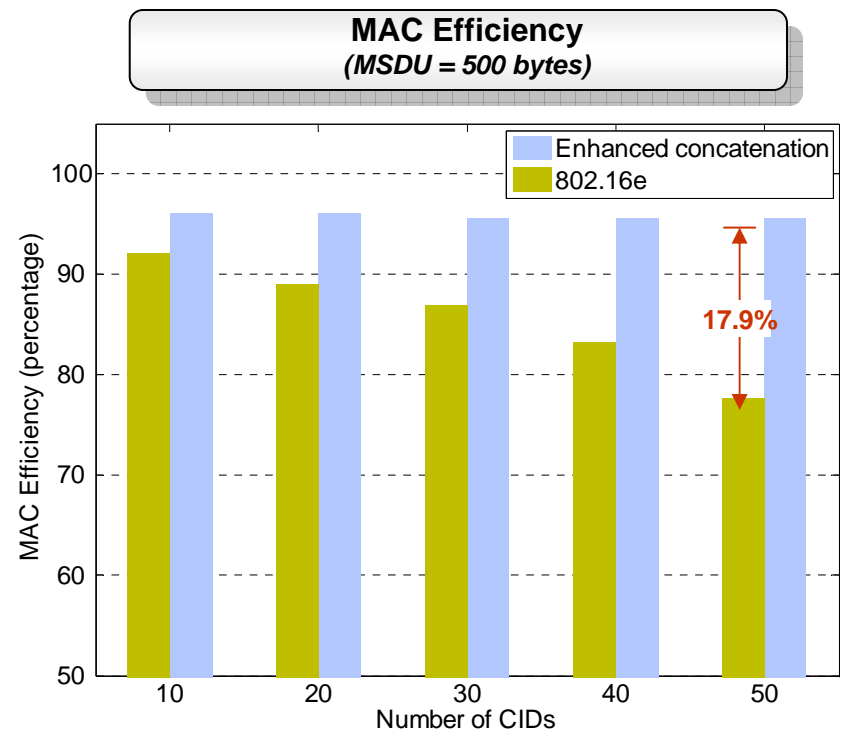
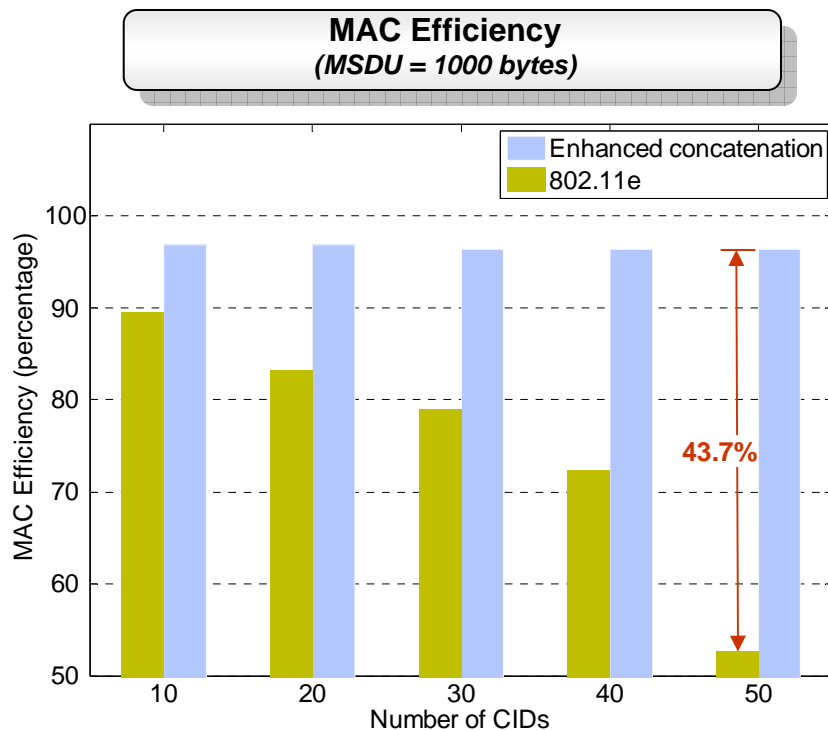
- The concatenation and UL-MAP IE extension provide significant MAC efficiency improvement (>40%)



