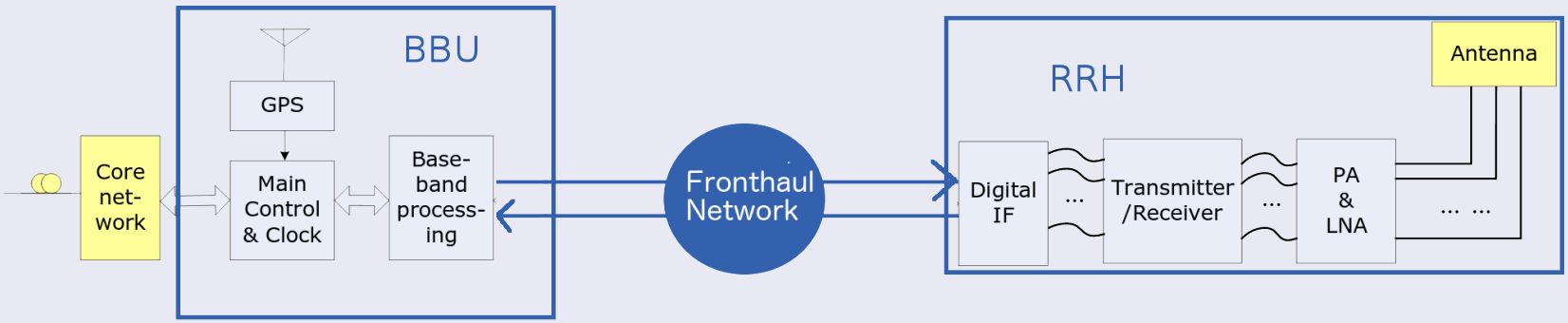
Contention management for Deterministic Networking

