Aggregation in 802.16j –Enhanced Concatenation and Packing

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Jeffrey Z. Tao, Koon Hoo Teo, Jinyun Zhang
Mitsubishi Electric Research Lab
201 Broadway, Cambridge, MA 02139, USA
Voice: 617-621-{7557, 7527}
Fax: 617-621-7550
Email: {tao, teo, jzhang}@merl.com

Toshiyuki Kuze
Mitsubishi Electric Corp.
5-1-1 Ofuna Kamakura, Kanagawa 2478501, JAPAN
Voice: +81-467-41-2885
Fax: +81-467-41-2486
Email: kuze.toshiyuki@ah.MitsubishiElectric.co.jp

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Purpose:

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

Aggregation in 802.16j
– *Enhanced Concatenation and Packing*

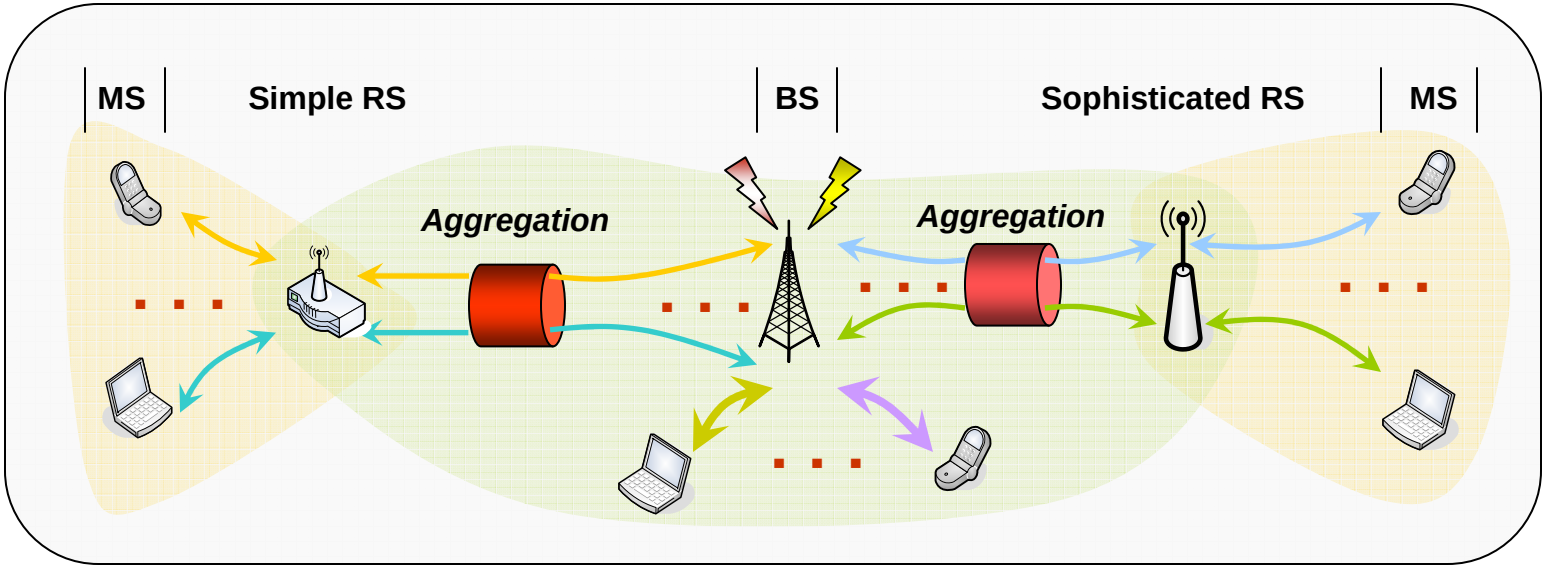
Authors:

Jeffrey Z. Tao, Koon Hoo Teo, Jinyun Zhang
Mitsubishi Electric Research Lab
201 Broadway
Cambridge, MA 02139

Toshiyuki Kuze
Mitsubishi Electric Corp
5-1-1 Ofuna Kamakura, Kanagawa
2478501, Japan

