
Designing a Multi-Channel MAC Protocol for Integrated Wireless LAN

Jen-Chu Liu

MNETLAB

Multi-Channel Wireless LAN

- Using multiple channels to achieve higher network throughput [1,2,3,4,5,6,7,8,]
 - Does IEEE 802.11 support multi-channel mode?
 - PHY → yes
 - MAC → no
 - Multi-channel hidden terminal problem[2]
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Multi-Channel MAC (1 / 9)

- Single transceiver vs. Multi-transceivers
 - Multi-transceiver[4][6]
 - Using common control channel
 - N data channel
 - Transmit data and receive control signal currently
 - Single transceiver [2][8]
 - The 802.11 device is equipped with on half-duplex transceiver
 - The transceiver is switching channel dynamically , but it only transmit or listen on one channel at a time
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Multi-Channel MAC (2/9)

- Three types of mobile node:
 - Single channel using single transceiver (type 0)
 - Multi-channel using single transceiver (type 1)
 - Multi-channel using multi-transceiver (type 2)

 - How to design a multichannel MAC for different type of MHs?
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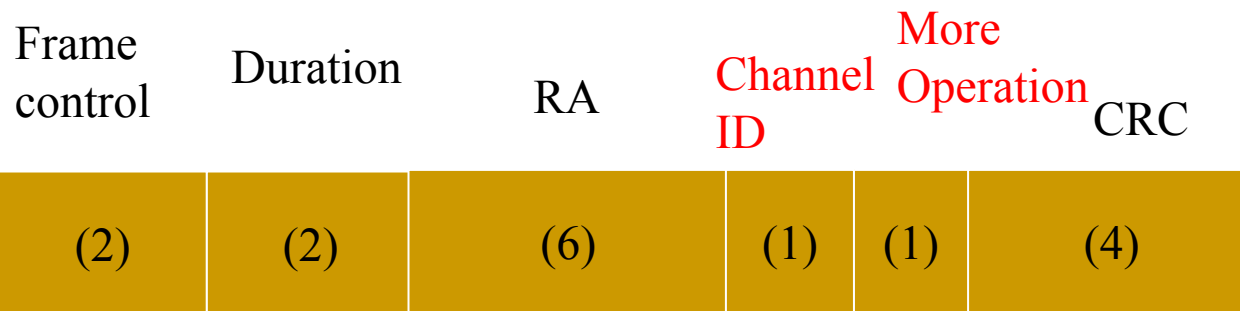
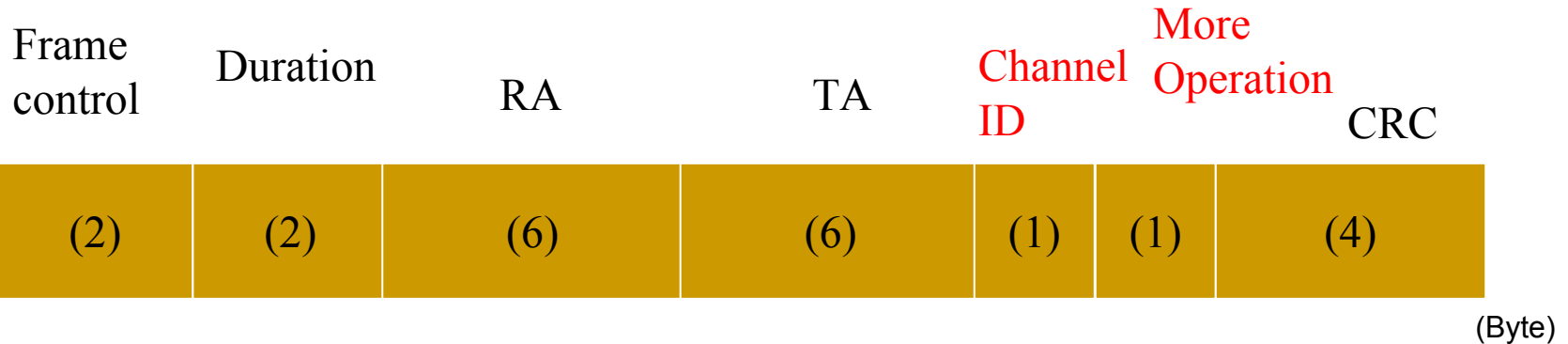
Multi-Channel MAC (3/9)

