

Collision Prevention in Distributed 6TiSCH Networks

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Outline

Introduction & Background

- General Introduction

- IEEE802.15.4 Protocols

- Project challenges & Objectives

Proposed Mechanism

- Using 6top Transaction

- Avoid Table

- Cell Buffer

Simulator and Results

- Simulator

- Results

Summary and Contributions

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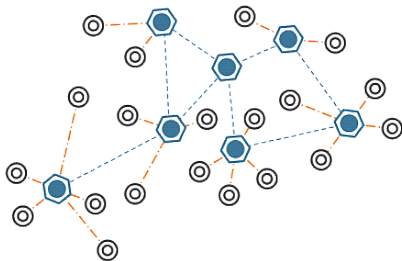
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Summary and Contributions

General Introduction

IoT & Wireless Sensor Networks

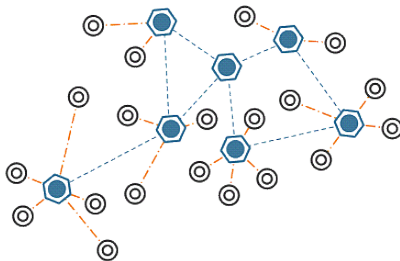
- ▶ Network technologies and IoT.



General Introduction

IoT & Wireless Sensor Networks

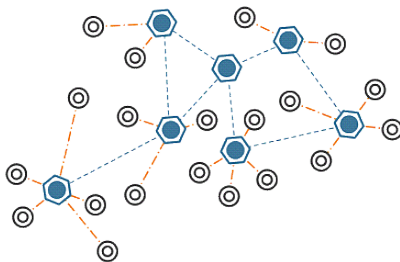
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- ▶ WSN: standardization of IoT nodes communication.



General Introduction

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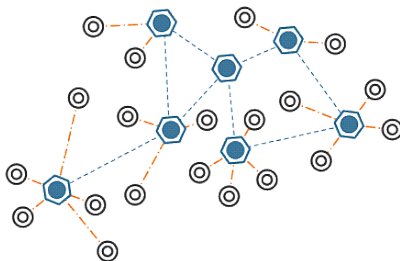
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- ▶ Low power consumption, low cost.



General Introduction

IoT & Wireless Sensor Networks

- ▶ Network technologies and IoT.
- ▶ WSN: standardization of IoT nodes communication.
- ▶ Low power consumption, low cost.
- ▶ IEEE802.15.4 one of the main standards of WSN.

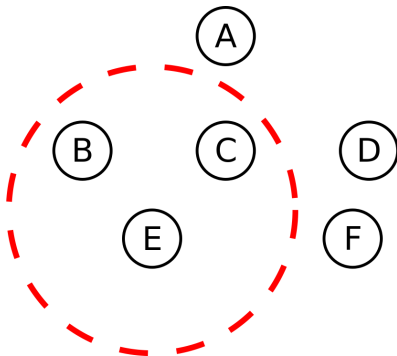


General introduction

IEEE802.15.4

Converge Cast Structure

- ▶ Nodes radio range defines the neighborhood.

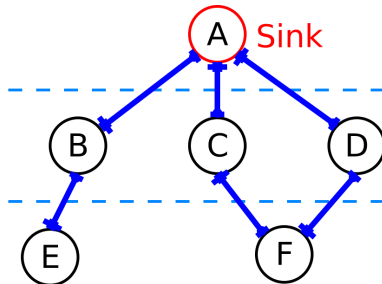


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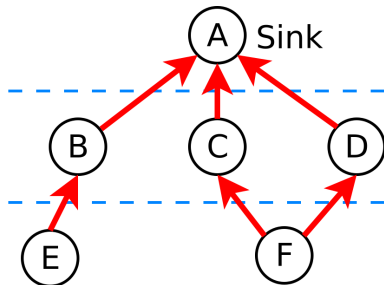


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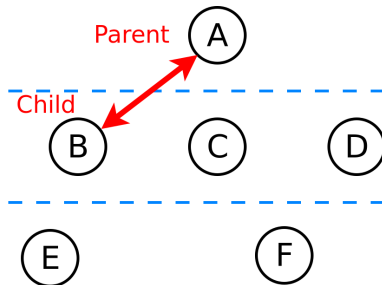


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- ▶ Communication pairs.



