# Performance Analysis of Dynamic Channel Bonding in Spatially Distributed High Density WLANs [1]

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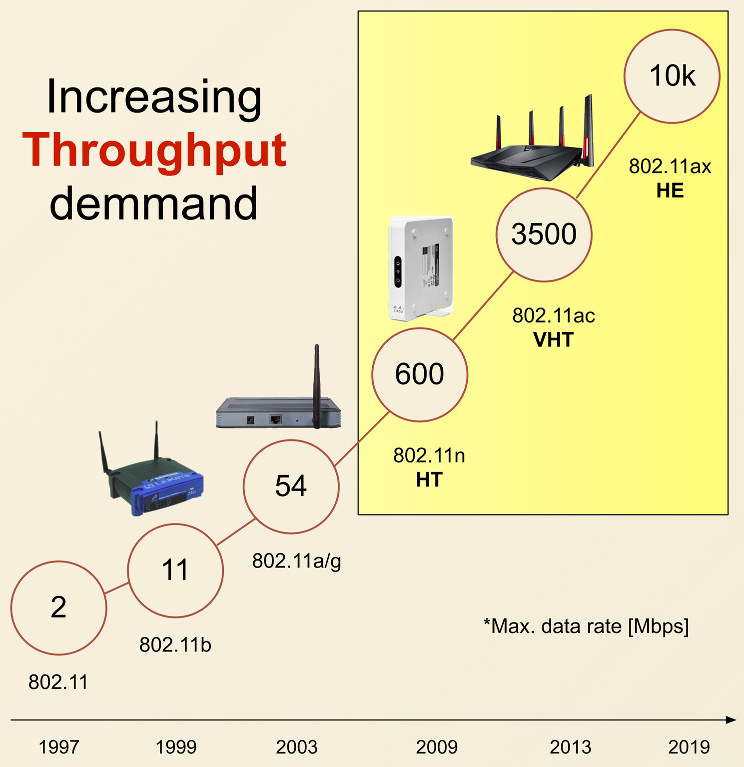
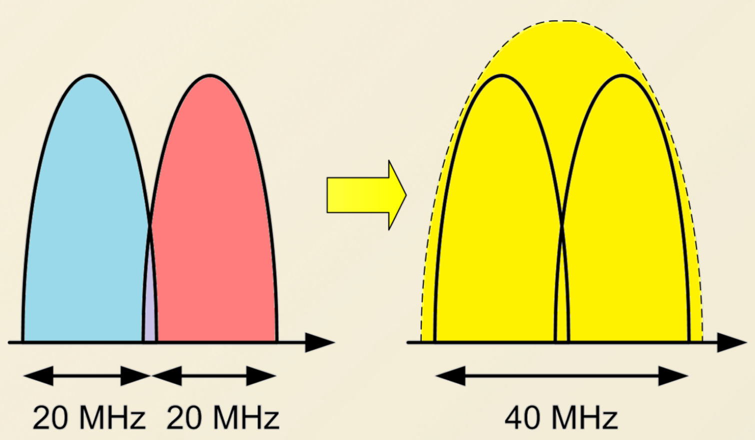
## Abstract

We present novel insights on the effects of **dynamic channel bonding** (DCB) policies in WLANs. We depict the complex interactions that are given in **spatially distributed** scenarios through Continuous Time Markov Networks (CTMNs). Then, we assess the performance of such policies in high density (HD) IEEE 802.11ax scenarios by means of simulations. We show that always picking the widest channels available can be suboptimal in terms of individual throughput and fairness. Thus, more flexible policies like **stochastic width selection** are required. Besides, we show that policy learning and/or adaptation is required on a per WLAN basis.

