# Collision Prevention in Distributed 6TiSCH Networks

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Dr. Olivier Alphand, Dr. Franck Rousseau
Dr. Karine Altisen, Dr. Stéphane Devismes

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# Outline

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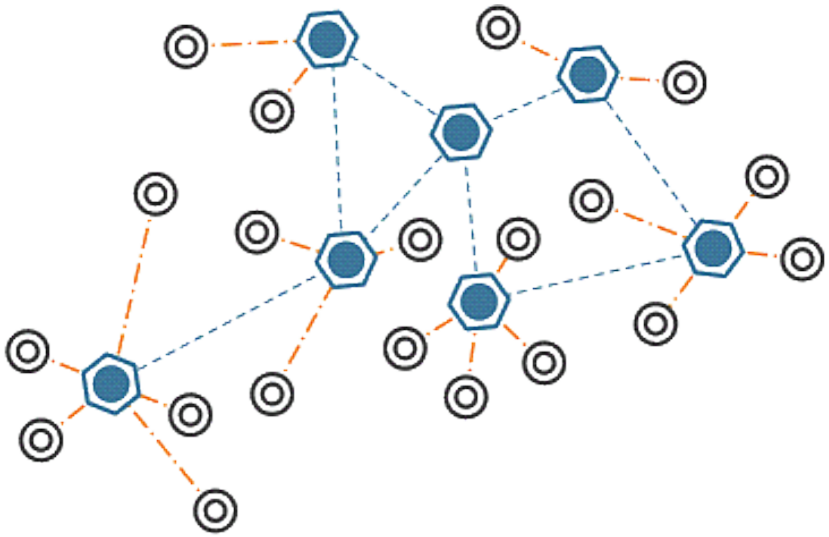
# General Introduction

## IoT & Wireless Sensor Networks

- Network technologies and IoT.



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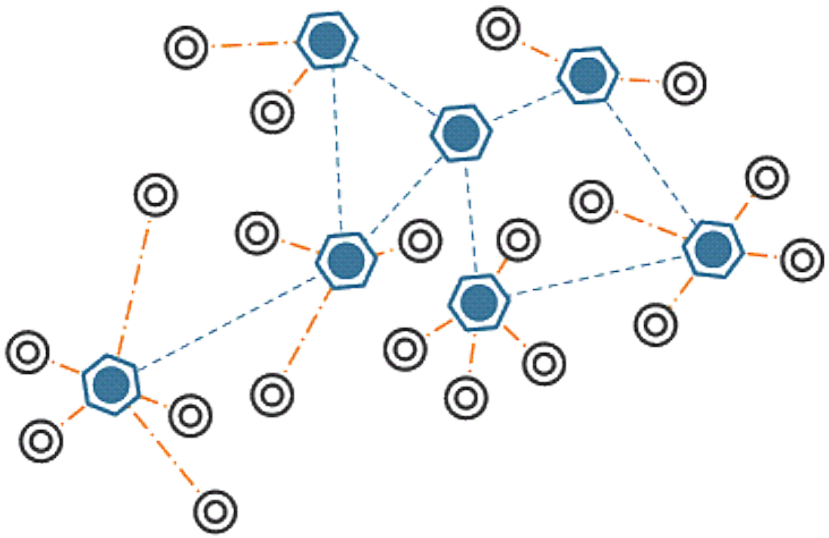

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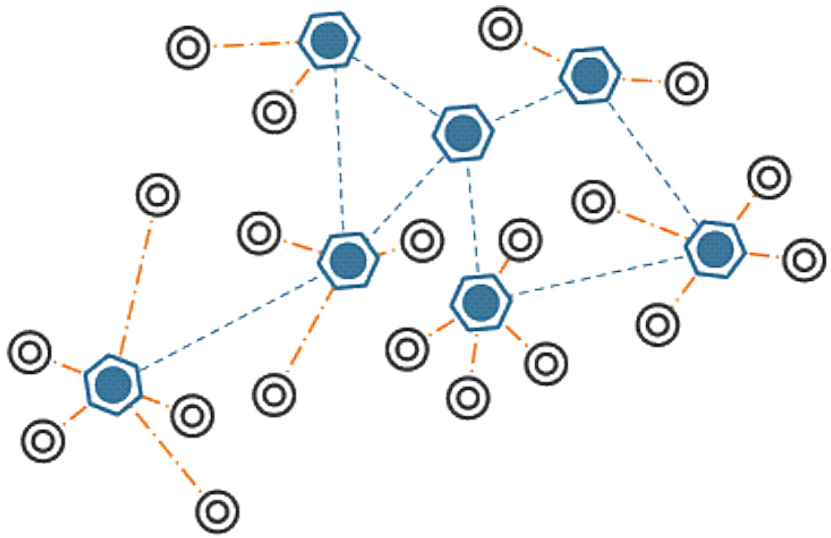

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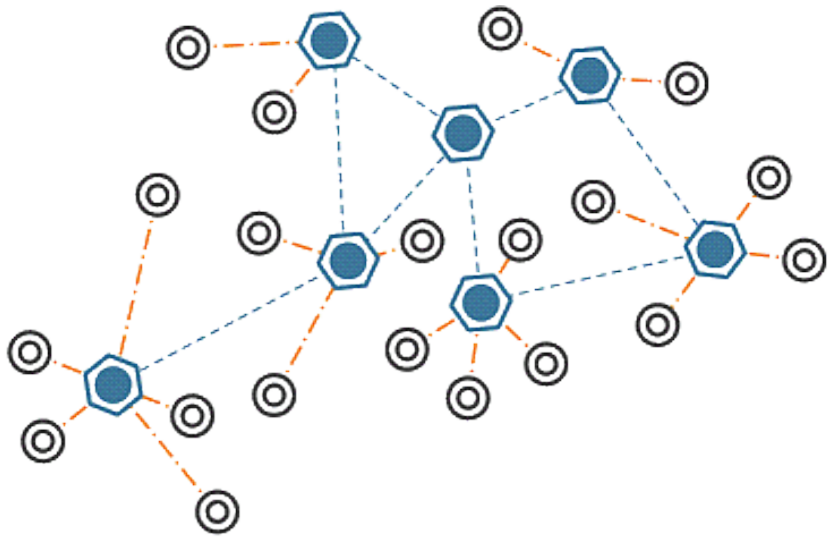
- IEEE802.15.4 one of the main standards of WSN.



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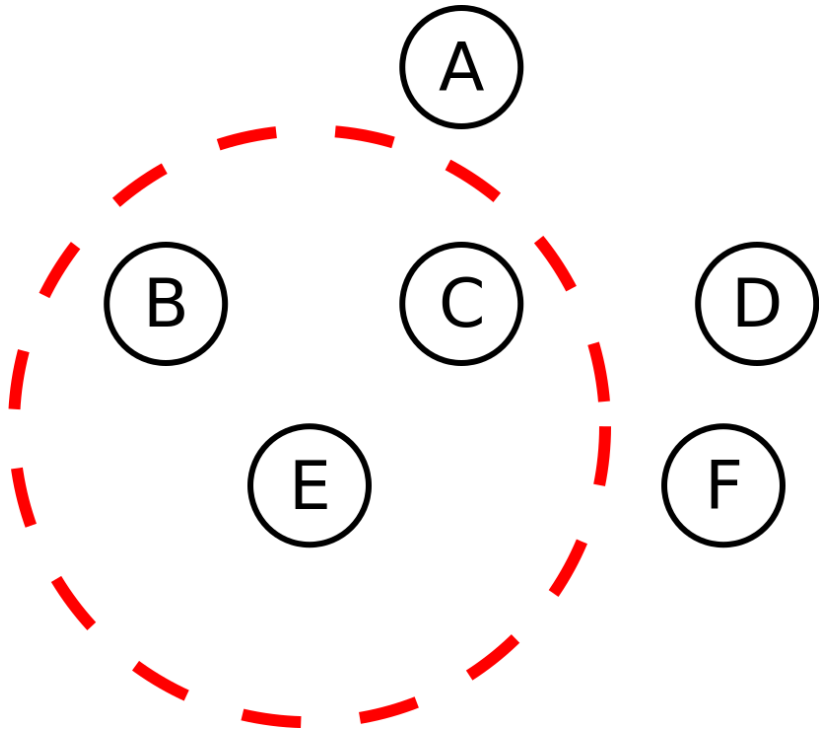
## IEEE802.15.4

### Converge Cast Structure

- Nodes radio range defines the neighborhood.



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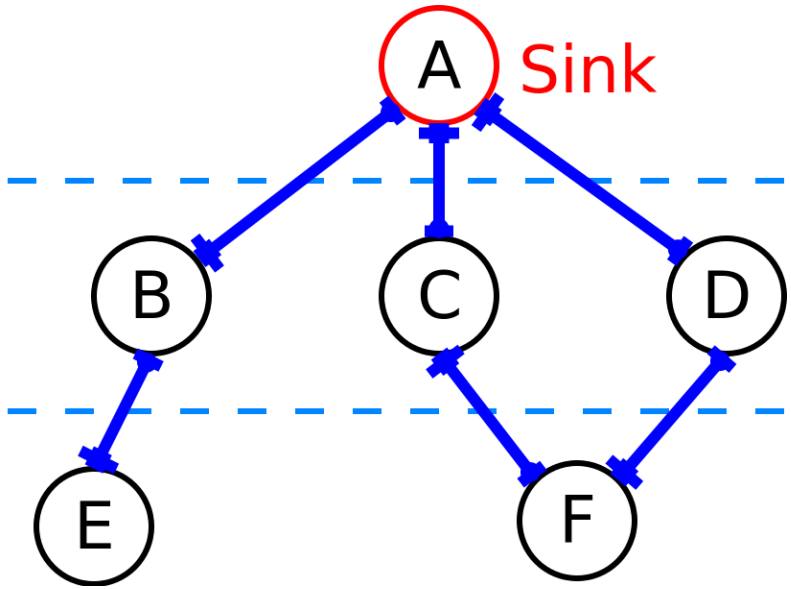

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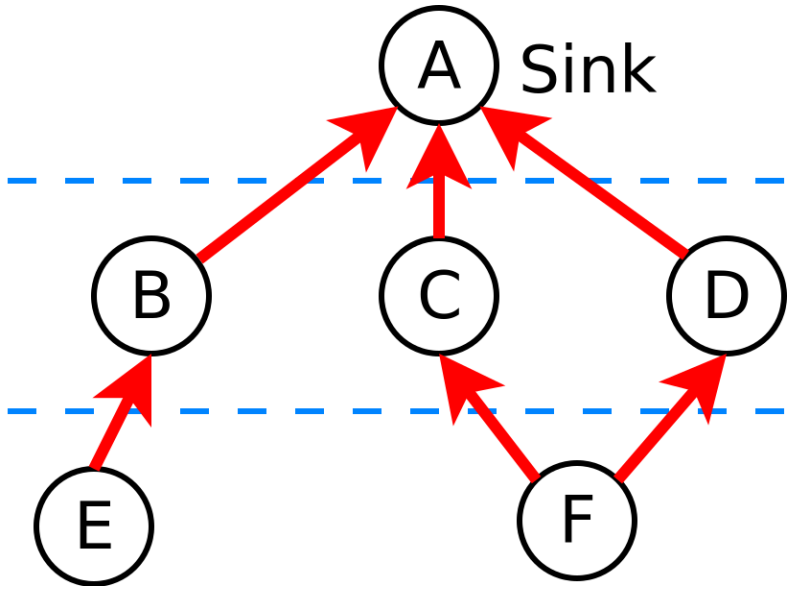