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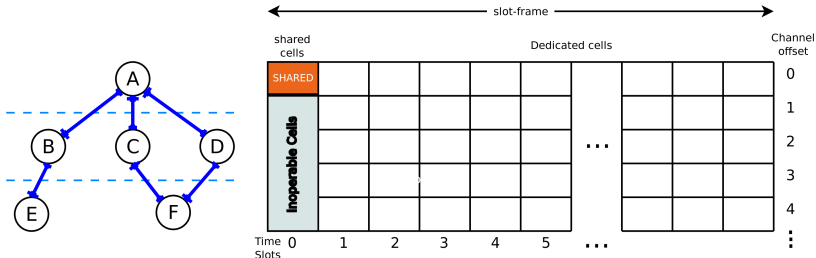
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IEEE802.15.4 Protocols

IEEE802.15.4e TSCH

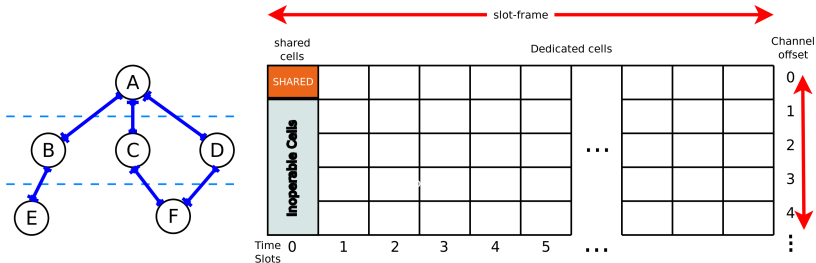
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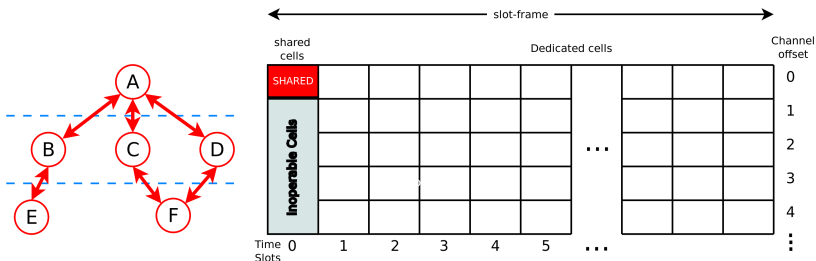
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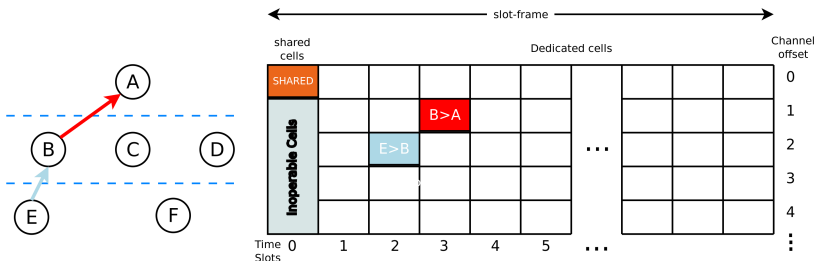
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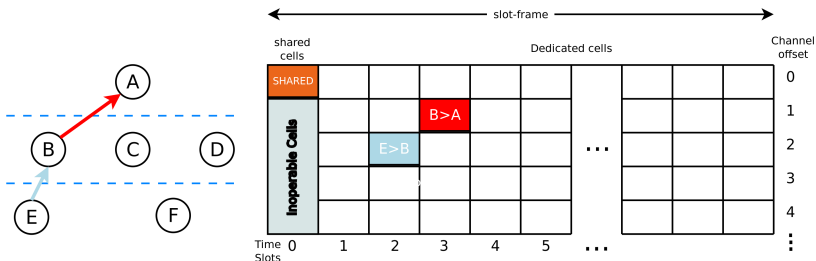
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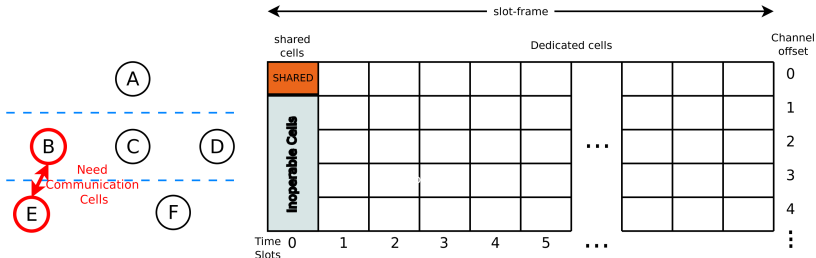
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- ▶ Shared cells/Dedicated cells..
- ▶ 6TiSCH operation sublayer 6top will manage the TSCH.



