

Efficient Wider Bandwidth Operation

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Authors:

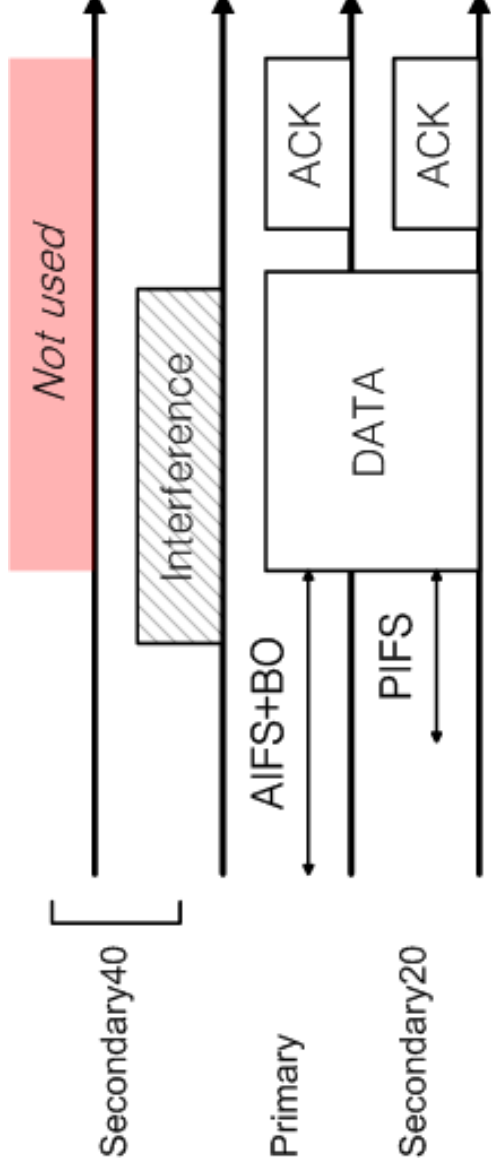
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Abstract

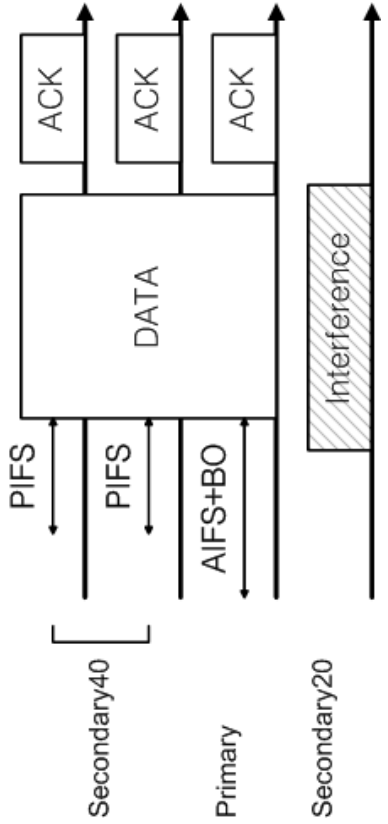
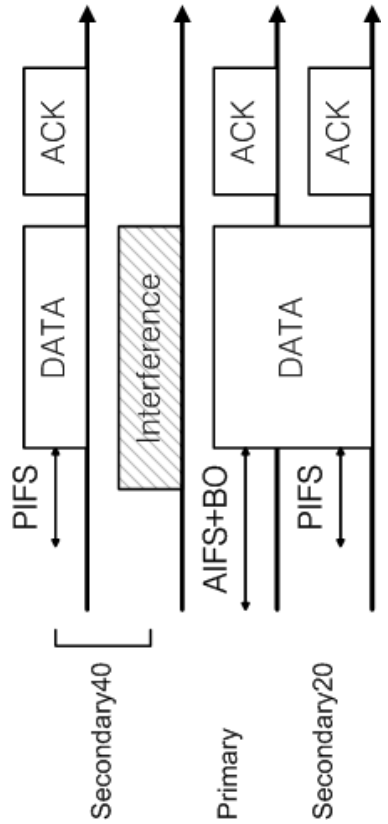
- Main goal of HEW SG is to enhance efficiency [1]
- This proposal analyzes wider bandwidth operation from the perspective of efficiency

Problem definition

- **Legacy channel access in wider bandwidth**
 - Contending (AIFS + backoff) access in primary channel
 - PIFS access in secondary channels
- **Legacy channel access can not utilize resource fully**
 - When interference is detected in a secondary channel, remaining secondary channels can not be used



