

# Video Multicast over WLAN

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March 1, 2004

Soumya Das

Advisor: Dr. Dipankar Raychaudhuri

# Outline:

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- ❑ Problem Statement
- ❑ Our Approach
- ❑ OPNET Simulation Model
- ❑ Simulation Results
- ❑ Work in progress and Future Work

# Challenges for video streaming over WLAN:

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Wireless video transmission is a challenging task because of the following factors:

- limited bandwidth
- high bit errors compared to wired links
- time-varying error-prone environment
- receiver heterogeneity

# The problem at hand:

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How MAC multicast and error control techniques can improve service quality and/or capacity of a video streaming application over WLAN?

# How can we do better:

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- ❑ FEC – sender transmits additional redundant packets that can be used at the receivers to reconstruct lost packets.
- ❑ ARQ - sender retransmits packets that have not been received correctly at the receivers.
- ❑ Hybrid ARQ

# Ways to deal with receiver heterogeneity:

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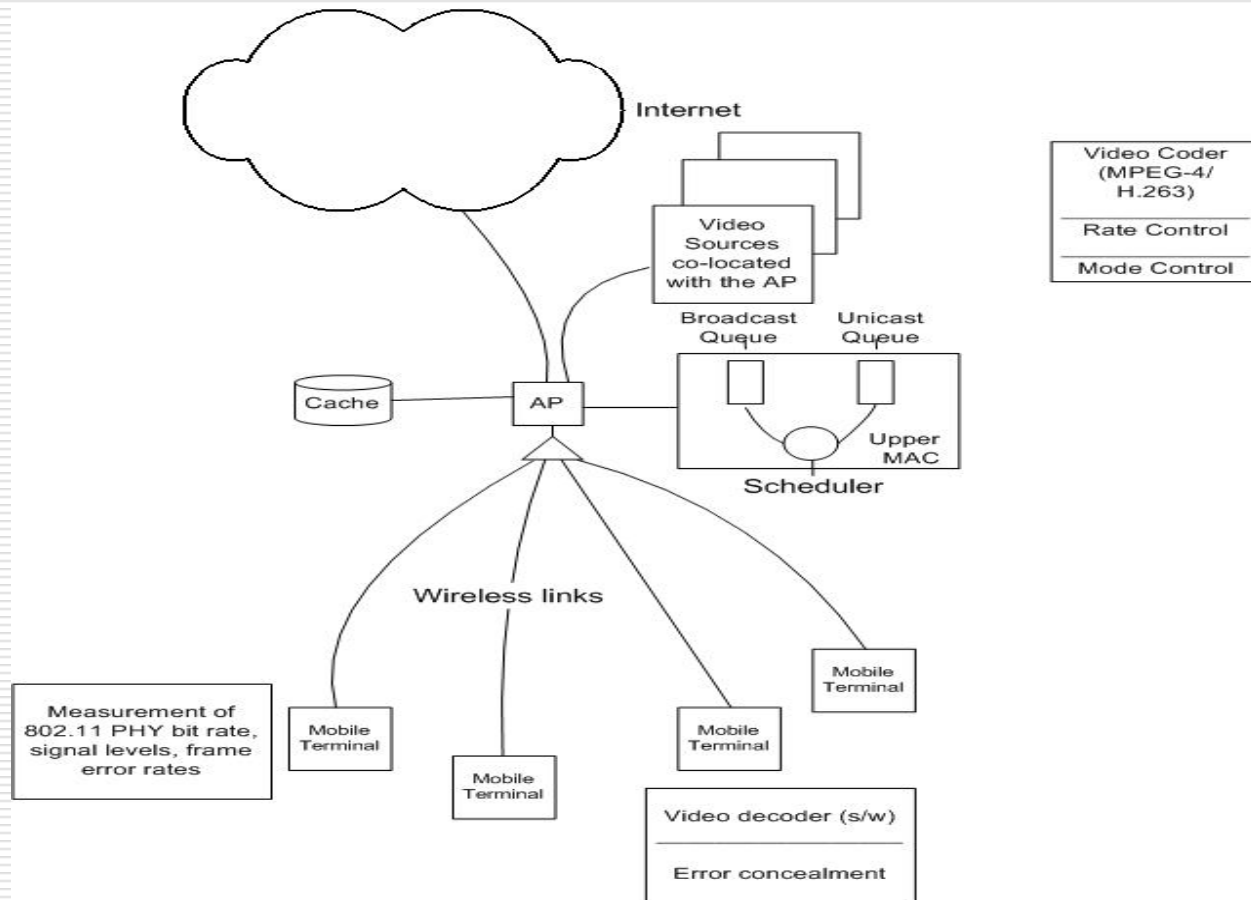
- ❑ Video server simulcasts the content at different rates and clients subscribe to multicast groups according to their bandwidth estimations.
- ❑ Layered coding: This is the basis of Receiver Driven Layered Multicast scheme.

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# Network Architecture:





# System Model:

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- ❑ Multi-resolution streams of video are available from the server (co-located with AP). The bit rates are 1.5 Mbps, 768 kbps, 384 kbps and 128 kbps.
- ❑ Clients subscribe to multicast groups based on their estimates/measurements of channel conditions.