EC: Performance Evaluation

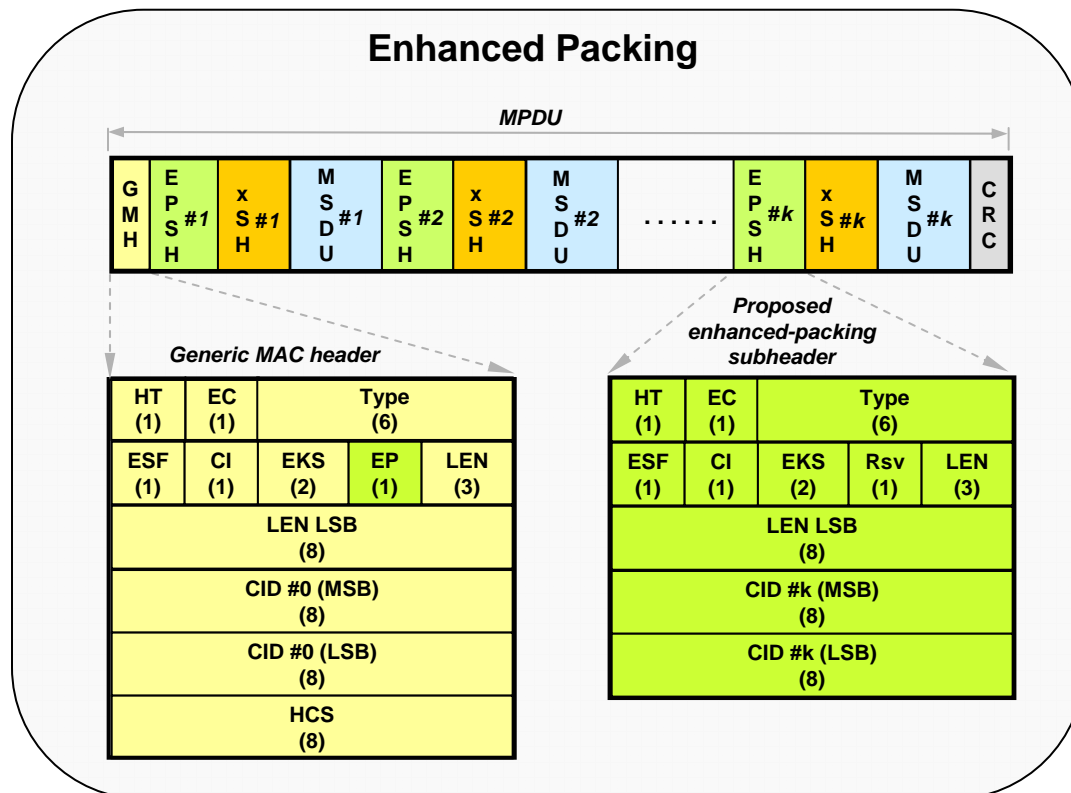
Major findings:

- The MAC efficiency is highly dependent on the *MSDU size*, and the *scheduling/OFDMA mapping* algorithm adopted.
- However, the efficiency improvement persists, throughout a wide range of MSDU size.