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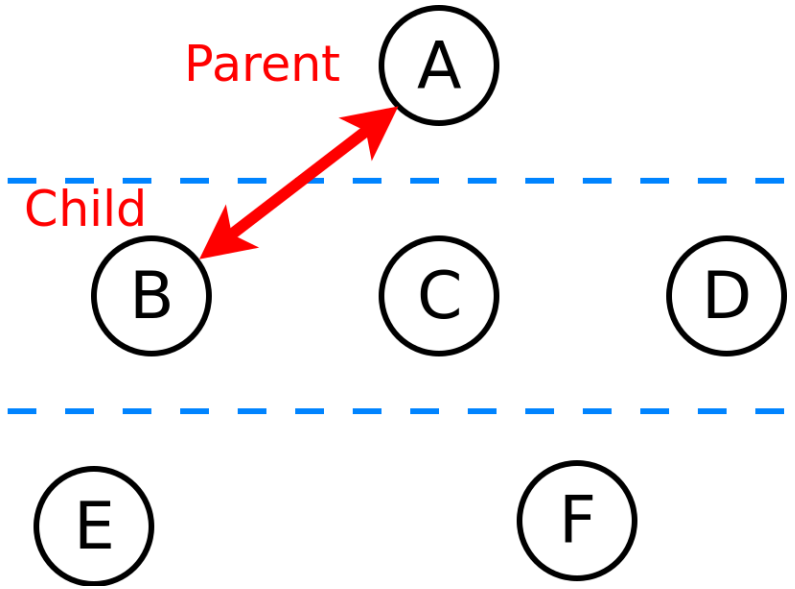

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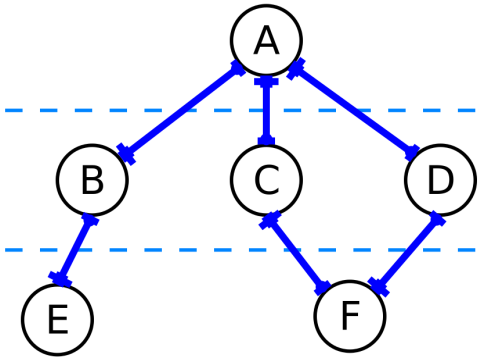
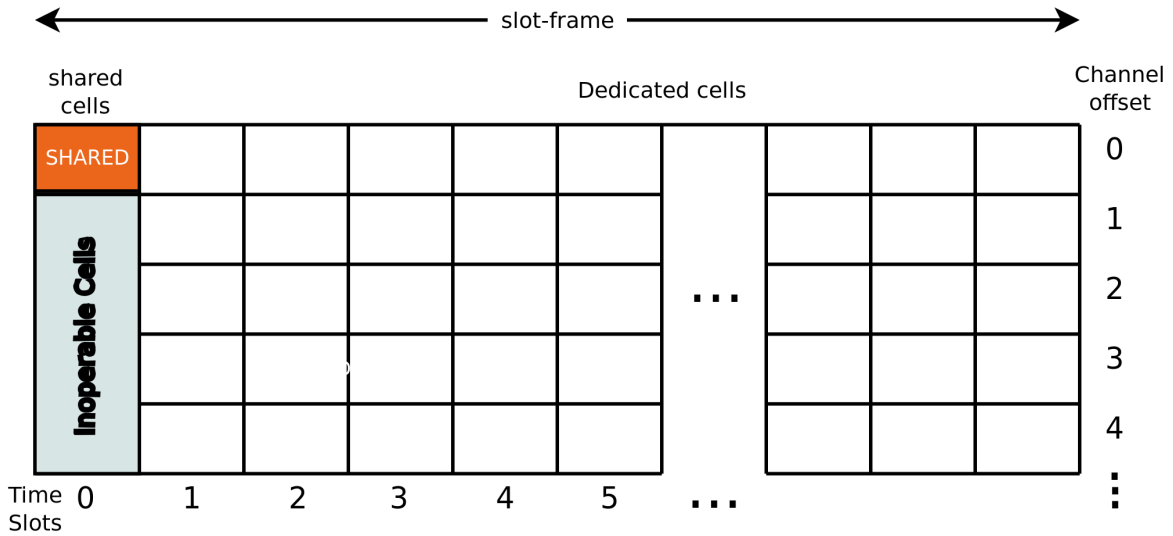
- TSCH is an extension of the MAC layer of IEEE802.15.4.



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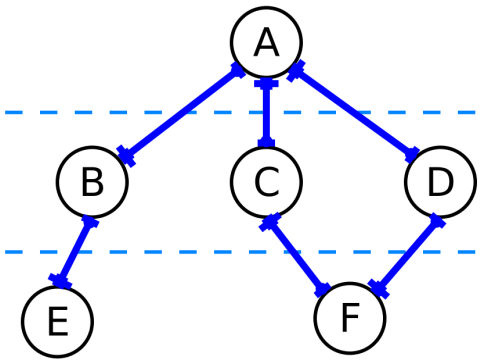


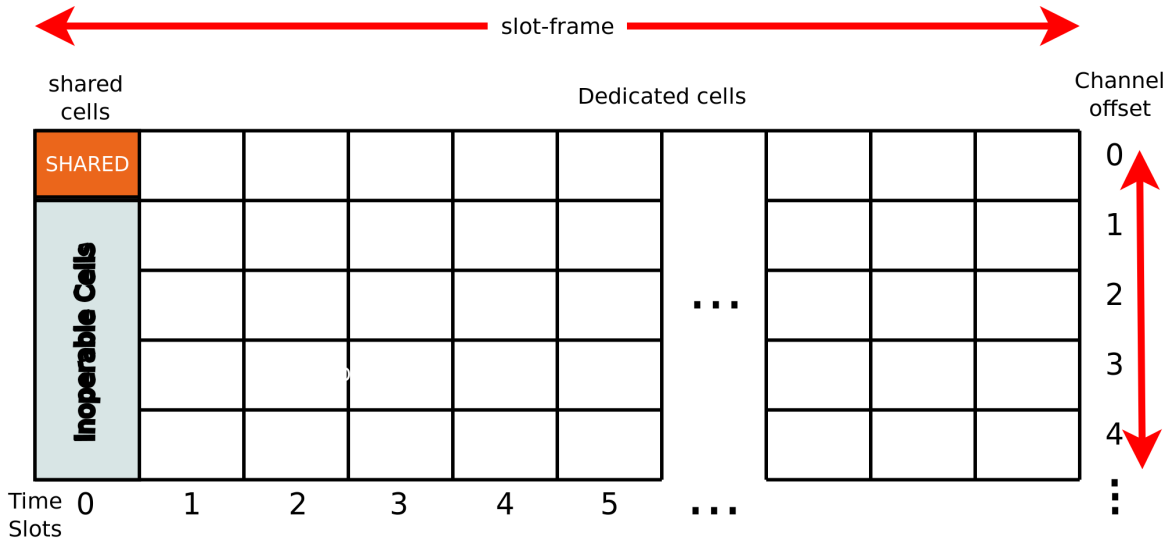

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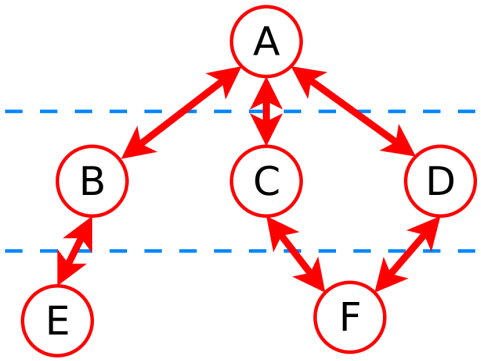


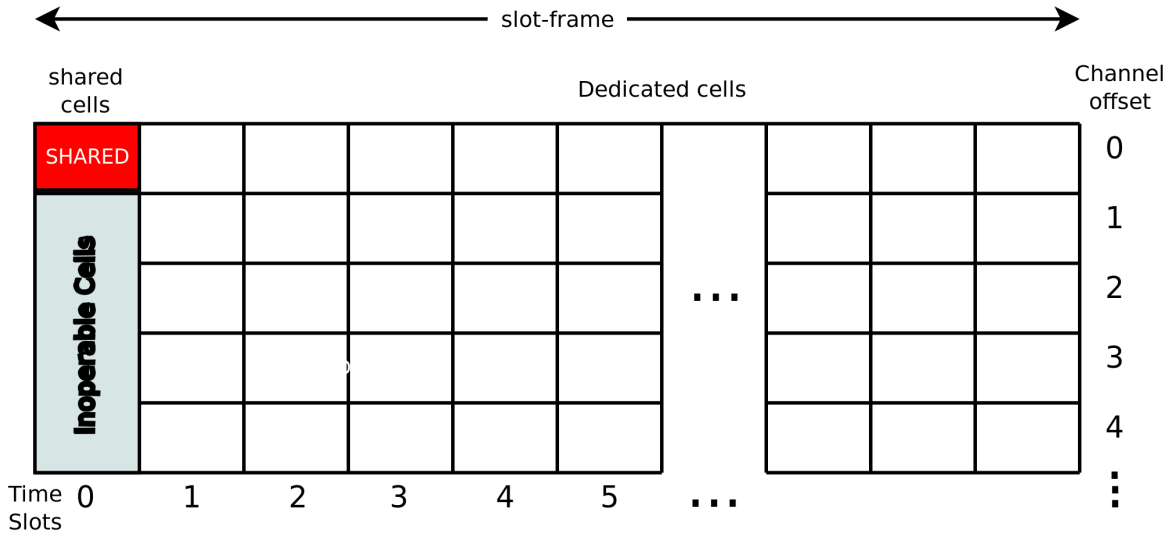

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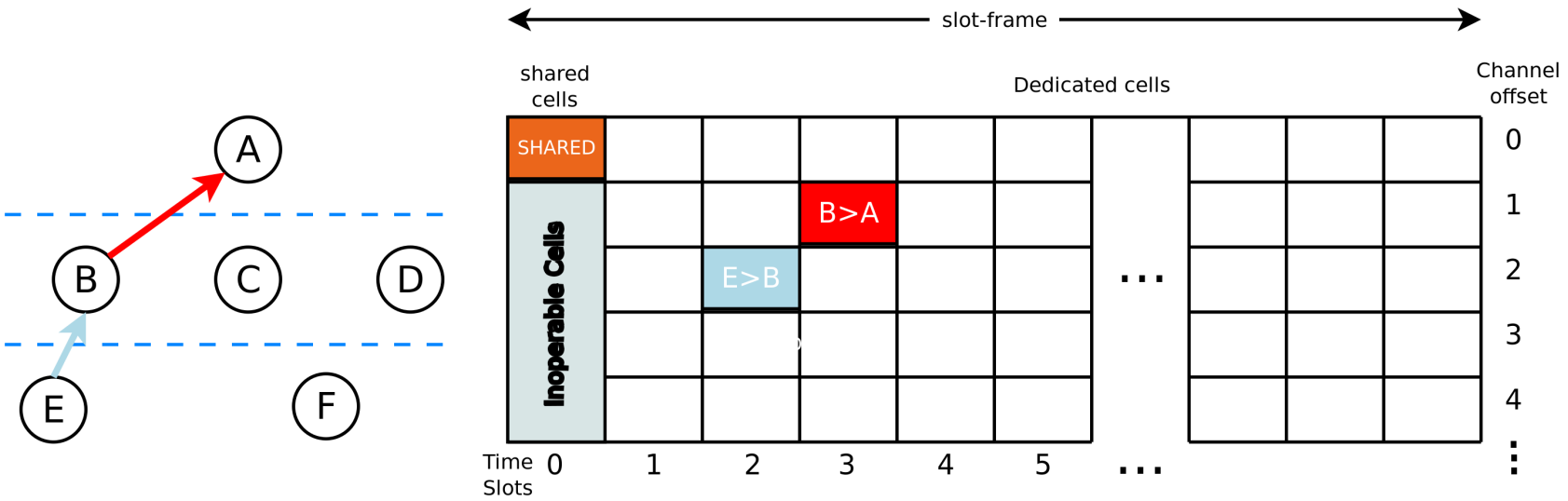

