



Quality Of Service and MObility driven cognitive radio Systems

# MAC Layers for White Space Radio Systems

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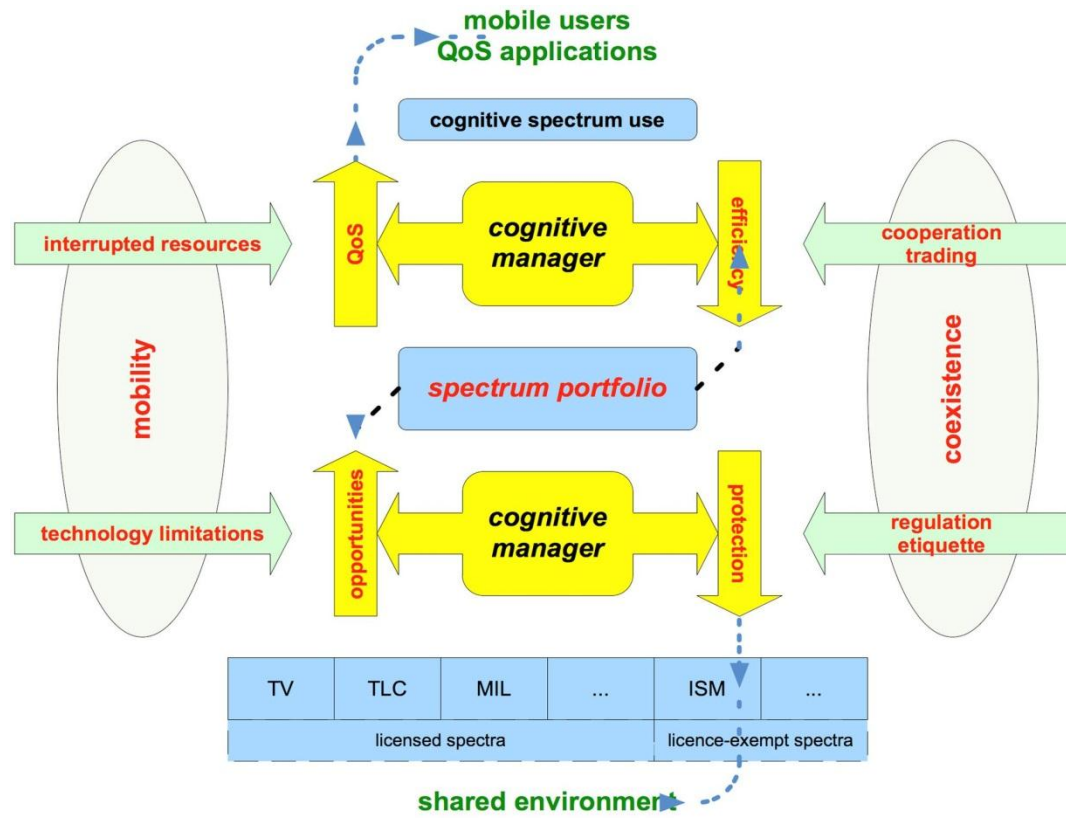
# Introduction

- QoS concept for accessing WS
- Scheduled vs. contention MACs
- Contention MACs for TVWS
  - Standards
  - Performance characterization
- Summary



# QoS MOS Concept

- 2 cognitive managers





# Scheduled MAC vs.. Contention MAC for WS

- Scheduled MAC can offer QoS guarantees  
but:
  - White spaces vary temporally and spatially. Available channels may vary in quality
  - Secondary systems may have to share channels (higher layer management may or may not be available)
- Contention MAC is only best effort  
but:
  - It is simple, distributed and robust
  - Performance can still be optimized (e.g., service differentiation, parameter optimisation)



# Contention MACs for TVWS

- TVWS: IEEE 802.11af, ECMA-392, IEEE 1900.7?
- Similar techniques could be used for other WS
- ECMA-392 and 802.11 contention MACs are similar:
  - Slight difference in backoff rules
  - Significant differences in behaviour can be exhibited

