

# Contention management for Deterministic Networking



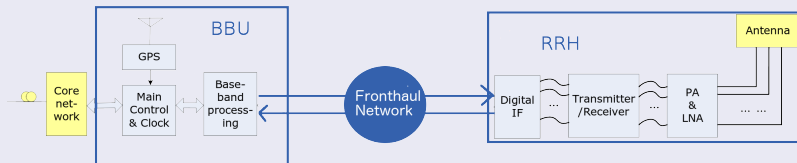
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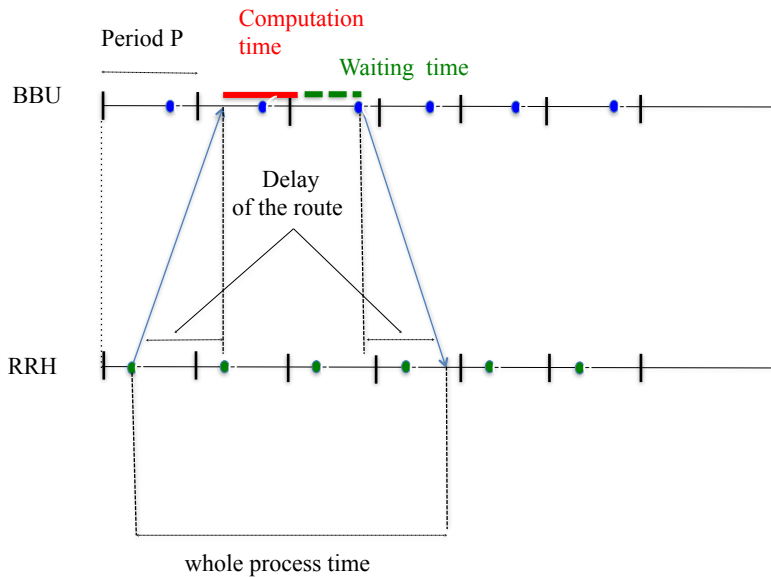
# Problematic

- Latency critical application (C-RAN, ....).
- Stochastic networks could not ensure a low latency.
- NP-hard

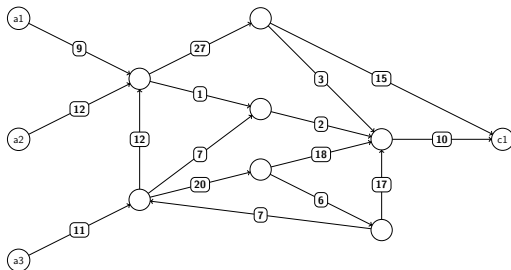
## Periodic Process



- Contention in the fronthaul network
- Need to guarantee the latency



# Model



- Network : Directed Graph
- RRH / BBU  $\rightarrow$  set of vertices A (Antennas) and C (Computation)
- Physical Delay of a link  $\rightarrow$  Weight on arcs

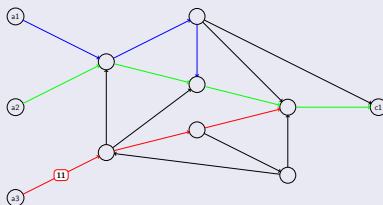
# Model

## Slotted time

The time is discrete.

- Slot  $\rightarrow 1\mu s$ .
- Step by step.

## Message sending



Block of one or several slots used by the messages.

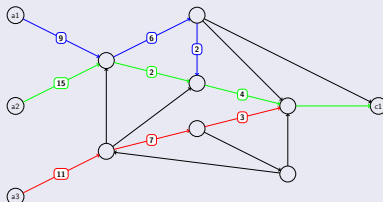
# Latency

## Latency

3 factors increases the latency

- 1 The physical delay of the links (not alterable).
- 2 The time before inserting a messages in the network.
- 3 The buffering time of the messages in the network.

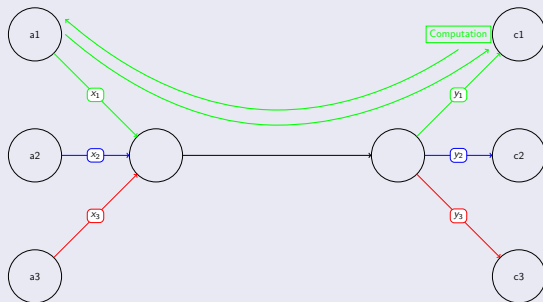
## Collisions



# An easy topology

Control of the contention : reserving slots on routes.

## Star network



# Problem

## Problem

Find some time at which send the messages from the BBU/RRH, such that there is no collisions in the network.

## NP-hard

On topology with restricted parameters.



# Main ideas

## No buffering in BBU

- Greedy Policy : ensure a solution for small loads
- Shortest-Longest : ensure a solution for similar length of routes
- Exhaustive search : optimal solutions for few routes

## Allowing buffers in BBU

Two greedy parts:

