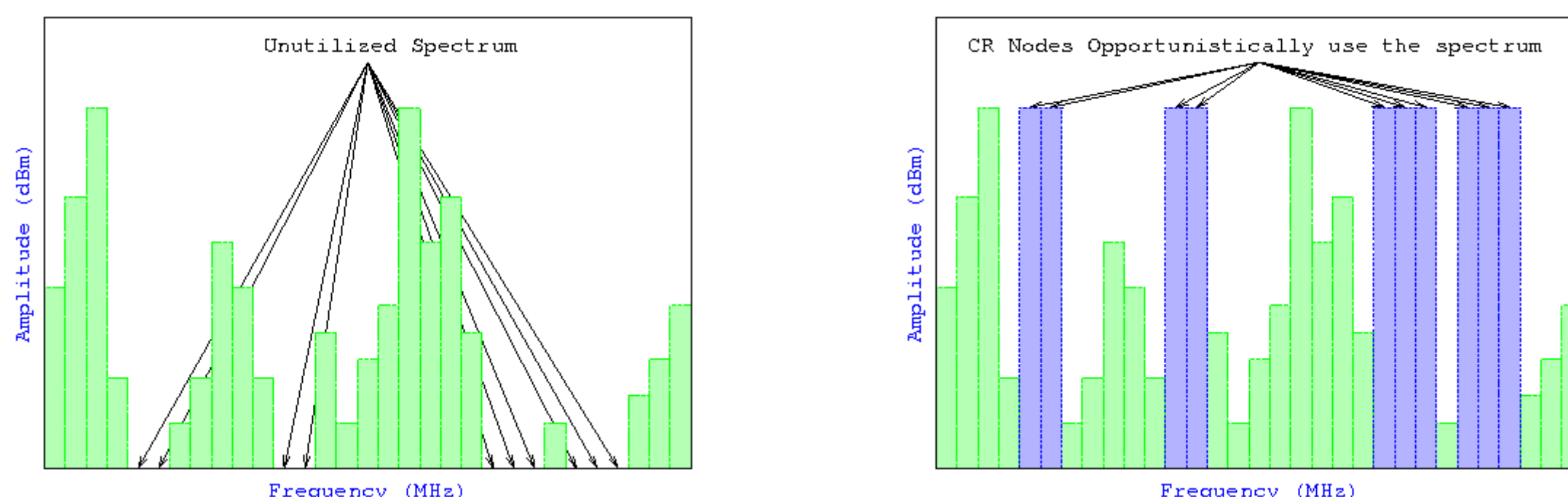


Mubashir Husain Rehmani, Aline Carneiro Viana, Hicham Khalife, and Serge Fdida

✧ Cognitive Radio Networks (CRNs)

✧ Motivation

- Limited available spectrum in today's wireless networks
- Fixed spectrum assignment policy
- Geographical and temporal utilization of spectrum varies from 15%-85% (FCC) [1]
- Results in the:
 - ✓ Inefficiency in spectrum usage
 - ✓ Creation of spectrum holes



✧ Cognitive Radio Nodes

In CRNs, Cognitive Radio (CR) nodes:

- Utilize free parts of unlicensed spectrum
- Opportunistically exploit licensed band

✧ Operating Constraints

- CR transmissions should not degrade the reception quality of PR nodes
- CR node should immediately interrupt its transmission whenever a neighboring PR activity is detected [2]

✧ Challenges

- Frequency agility
 - ✓ CR nodes rapidly changes the channels
- Multiple channels
 - ✓ CR nodes can access to a range of channels
- Intermittent connectivity
 - ✓ Due to PR activity, links are not consistent
- Unreliability
 - ✓ Difficulty for CR nodes to select a particular channel

✧ Traffic Pattern and Activity of PR Nodes

- Traffic pattern of PR nodes are of key importance
 - ✓ Highly used channel by PR nodes in terms of agility and time \Rightarrow Less availability of that channel to CR node
- Occupancy is time-variant and hardly predictable

✧ Adaptive and occupancy-based Channel Selection

✧ Our Goal

- Select channel that is less occupied by PR nodes as well as increase the number of CR receivers
- To understand the behavior of the mechanism before start with multi-hop scenario

✧ How?