IEEE802.15.4 Protocols

Cell Reservation Process

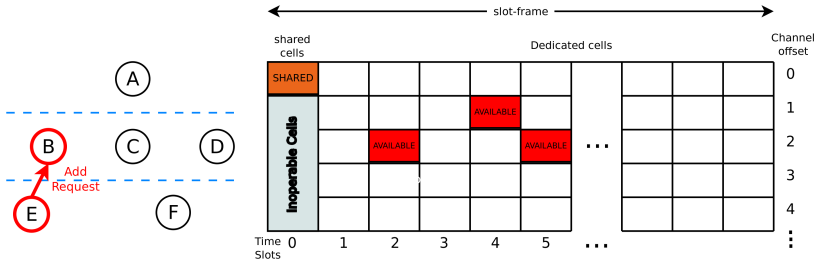
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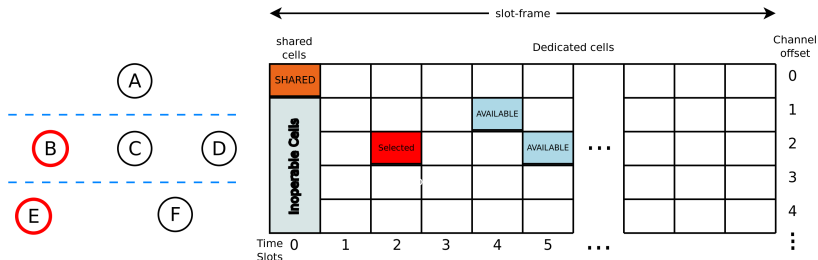
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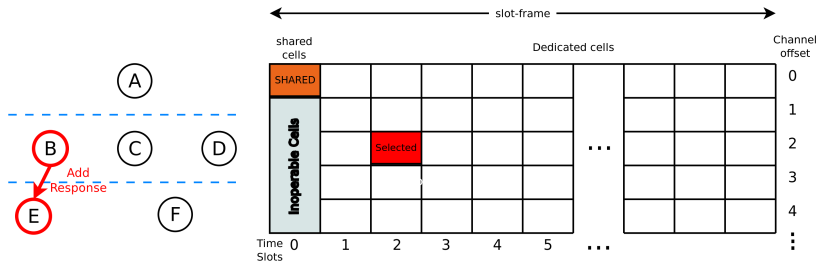
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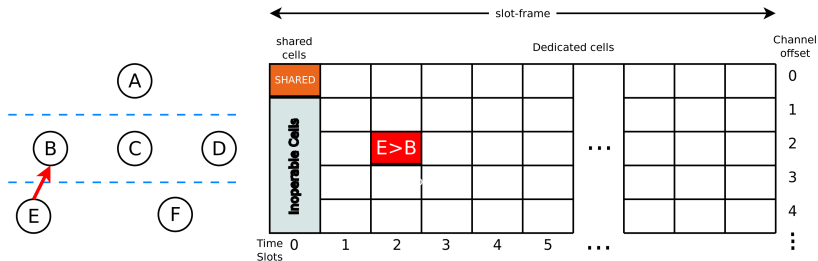
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4. Parent node replies with an Add response.
5. Cell is added and communication starts.



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Simulator and Results

- Simulator

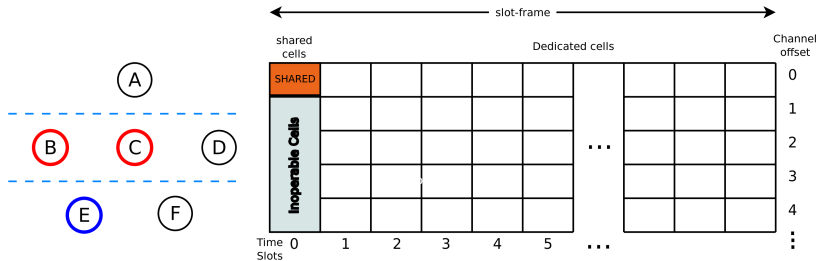
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Collision in Dedicated Cells