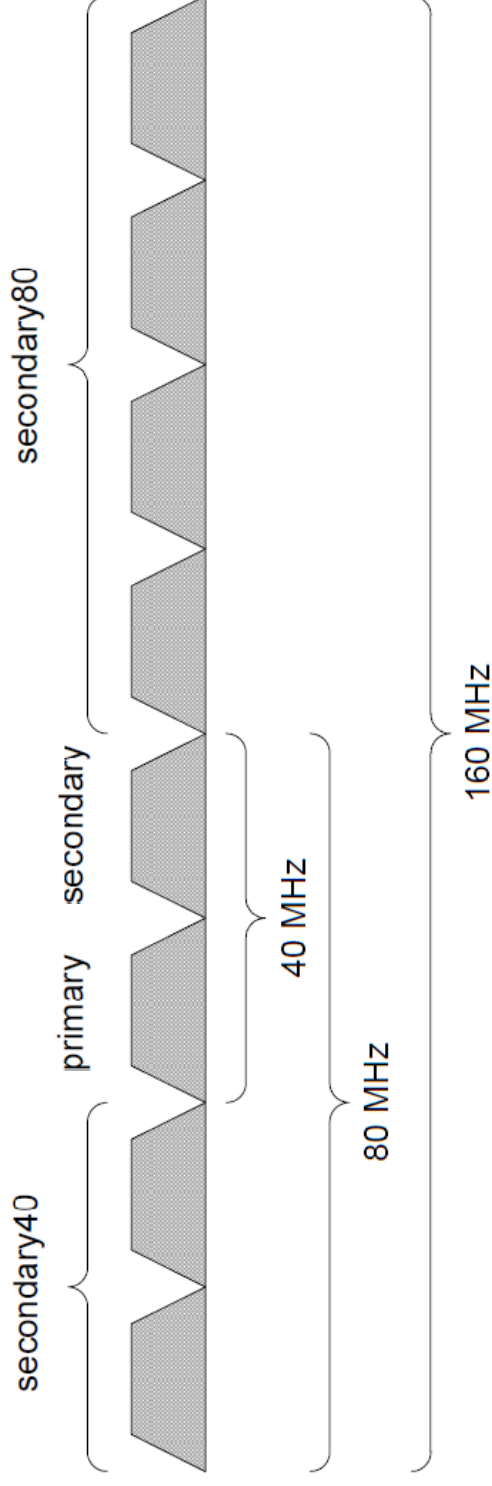
Possible approaches

Approach I.	Approach II
Supporting additional contiguous bandwidth option	Supporting non-contiguous bandwidth
Add contiguous 60/100/120/140 MHz bandwidth option	Develop non-contiguous bandwidth structure (e.g. 20 + 20 MHz, 20 + 40 MHz, 40 + 80 MHz, and so on)
 Timing diagram for Approach I (contiguous bandwidth): Primary (20 MHz): PIFS, DATA, ACK Secondary (40 MHz): PIFS, ACK Secondary (20 MHz): AIFS+BO, DATA, ACK Interference: Occurs in the Primary channel during the Secondary channel's PIFS period.	 Timing diagram for Approach II (non-contiguous bandwidth): Primary (20 MHz): PIFS, DATA, ACK Secondary (40 MHz): PIFS, ACK Secondary (20 MHz): AIFS+BO, DATA, ACK Interference: Occurs in the Primary channel during the Secondary channel's PIFS period.

Analysis on proposed approaches (1/2)

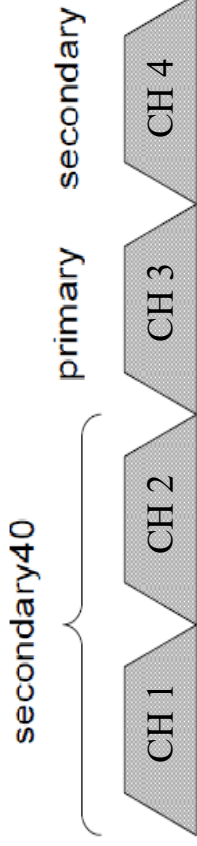
- Assumptions

- Channelization is based on 802.11ac spec D6.0
- 80/160 MHz bandwidth (four or eight 20MHz channels, respectively)
- **probability p** : probability with which each secondary channel is independently busy



Analysis on proposed approaches (2/2)