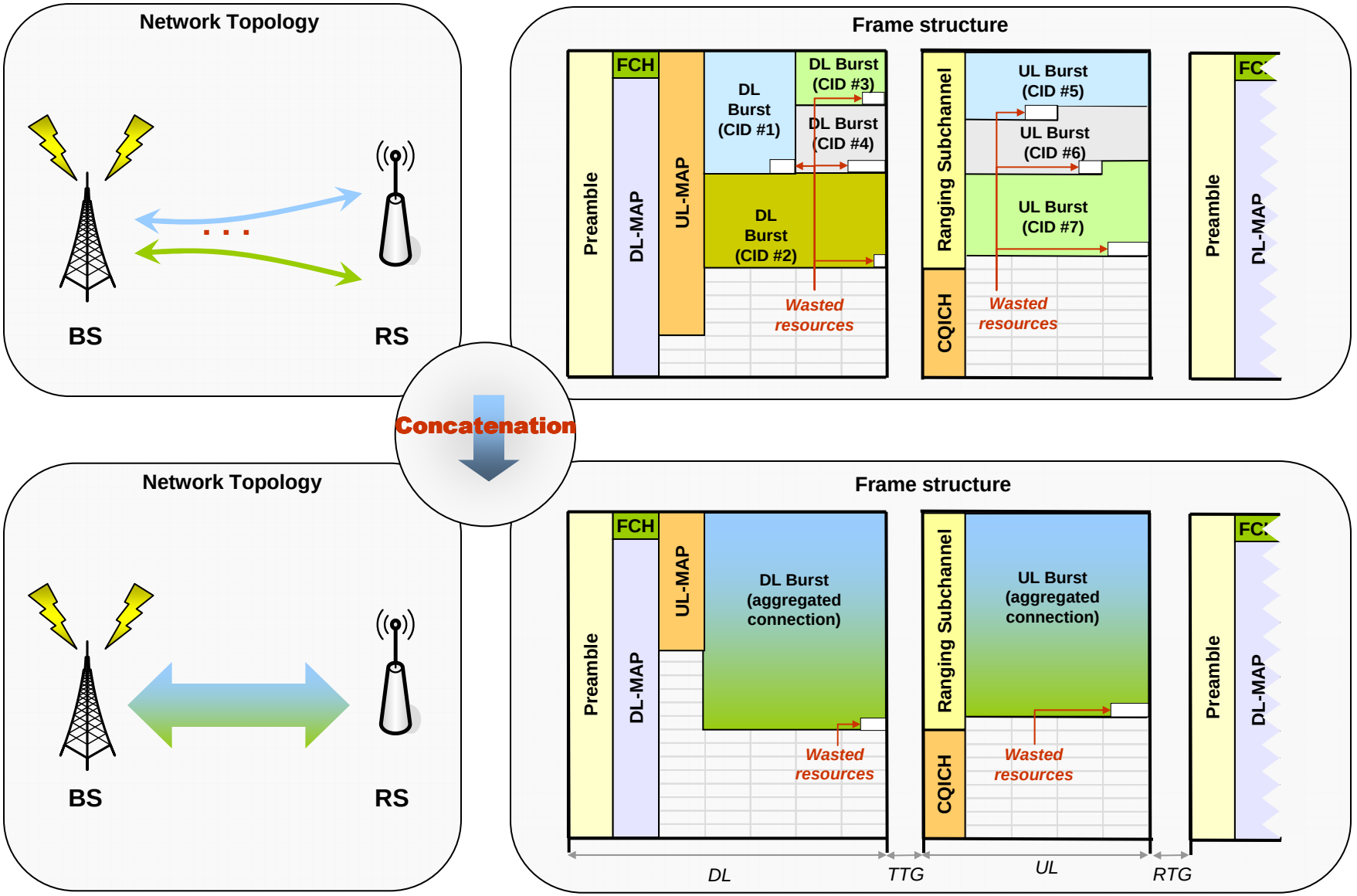
Aggregation

- 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”.