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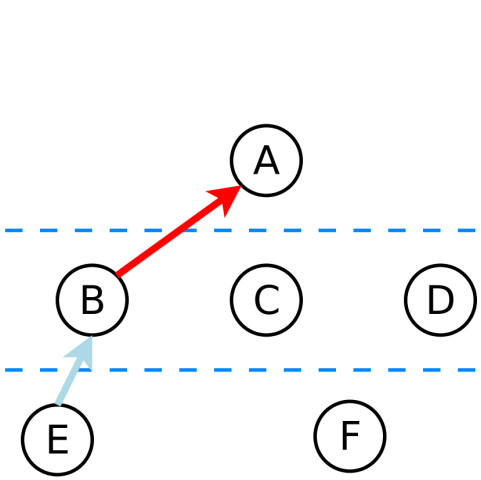
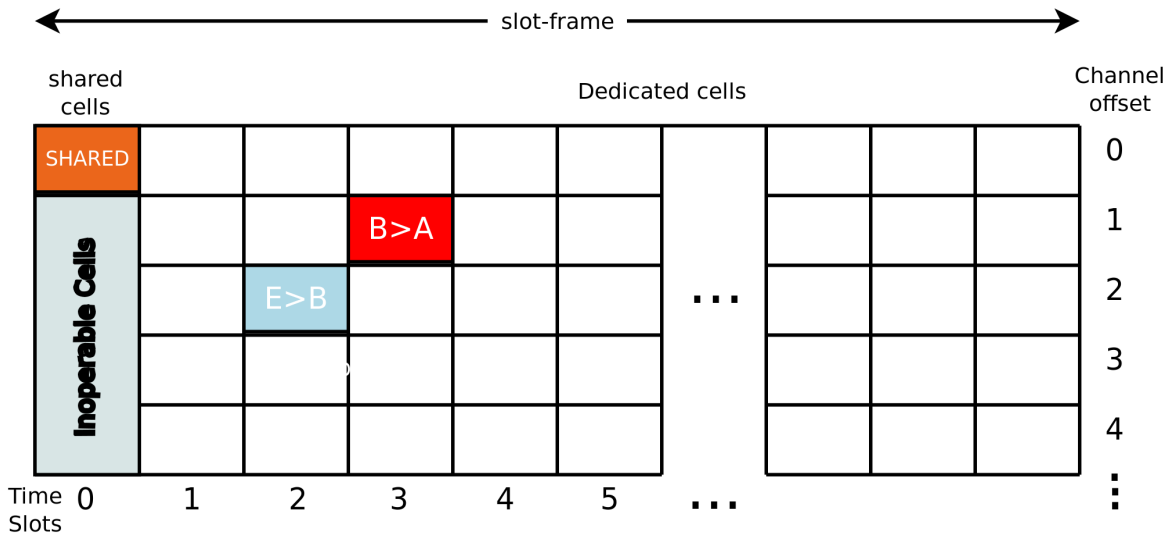
- 6TiSCH operation sublayer 6top will manage the TSCH.



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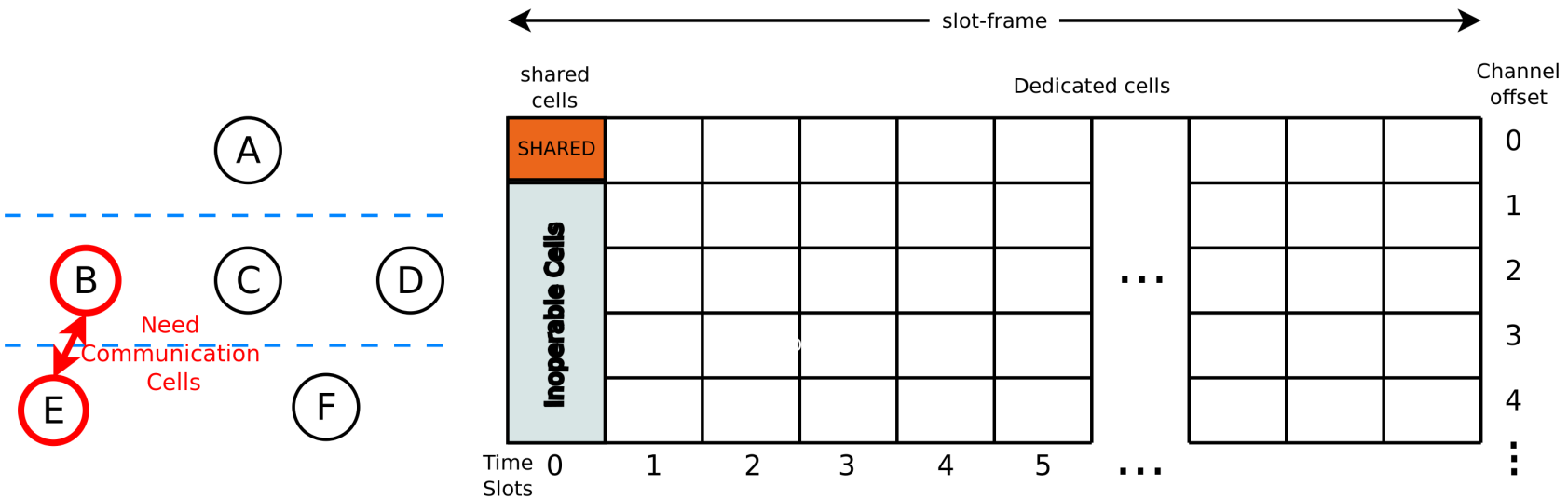
## Cell Reservation Process

1. Scheduling function decides if new cell should be assigned.



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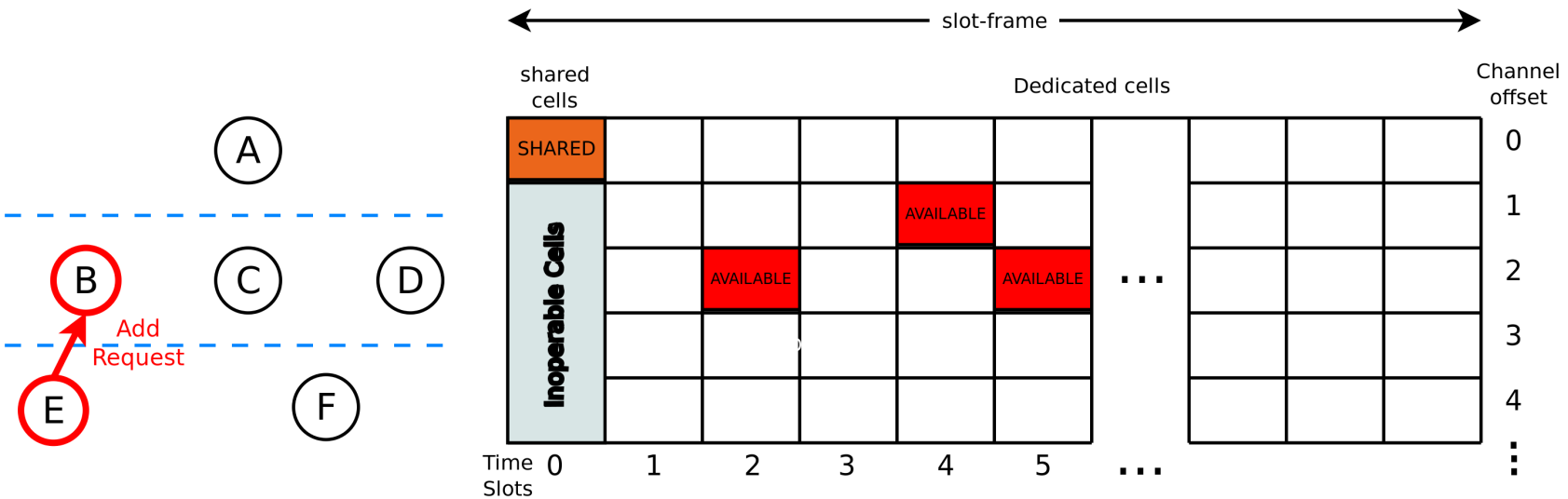

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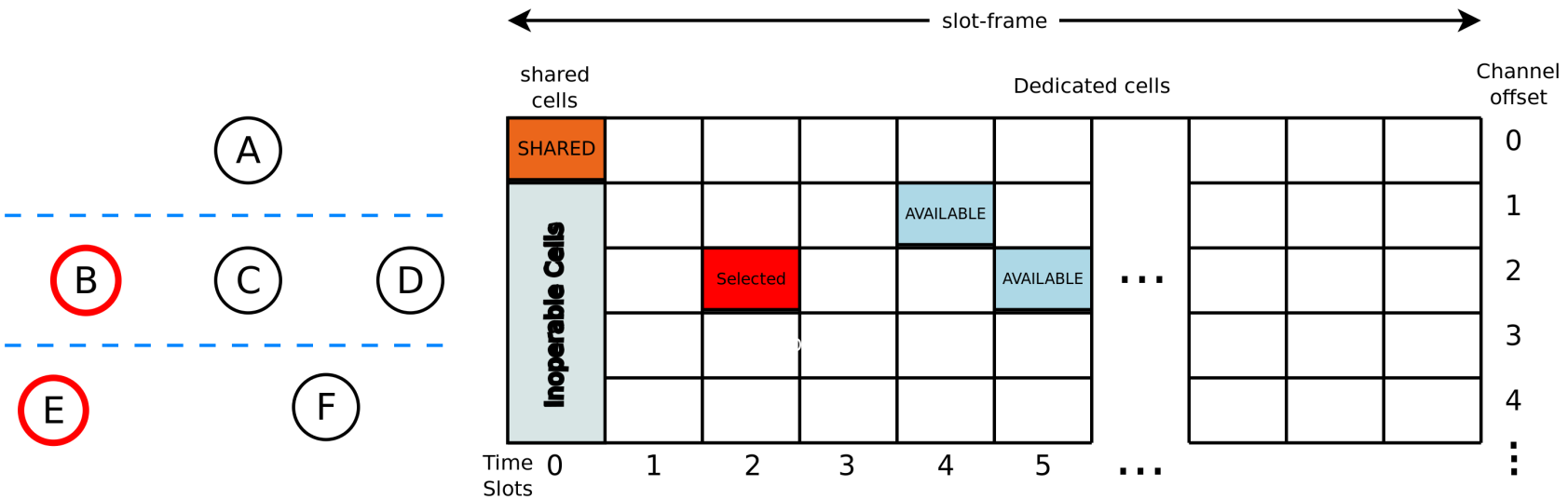

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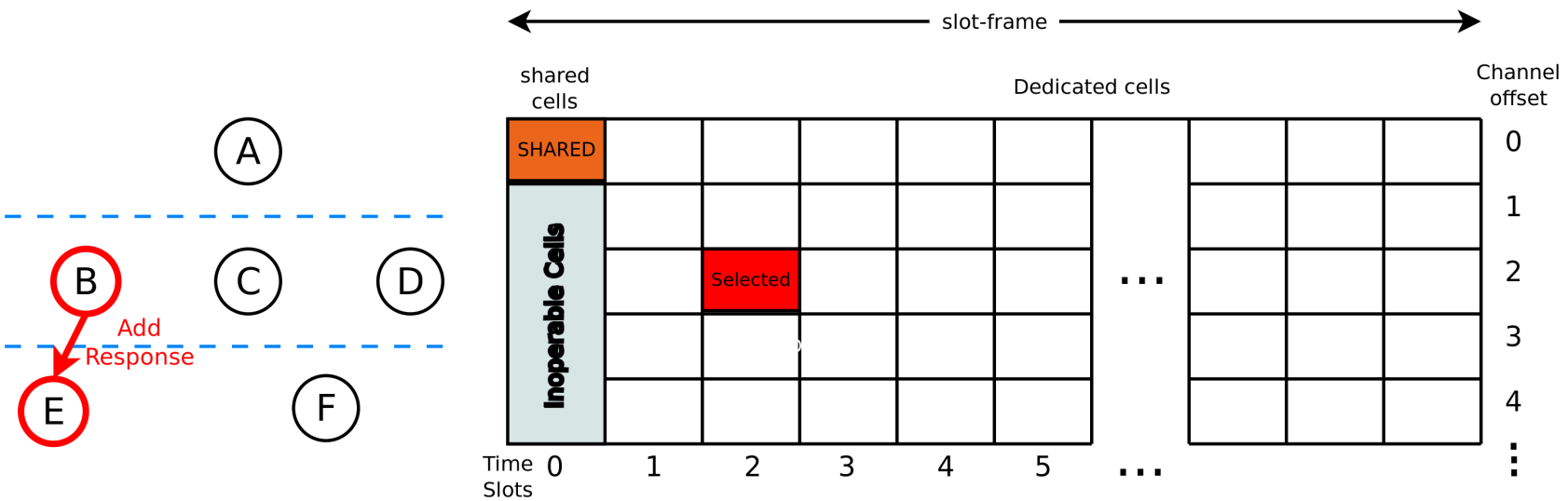