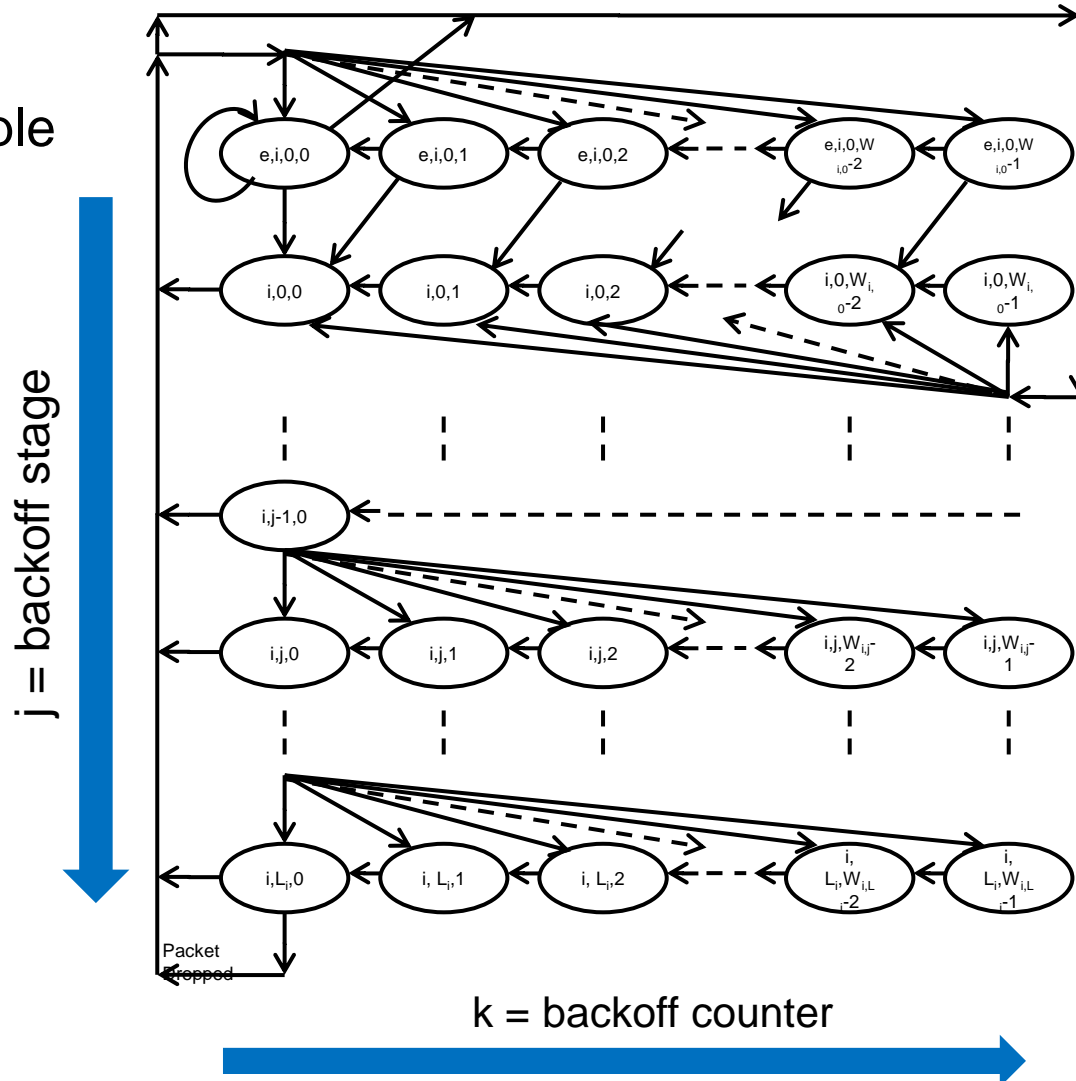


# MAC layer tuning

- Parameters (e.g.,  $CW_{min}$ ,  $CW_{max}$ ,  $AIFS$ ,  $TXOP_{limit}$ ) can be tuned based on network scenario and QoS requirements
- Markov chains used to calculate system performance
- Solving Markov chains is computationally complex
- Look up tables better suited for real-time. MAC has to be characterized in advance