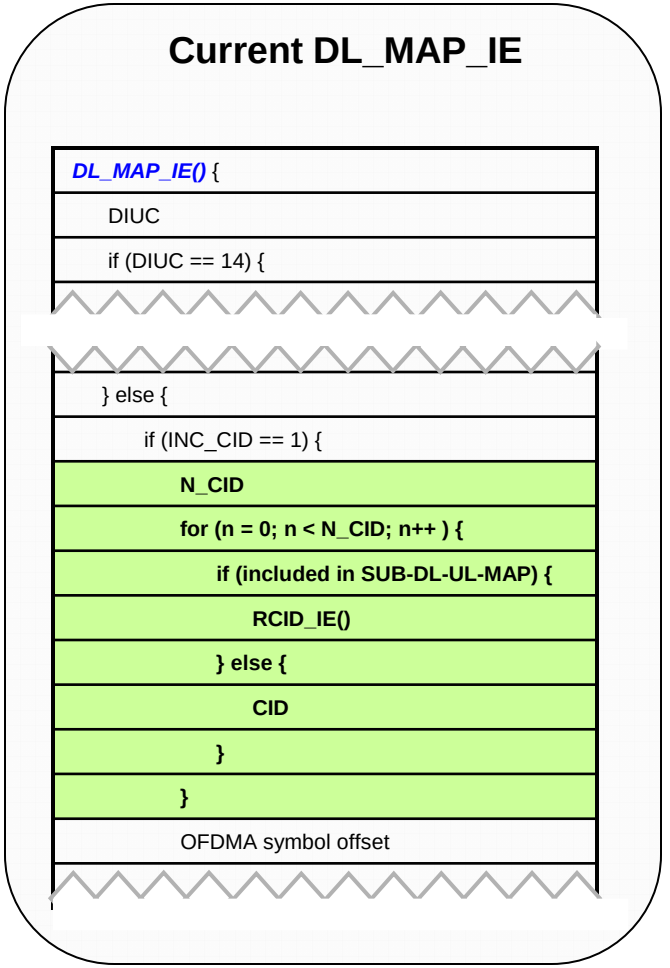
Enhanced Concatenation (EC)



Enhanced Concatenation: the Detail

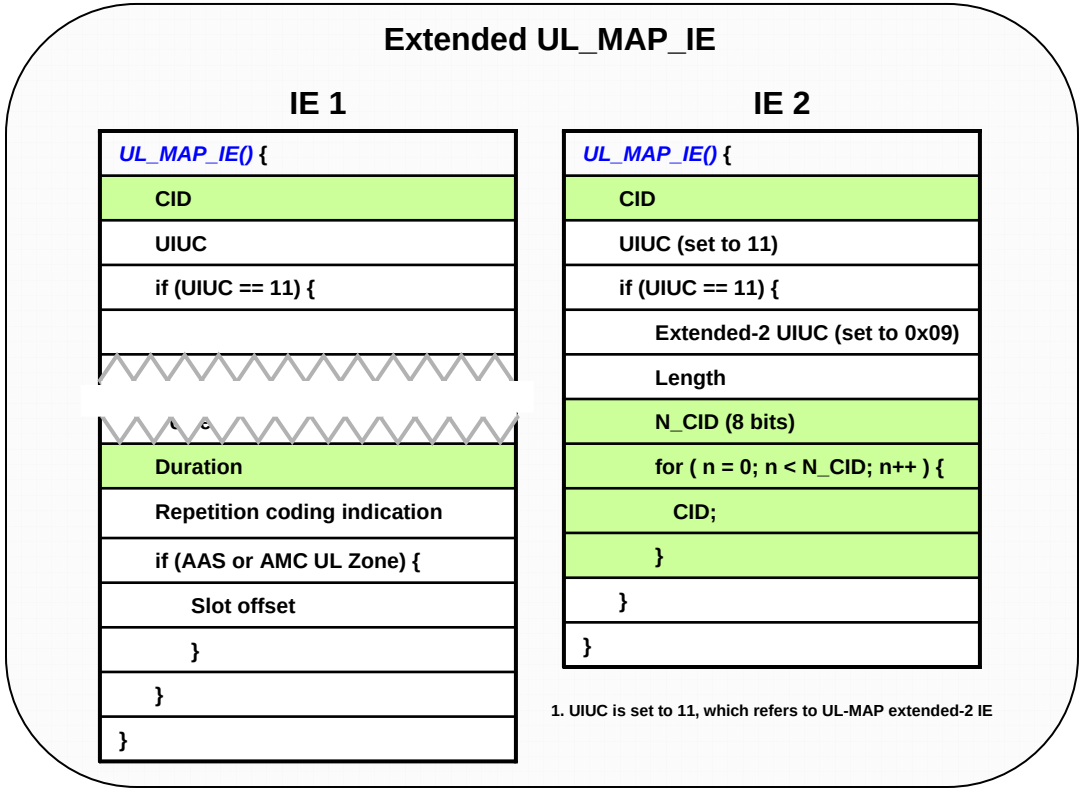
- Data plane
  - The concatenation defined in current 802.16 standard can support this operation.
  - Concatenation essentially is an MPDU level aggregation.