By exploiting PR Occupancy and Overhearing

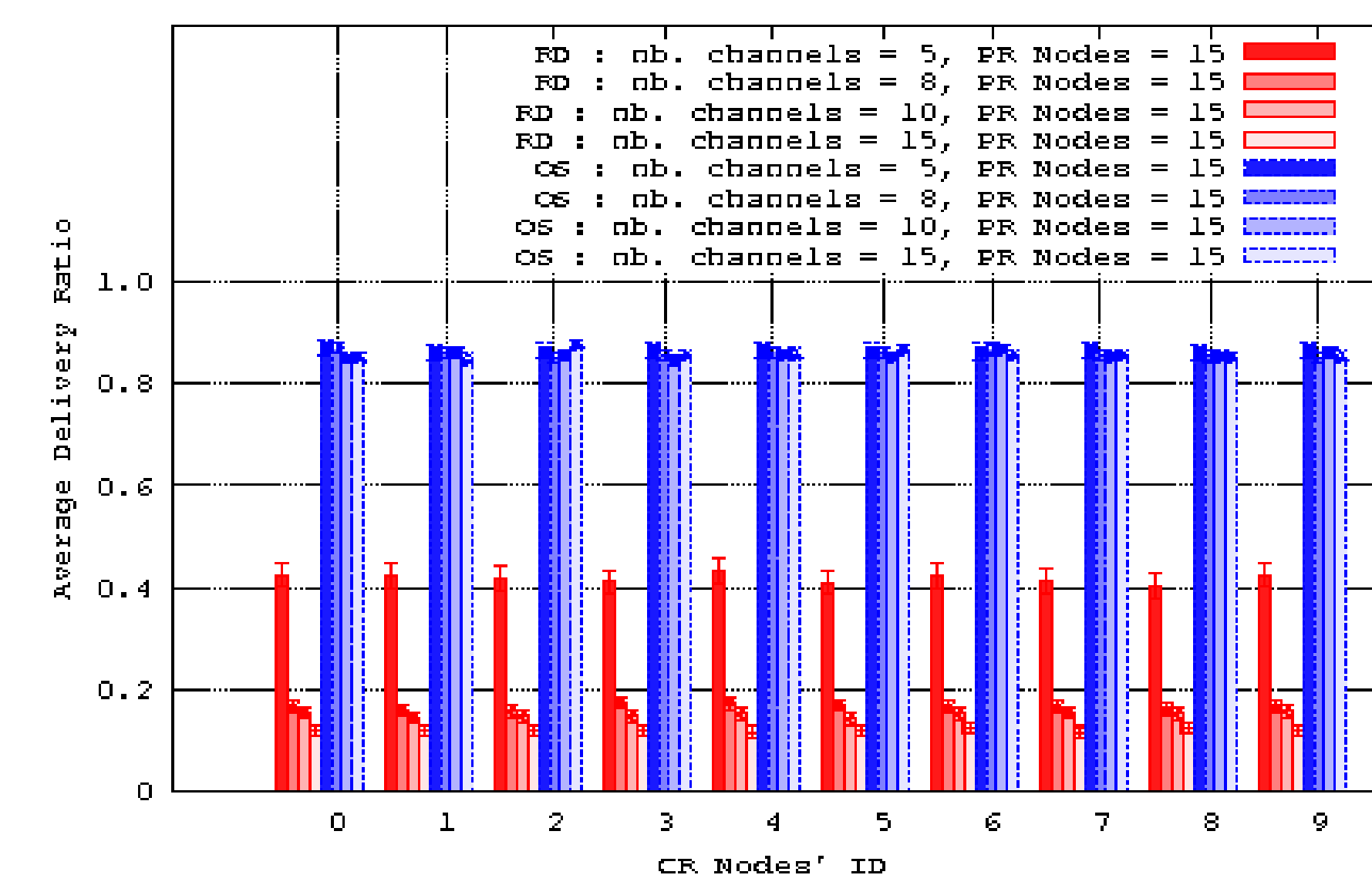
✧ Our Solution

- Each CR node sense channels
- Classify sensed channels in the decreasing order of availability for transmission and/or overhearing
 - ✓ Based upon PR and CR Occupancy
- Approaches are present [3] that provides PR Occupancy
- Assign weights to channels based upon PR Occupancy and CR Occupancy.
- PR Occupancy \Rightarrow Ratio of the PR nodes utilizing the channels over total number of PR nodes on that channel.
 - ✓ Based on PR nodes that are in activity and is based on PR nodes' state (i.e. if they are active – ON – or not – OFF)
- CR Occupancy \Rightarrow Number of active CR nodes competing for the channel
 - ✓ CR Occupancy = 1 – PROccupancy
- Channels' weight is calculated based on formula:

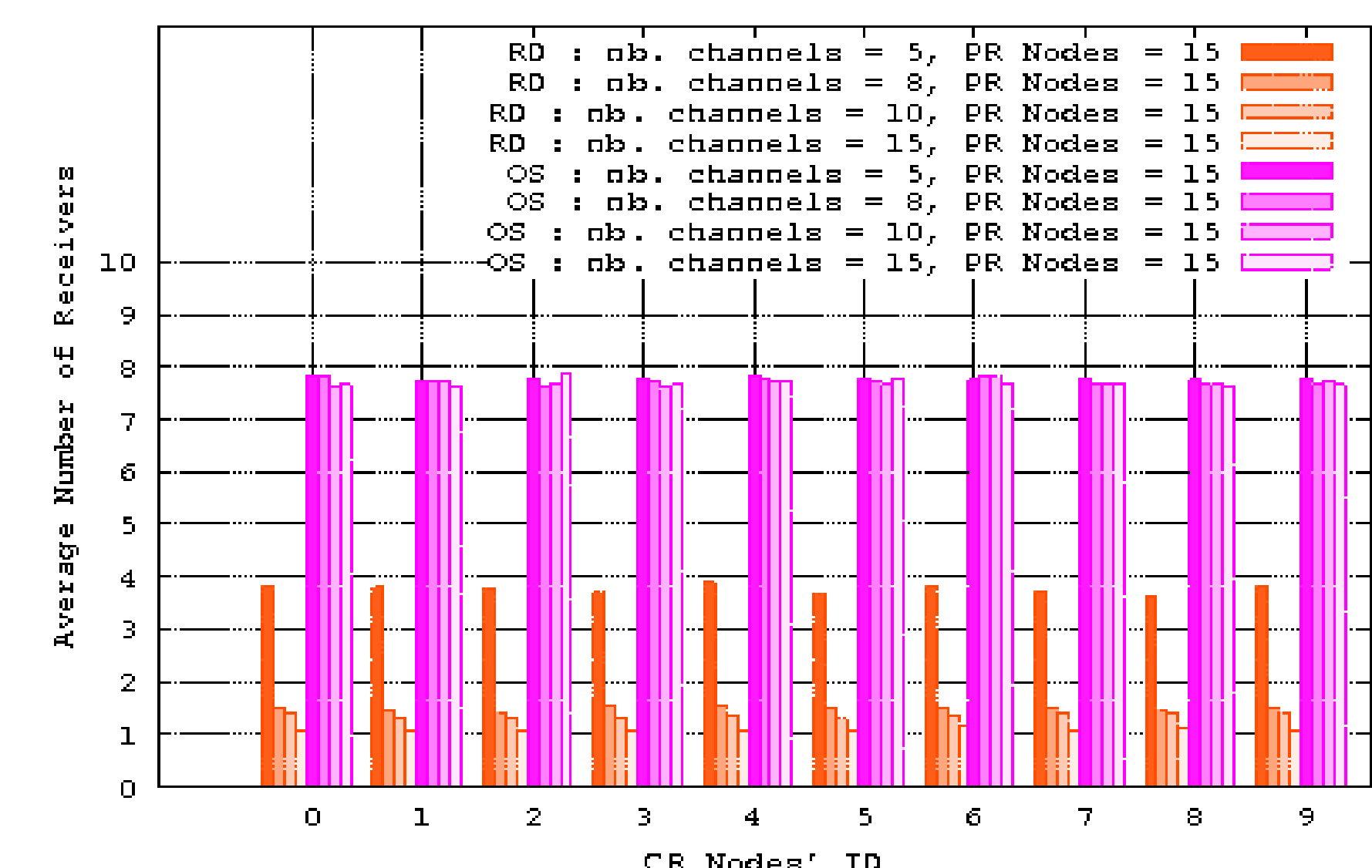
$$P_{channel} = e^{-PROccupancy} \times CROccupancy$$

✧ Simulation Results

- Comparison: Our Strategy (OS) and Random (RD), Single-Hop Scenario, network of 10 CR and 15 PR nodes



- OS guarantees the delivery of 80-85% messages, contrarily to less than 45-40% for the RD.



- OS also guarantees from 38-40% more nodes reception than with the RD

Advantages

- Increased throughput
- Reliable communication
 - ✓ High number of CR nodes overhears the channel
- Nodes make local decision
- Decrease disconnectivity of CR nodes
 - ✓ By using channels with less PR nodes
- Empowers CR nodes with the ability to infer, based on information regarding PR Occupancy, the less occupied channels to use

✧ Future Work

Multi-hop scenarios, opportunistically forwarding mechanisms, and comparison with related approaches

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- [3] T. Yucek and H. Arslan, "A Survey of Spectrum Sensing Algorithms for Cognitive Radio Applications", IEEE Communications Surveys and Tutorials, Vol. 11, No. 1, First Quarter 2009

M. H. Rehmani : Mubashir.Rehmani@lip6.fr

(ASAP/INRIA and LIP6/UPMC)

A. C. Viana : Aline.Viana@inria.fr
(ASAP/INRIA)



H. Khalife : Hicham.Khalife@lip6.fr

(LIP6/UPMC)

S. Fdida: Serge.Fdida@lip6.fr
(LIP6/UPMC)