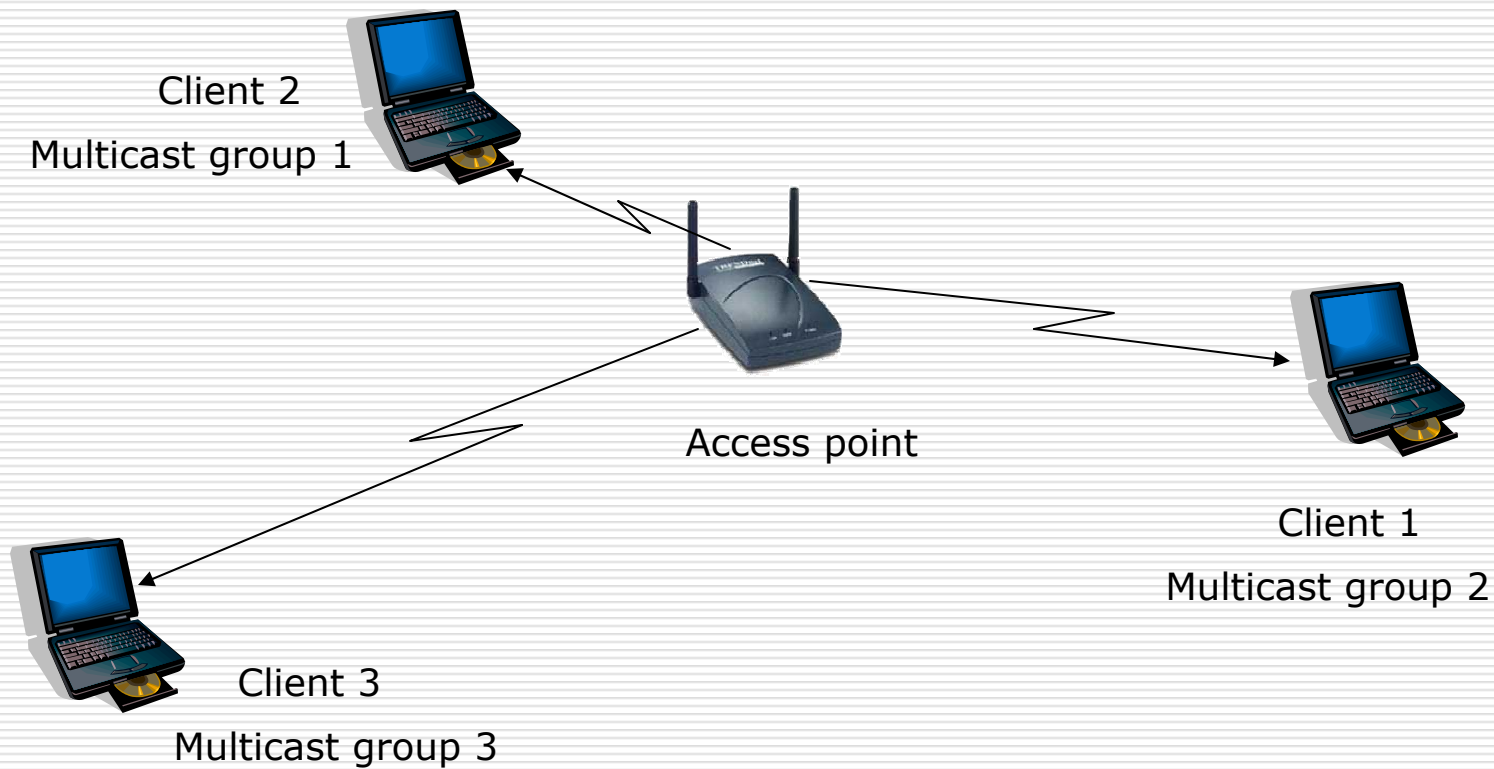
# Multicast groups and video bit rates:

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Video bit rate	Multicast group	Transmission data rate
1.5 Mbps	1	11 Mbps
768 kbps	2	5.5 Mbps
384 kbps	3	2 Mbps
128 kbps	4	1 Mbps

# How do clients decide multicast groups?

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# Problem revisited:

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The problem has been formulated as a general feedback control system with the following observation and control variables:

- BER
- SNR
- MAC multicast groupings
- Percentage/type of FEC
- Feedback rate by clients

# Our Objective - Maximizing Overall System Satisfaction:

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Satisfaction Index  $Q = f(R, SNR, BER)$