November 9, 2017

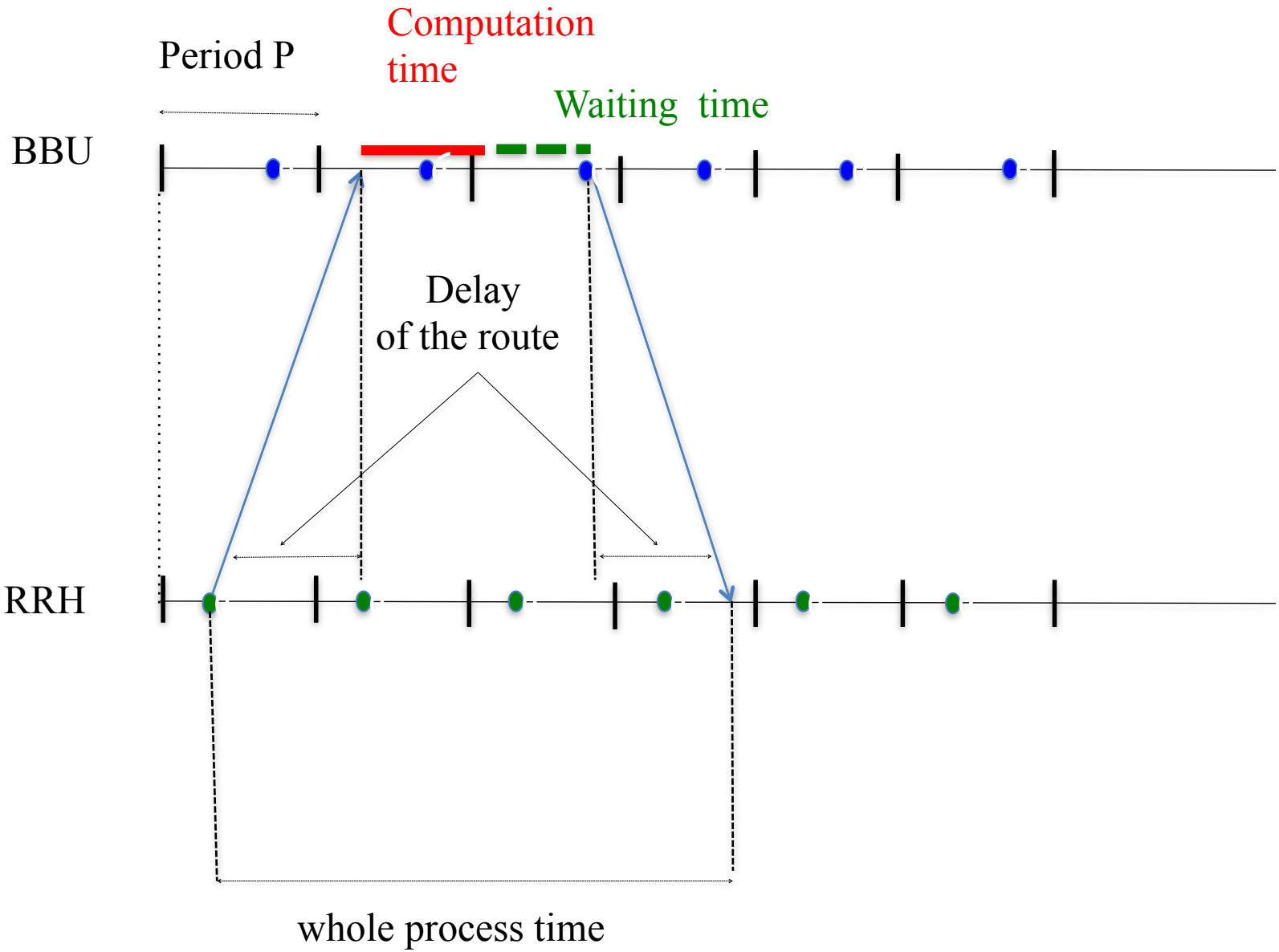
Problematic

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

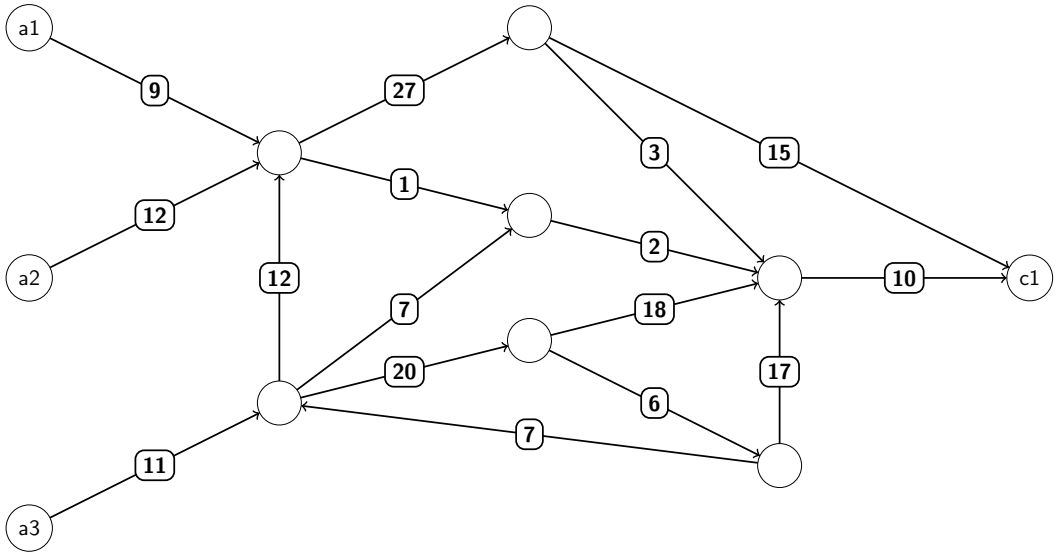
Periodic Process



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


Period P
Computation time
Waiting time
BBU
Delay of the route
RRH
whole process time

Model



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

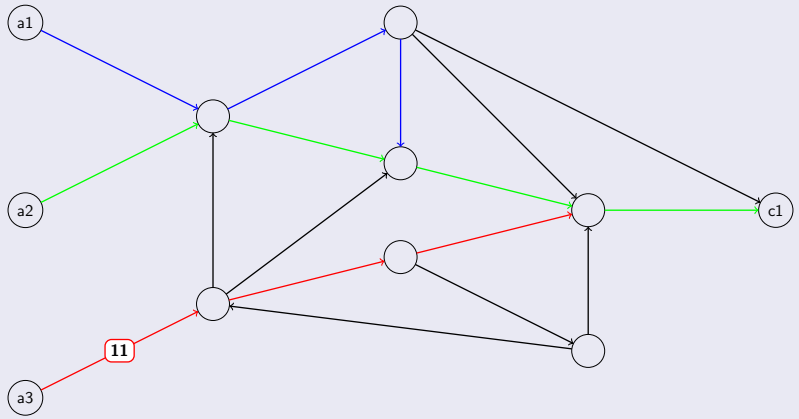
Model

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.

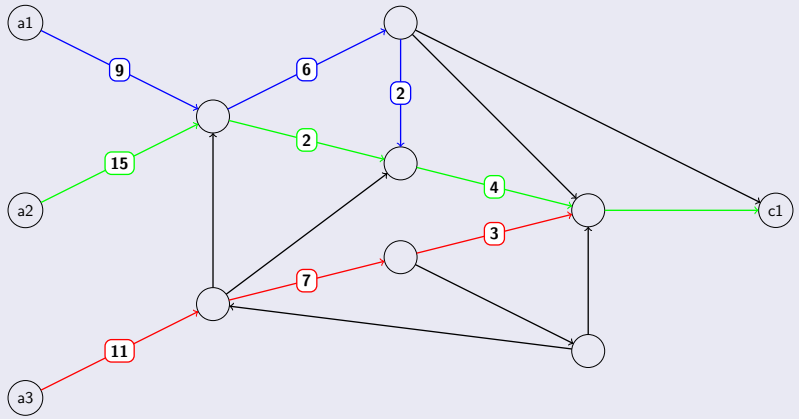
Latency

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.