- 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.



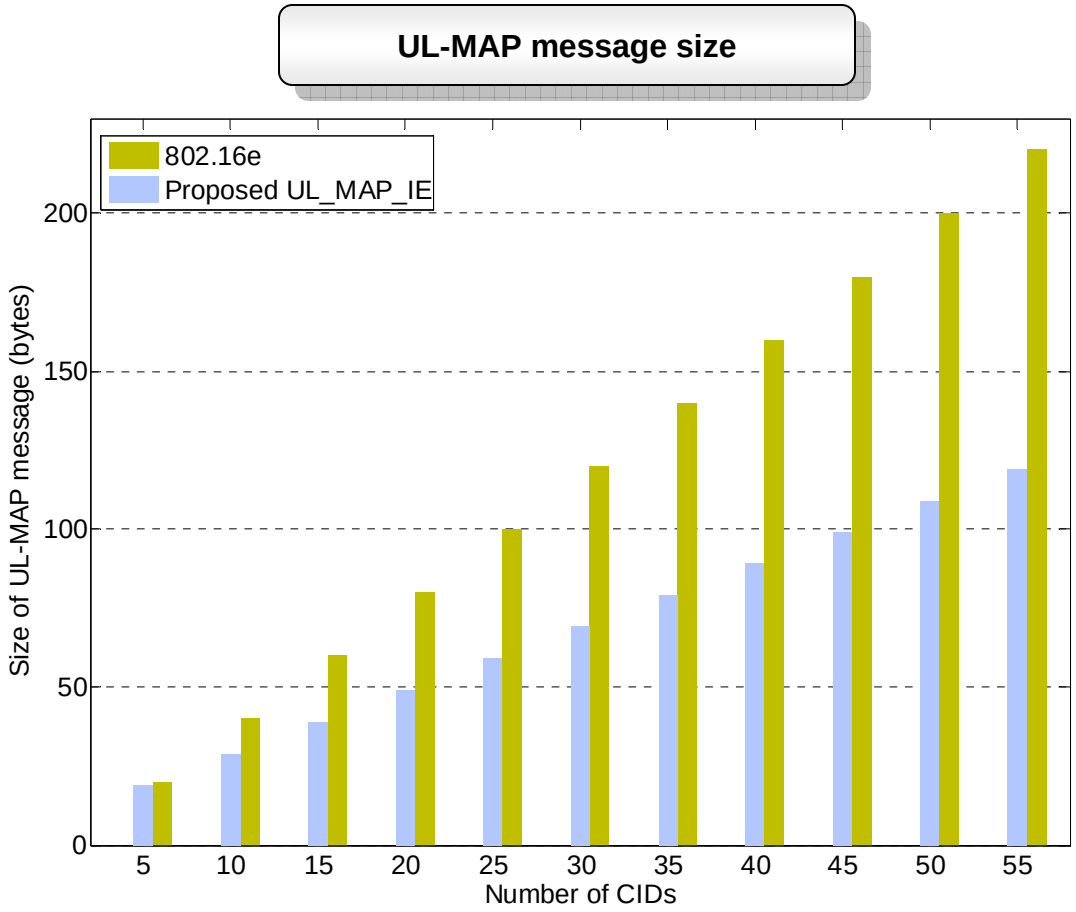
Enhanced Concatenation: the Detail

- 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.