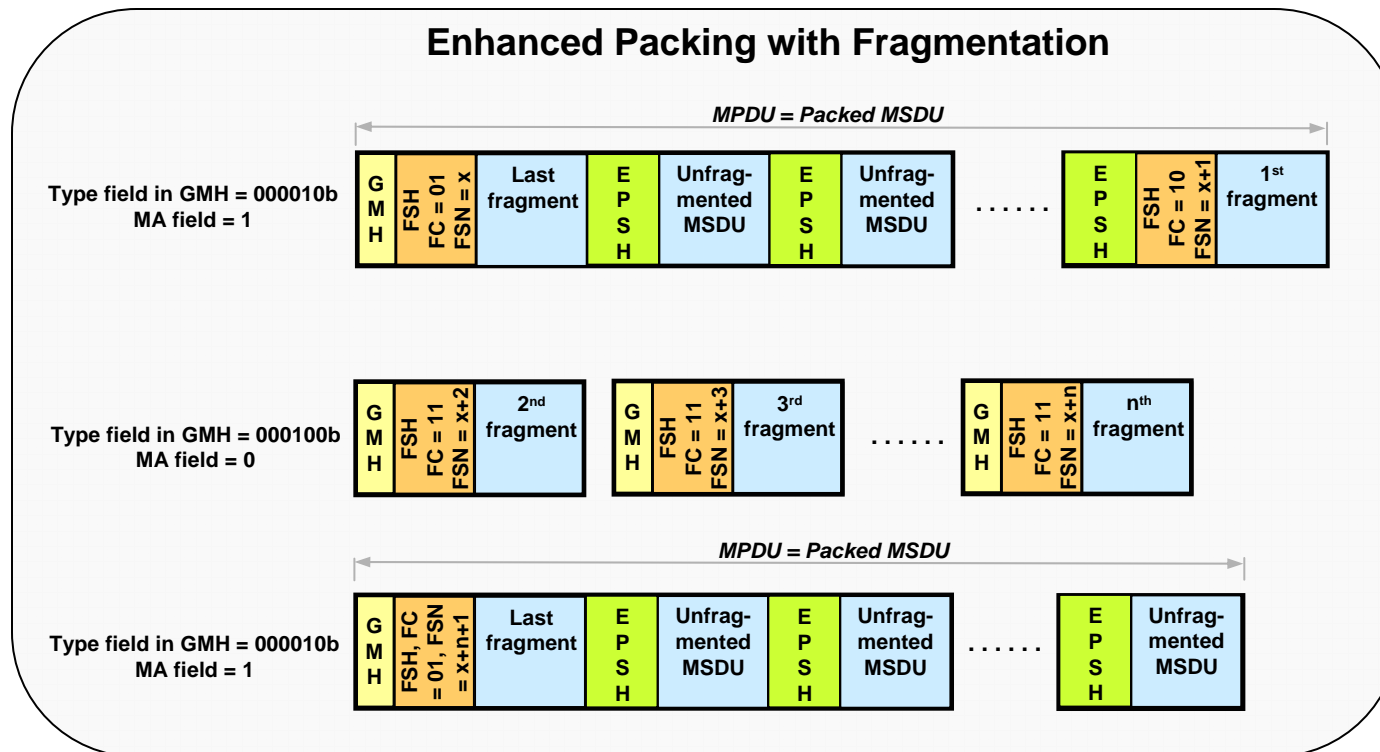
Enhanced Packing (EP)

- The packing defined in IEEE 802.16 only applies for MSDU of common CID.
- Enhanced packing attempts to extend the applicability of the packing to MSDUs of different CIDs but of common quality of service requirement.
- Options for EP indication:
 - The “Rsv” bit in the generic MAC header
 - The MSB of the type field in generic MAC header (mesh bit)
 - Any impossible combination of these 6 bits in the type field
- The “Length” field in the generic MAC header should describe the total length of the MPDU.
- The “CID” field in the generic MAC header is a CID that the intended destination can recognize.