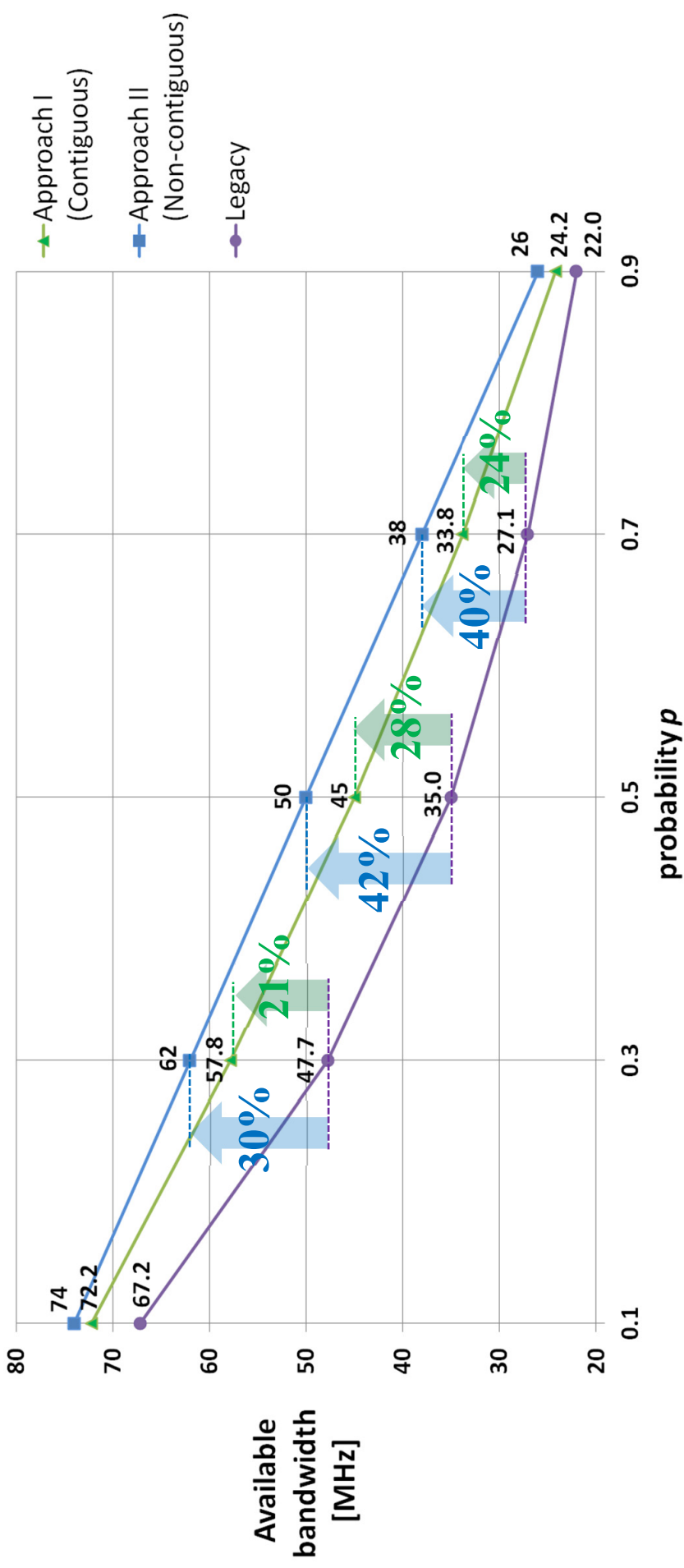
- **Example: 80 MHz case (4 channels)**
 - Legacy operation yields 5 inefficient cases out of total 8 cases