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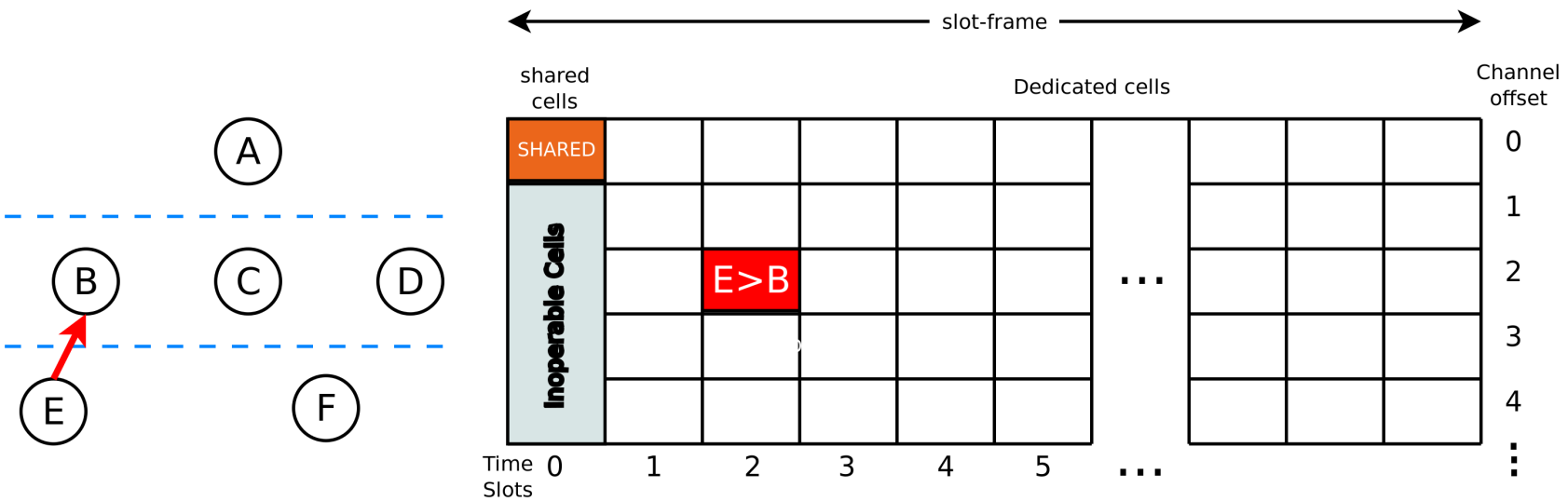
5. Cell is added and communication starts.



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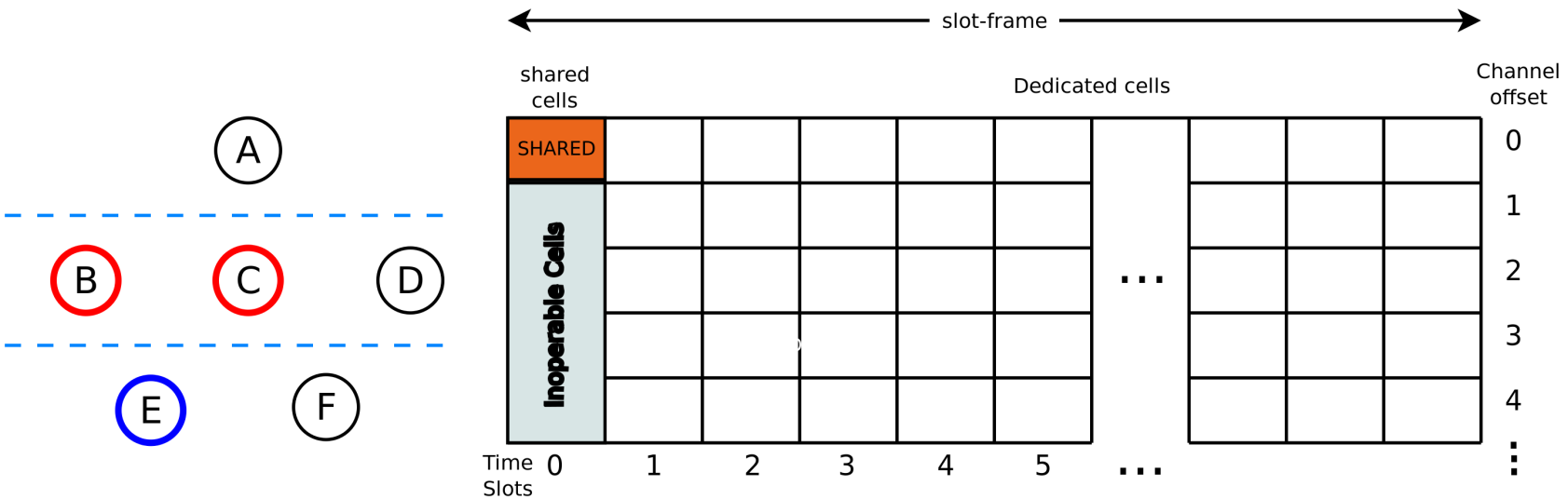
# Project challenges & Objectives

## Collision in Dedicated Cells

- Collision free Dedicated Cells?
- Neighbor nodes can select the same communication cell.



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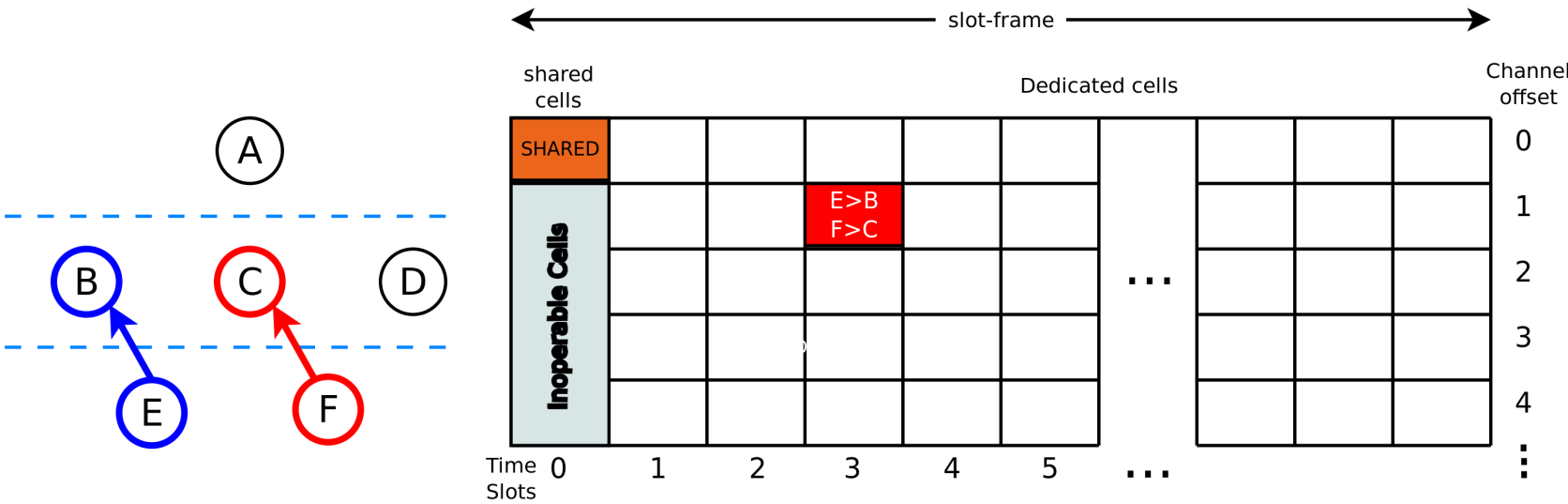

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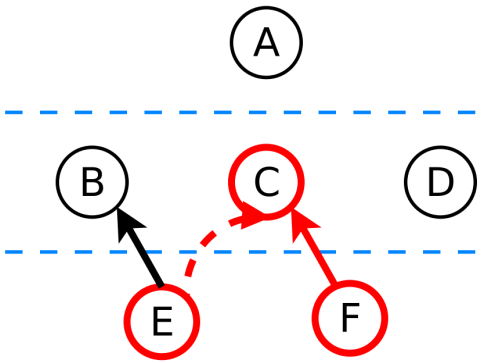


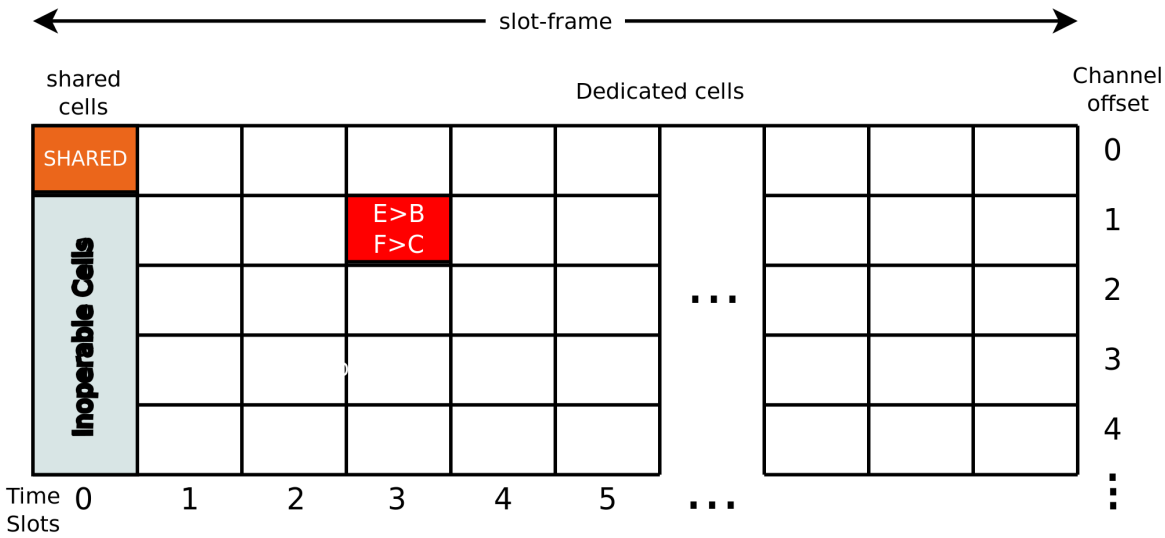

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- Creating a flexible mechanism, compatible with all scheduling functions

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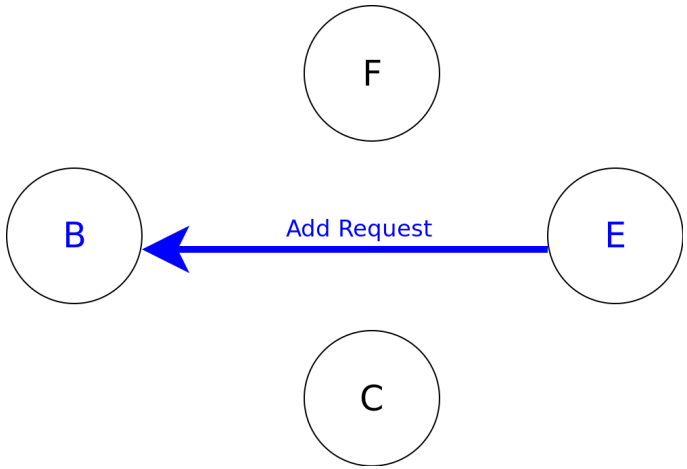
- Submitted in the shared slot.
- Contains the reserved cells.