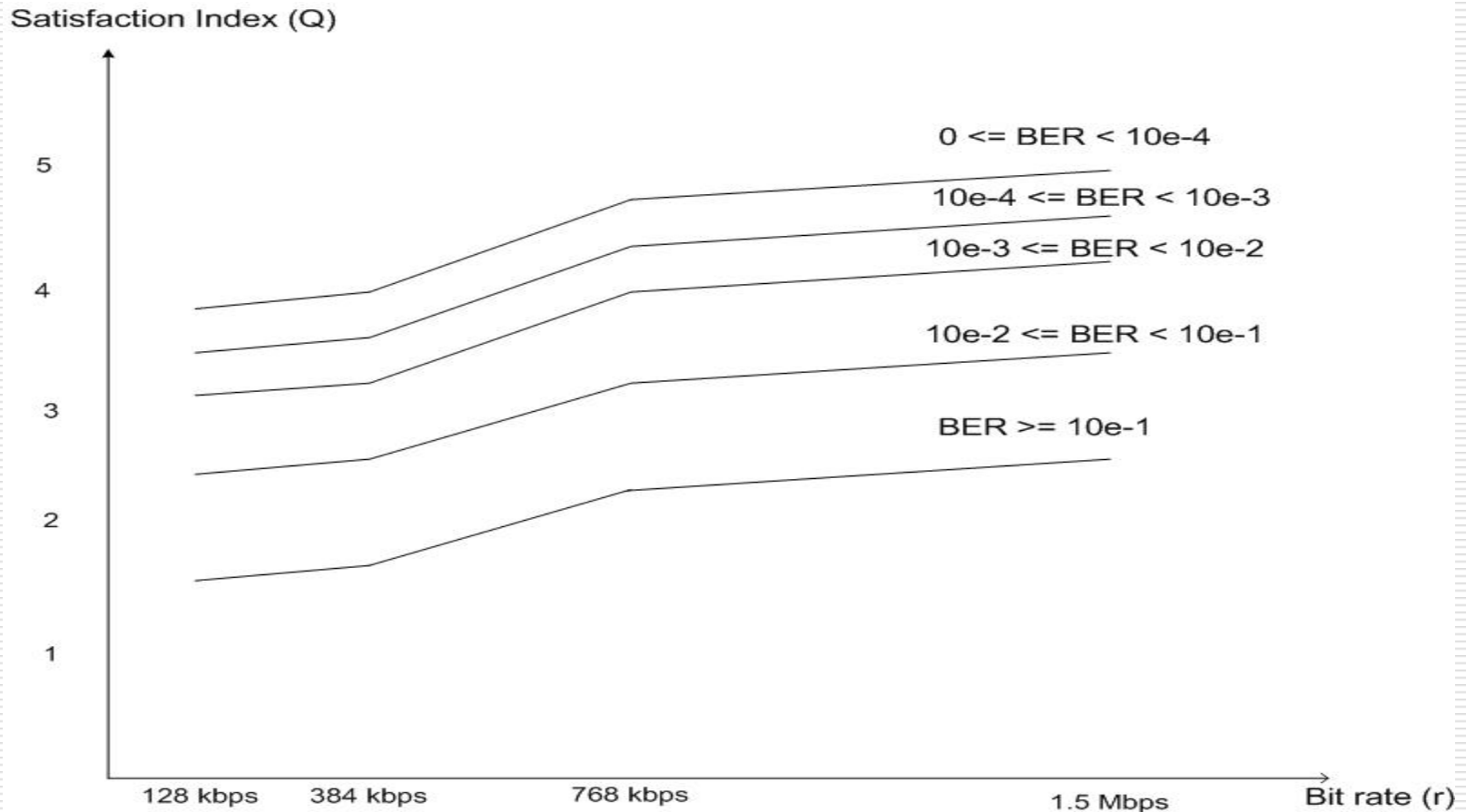
The algorithm under consideration aims to maximize the overall system satisfaction

$$Q_{system} = \sum Q_i, i = 1, 2 .. N$$

subject to the condition that the individual satisfaction for all the clients is greater than a threshold

satisfaction i.e.  $Q_i \geq Q_{threshold}, i = 1, 2 .. N$  by selecting the appropriate multicast group and adjusting the FEC as a function of the observed PHY bit rate, BER and SNR for each wireless client.

