

Relays in CDMA2000

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Overview

Overview – Introduction – Relays - Scheduling - Simulation Results – Conclusion

- Introduction and Motivation
- Relays
- Scheduling
 - Scheduling Algorithms
 - Scheduling with Relays
- Simulation Results
- Conclusion

Introduction and Motivation

Overview – **Introduction** – Relays - Scheduling - Simulation Results – Conclusion

- Need for enhanced Cell Coverage and Capacity Enhancement
 - ◆ Use of Relays

- Scheduling helps improve the overall performance of a system
 - ◆ Consideration of a direct link b/w BS and MS.

- Our Objective
 - ◆ Effective scheduling algorithm that selects either a direct link or a two-hop link.
 - ◆ Evaluate the performance of scheduler with relays.

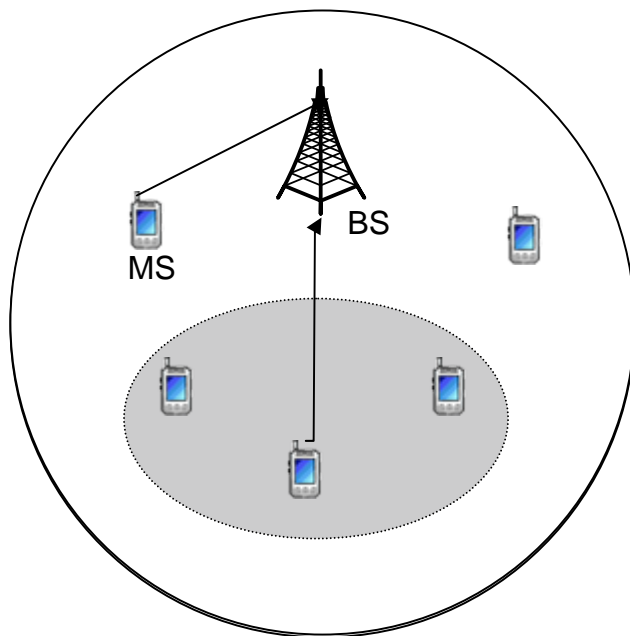
Relays

Current Problem in Cellular Networks:

- Poor Coverage due to lack of Line of Sight or fading.

Solution:

- Fixed Relays with good link to the BS to relay traffic to those with poor link.

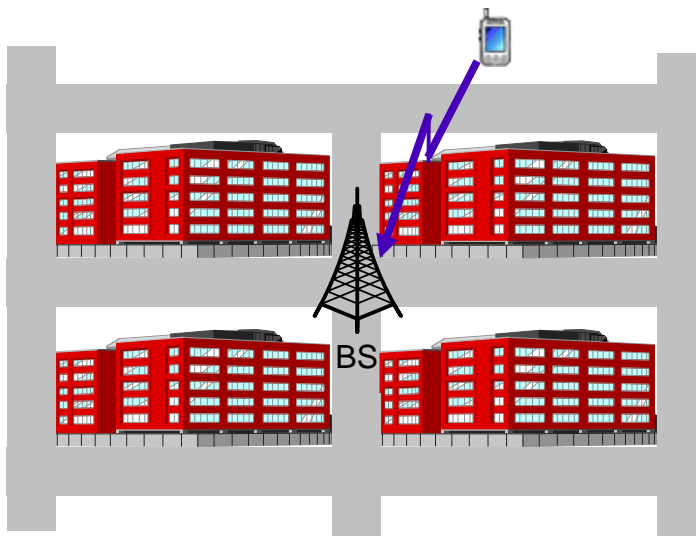


Without Relays:

- Essential MS transmit with high power.
- Causes a lot of interference.
- Reduced Cell Capacity..

Relays

Overview – Introduction – **Relays** - Scheduling - Simulation Results - Conclusion

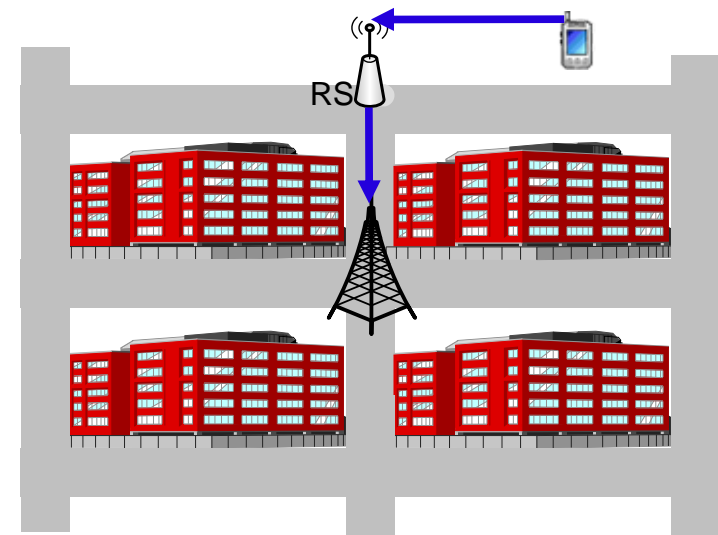


Without Relaying:

Non-Line of Sight transmission
Longer Distance b/w MS and BS
Higher Transmit Power

With Relaying:

Enhanced Cell Coverage
Line of Sight transmission in general
Shorter Distance b/w MS and RS
Lower Transmit Power



Scheduling Algorithms

Overview – Introduction – Relays - **Scheduling** – Simulation Results - Conclusion

Maximum C/I:

Principle: Schedule user with the best Channel Quality (pilot SINR) at time t .

$$j = \text{Max}_i\{R_i(t)\}$$

- $R_i(t)$ is the instantaneous rate of user i and time t .
- Ensures high cell throughput.
- Users experiencing bad channel quality, may not be scheduled for a long time.

Round Robin:

Principle: Schedule users in cyclic order, regardless of their data rates.

- Fair distribution of resources to users.
- Does not take into consideration channel conditions.

Scheduling Algorithms

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Proportional Fair (PF):

The PF scheduler selects at each time instant the node with maximum,

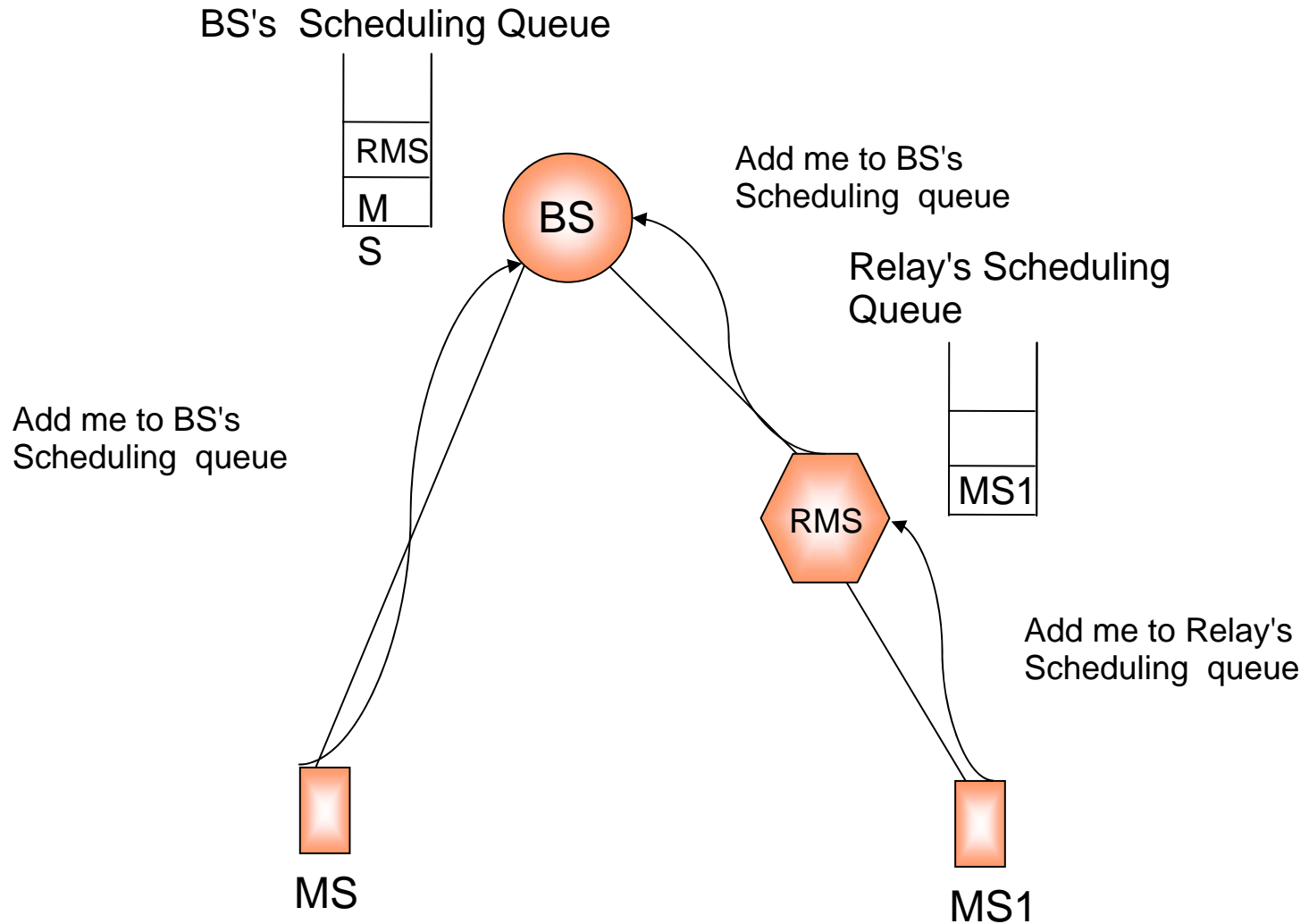
$$\frac{R_i(t)}{A_i(t)}$$

where, $R_i(t)$ is the instantaneous data rate of user i at time t and $A_i(t)$ is the average rate of user i .

- › It provides a trade-off between cell throughput and fairness.
- › Users near to the BS are not necessarily at an advantage.

Scheduling with Relays

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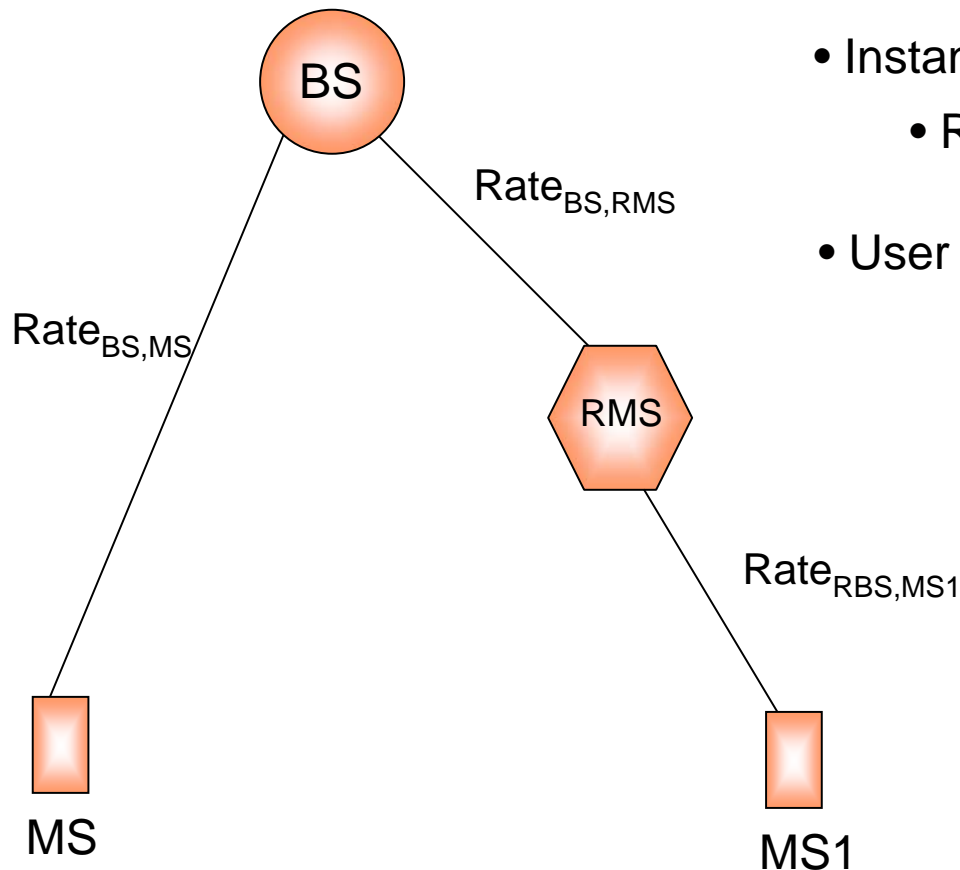


Scheduling with Relays

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Which user to schedule?