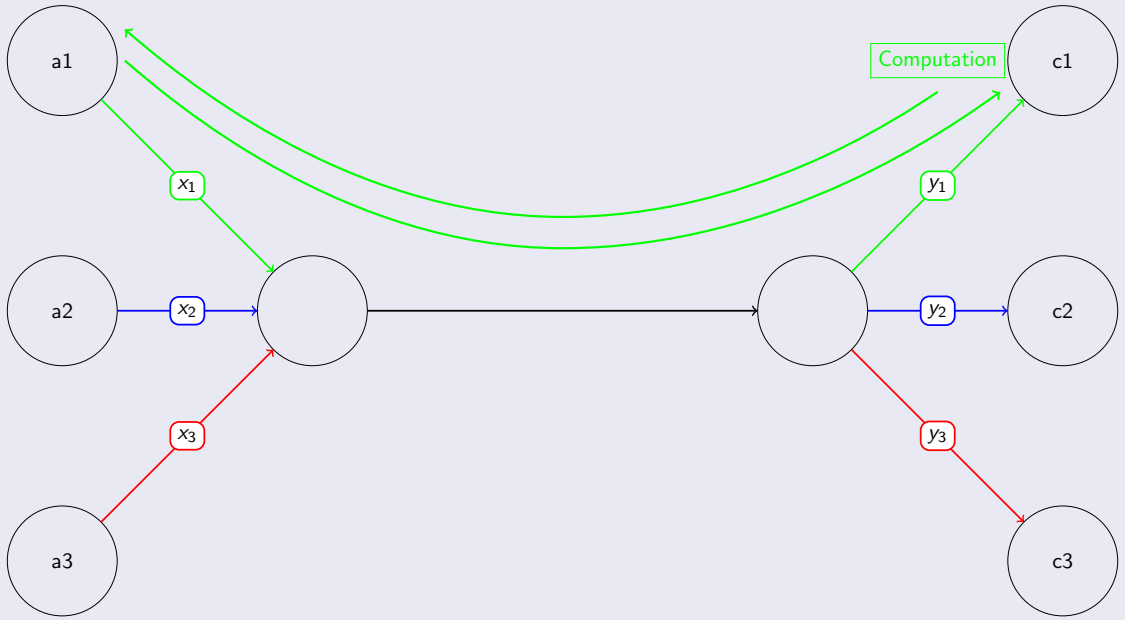
Collisions



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:

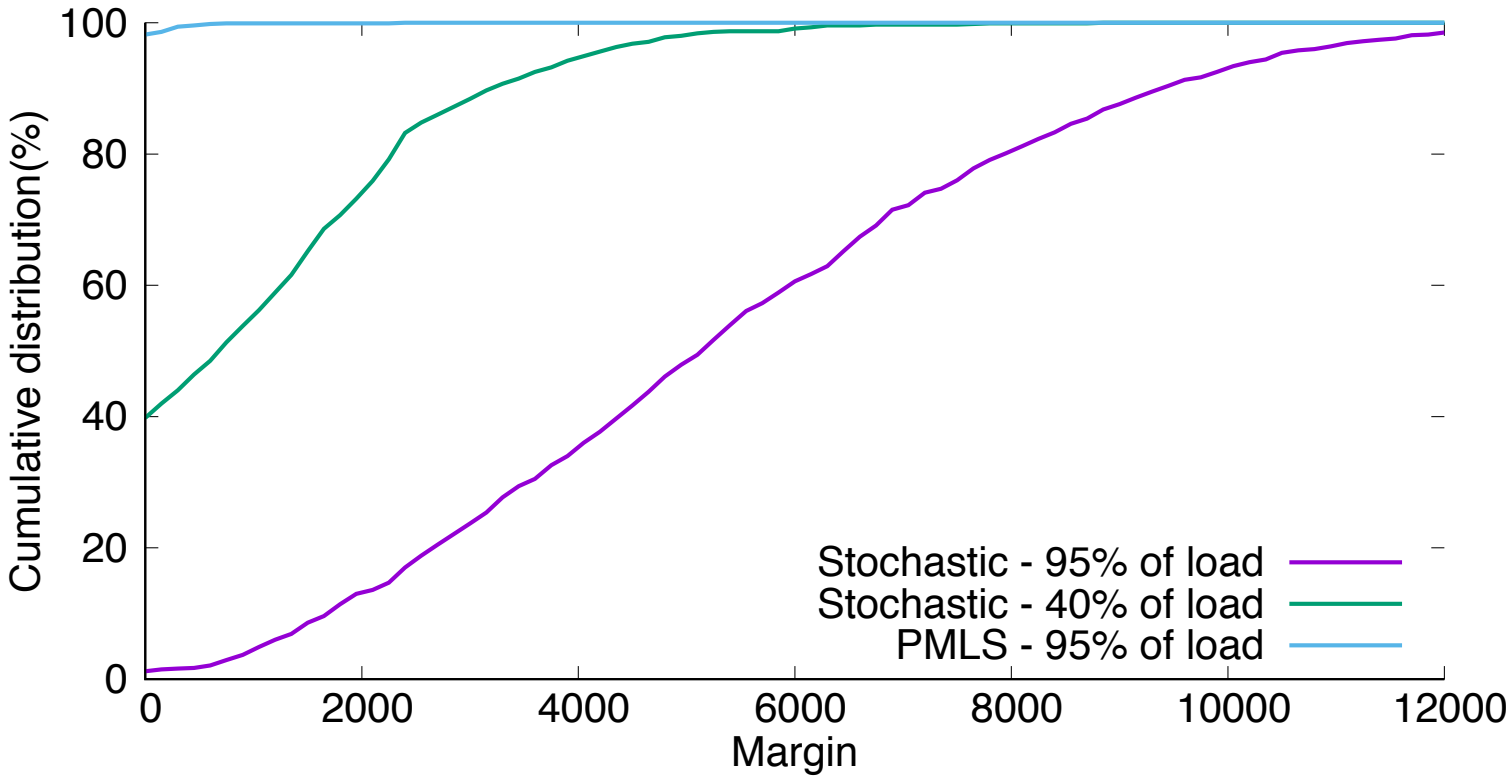
Way forward

- Multiple random sendings

Way backward

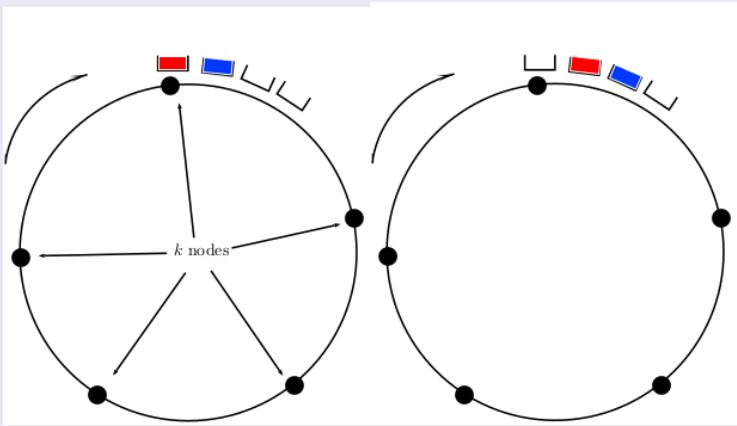
- Greedy Algorithm
- Adapted scheduling algorithm