## The problem: WLAN & Wi-Fi evolution

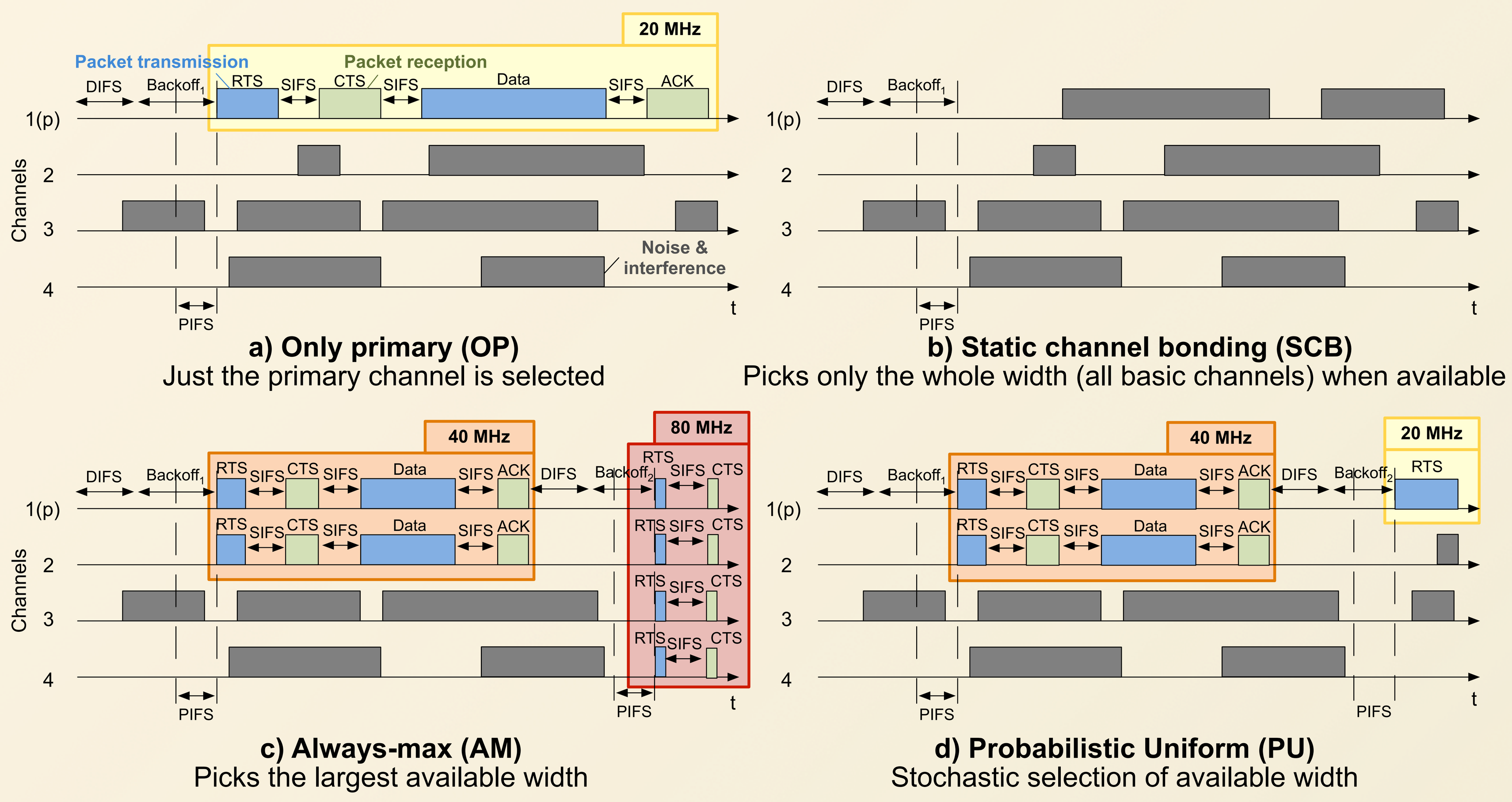




**More bandwidth is required**



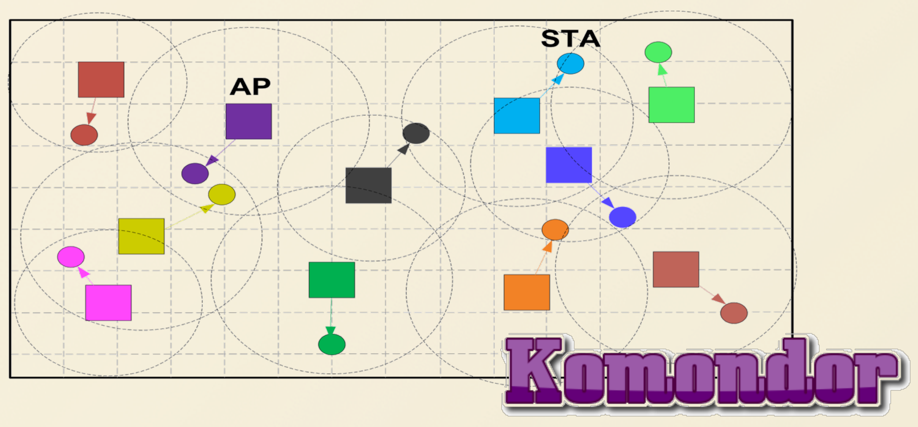

Larger **bandwidth**:
+ higher data rates
-lower SINR (packets loss)

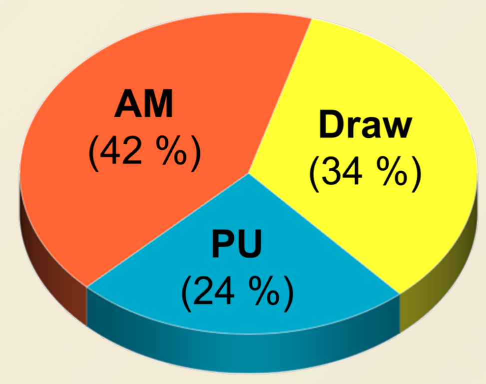