## How?

- The child node Sends an Add Request.



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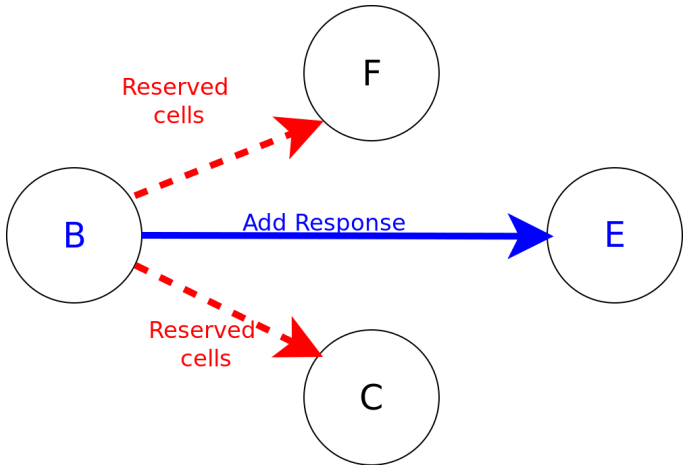

# Using 6top Transaction

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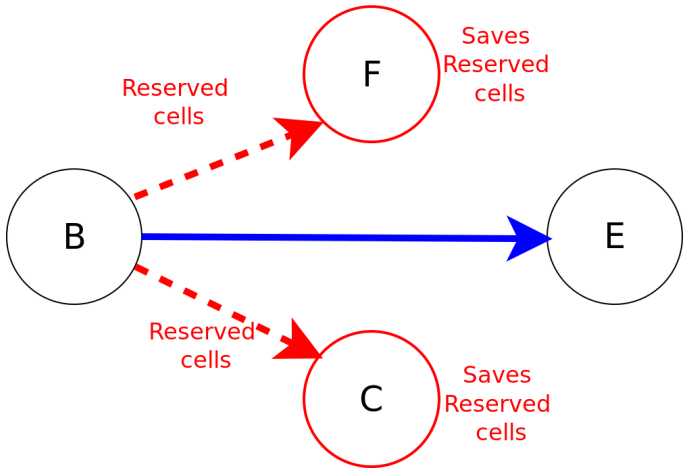
- The neighboring nodes collects the reserved cells and save them.



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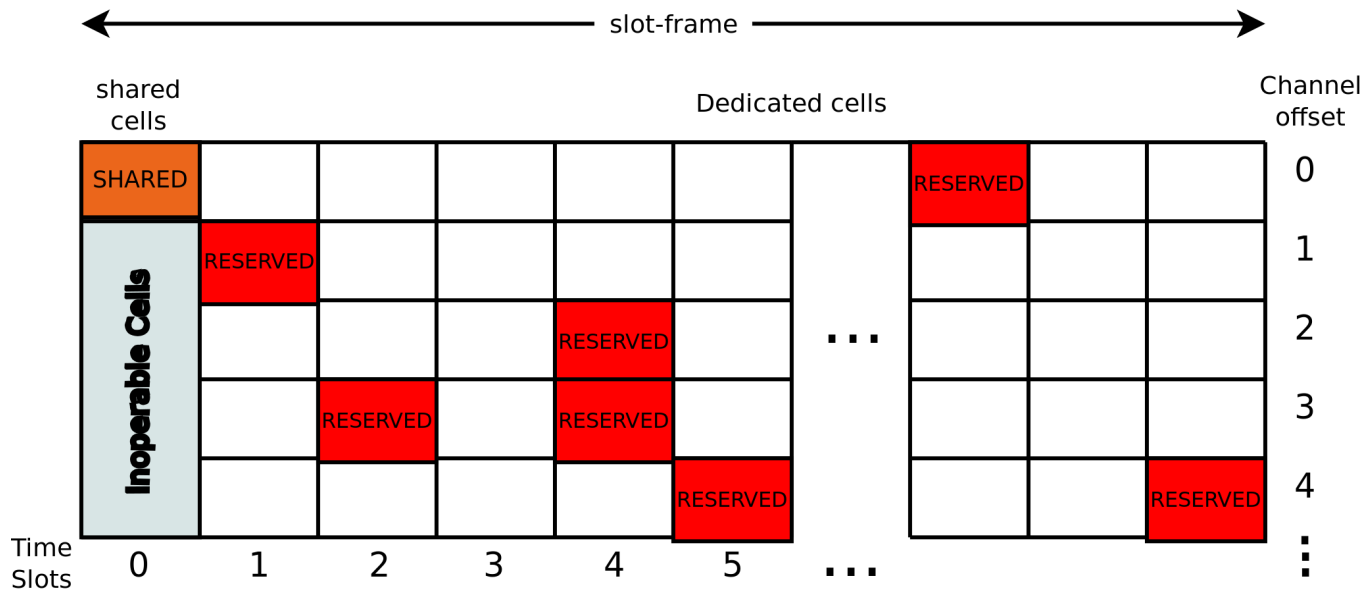
# Avoid Table structure and functioning

## Avoid Table

- The cells reserved by neighbors will be saved by a structure similar to that of TSCH table.



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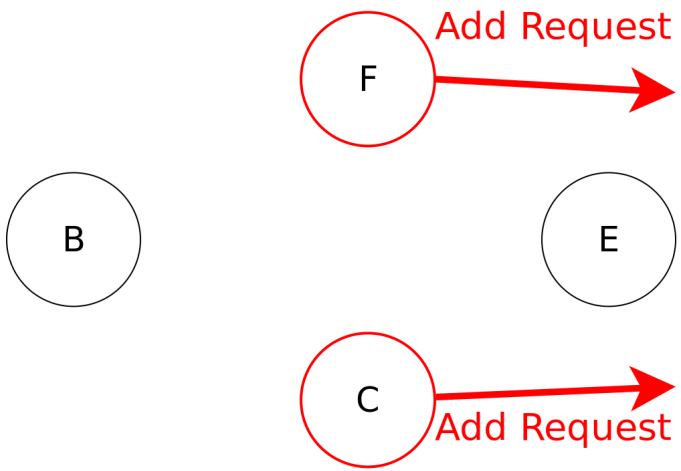

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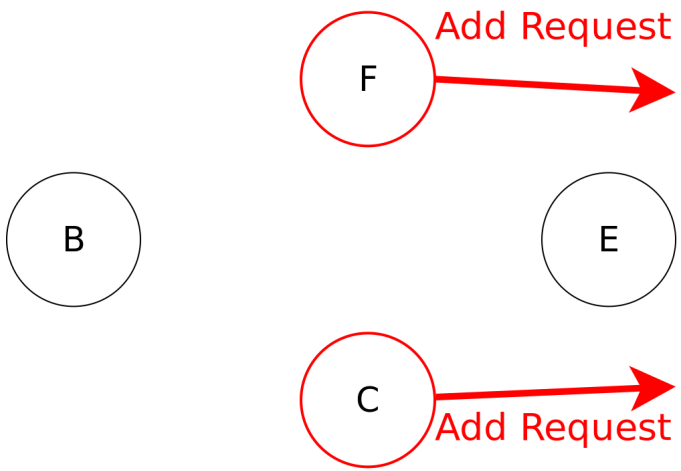
- 6top will manage this table.



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## Why?

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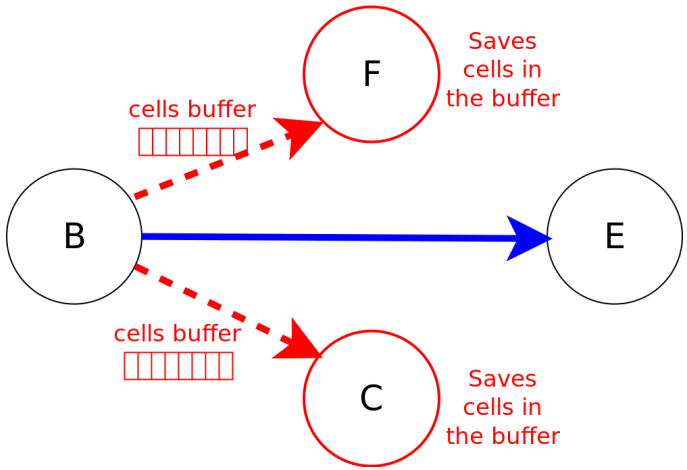
- Number of the neighbors will not receive the reserved cells.

## How?

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



# Cell Buffer

## Why?

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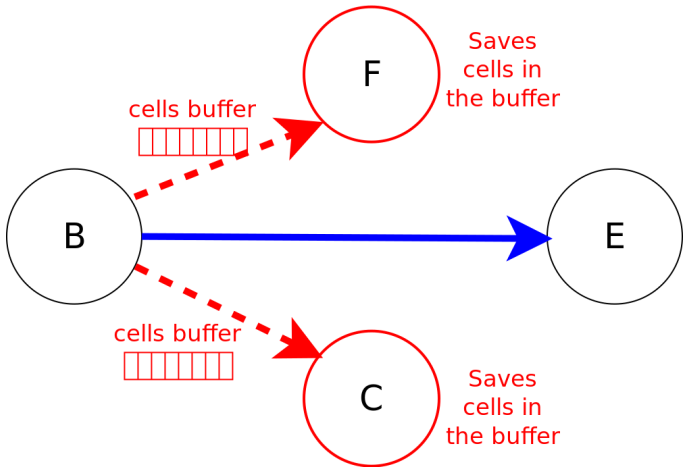
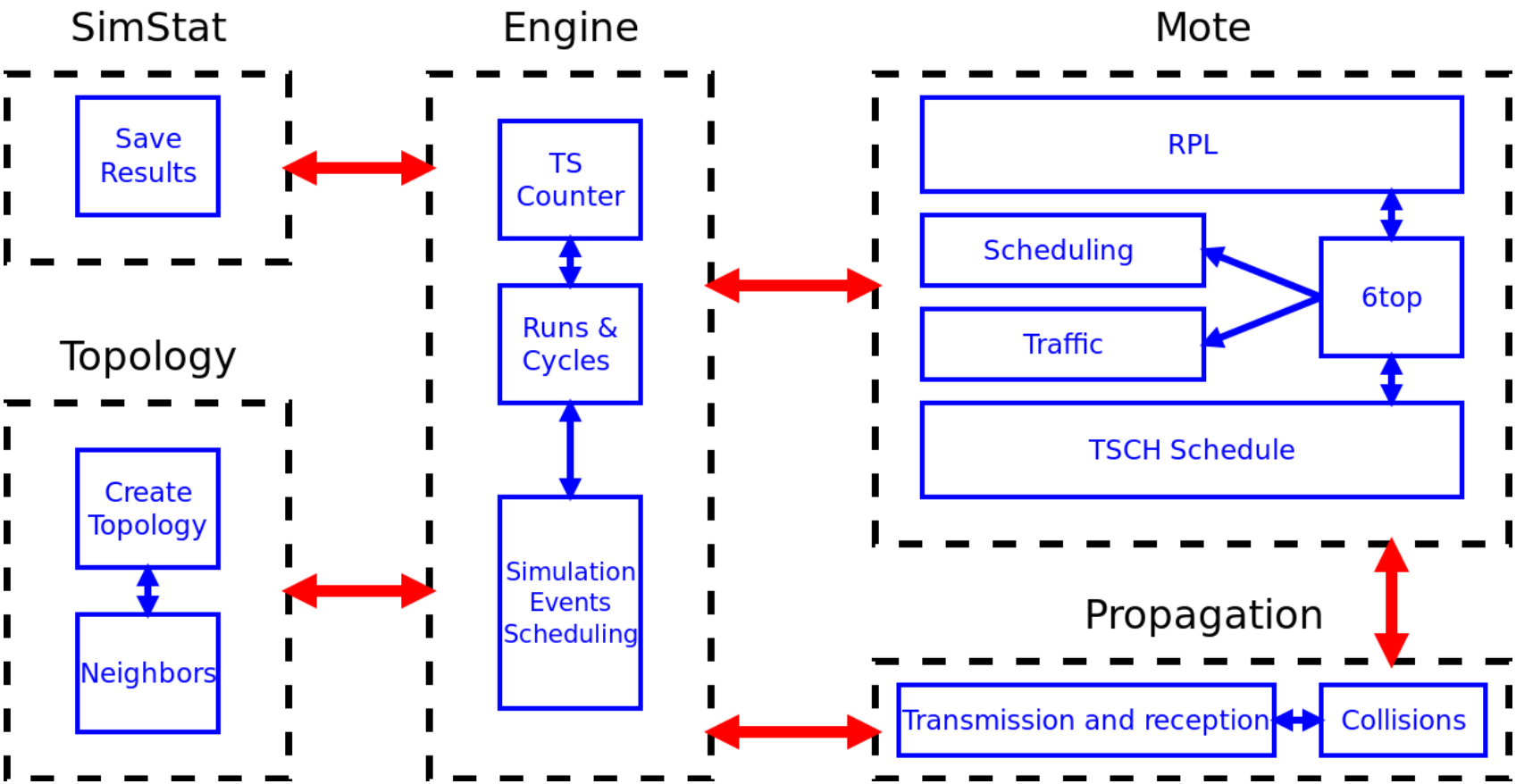
- Creating a cell buffer that will contain k reserved cells for each node.
- Transmitting the cell buffer each time a cell is reserved.