Deterministic vs Stochastic

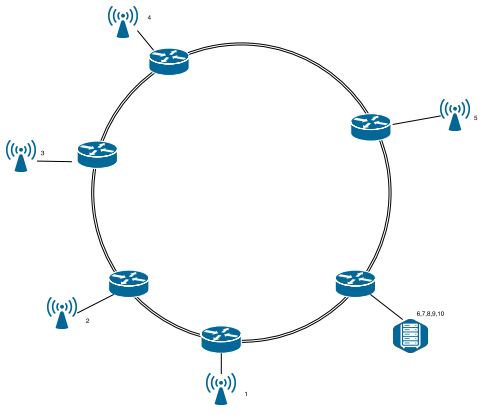


Optical ring

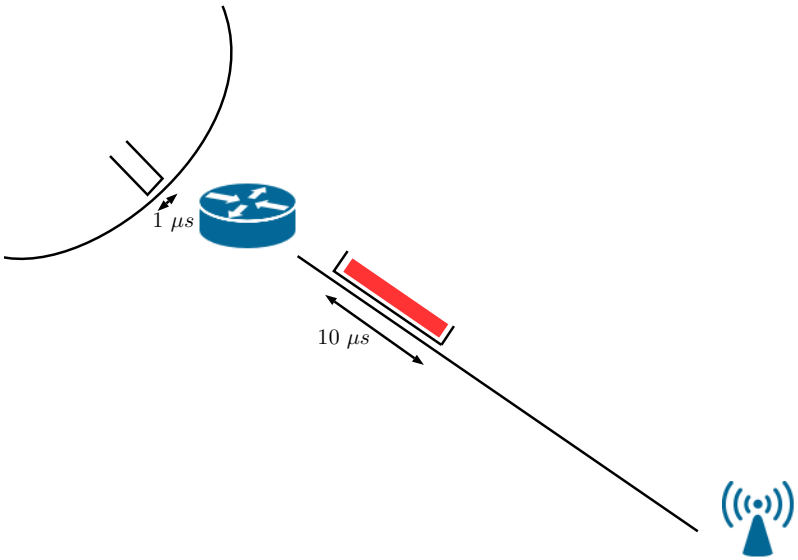
Model

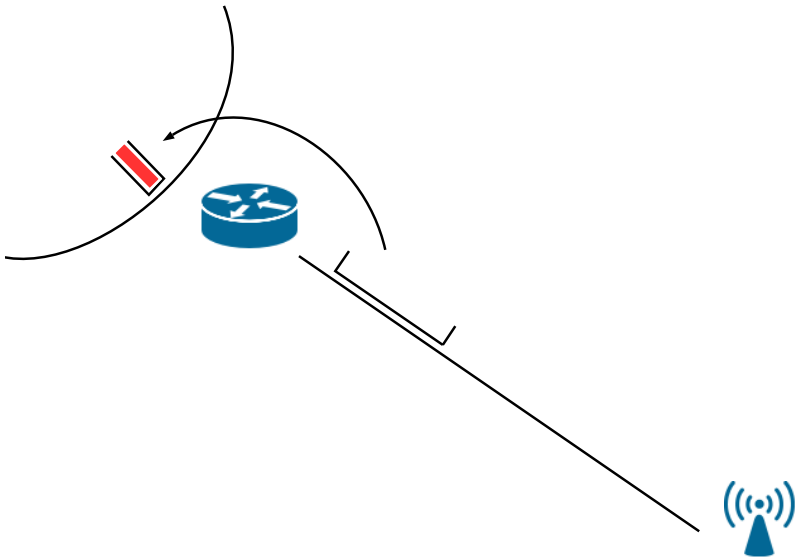


Waiting only at the insertion



Insertion





Parameters

Broadcast and select Policy

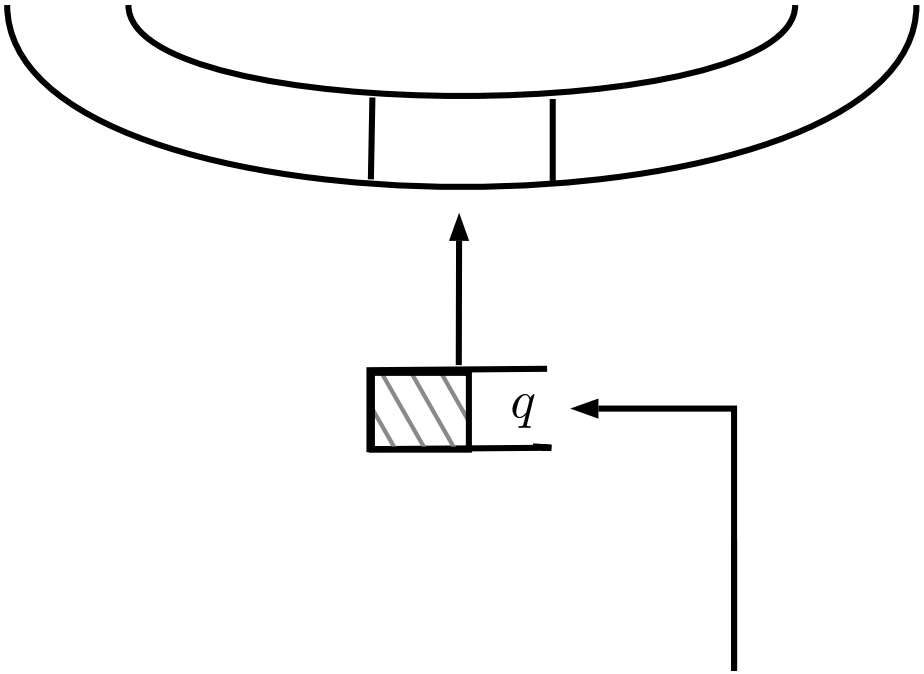
Parameters

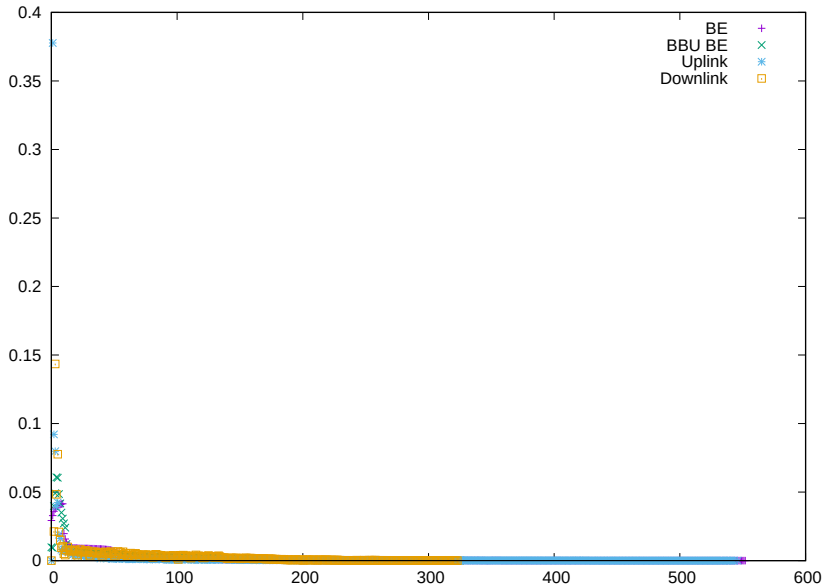
Length of the ring	20km	100 slots
Number of nodes	3 -10	
Duration of a slot	1μs	-
Bandwidth	100 Gbps	-
Period	1ms	1000 slots
Capacity of a packet	1Mb	-
Flow of an antenna	5Gbps	1 packet/Every 10 slots during 500 slots