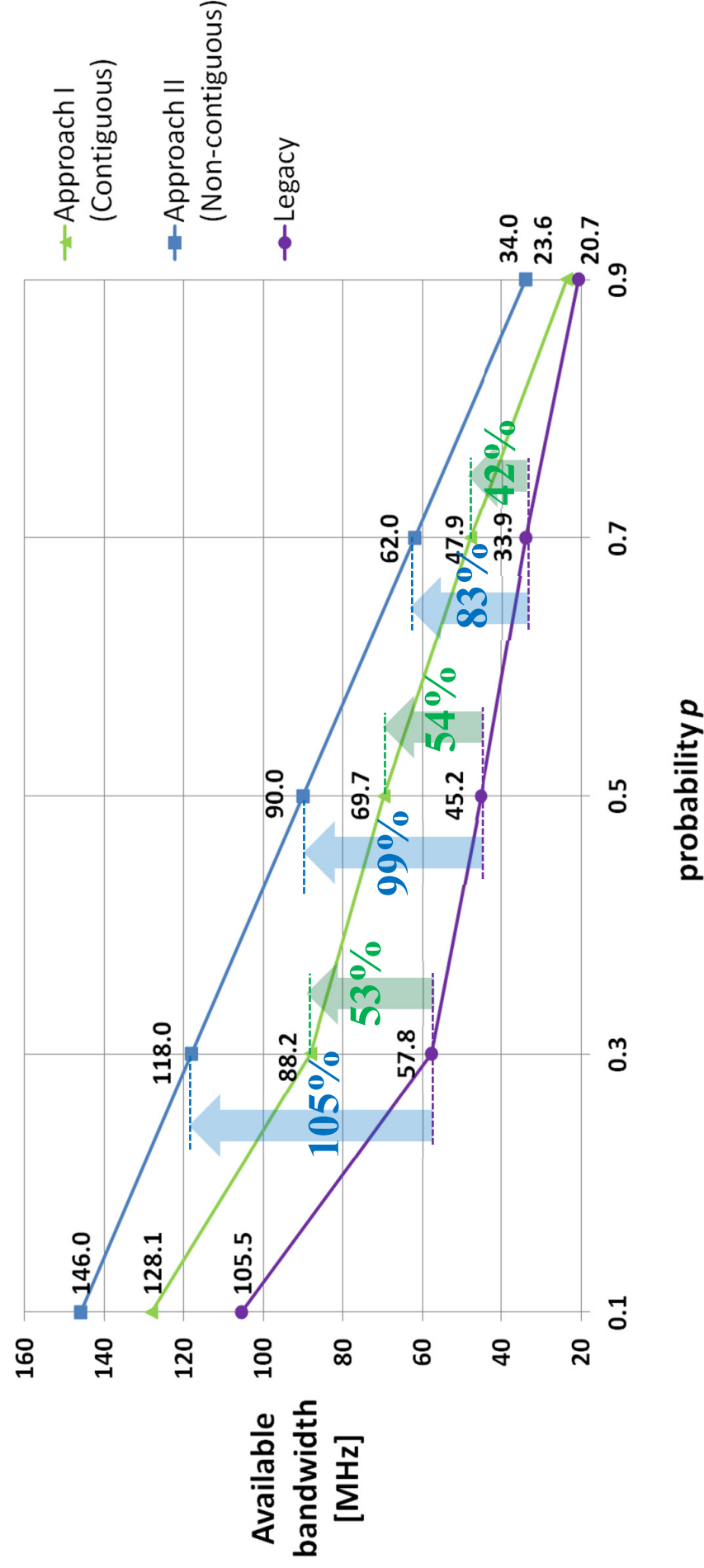
	Channel (red color means <i>busy</i>)					Resource utilization			
	CH1	CH2	CH3	CH4	probability	Legacy	Approach I.	Approach II.	
Case 1					$p(1-p)^2$				
Case 2					$p(1-p)^2$				
Case 3					$p(1-p)^2$				
Case 4					$p^2(1-p)$				
Case 5					$p^2(1-p)$				

Analysis results (1/2) - 80 MHz

- Available bandwidth
 - Amount of resource that can be utilized in average sense



Analysis results (2/2) - 160 MHz



Summary on analysis

- **Proposed approaches provide higher available bandwidth than legacy operation**
 - 42% available bandwidth gain (80 MHz, p is 0.5)
 - 105% available bandwidth gain (160 MHz, p is 0.3)
- **Available bandwidth gain increases with bandwidth, i.e. higher gain in 160MHz than in 80MHz.**
- **Approach II, i.e. supporting non-contiguous bandwidth provides higher gain than approach I for all given p**

Conclusion

- **We analyzed wider bandwidth operation for enhancement on bandwidth efficiency**
- **Analysis shows that supporting non-contiguous bandwidth is necessary for HEW**
- **Need to discuss to support non-contiguous bandwidth**
 - OFDMA (for multi-user) [2]
 - Channel bonding (for single-user) [3]
 - Multiple RFs [3]
 - Mixed mode
 - Etc..

References

- [1] 11-13-0657-06-0hew-hew-sg-usage-models-and-requirements-liaison-with-wfa
- [2] 11-13-0871-00-0hew-discussion-on-potential-techniques-for-hew
- [3] 11-09-1022-00-00ac-multi-channel-transmissions