# Outline

# Simulator Architecture

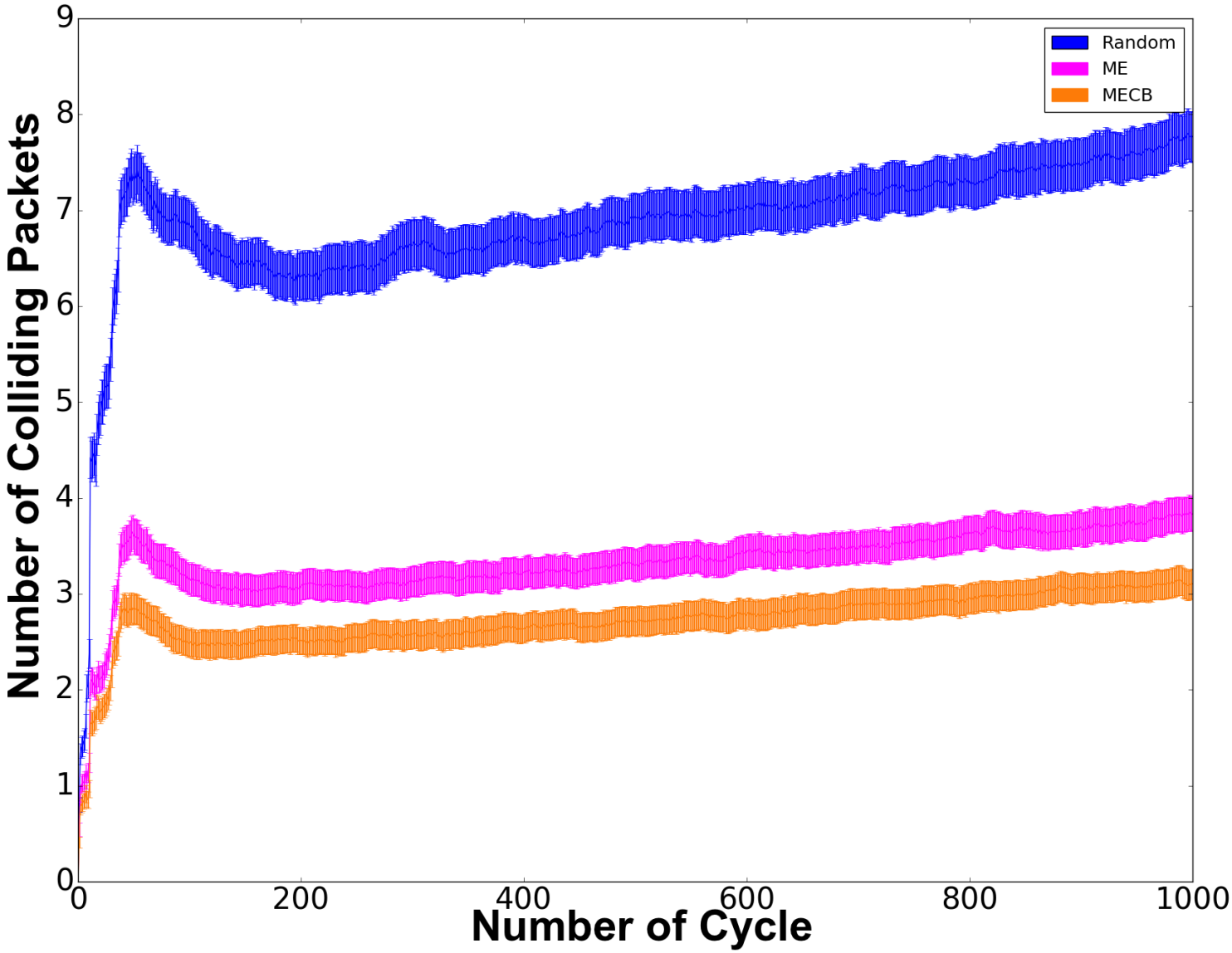


# Simulation Parameters

| 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 | $\geq$ 3 neighbors with PDR 50 % |
| Radio sensitivity | $-97$ dBm |
| Radio range | 100m |
| Traffic | 1 packet/node each 10 cycles |

# Outline

# Comparison with random scheduling



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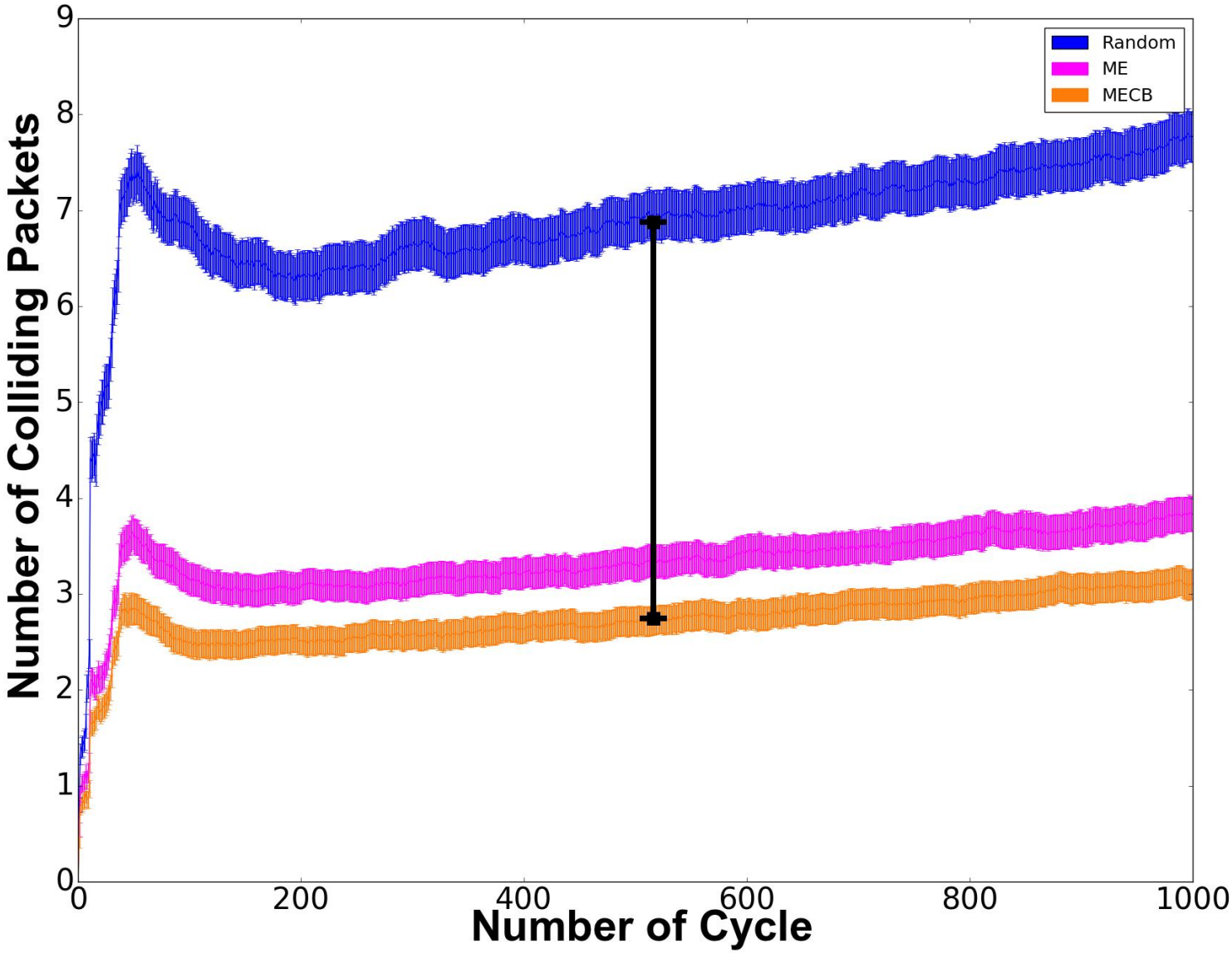