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

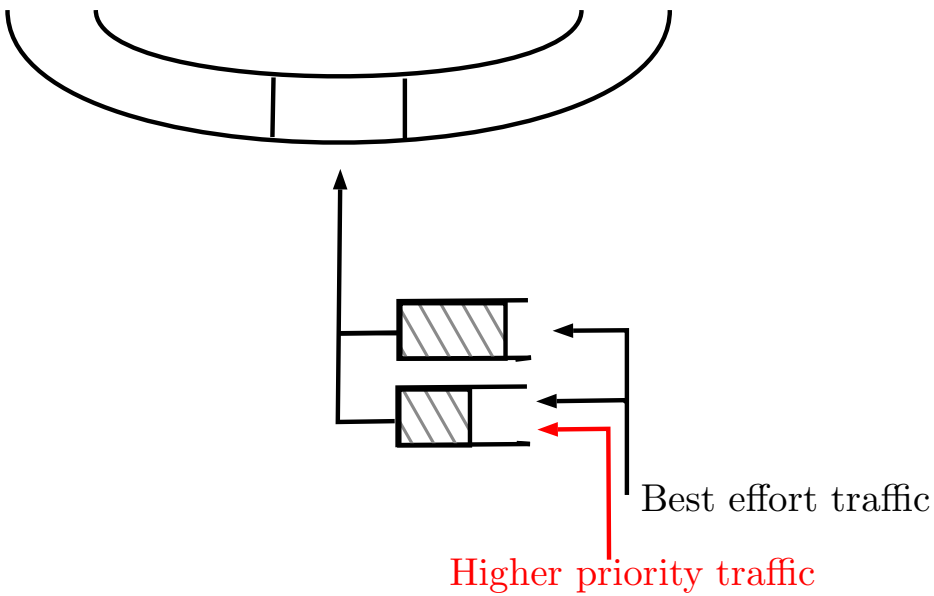
No management

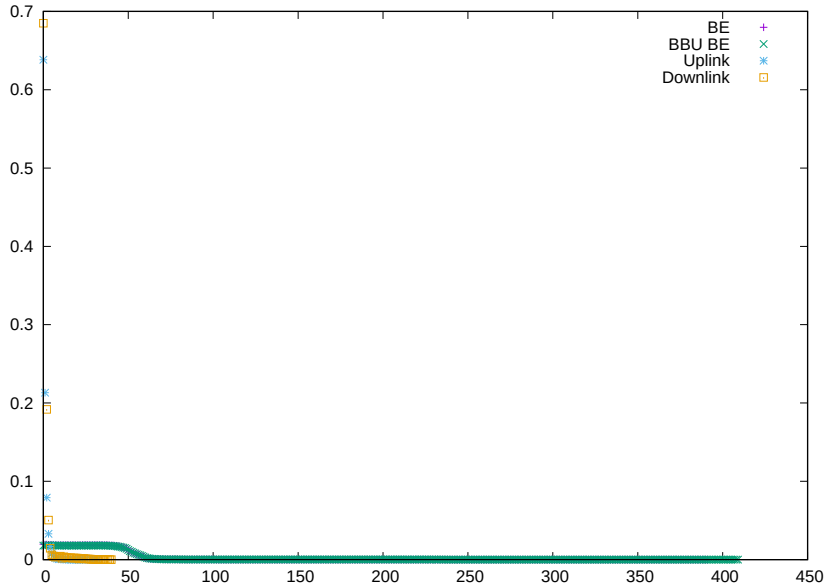




Average Load = 0.8