## Approaches: DCB policies




## Evaluation of DCB in IEEE 802.11ax HD WLANs

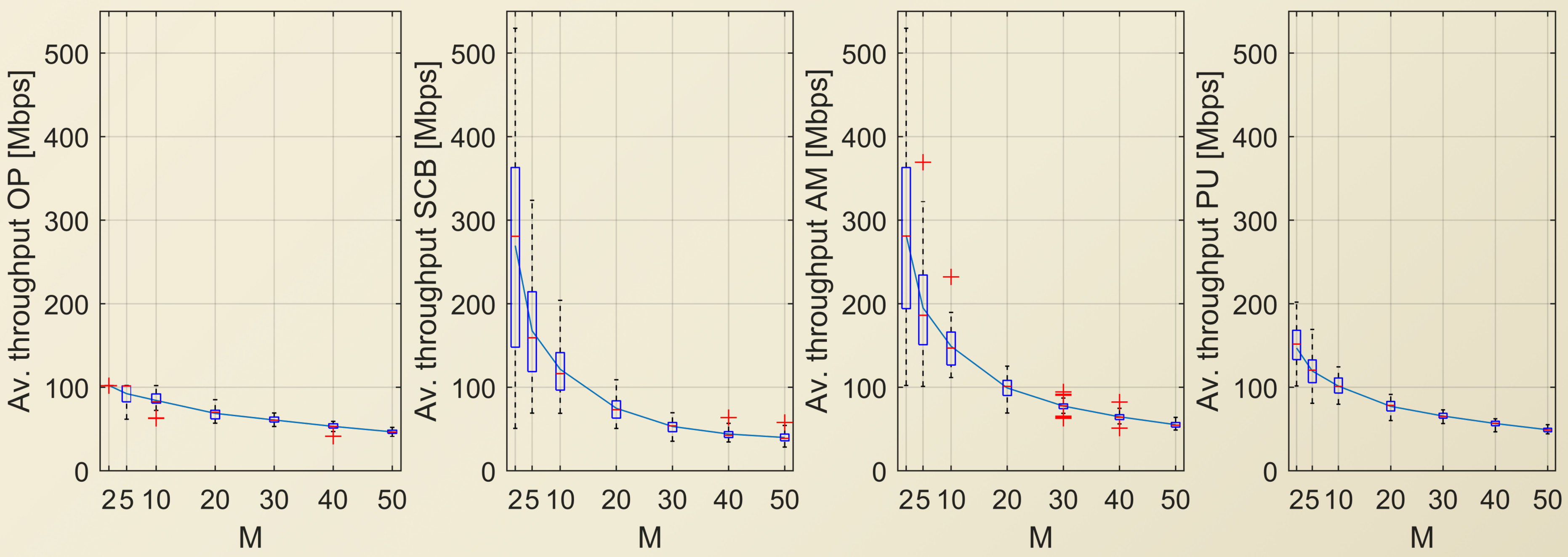
- Analysis of throughput vs. node density in 11ax spatially distributed networks
- Up to $M = 50$ WLANs in a 100 x 100 $m^2$ random deployment
- 1400 scenarios simulated in the open source Komondor simulator [3]