# Piecewise linear S-Curve of Satisfaction Index:

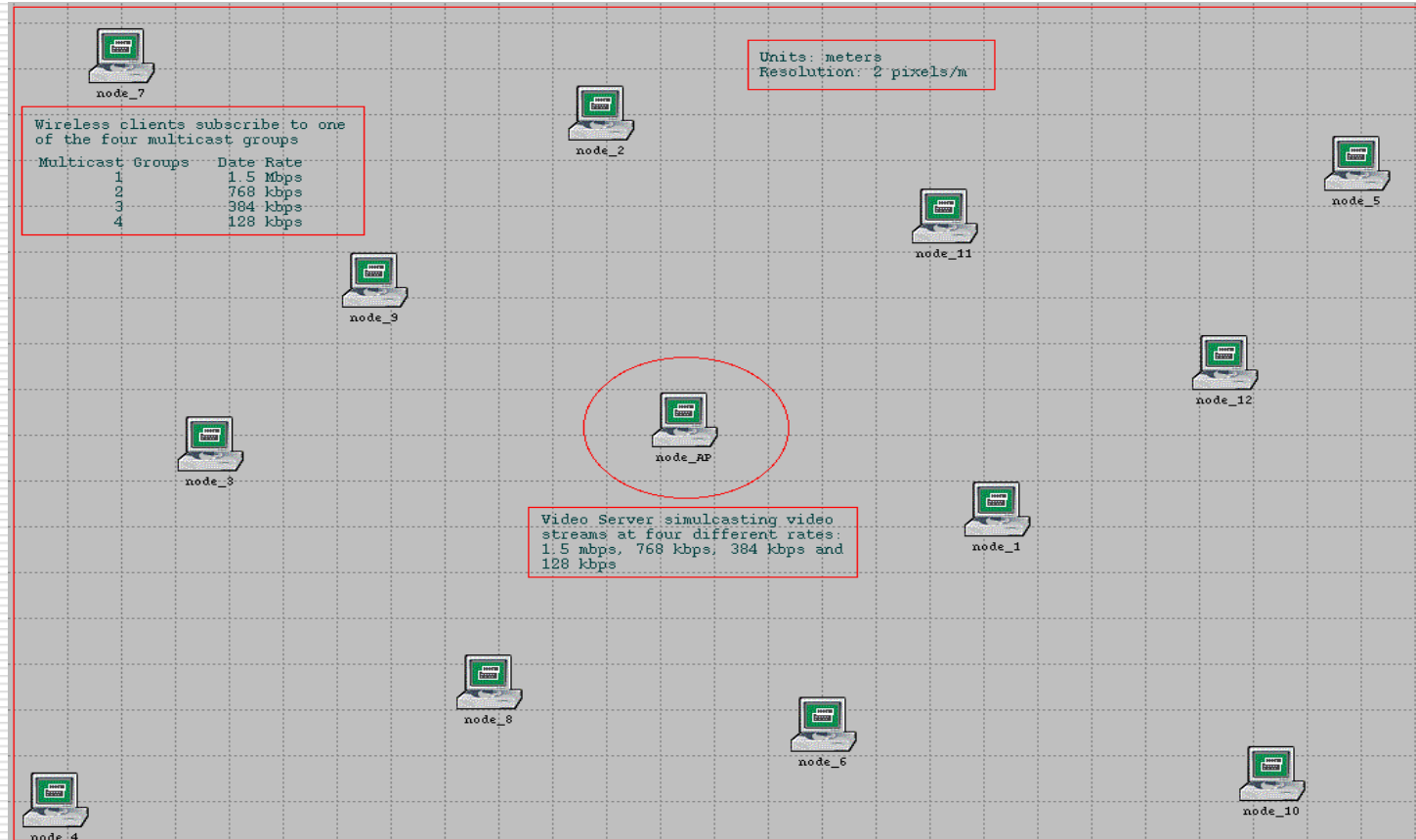


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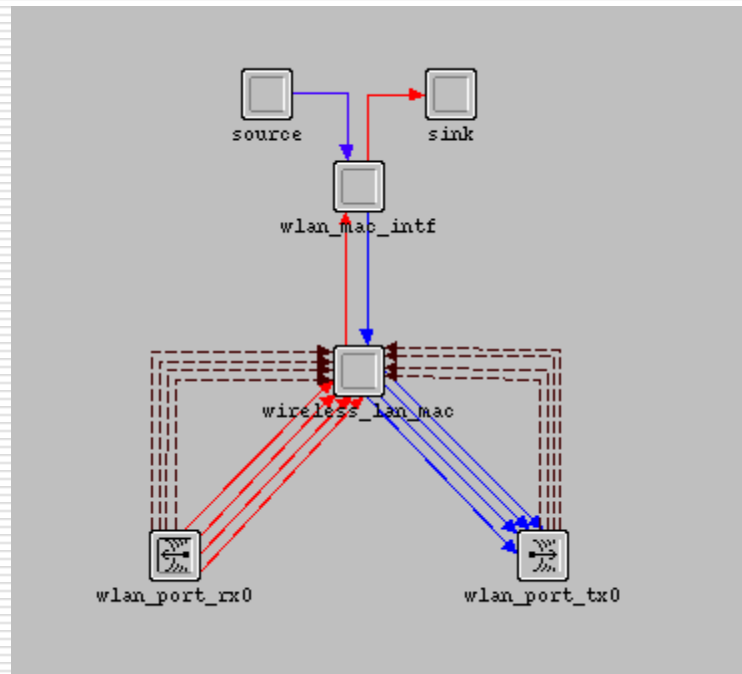
# Experimental Setup in OPNET:





# The wlan node model in OPNET:

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# Modifications done in OPNET Model:

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- ❑ Modified Source Process Model can generate multiple traffic streams for multiple destinations.
- ❑ MAC multicast has been implemented in the MAC process model.
- ❑ A number of modifications made in the OPNET radio pipeline stages.

# Traffic Source:

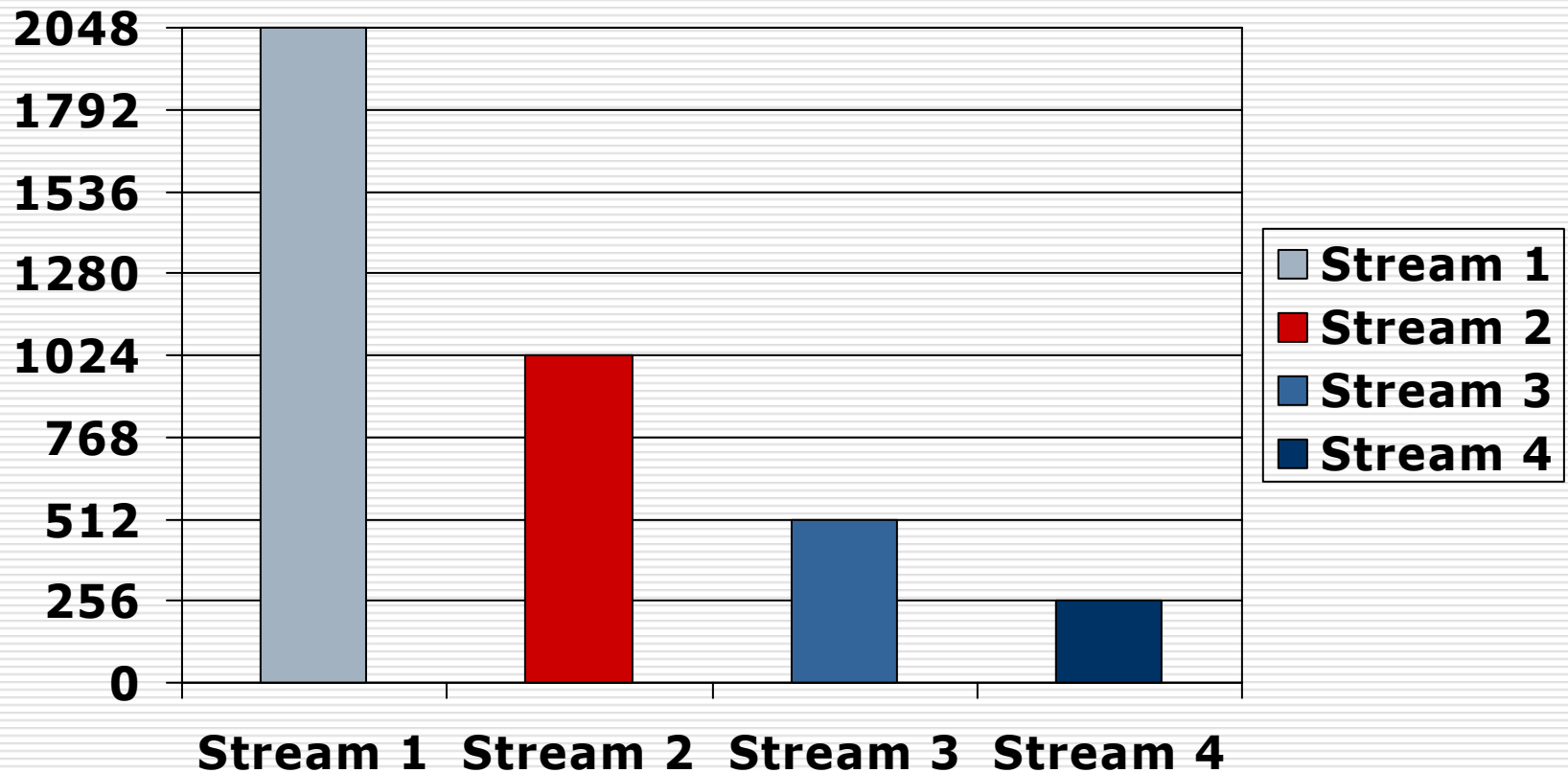
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## ON/OFF Source