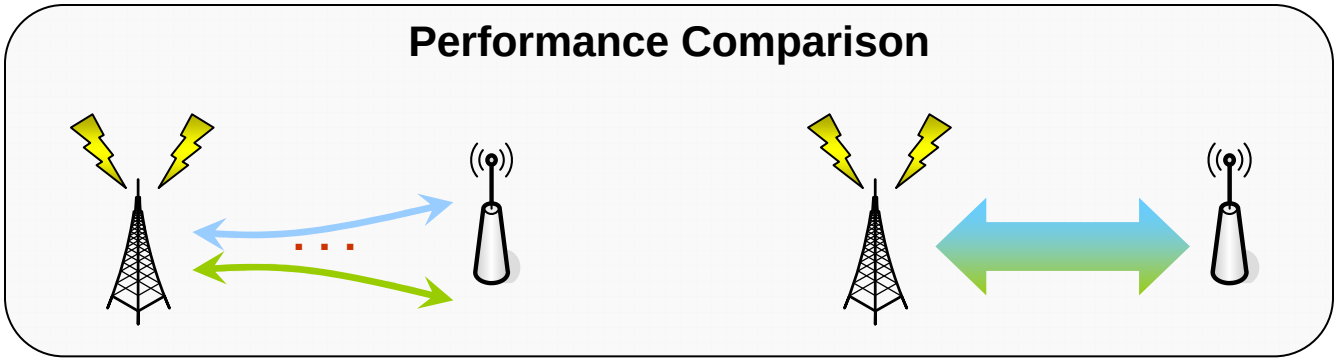


Management Message Overhead

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



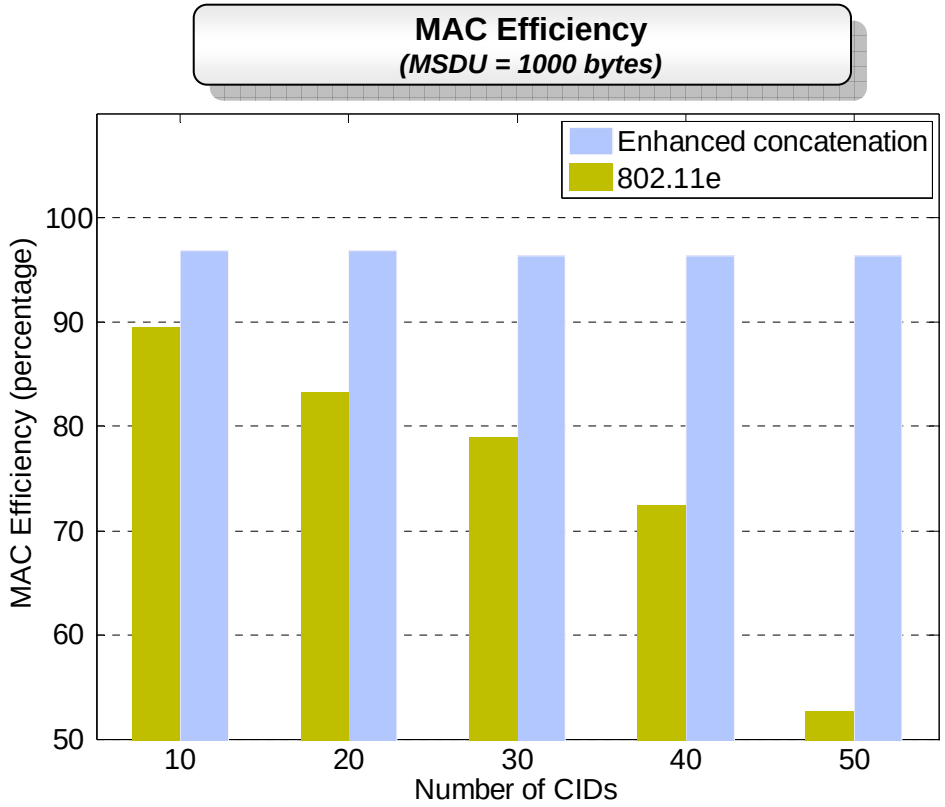
EC: Performance Evaluation



Parameter			
DL	*PUSC (2 symbols per slot)*	**Number of subchannels (DL PUSC)**	*30*
UL	*PUSC (3 symbols per slot)*	**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 ¾ coding rate*	**Number of UL BW/RNG subchannels**	*6*
MCS for preamble and MAP	*QPSK with ½ 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*		