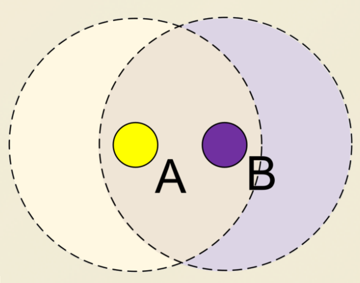

*Scenarios where the policy is optimal

**Evaluation of dense scenarios**:
- Low density → Aggressive policies (SCB or AM)
- High density → Flexible policies (AM or PU)
- OP occupies min. bandwidth at max. power → Exposed nodes in same channel
- PU is more fair than AM → Higher risk of starvation in AM than PU

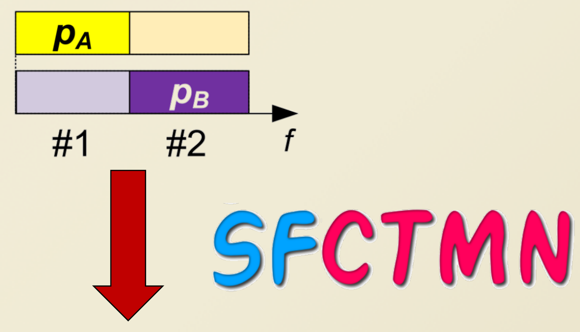


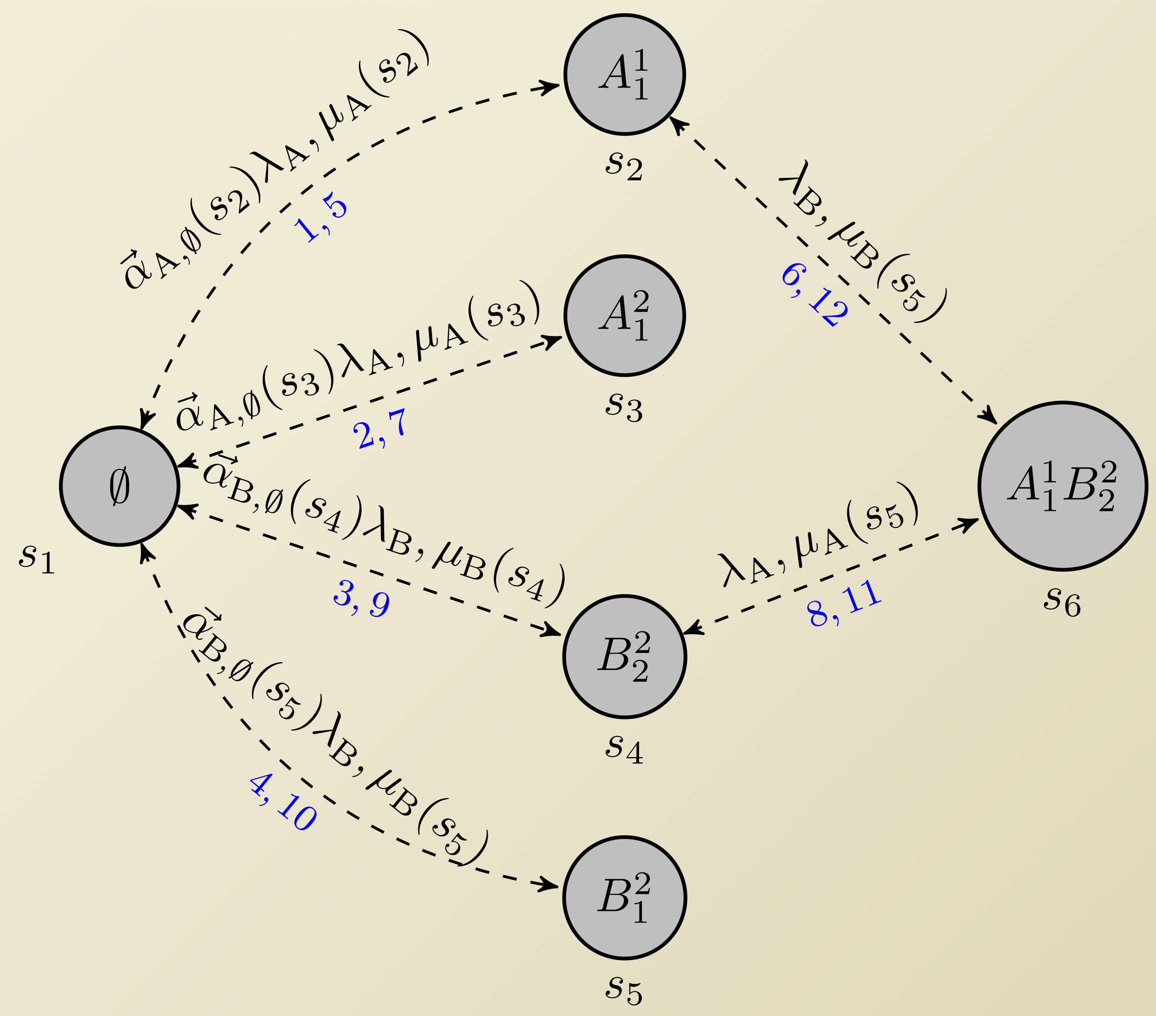

## Analytical framework

- SFCTMN [2] models spatially distributed DCB WLANs
- Based on CTMNs
- DCB policies defined by vectors $\vec{\alpha}$
- Closed-form throughput expression




**Evaluation of toy scenarios**:
- Feasible states depend on the policy
- AM is not always optimal
- Complex spatial interdependences
- No policy *rules them all*



## Next steps: towards adaptive DCB

AM is normally the best policy to maximize the individual short and long-term throughput but there are cases, specially in high density scenarios, where other policies like stochastic PU perform better both in terms of individual throughput and fairness.

Thus, DCB can be importantly improved by implementing **adaptive policies** capable of making the most of the knowledge gathered from the medium and/or via information distribution.

### References

[1] Barrachina-Muñoz, S., Wilhelmi, F., & Bellalta, B. (2018). **Performance Analysis of Dynamic Channel Bonding in Spatially Distributed High Density WLANs.** *arXiv preprint arXiv:1801.00594.*
[2] Barrachina-Muñoz, S. (2017). **Komondor: An IEEE 802.11ax Simulator.** *GitHub repository.* Available online at https://github.com/wn-upf/Komondor
[3] Barrachina-Muñoz, S., & Wilhelmi, F. (2017). **Spatial Flexible Continuous Time Markov Network (SFCTMN).** *GitHub repository.* Available online at https://github.com/sergiobarra/sfctmn

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