- Instantaneous data rate for entire link
 - $\text{Rate}_{\text{BS,MS1}} = \min(\text{Rate}_{\text{BS,RMS}}, \text{Rate}_{\text{RBS,MS1}})$
- User $j = \max(\text{Rate}_{\text{BS,MS}}, \text{Rate}_{\text{BS,MS1}})$



Scheduling with Relays

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At Relays:

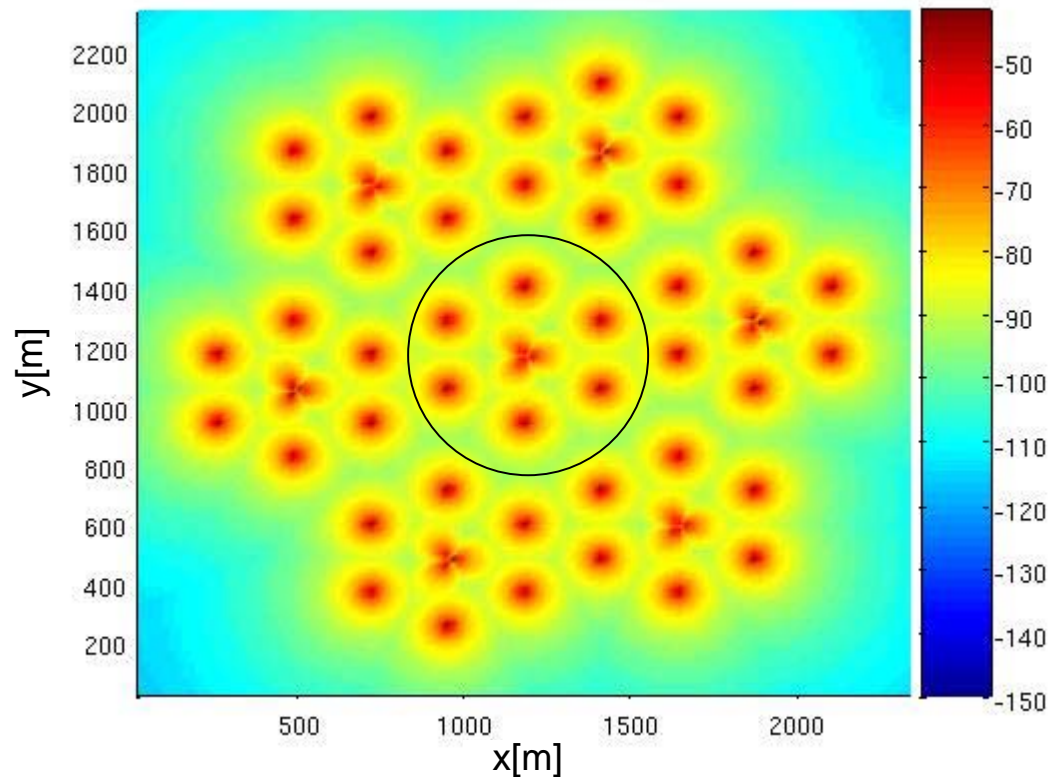
- Collect data rates achievable for each MS from the Relay.
- Report the data rates to the BS.
- If scheduled, receive data from BS and transmit to MS.

At Base Station:

- Receive the data rate vector from Relays.
- For each Relay, collect the data rates achievable from BS.
- Calculate the data rate for the entire link.
- Select the best MS.
- Transmit data to the scheduled user.