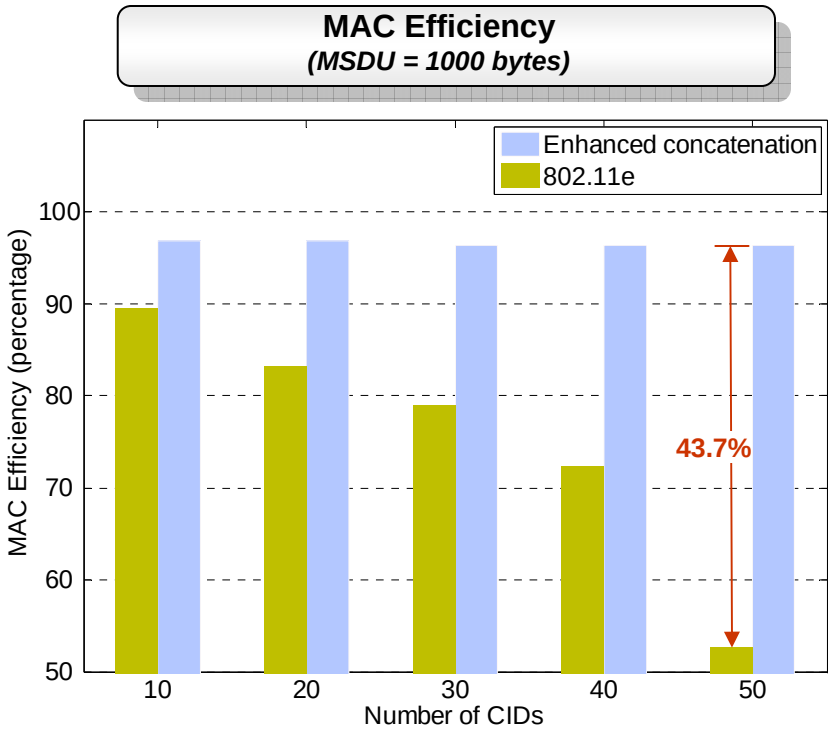
EC: Performance Evaluation

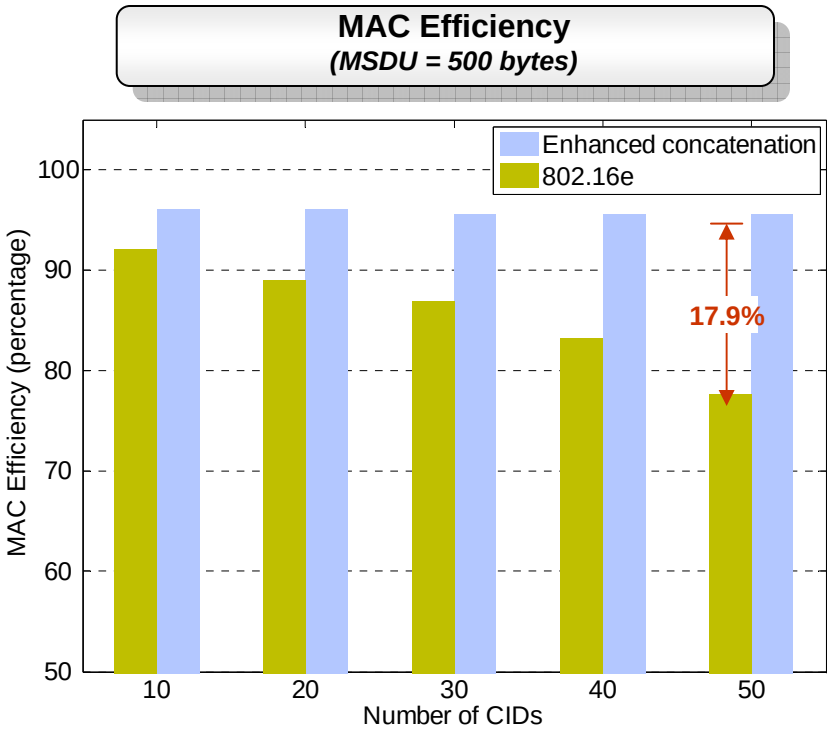
- **Major findings:**
  - The concatenation and UL-MAP IE extension provide significant MAC efficiency improvement (>40%)