# Markov Chain Example

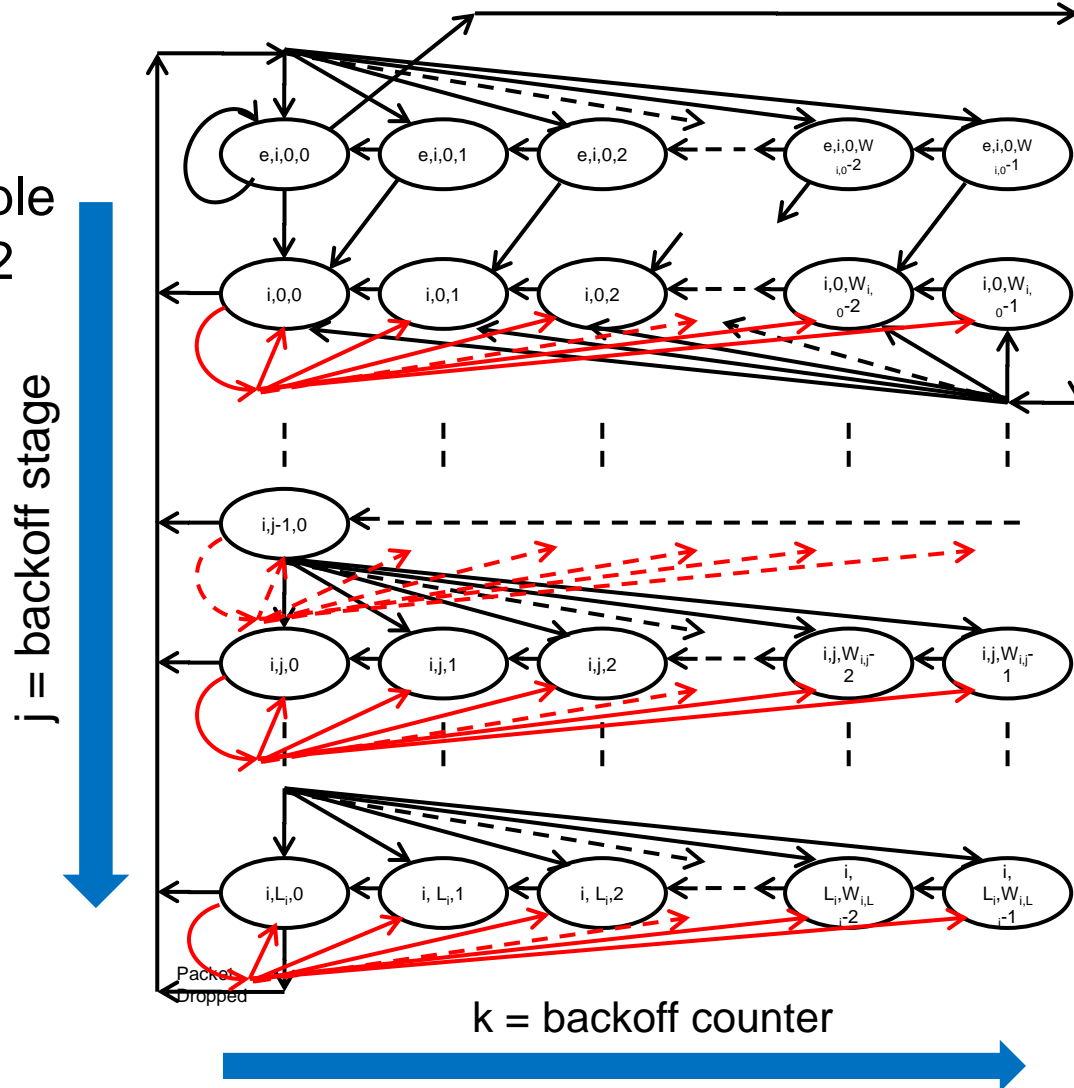
- 802.11 example



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# Markov Chain Example

- Modifying 802.11 example for ECMA-392

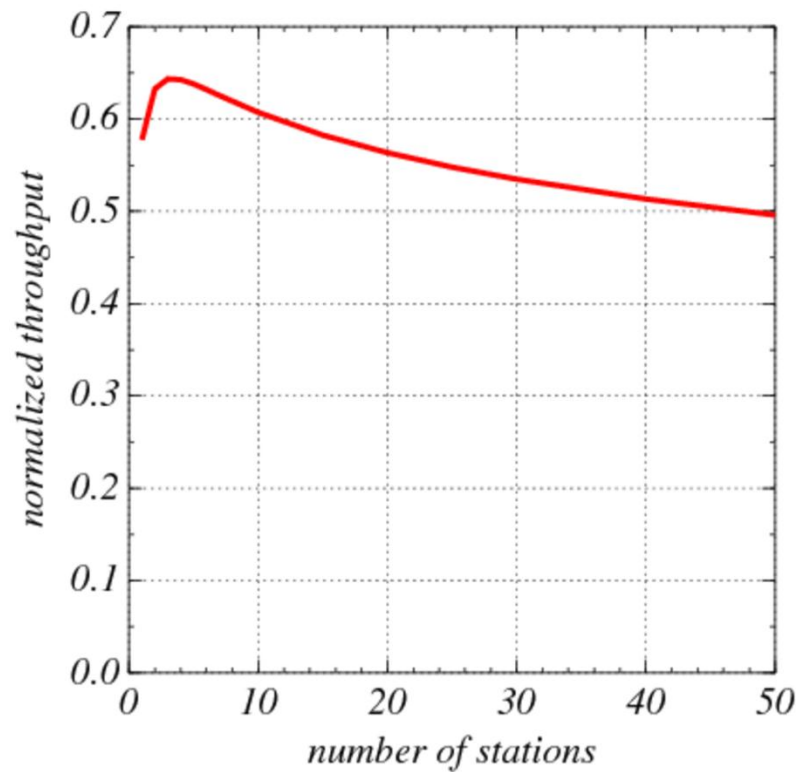