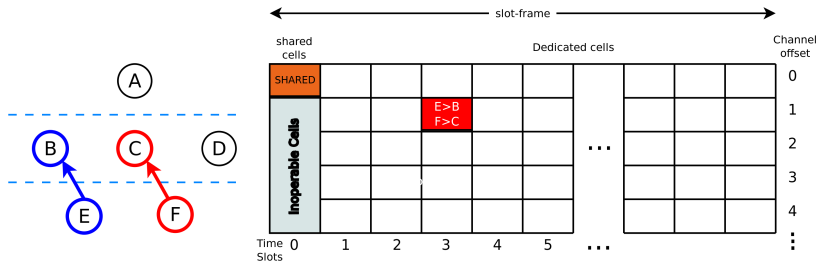
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Project challenges & Objectives

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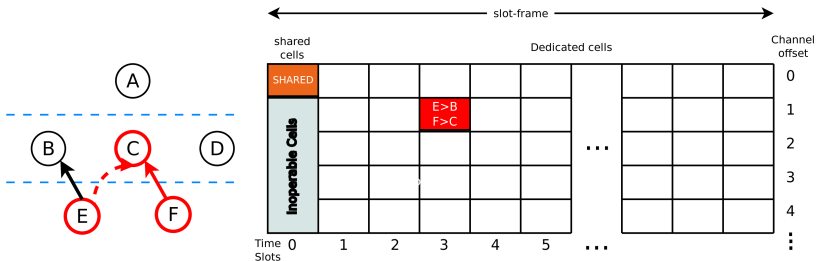
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Project challenges & Objectives

Collision in Dedicated Cells

- ▶ Collision free Dedicated Cells?
- ▶ Neighbor nodes can select the same communication cell.
- ▶ Collision at the reception Node.



Project Objectives

- ▶ Reducing the collisions in TSCH dedicated cells.

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- ▶ Modifying the Cell reserving process without introducing new overhead on the network
- ▶ Creating a flexible mechanism, compatible with all scheduling functions

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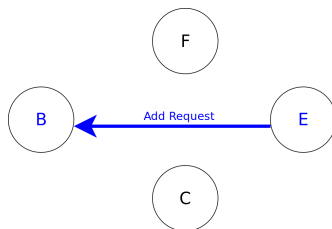
Using 6top Transaction

Why?

- ▶ Submitted in the shared slot.
- ▶ Contains the reserved cells.

How?

- ▶ The child node Sends an Add Request.



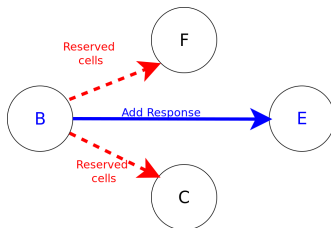
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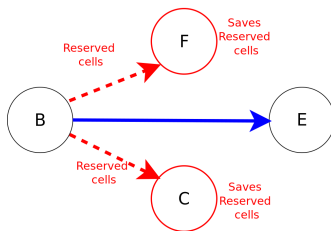
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Why?

- ▶ Submitted in the shared slot.
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How?

- ▶ The child node Sends an Add Request.
- ▶ The parent replies with the selected cells.
- ▶ The neighboring nodes collect the reserved cells and save them.



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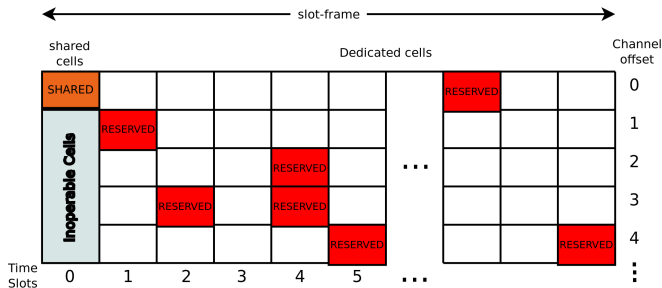
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Avoid Table structure and functioning

Avoid Table

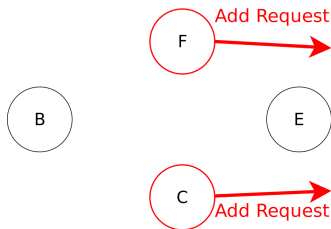
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Avoid Table structure and functioning

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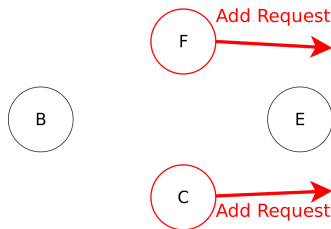
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Avoid Table structure and functioning

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- ▶ Scheduling function will avoid selecting cells found in this structure.
- ▶ 6top will manage this table.