- Modifying the 802.11 MAC control frame
 - Modifying the “type” and “subtype” fields
 - 010000 for type 0
 - 010001 for type 1
 - 010010 for type 2

Protocol version	Type	Subtype	To DS	From DS	More Frag	Retry	Pwr Mgt	More Data	WEP	Order
(2)	01	0000~0010	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)

Multi-Channel MAC (4/9)

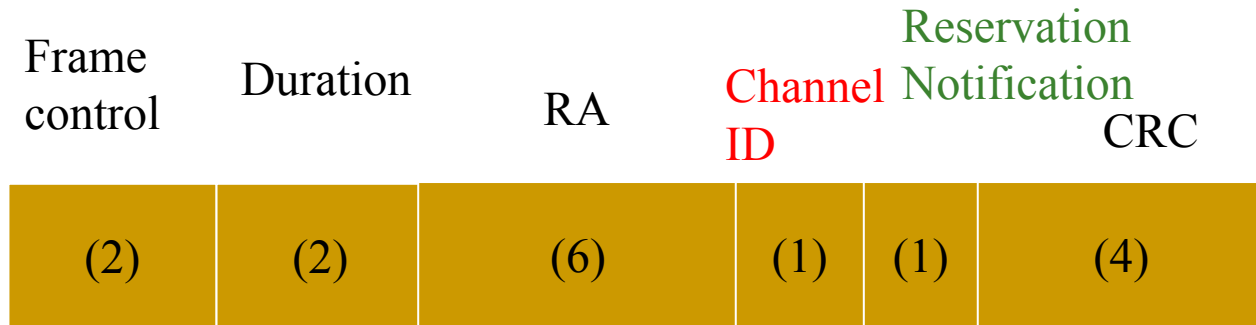
- Designing new multichannel RTS/CTS frames (called MRTS/MCTS)



(Byte)

Multi-Channel MAC (5/9)

■ MCTS Reservation notification (MCTS-R)