EC: Performance Evaluation

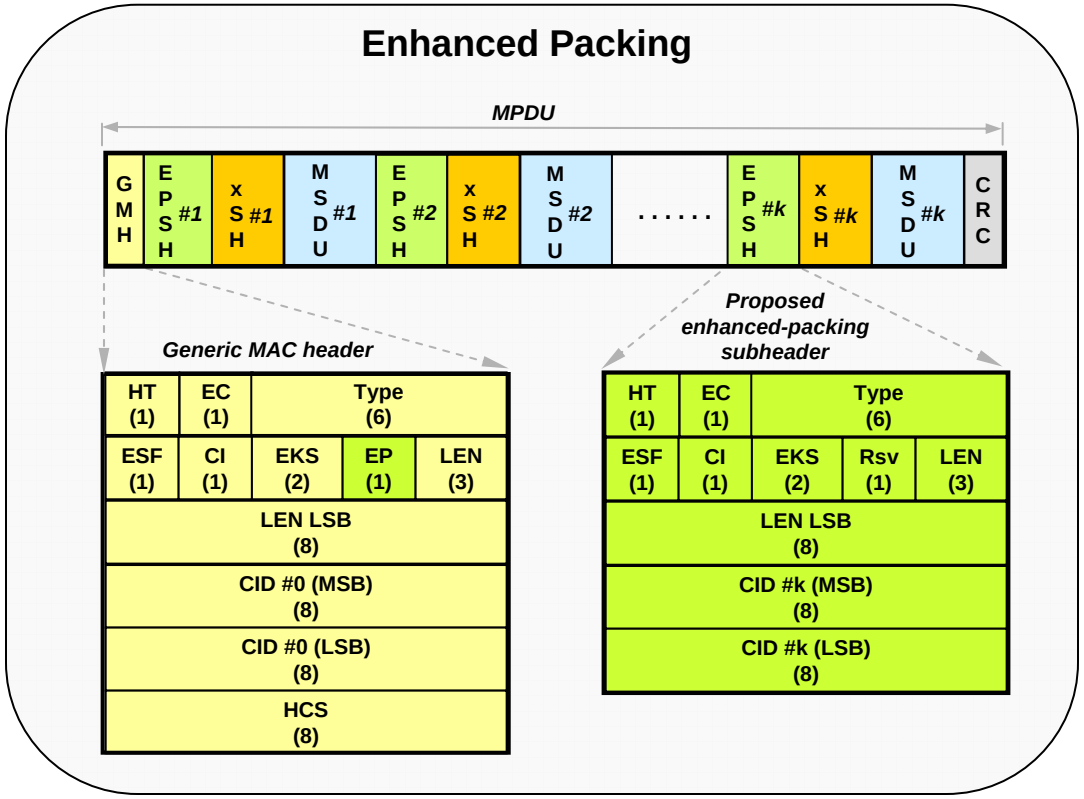
- **Major findings:**
  - The MAC efficiency is highly dependent on the *MSDU size*, and the *scheduling/OFDMA mapping* algorithm adopted.
  - However, the efficiency improvement persists, throughout a wide range of MSDU size.