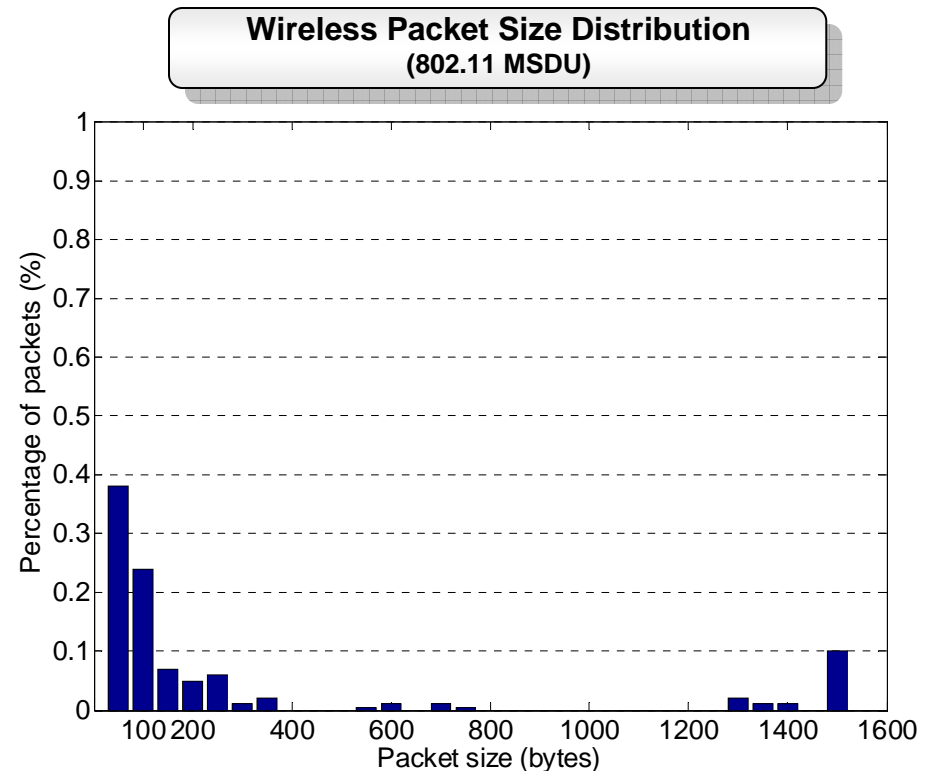
EP with Fragmentation

- Enhanced packing and fragmentation can occur in parallel, in the same way as the coexistence of packing and fragmentation.



EP: Performance Evaluation

- **Evaluation: Mixed traffic**
 - Short packets represent a significant portion of traffic in both wired backbone [1] and wireless access network [2][3].
 - IEEE 802.16e has also defined many short management packets.
 - Use the traffic statistics provided in [1~3], the overall MAC efficiency for 802.16e system and MSDU aggregation with *mixed traffic* can be computed.
- **Major findings:**
 - Enhanced packing can achieve similar level (**66%**) of efficiency improvement as legacy packing defined in 802.16-2004.



Key Observations & Summary

- Transmission between RS and BS (both UL and DL) can invoke the concatenation mechanism defined in 802.16/802.16e.
- The associated management messages (i.e., DL-MAP, DCD, UL-MAP, and UCD) describe the allocated resources in an aggregate manner for a set of connections between BS and RS.
- We propose to *enhance* the *current UL-MAP IE* format to support multiple CIDs in the UL.
- We propose to *enhance packing* to extend its applicability to MSDUs of different CIDs but same QoS requirement.

References

1. *IP Data Analysis*, Applied Research Lab of Sprint, January 10th, 2005, <http://ipmon.sprint.com/packstat/viewresult.php?NULL:pktsz:sj-01.0-050110:>
2. C. Na and T. S. Rappaport, “Measured Wireless LAN Public Hotspot Traffic Statistics”, *IEEE Electronics Letters*, Vol. 40, Issue 19, September 16, 2004
3. J. Yeo, M. Youssef and A. Agrawala, “Characterizing the IEEE 802.11 Traffic: The Wireless Side”, Technical report, Department of Computer Science, University of Maryland, March 1, 2004 <http://www.cs.umd.edu/~moustafa/papers/CS-TR-4570.pdf>