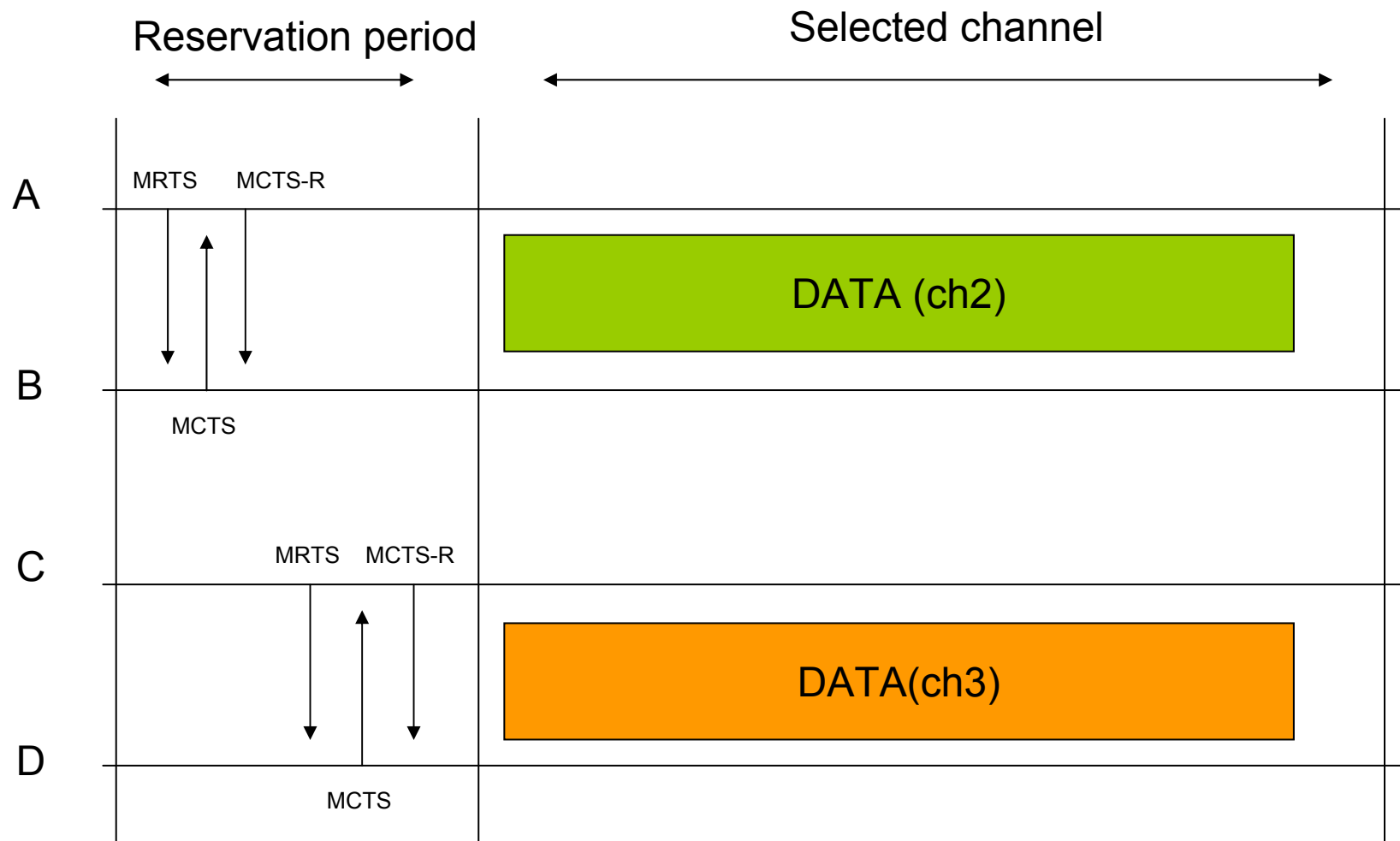


(Byte)

Multi-Channel MAC (6/9)

- Type 0 communicate with all type
 - Using traditional IEEE 802.11 communication
 - Type 1 communicate with type 1
 - Using a common channel as a control channel
 - Channel Negotiation and switching channel dynamically
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Multi-Channel MAC (7/9)