- ❑ Generates 30 frames/sec for each of the four streams i.e. every 33 msec generates a packet for each stream according to the distributions specified.

# Mean packet sizes in bytes for different streams:

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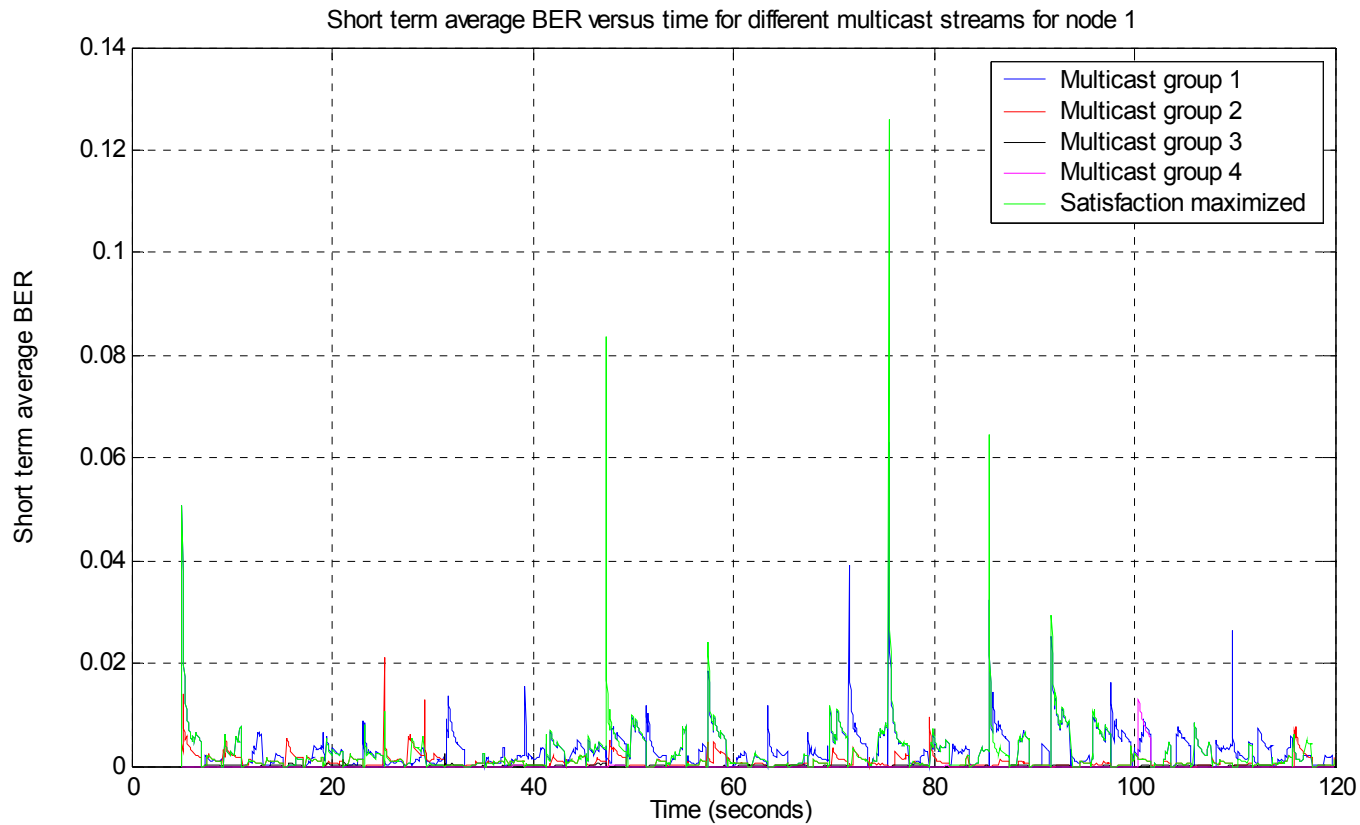