Simulation Scenario

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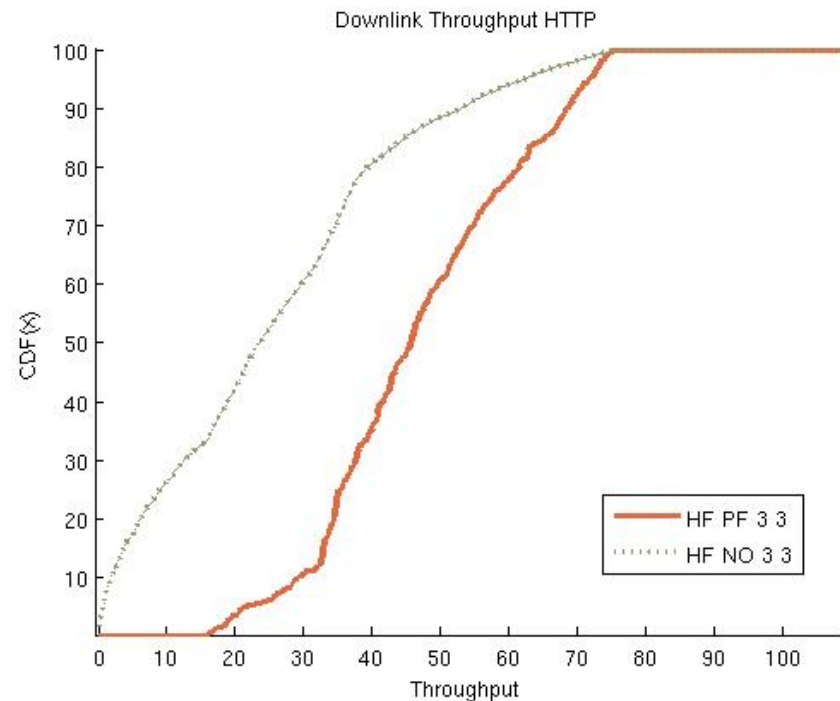
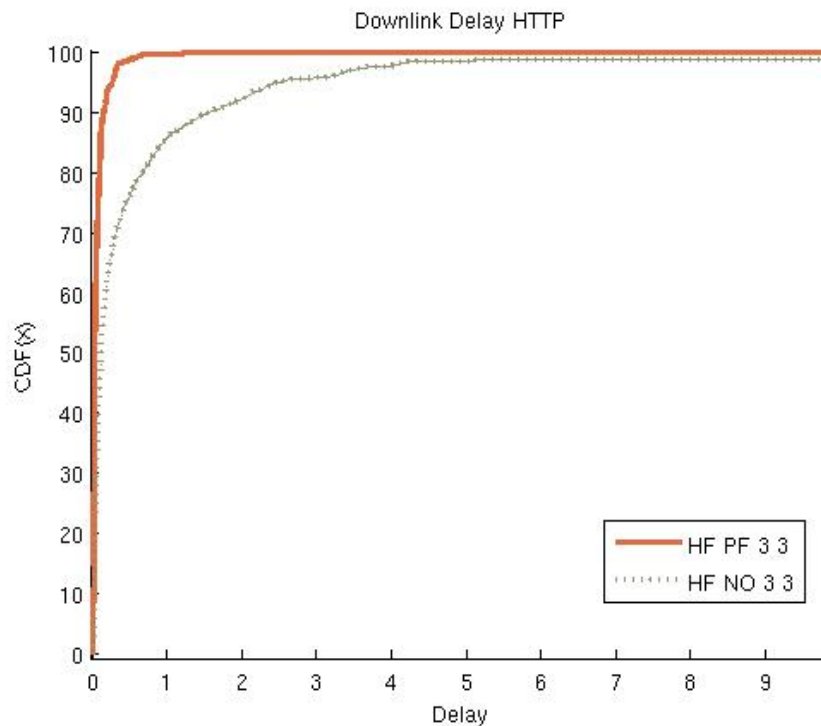


- 1 Base Station
- 6 Relays
- Scheduling: F-SCH
- Slots: 16
- Simulation Time: 250sec
- FTP Services: 4 codes
- HTTP Services: 16 codes

Simulation Results

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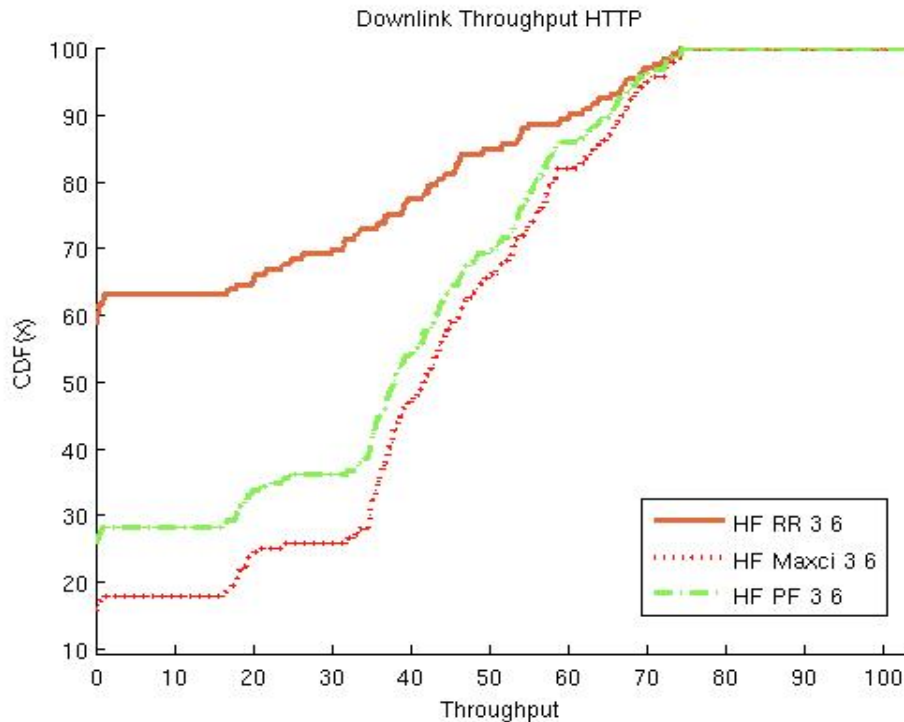
Comparison of Scheduling with No Scheduling