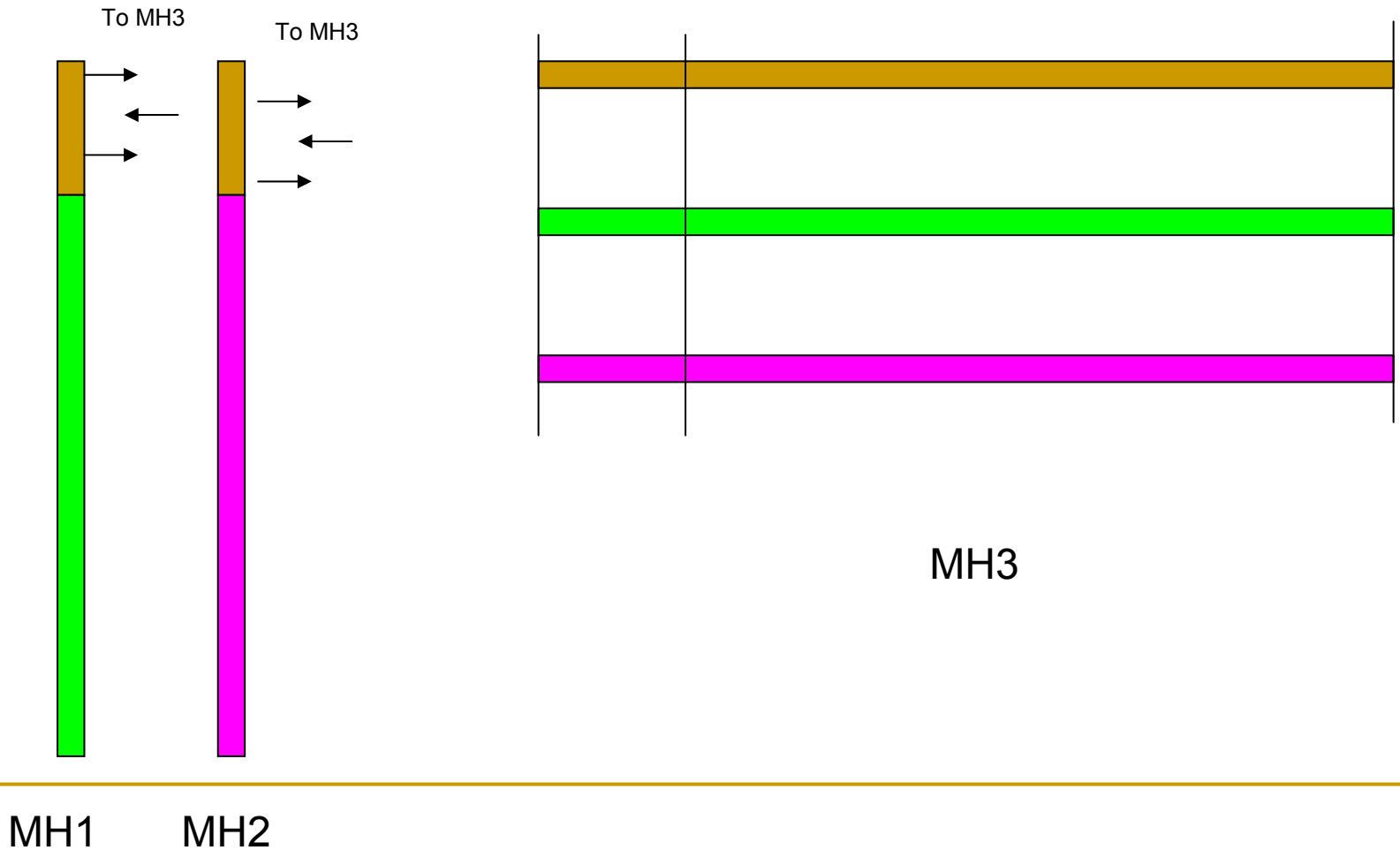


Multi-Channel MAC (8/9)

- Type 2 communicate with type 2
 - Using a common channel as a control channel
 - Channel Negotiation and switching channel dynamically
 - Different transceivers represent different channels
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Multi-Channel MAC (9/9)

- Type 1 communicate with type 2



Discussions

- The reservation period is a major overhead in our MAC protocol
 - Especially in type 2 scenario
 - If using persistent reservation?
 - The reservation period should be changed dynamically
 - How and when?
 - How about according to the number of mobile nodes?
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Discussions

- When the number of type-0 MH increased, the network is more like traditional IEEE 802.11 WLAN.
 - If clustering all type-0 MHs, using cluster head to communicate with other type of MHs?
 - Our scheme may adapt different channel selection schemes, because of the “more operation” field.
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References

1. A. Raniwala, K. Gopalan, and T. Chiueh, " **Centralized Channel Assignment and Routing Algorithms for Multi-Channel Wireless Networks**," ACM Mobile Computing and Communications Review, Volume 8, Number 2. June 2004.
 2. J. So and N. Vaidya, " **Multi-Channel MAC for Ad Hoc Networks: Handling Multi-Channel Hidden Terminals Using A Single Transceiver**," ACM Mobihoc, May 2004.
 3. V. Bahl, A. Adya, J. Padhye, A. Wolman, " **Reconsidering the Wireless LAN Platform with Multiple Radios**," Eorkshop on Future Directions in Network Architecture '03.
 4. S. L. Wu, C. Y. Lin, Y. C. Tseng, and J. P. Sheu, " **A New Multi-Channel MAC Protocol with On-Demand Channel Assignment for Multi-Hop Mobile Ad Hoc Networks**," in Int'l Symposium on Parallel Architectures, Algorithms and Networks (I-SPAN), 2000.
 5. T. R. Jensen and B. Toft, " **Graph Coloring Problems**," Wiley Interscience, New York, 1995.
 6. W. Hung, K. Law and A. Leon-Garcia, " **A Dynamic Multi-Channel MAC for Ad Hoc LAN**," in Proc. Of 21st Biennial Symposium on Communications, April 2002.
 7. A. Nasipuri and S. R. Das, " **Multichannel CSMA with Signal Power-based Channel Selection for Multihop Wireless Networks**," in Proc. of IEEE Vehicular Technology Conference (VTC), September 2000.
 8. J. H. Chen and Y. D. Chen, " **AMNP: Ad Hoc Multichannel Negotiation Protocol for Multihop Mobile Wireless Networks**," IEEE International Conference on Communication, 2004.
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