# Outline:

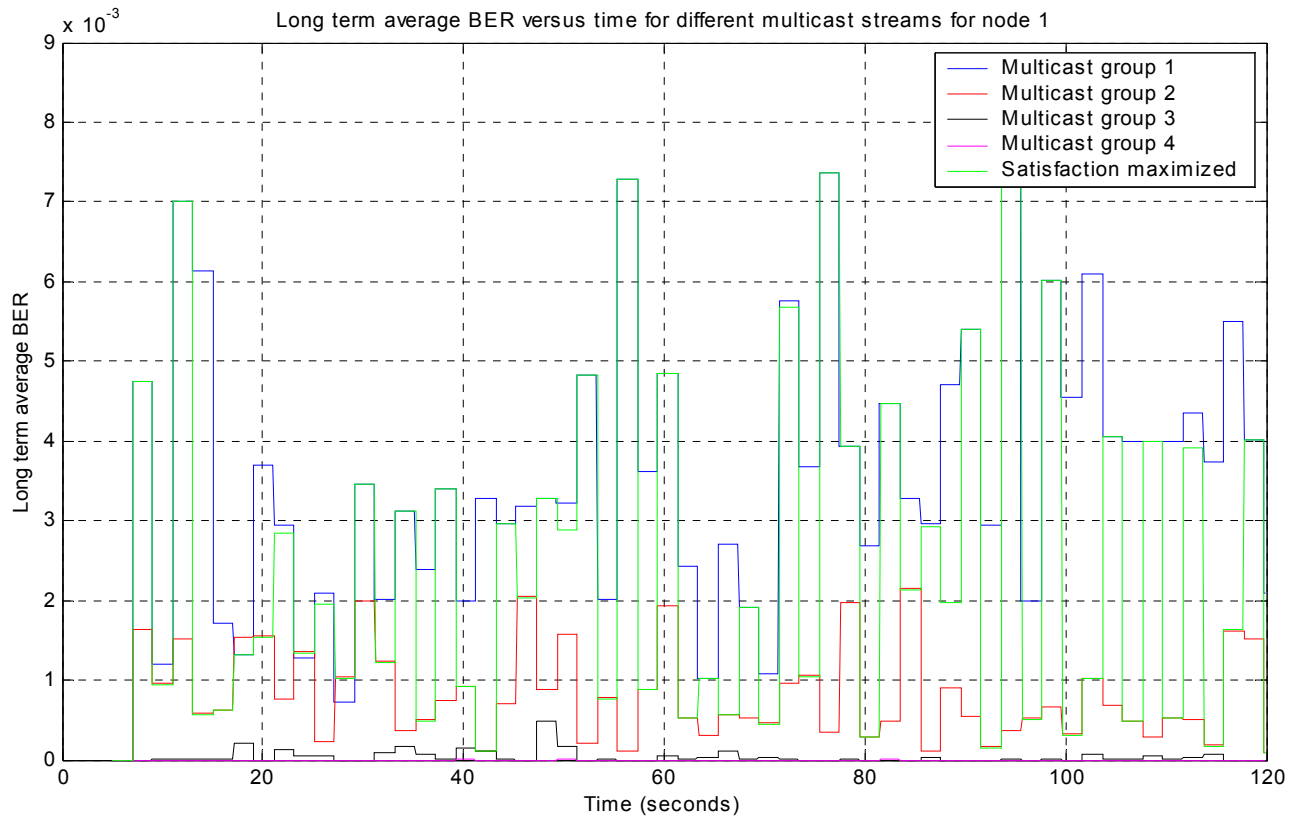
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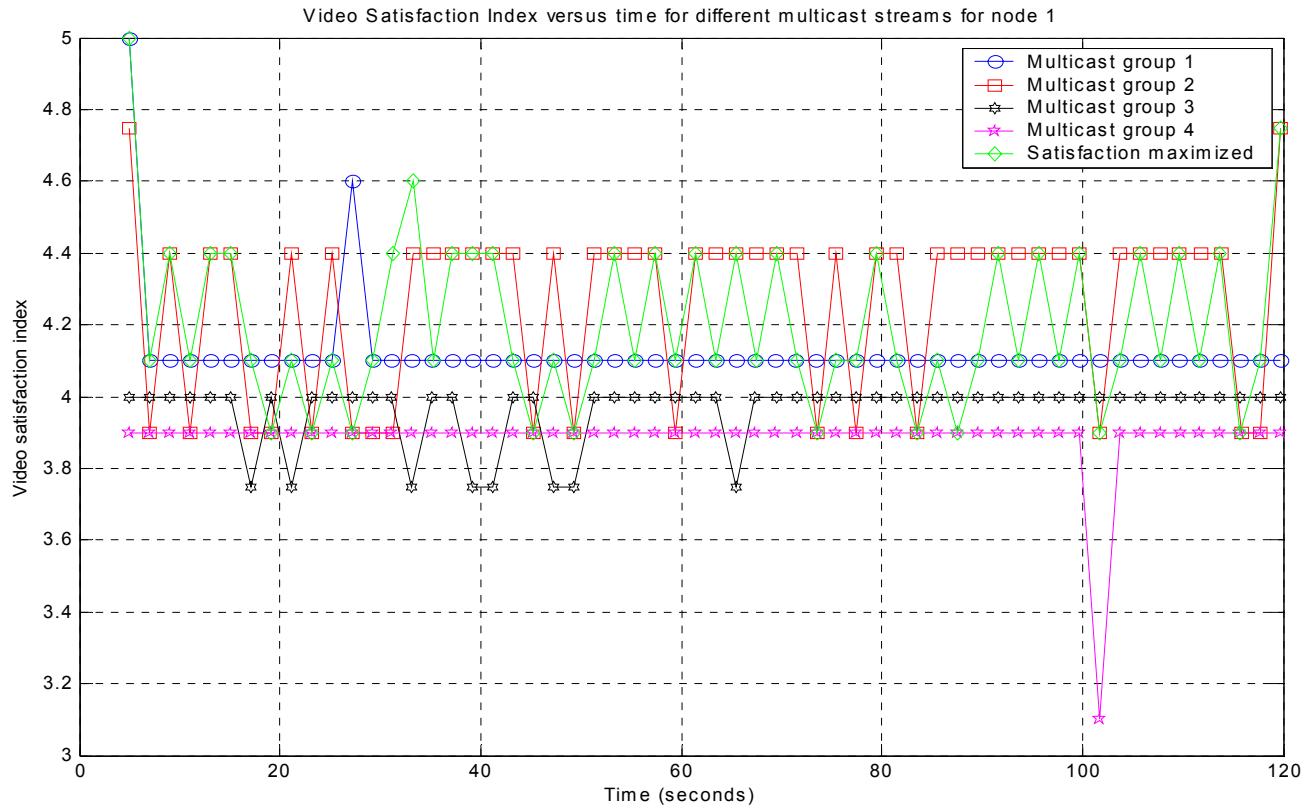
# Short term average BER for client 1 ( $d \sim 100$ m.)