- › FTP + HTTP Services
- › 3 FTP and 3 HTTP users per Sector
- › Scheduling helps improve Throughput and Delay considerably

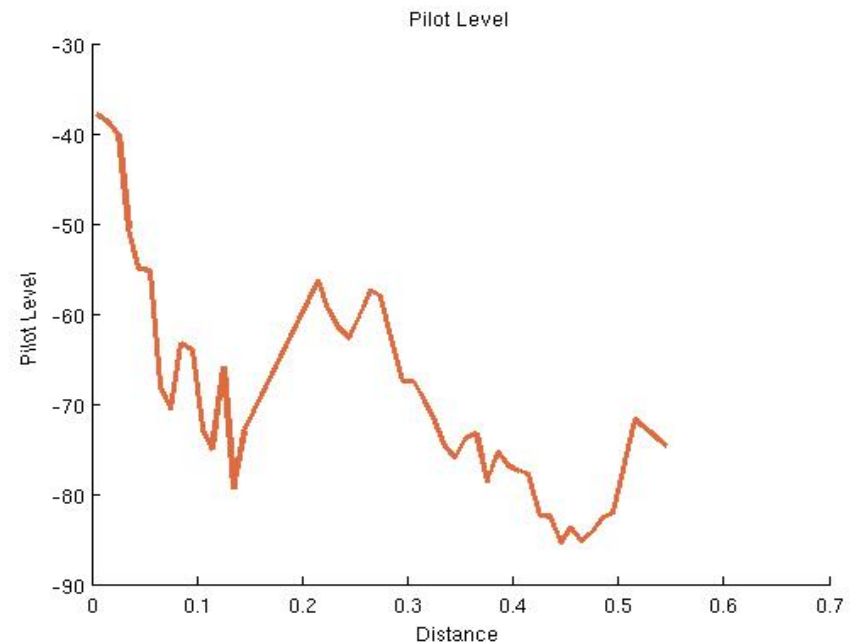
Simulation Results

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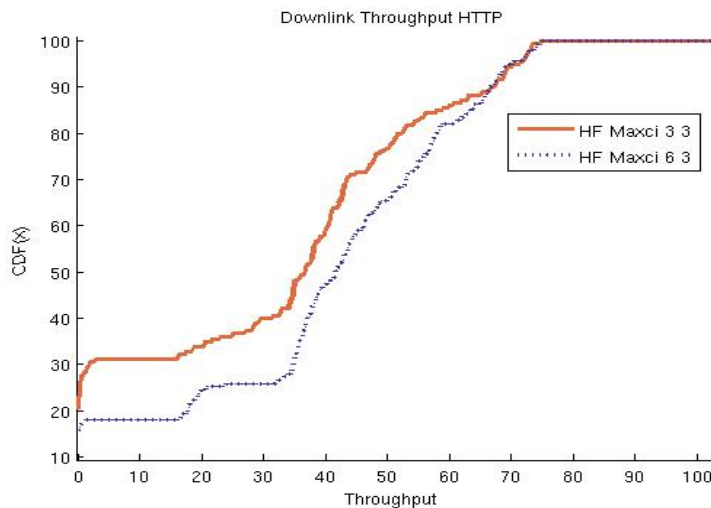
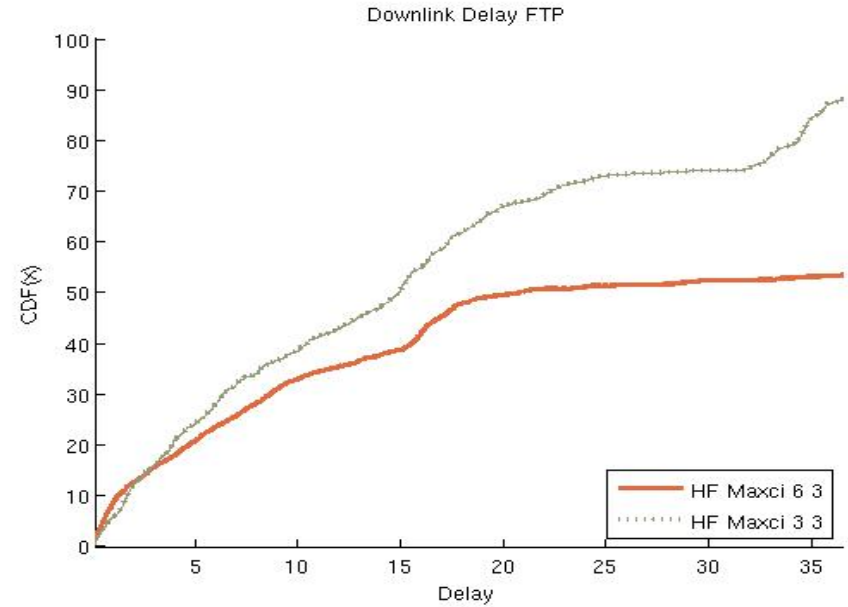
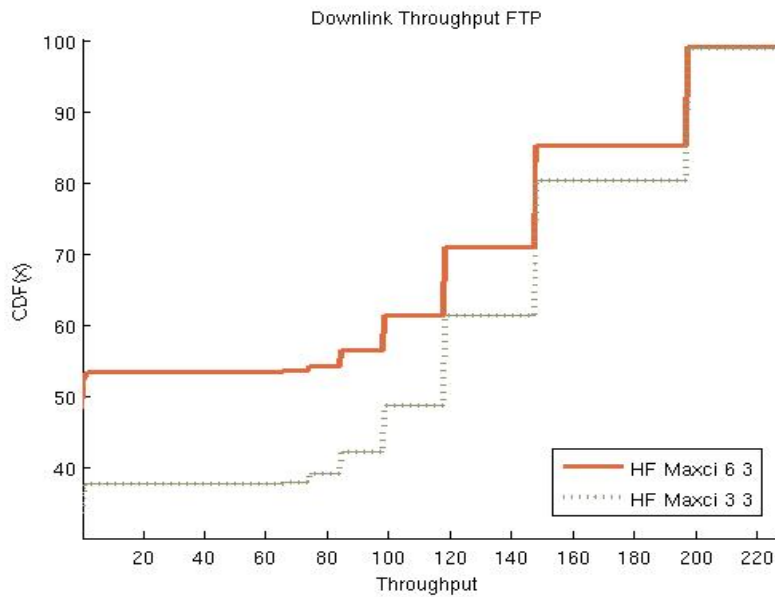
Max C/I has performs the best.