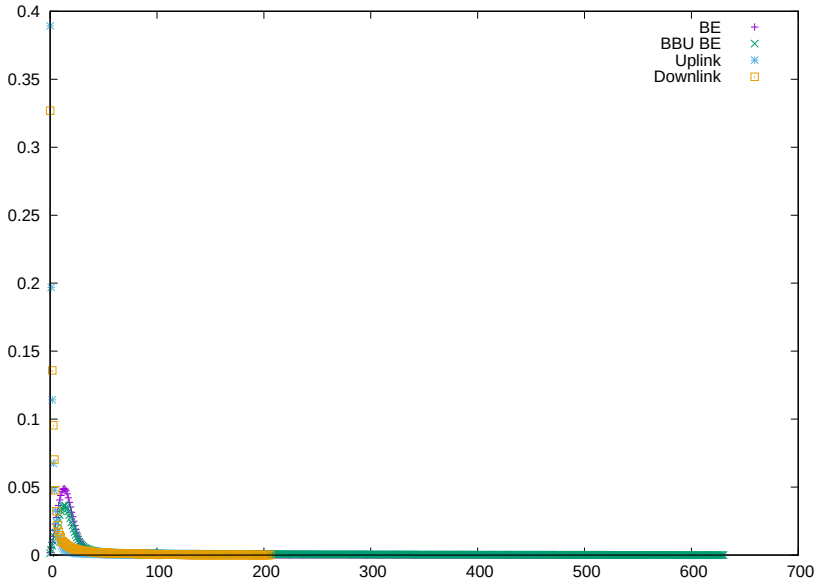
Priority with low load





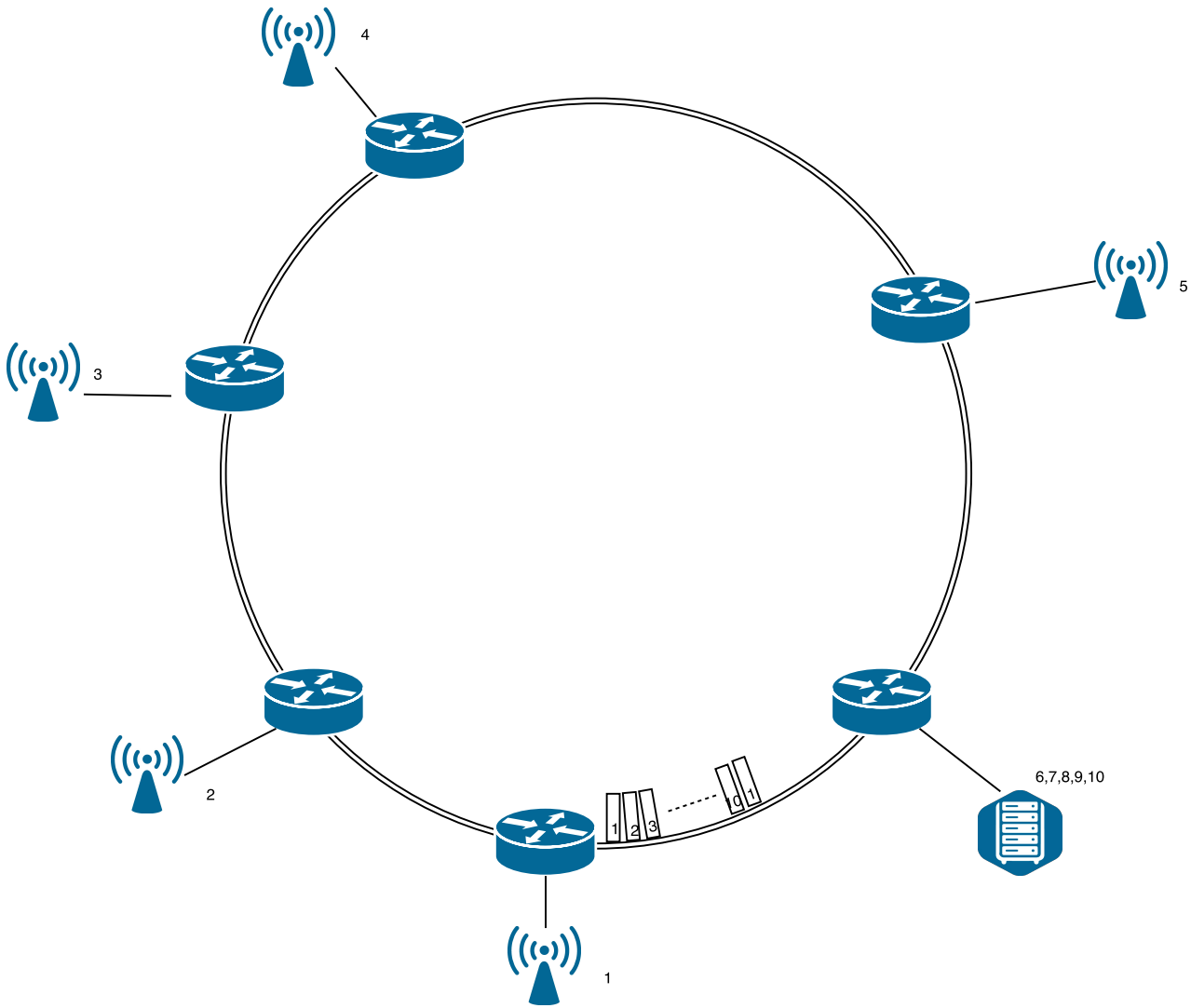
Average Load = 0.58

Priority with high load