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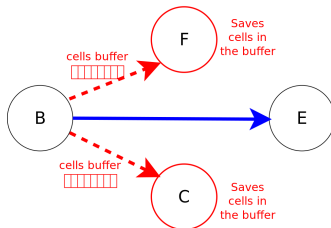
Cell Buffer

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- ▶ Some of the 6top Transaction are lost.
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How?

- ▶ Creating a cell buffer that will contain k reserved cells for each



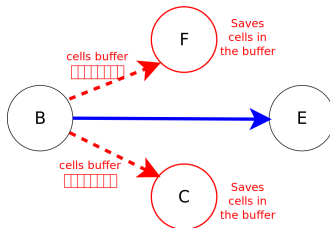
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Why?

- ▶ Some of the 6top Transaction are lost.
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- ▶ Creating a cell buffer that will contain k reserved cells for each node.
- ▶ Transmitting the cell buffer each time a cell is reserved.



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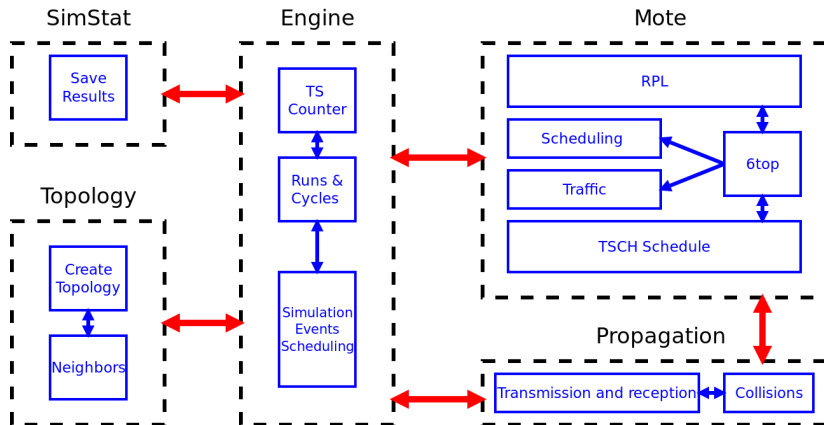
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Summary and Contributions

Simulator Architecture



Simulation Parameters

Parameter	Value
Number of Motes	100
Number of cycles per run	1000
Number of runs per simulation	1000
Timeslot duration	10ms
Slotframe length	101
Number of channels	16
Area	1Km \times 1Km
Topology constraint	≥ 3 neighbors with PDR 50 %
Radio sensitivity	-97 dBm
Radio range	100m
Traffic	1 packet/node each 10 cycles