- Round Robin has the least throughput
- PF performs similar to Max C/I because of the Relays



Simulation Results

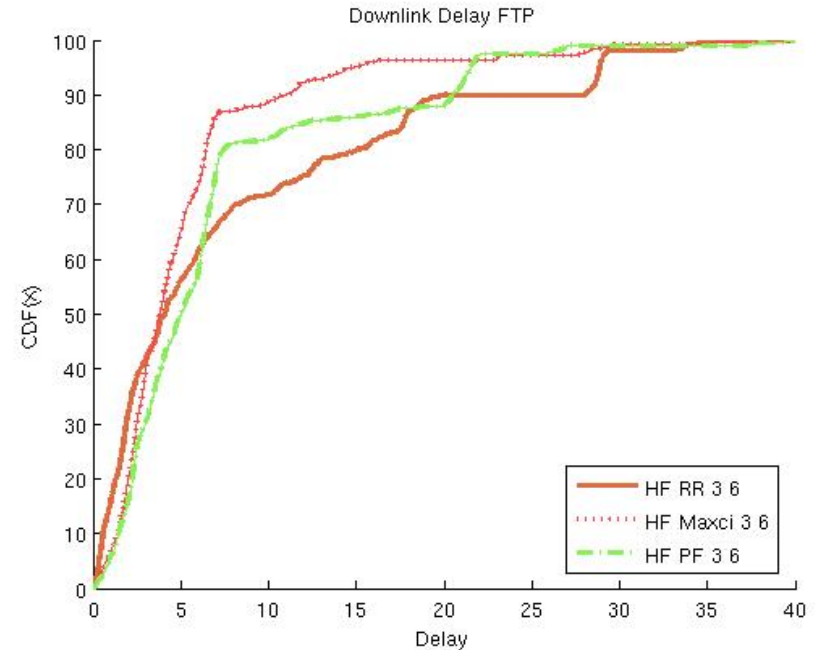
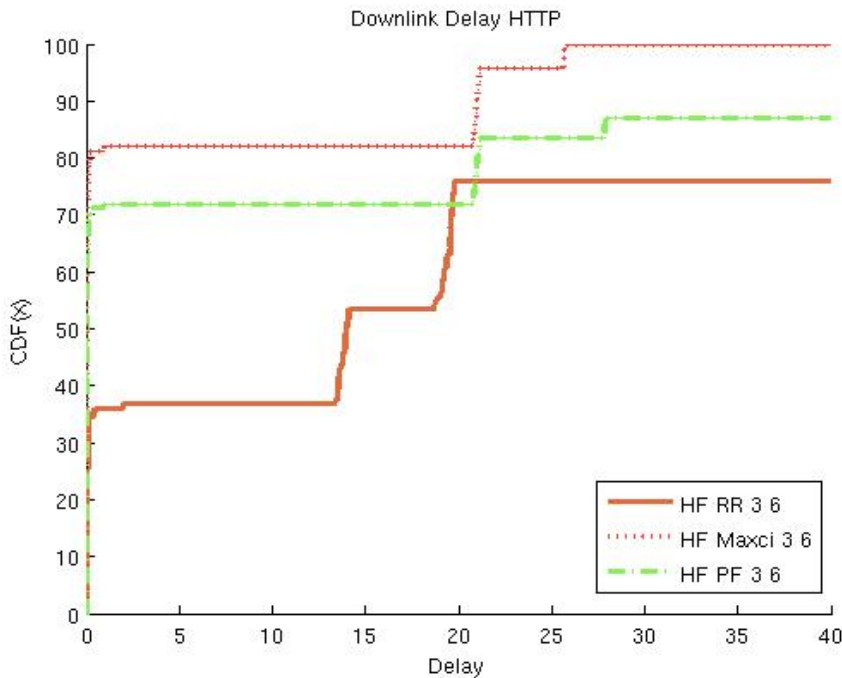
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- Limited Resources for FTP services
- HTTP users performance increases.