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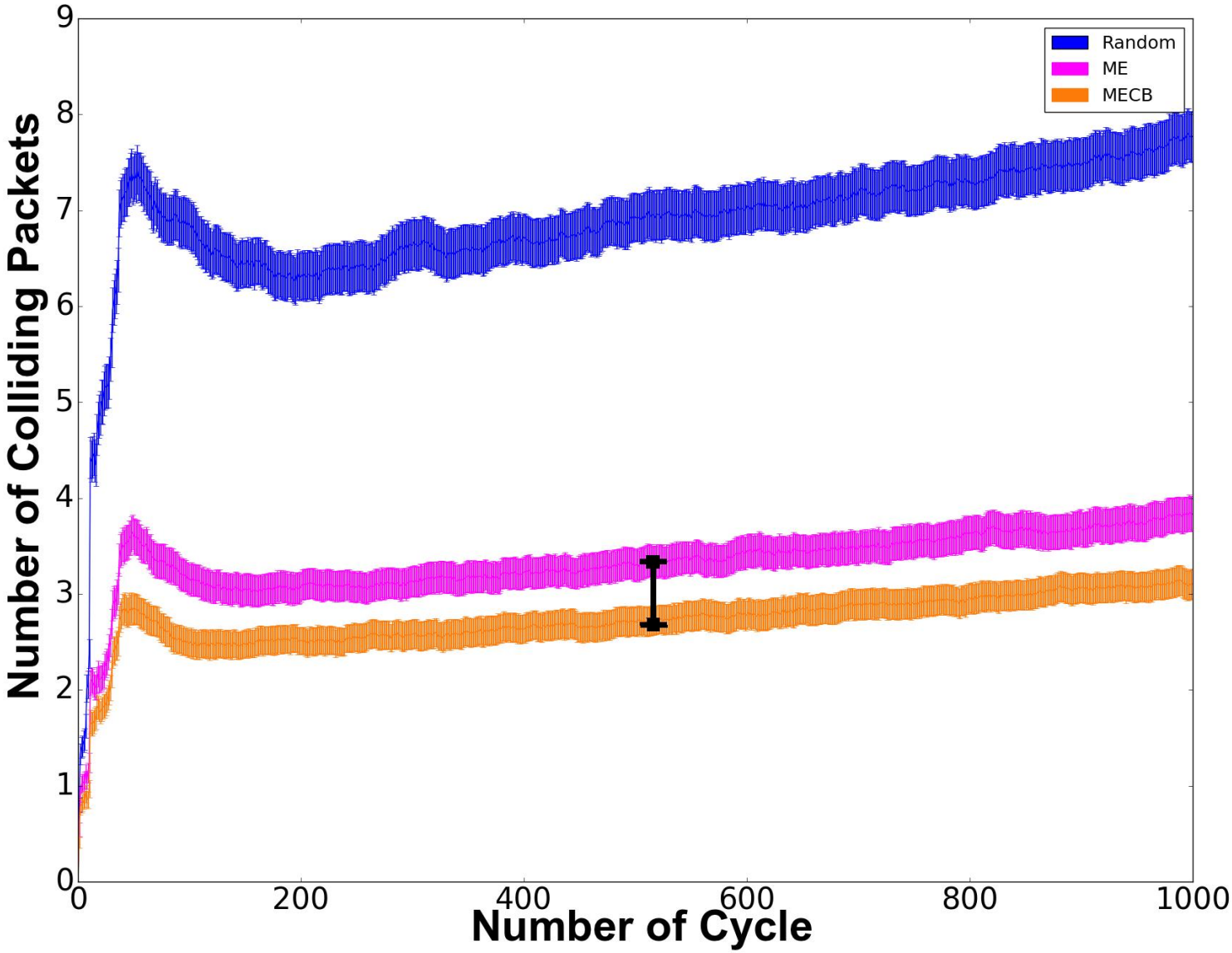
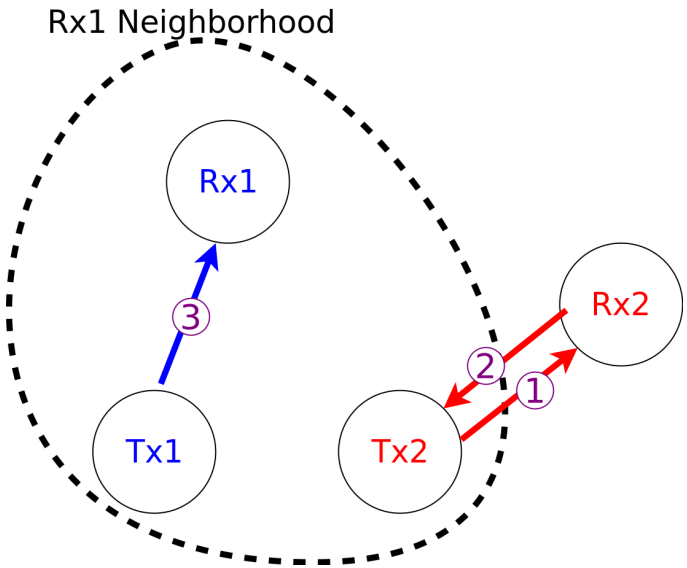


# Results

## Collision reasons

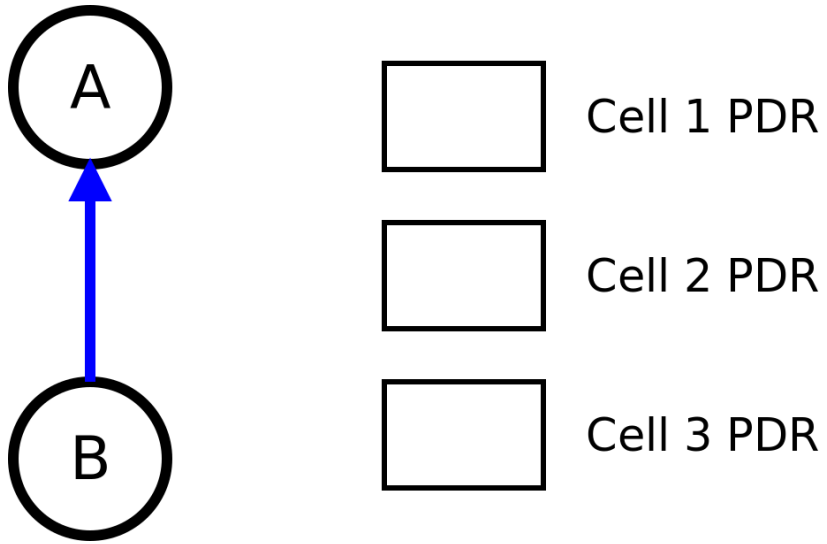
- The lost 6top transactions.
- Special case that induce collisions.



# Housekeeping Approach

## Collision in Dedicated Cells

- Housekeeping approach and cell relocation.
- Tx housekeeping.



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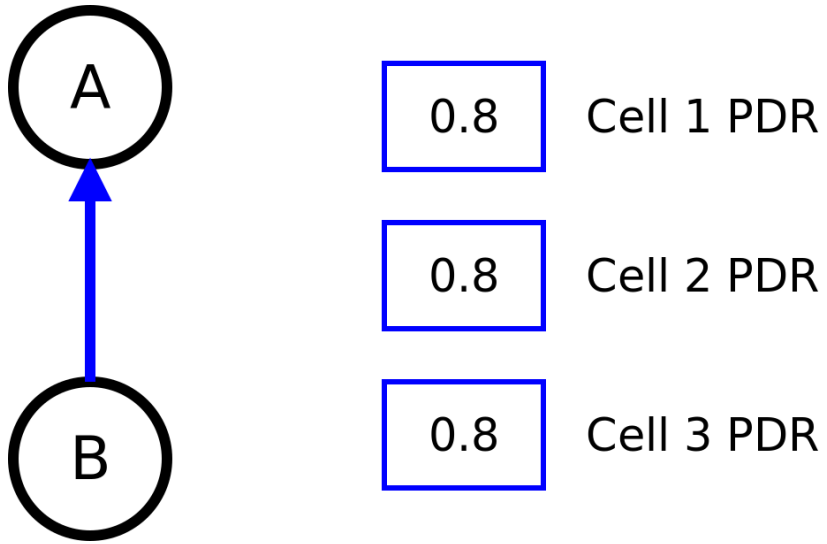

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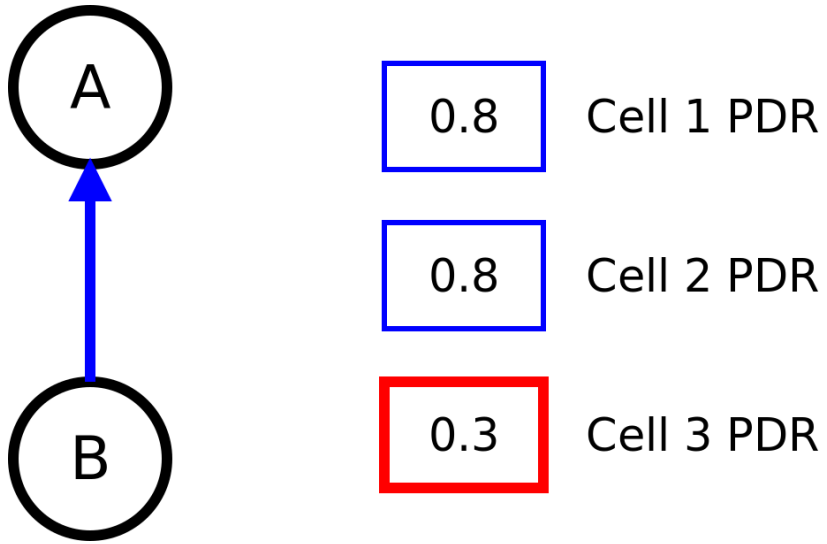

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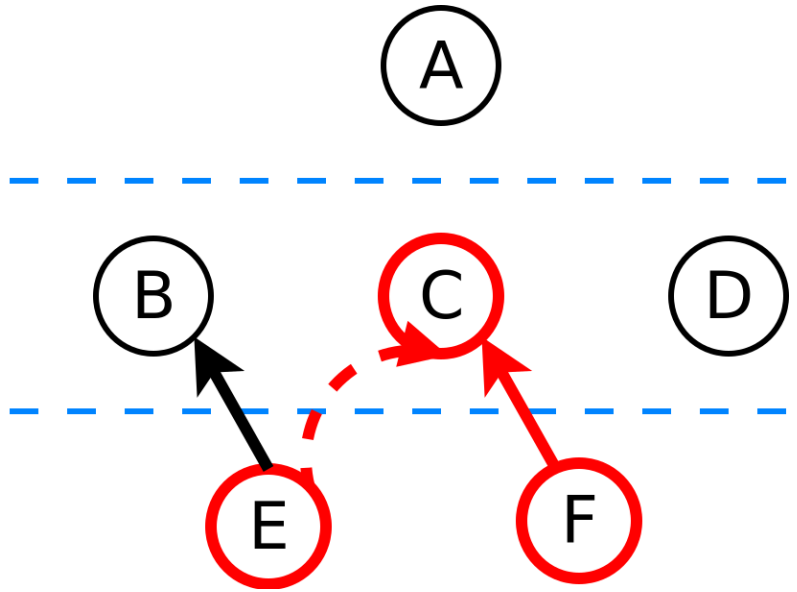

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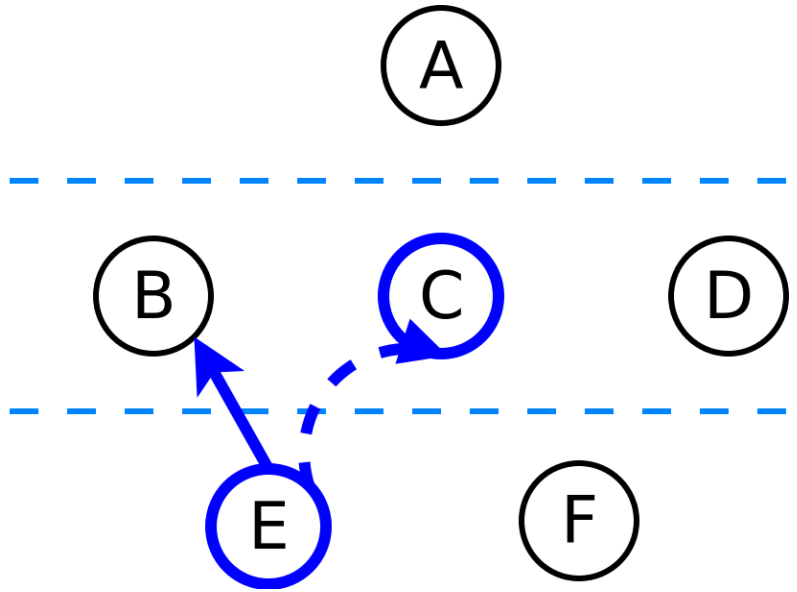