# Long term average BER for client 1

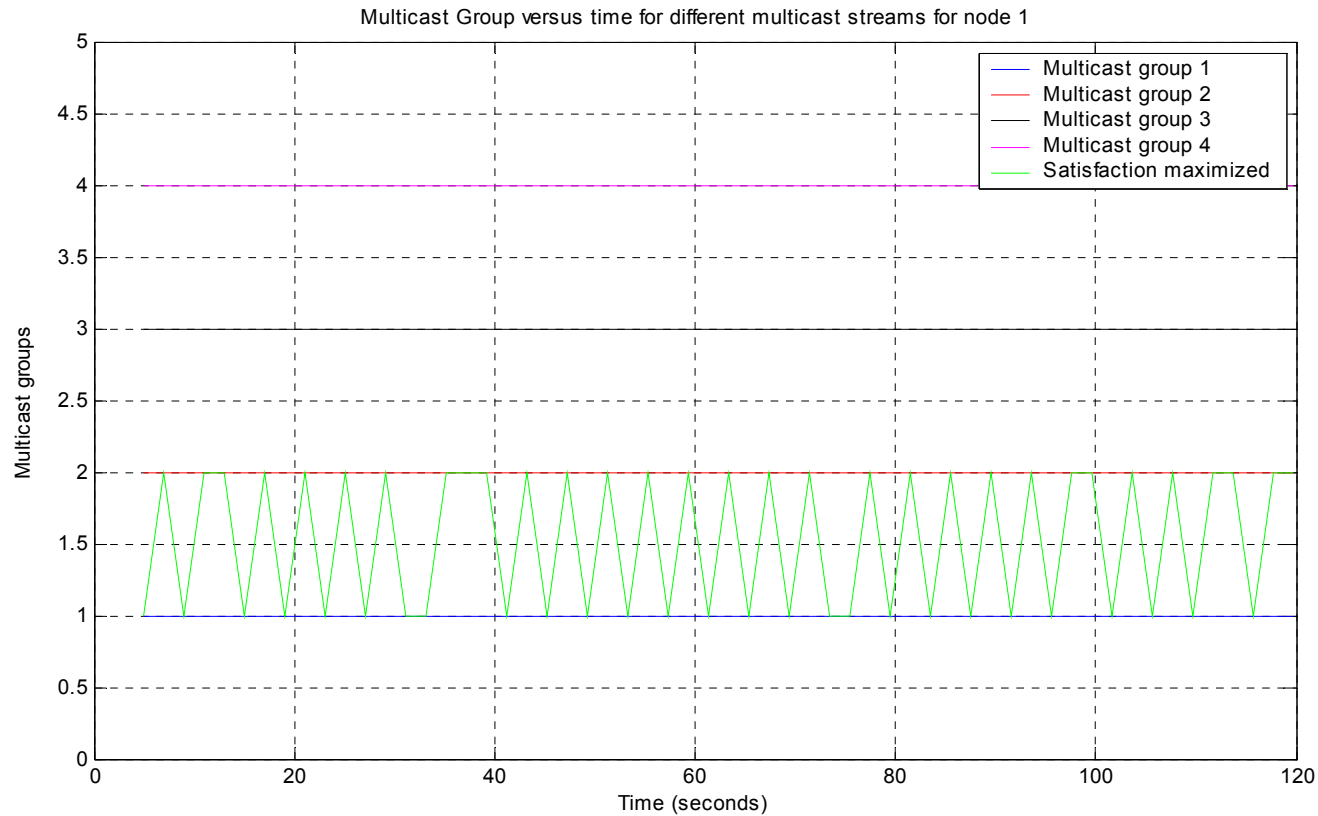


# Satisfaction Index for client 1