Simulation Results

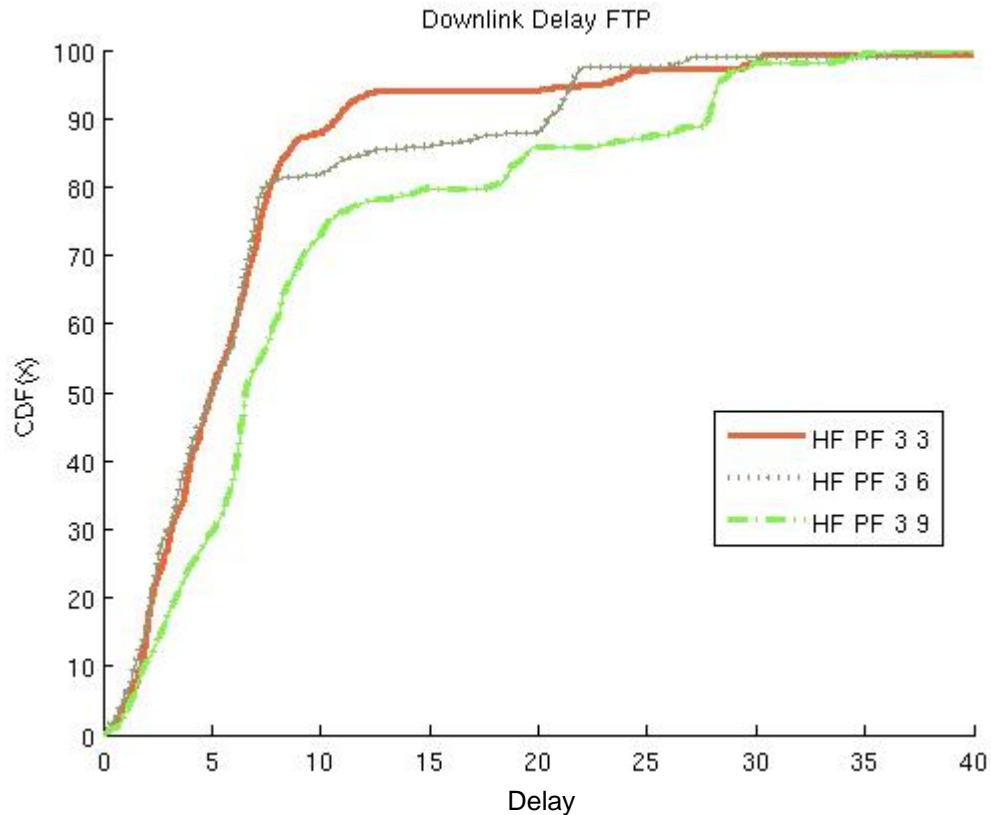
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- Max C/I has the least Delay.
- Delay experienced by FTP users is greater than HTTP users.
- Lesser number of retransmissions for RR users.

Simulation Results

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➤ As load increases, Delay increases

Conclusion

- Scheduling improves system performance.
- Max C/I provides the highest throughput per sector.
- Relays enhances the performance of PF scheduler.
- Delays experienced by HTTP users is less compared to FTP users for higher FTP load.

Thank you for your attention !