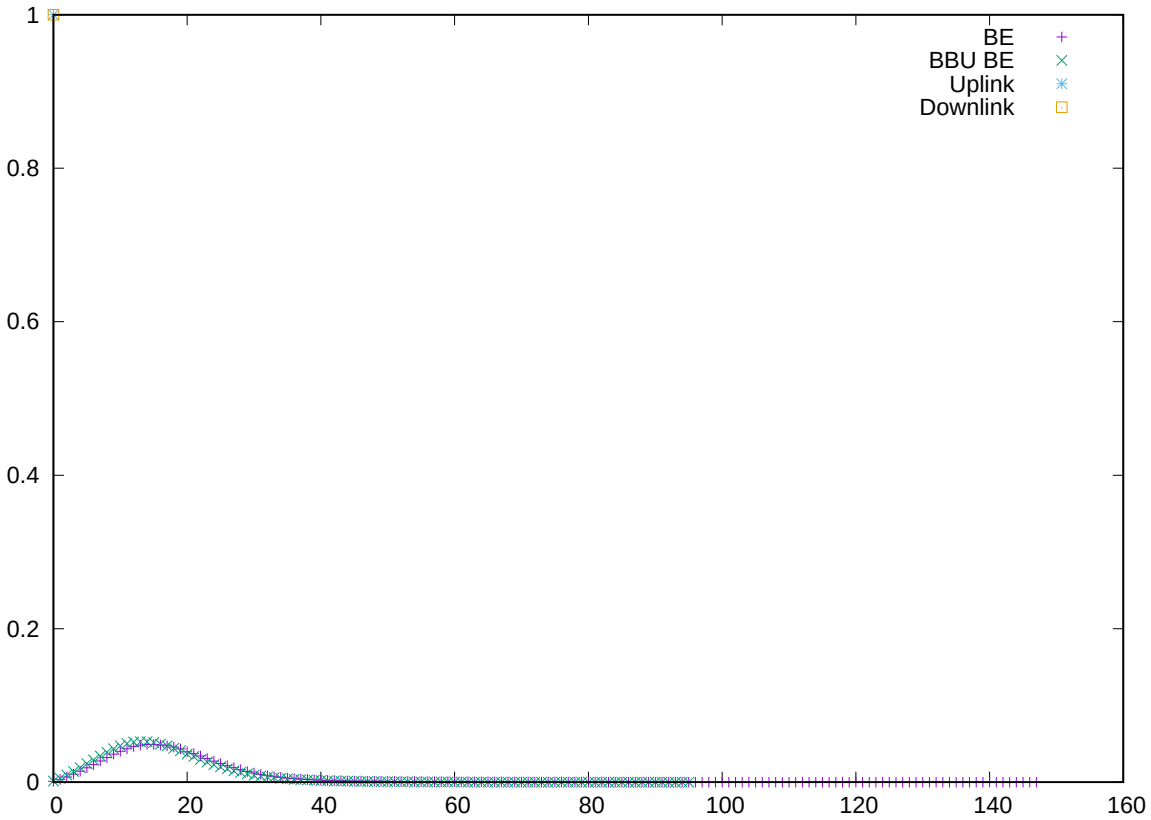


- Average load = 0.85
- More BE than without priority

Deterministic policy

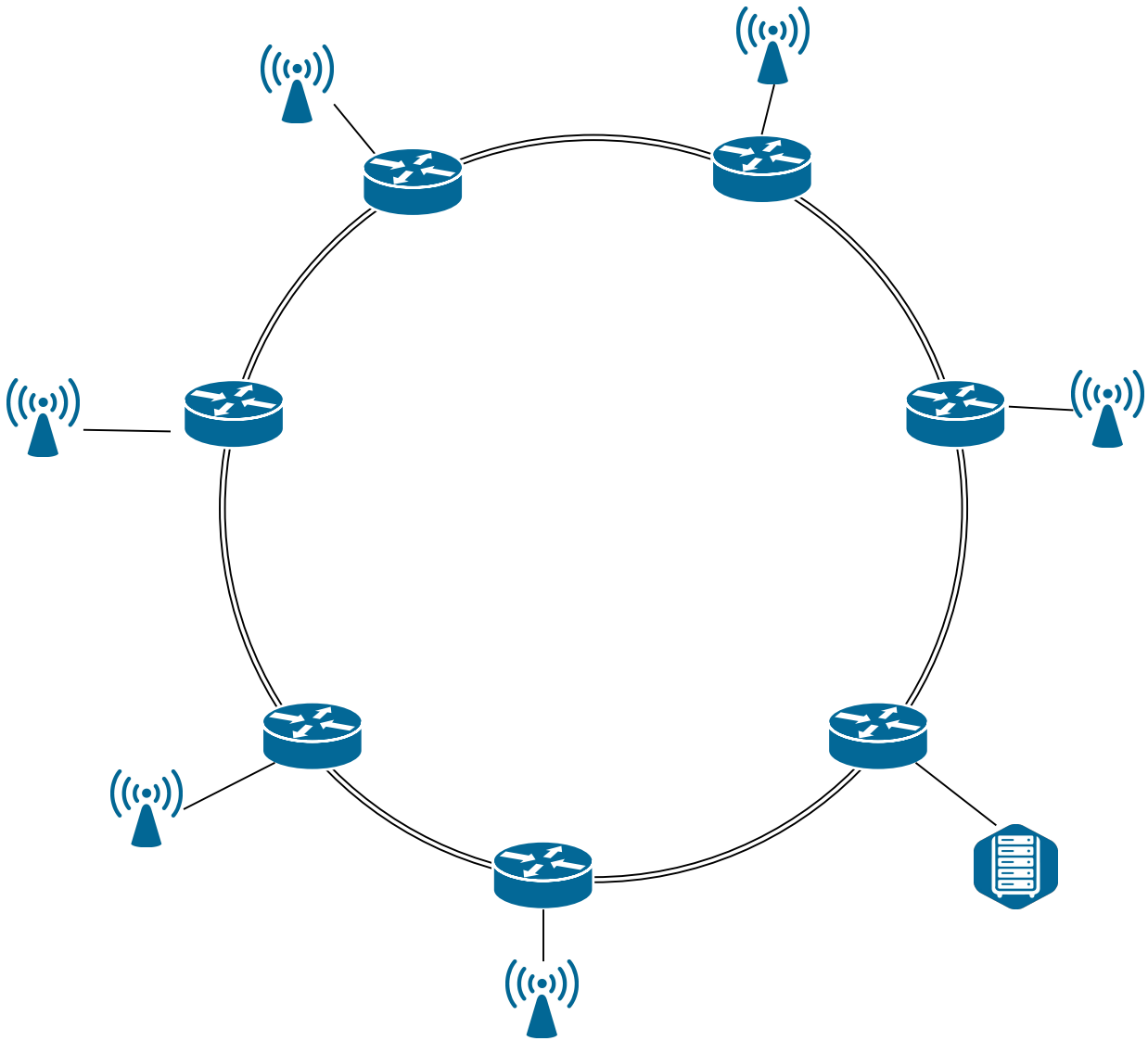


Rerservation