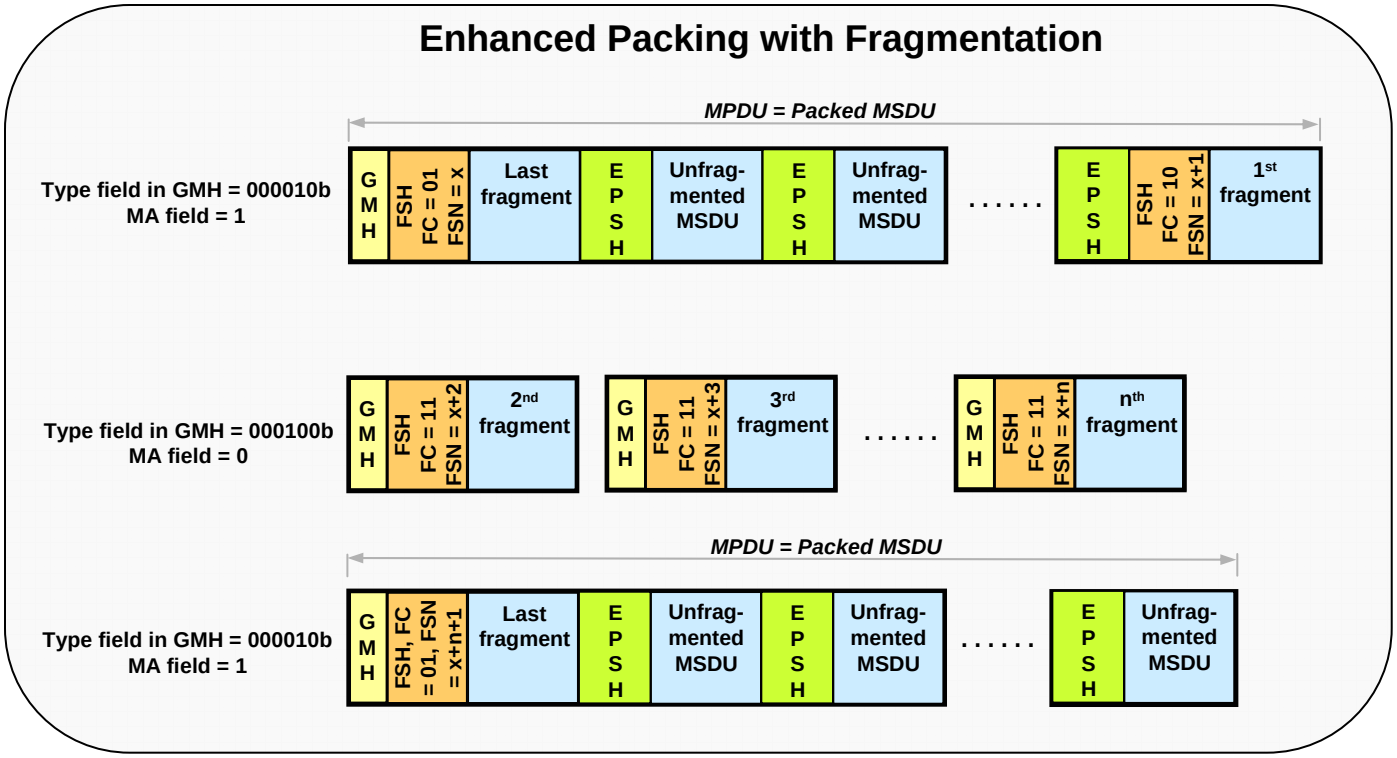
Enhanced Packing (EP)

- 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

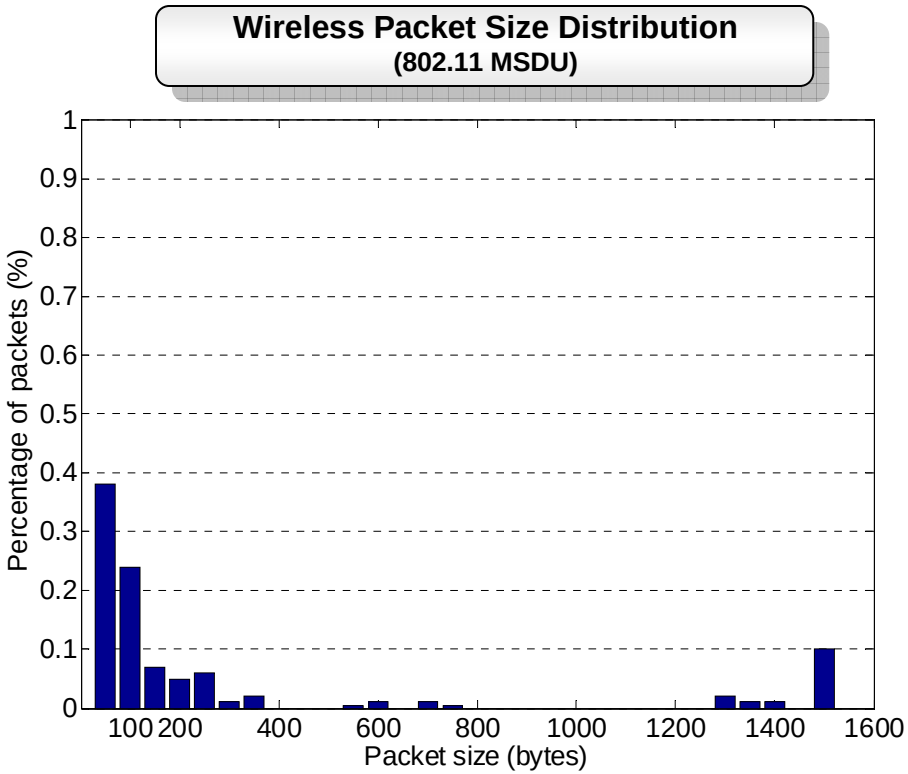
- Enhanced packing and fragmentation can occur in parallel, in the same way as the coexistence of packing and fragmentation.



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*