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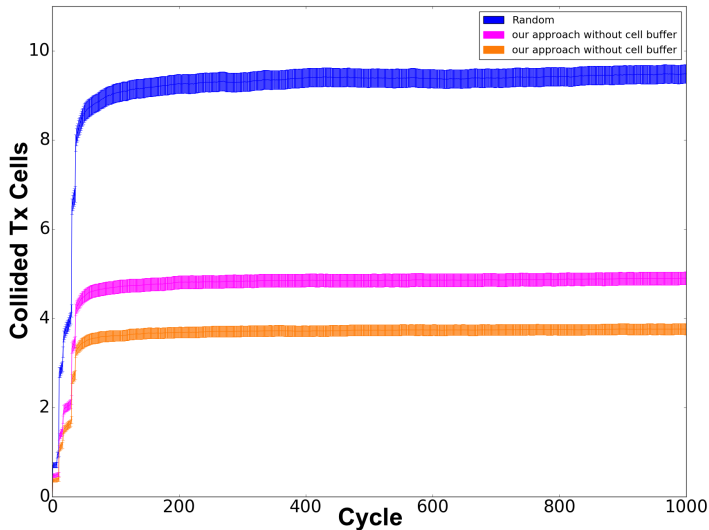
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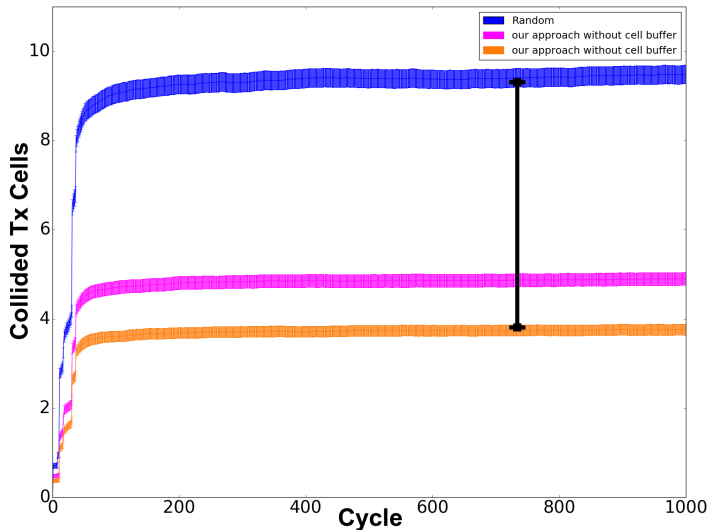
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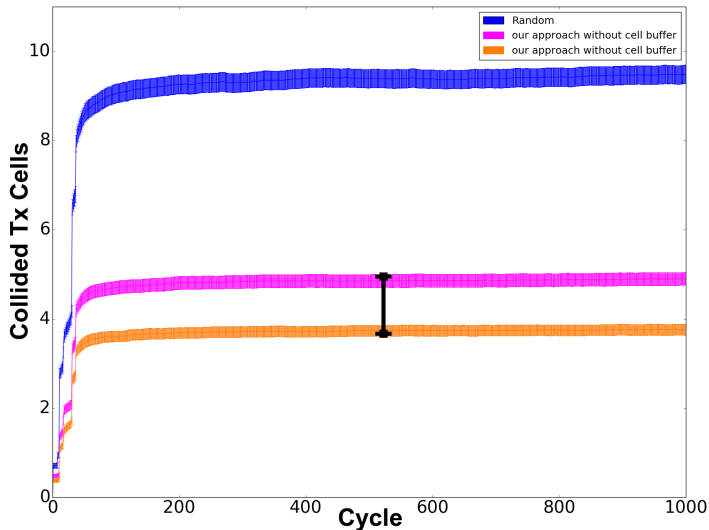
Comparison with random scheduling



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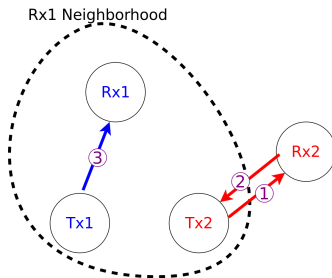
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Collision reasons

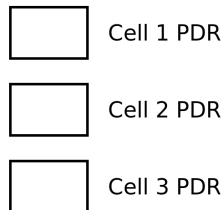
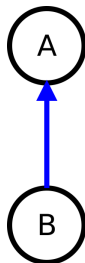
- ▶ The lost 6top transactions.
- ▶ Special case that induce collisions.



Housekeeping Approach

Collision in Dedicated Cells

- ▶ Housekeeping approach and cell relocation.
- ▶ Tx housekeeping.



Housekeeping Approach

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0.8

Cell 1 PDR

0.8

Cell 2 PDR

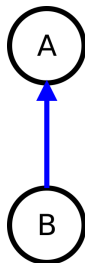
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Cell 3 PDR