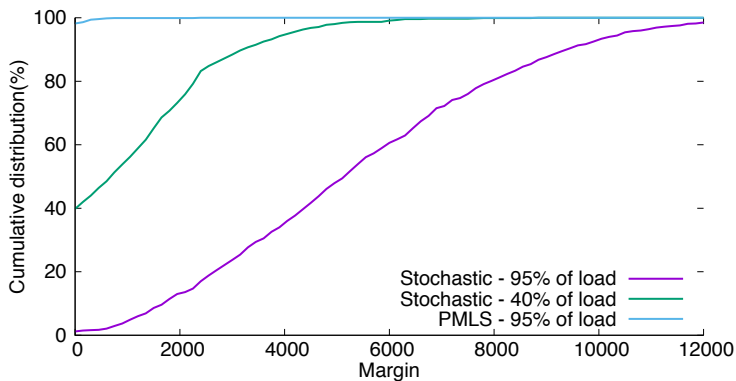
Way forward

- Multiple random sendings

Way backward

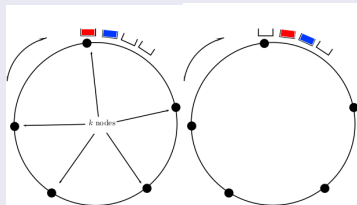
- Greedy Algorithm
- Adapted scheduling algorithm

# Deterministic vs Stochastic

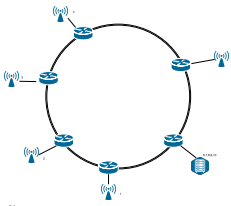


# Optical ring

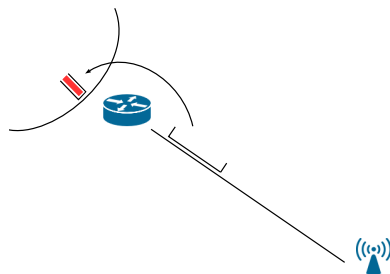
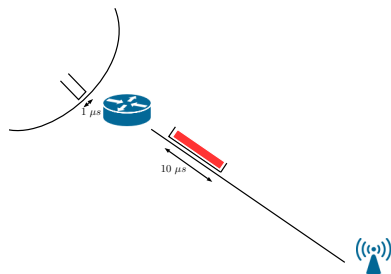
## Model



Waiting only at the insertion



# Insertion



## Broadcast and select Policy

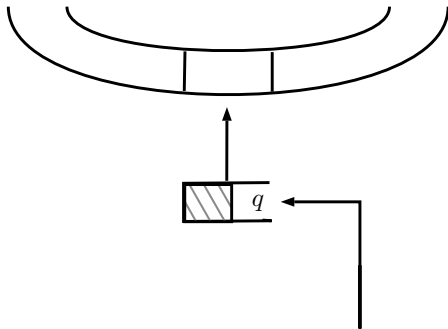
### Parameters

Length of the ring	20km	100 slots
Number of nodes	3 -10	
Duration of a slot	1 $\mu$ s	-
Bandwidth	100 Gbps	-
Period	1ms	1000 slots
Capacity of a packet	1Mb	-
Flow of an antenna	5Gbps	1 packet/Every 10 slots during 500 slots

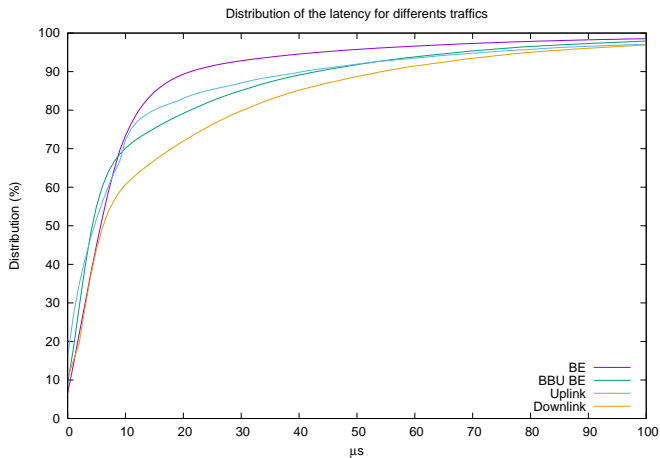
# Optical ring problematic

- We got two kinds of traffic : CRAN - high priority, Best effort
- We want to observe the behavior of the ring and analyze the latency of CRAN
- We will try to find some methods to decrease the CRAN latency without increasing the Best effort latency too much

# No management

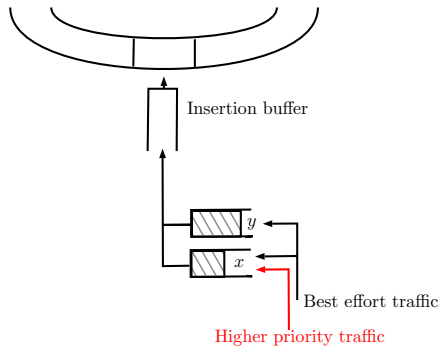


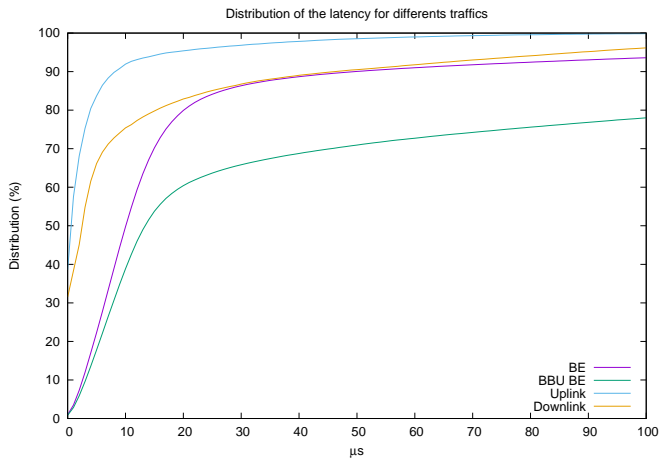
# No management





# Priority





# Deterministic policy