# MAC layer characteristics

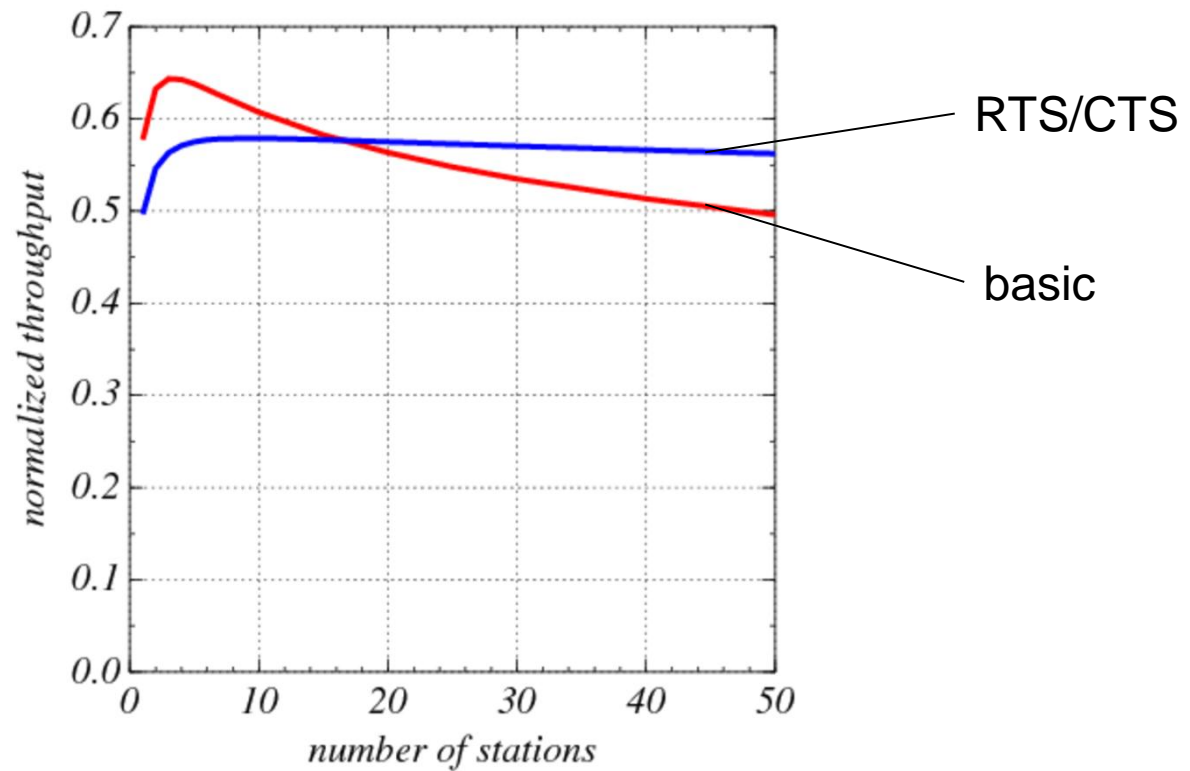
- 802.11 performance: basic





# MAC layer characteristics

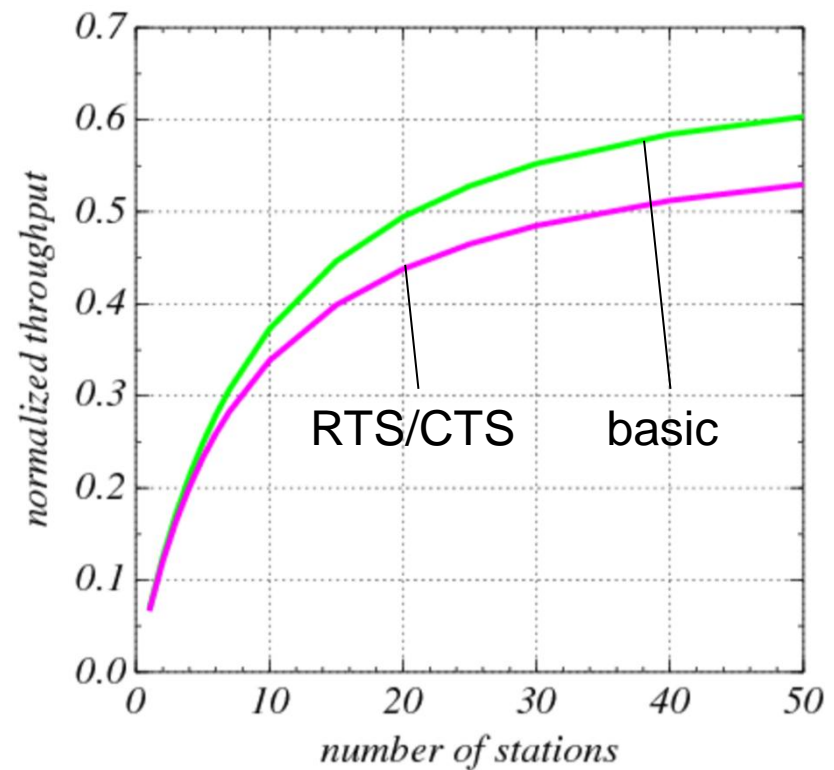
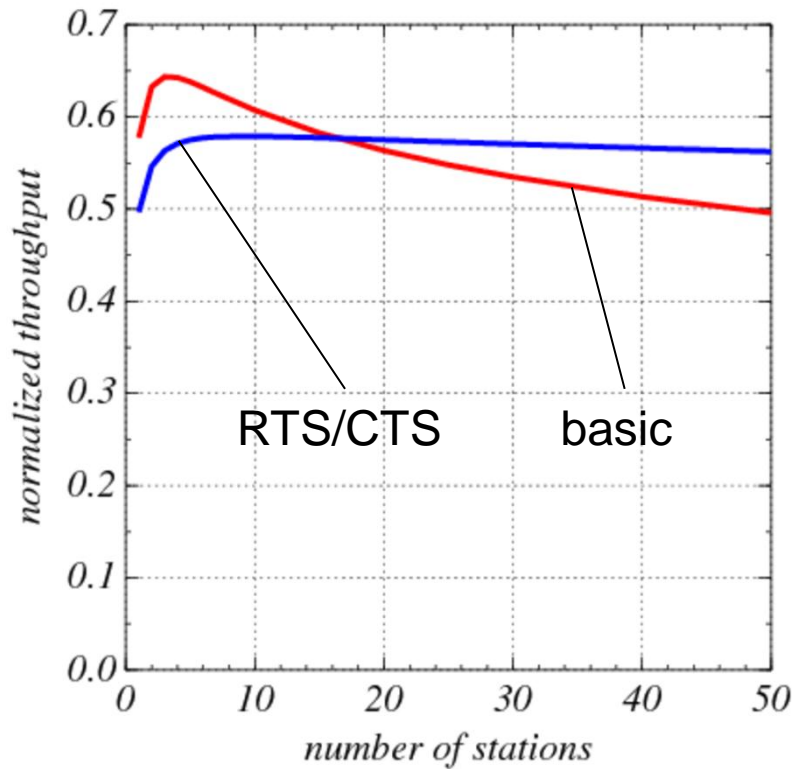
- 802.11 performance: basic vs. RTS/CTS





# MAC layer characteristics

- 802.11 vs. ECMA-392 performance





# Summary

- QoS MOS concept overview
- Scheduled vs. contention MAC for white spaces
- Characterization of contention MAC

For more information on the QoS MOS please visit:

<http://www.ict-qosmos.eu>