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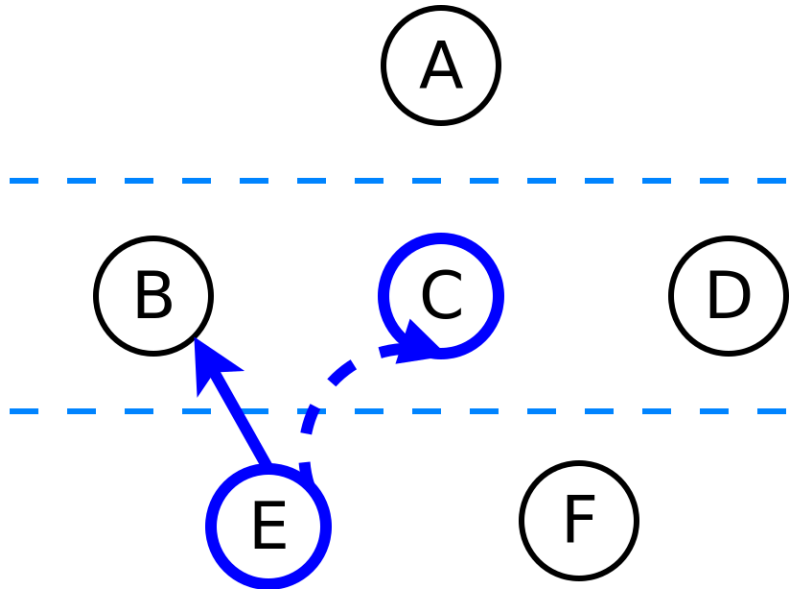
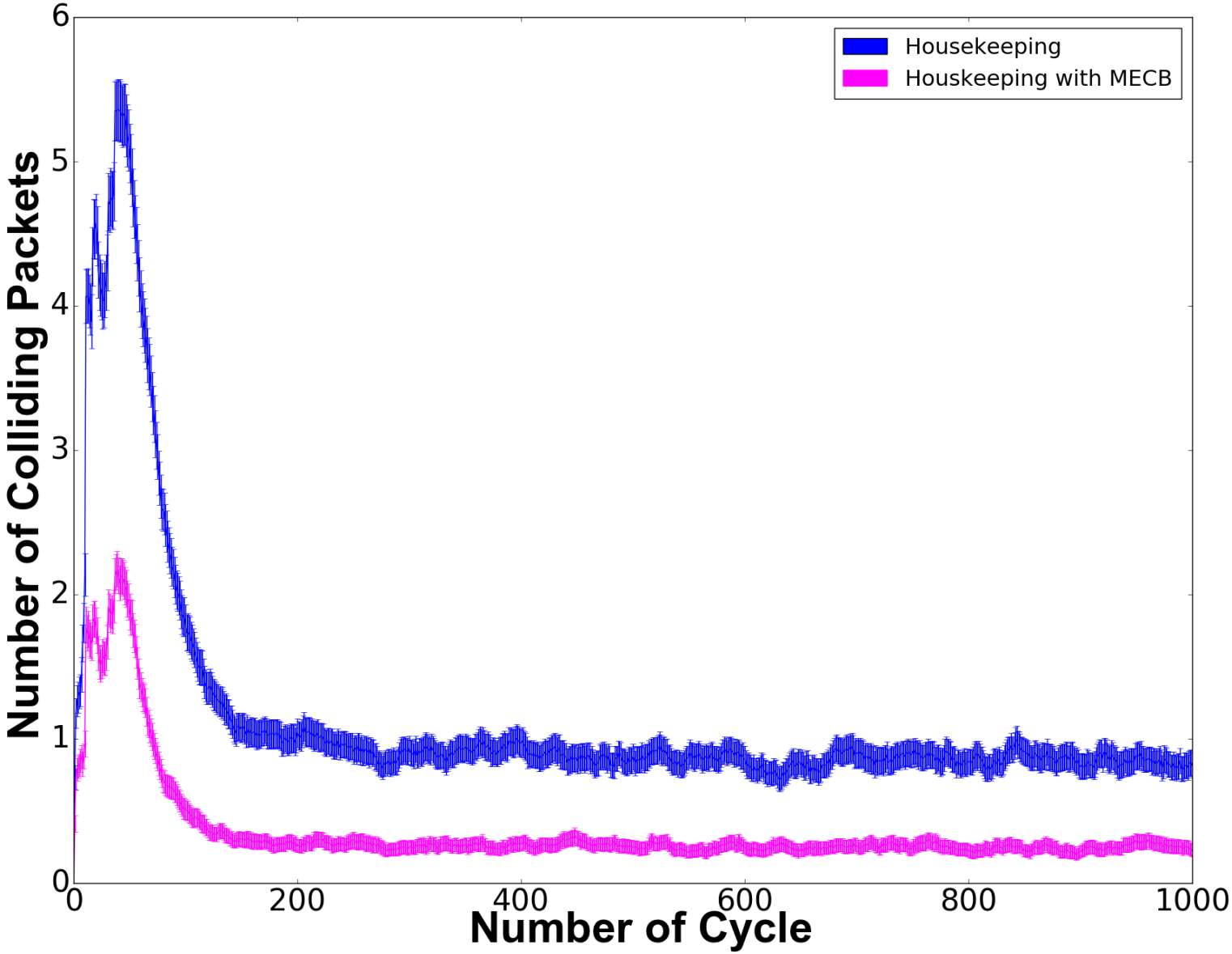
## Collision in Dedicated Cells

- 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.

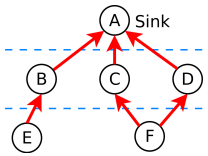
- Outlook
  - Our goal is to reach a place were we have collision free network, using more complex methods.
  - Our perspective in this project was to work on 6top, but our next steps is to study the effects of traffic in the protocol performances.

## General intoduction

IEEE802.15.4

**Converge Cast Structure**

- Nodes radio range defines the neighborhood.
- Sink is selected.
- Packets are forwarded toward the sink.

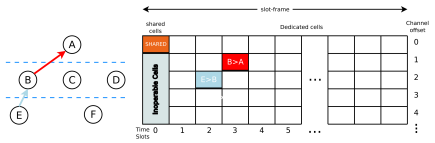





## IEEE802.15.4 Protocols

**IEEE802.15.4e TSCH**

- IEEE802.15.4 defines the MAC and PHY layers.
- TSCH is an extension of the MAC layer of IEEE802.15.4.
- Time/Frequency multiplexing of the bandwidth.
- Shared cells/Dedicated cells..
- 6TiSCH operation sublayer 6top will manage the TSCH.





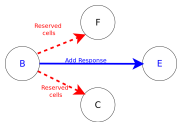

## Using 6top Transaction

**Why?**

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

**How?**

- The child node Sends an Add Request.
- The parent replies with the selected cells.

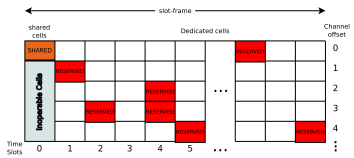





## Avoid Table structure and functioning

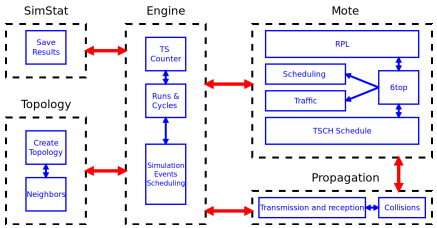
**Avoid Table**

- The cells reserved by neighbors will be saved by a structure similar to TSCH table.



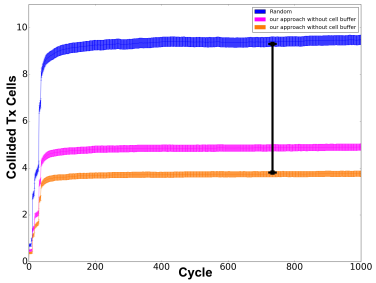



## Simulator Architecture






## Comparison with random scheduling






# Thanks for your attention!
# Questions?

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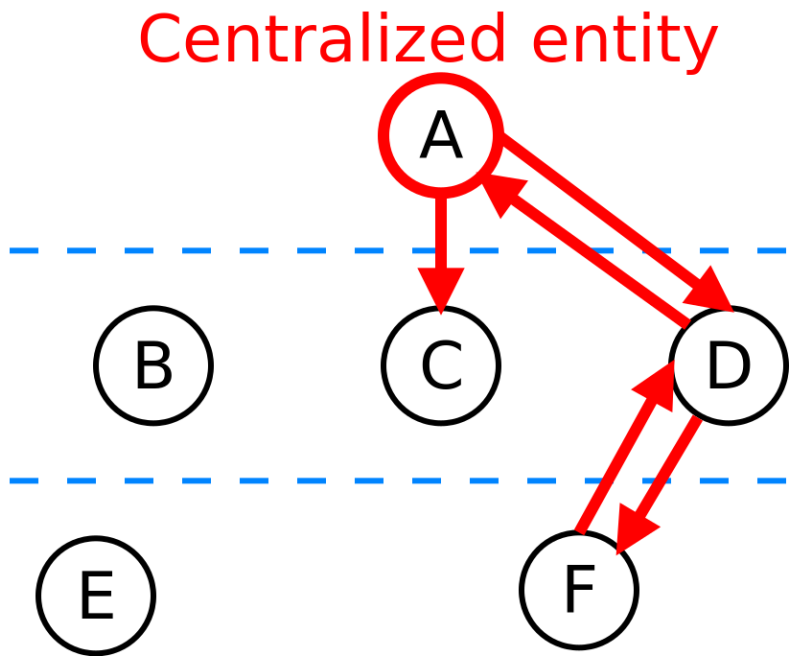

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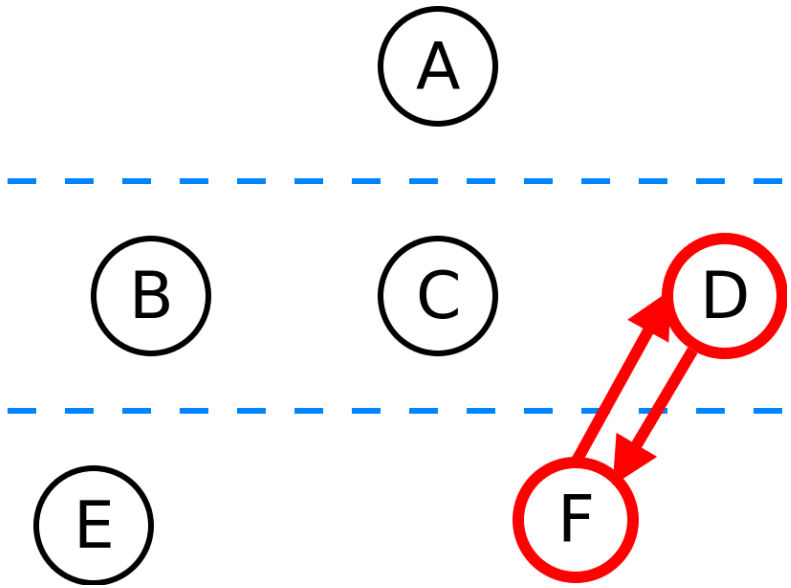

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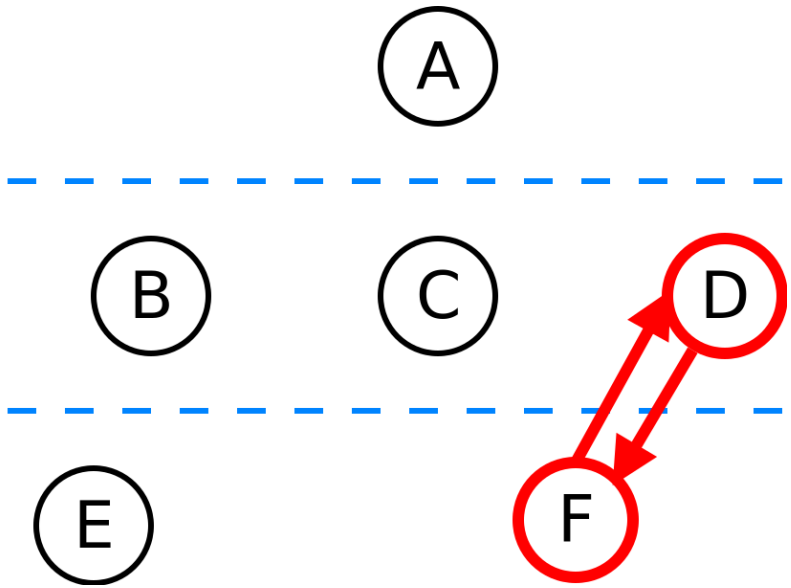

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