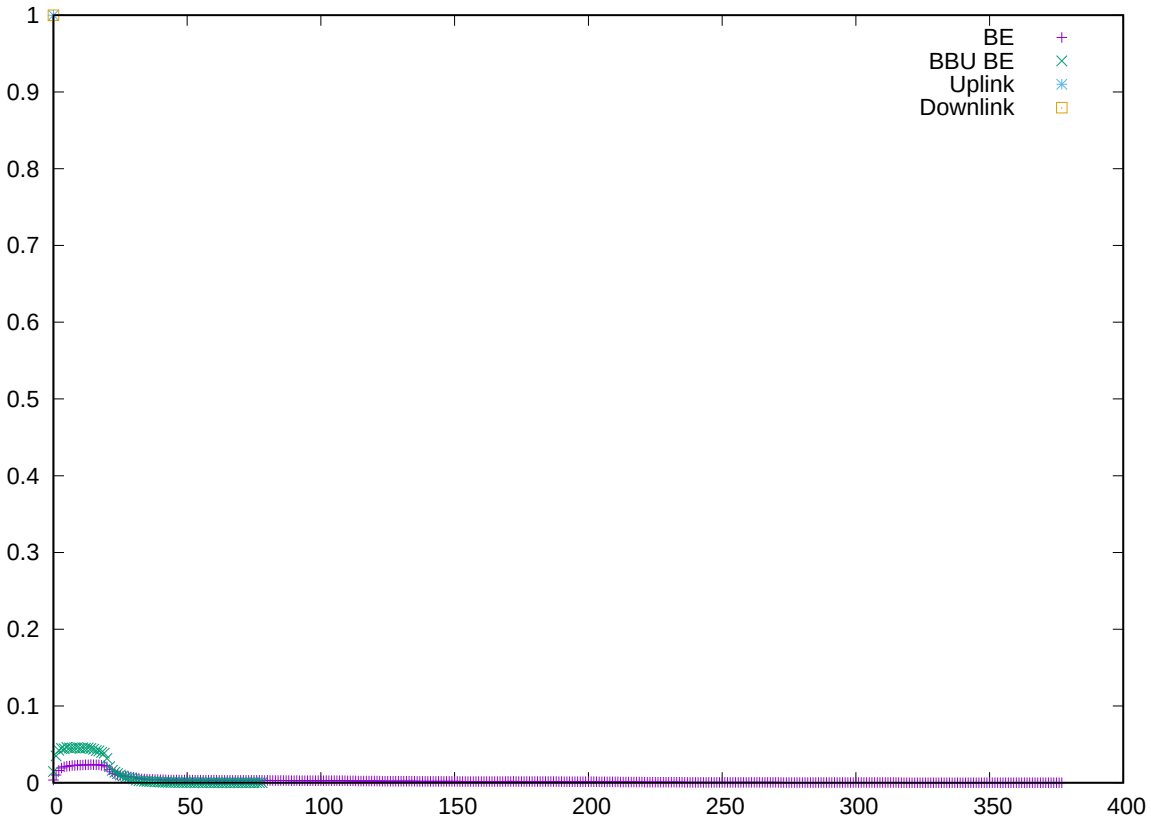


Loaded network

An harder topology



Split frequencies



6 antennas/ less BE/ load increased

Future work

1. Infocom review
2. Ngreen results