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0.8

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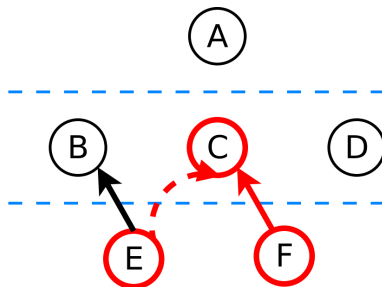
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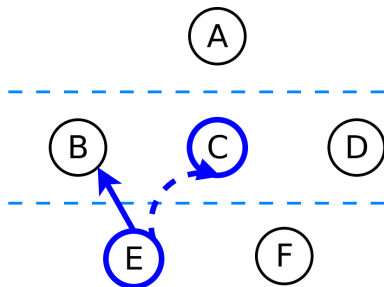
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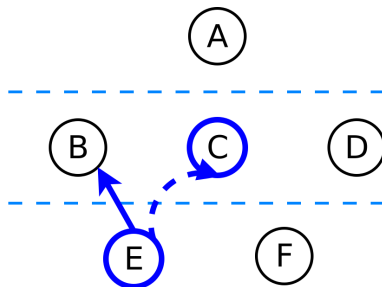
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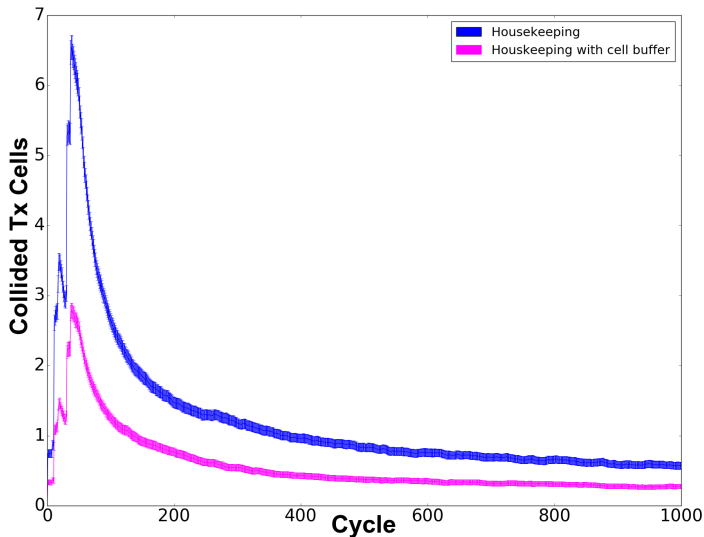
Housekeeping Approach

Collision in Dedicated Cells

- ▶ Housekeeping approach and cell relocation.
- ▶ Tx housekeeping.
- ▶ Rx housekeeping.
- ▶ Dealing with collisions after they occur. Good idea ?



Comparison with Housekeeping



Summary

- ▶ Our implementation introduces **no overhead** in the network.
- ▶ The implementation **achieves 60% reduction** in the number of collided Tx cells.
- ▶ The Combination of Our approach and Housekeeping accomplish an **almost collision free dedicated cells**.
- ▶ Outlook
 - ▶ Our goal is to reach a place where we have collision free network, using more complex methods.
 - ▶ Our perspective in this project was to work on 6top, but our next steps is to study the effects of traffic in the protocol performances.

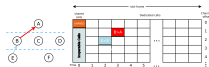
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- Time/Frequency multiplexing of the bandwidth.
- Shared cells/Dedicated cells.
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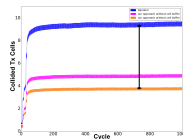
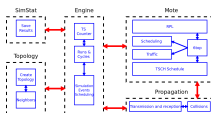
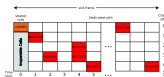
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Thanks for your attention!
Questions?

IEEE802.15.4 Protocols

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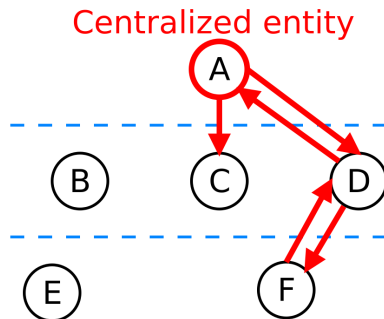
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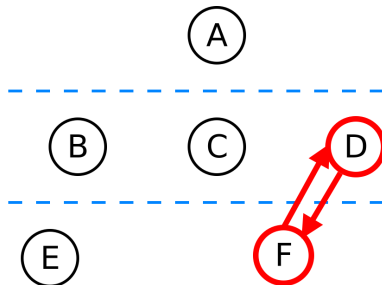
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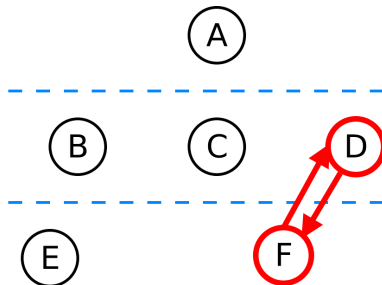
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- ▶ 6top contains:
 - ▶ 6top transactions.



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- ▶ 6top contains:
 - ▶ 6top transactions.
 - ▶ Scheduling function.