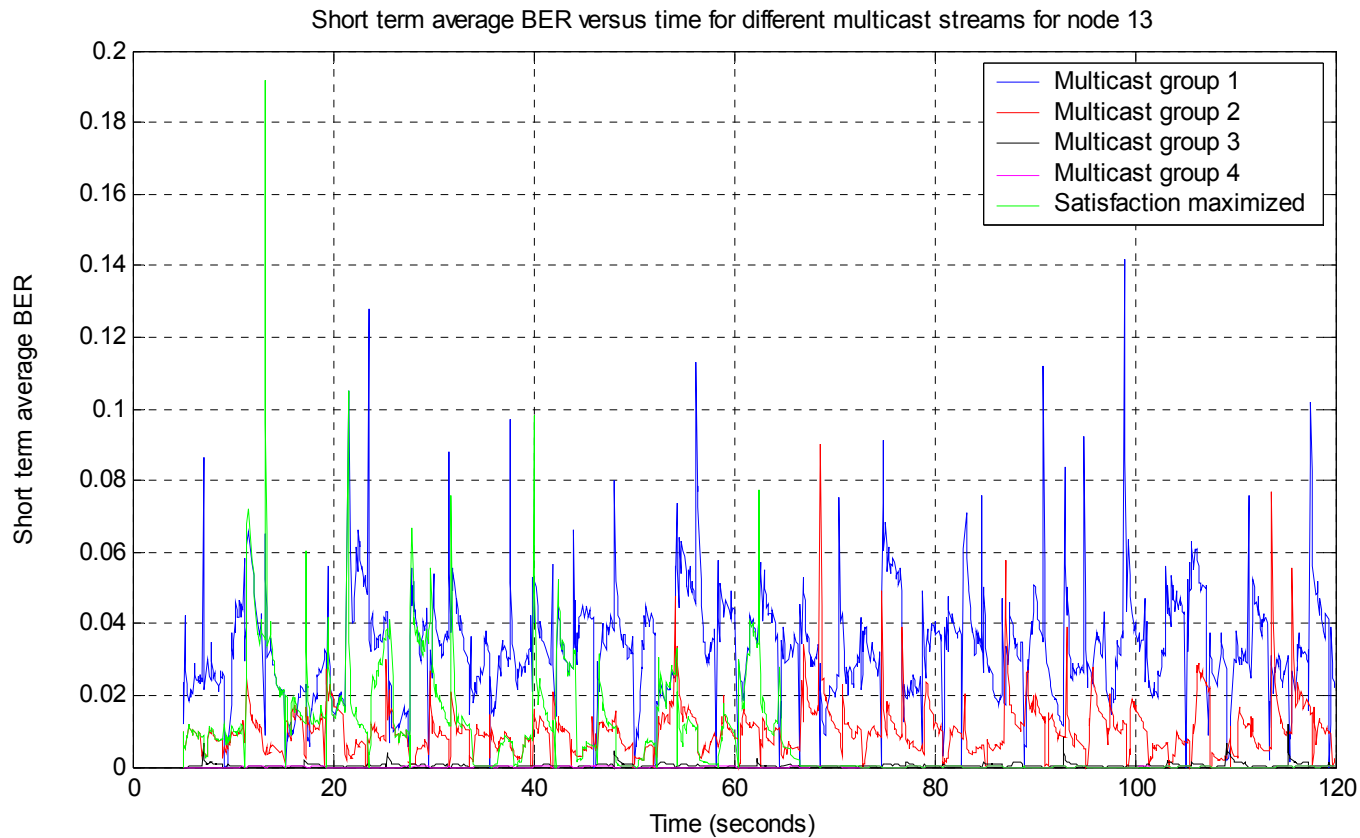




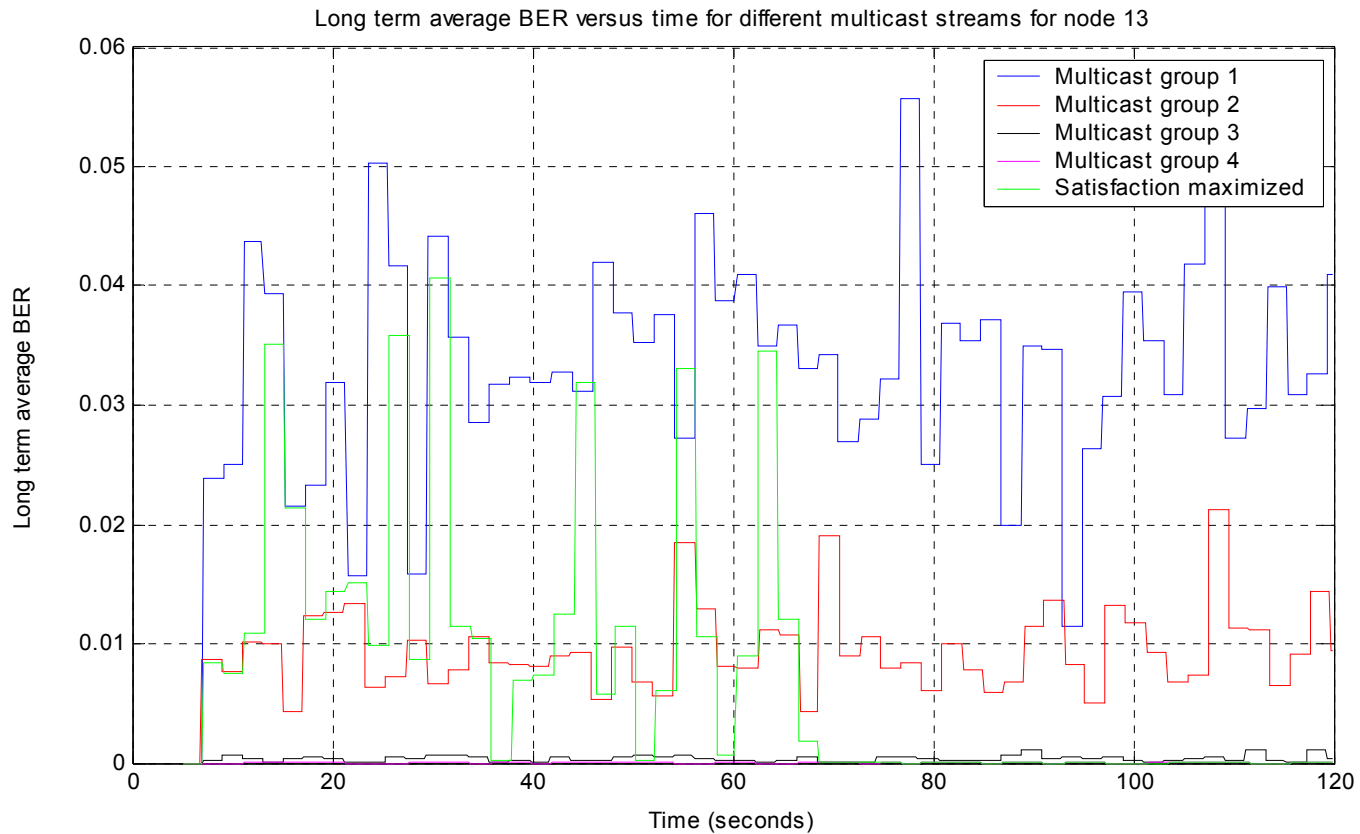
# Multicast groupings for client 1



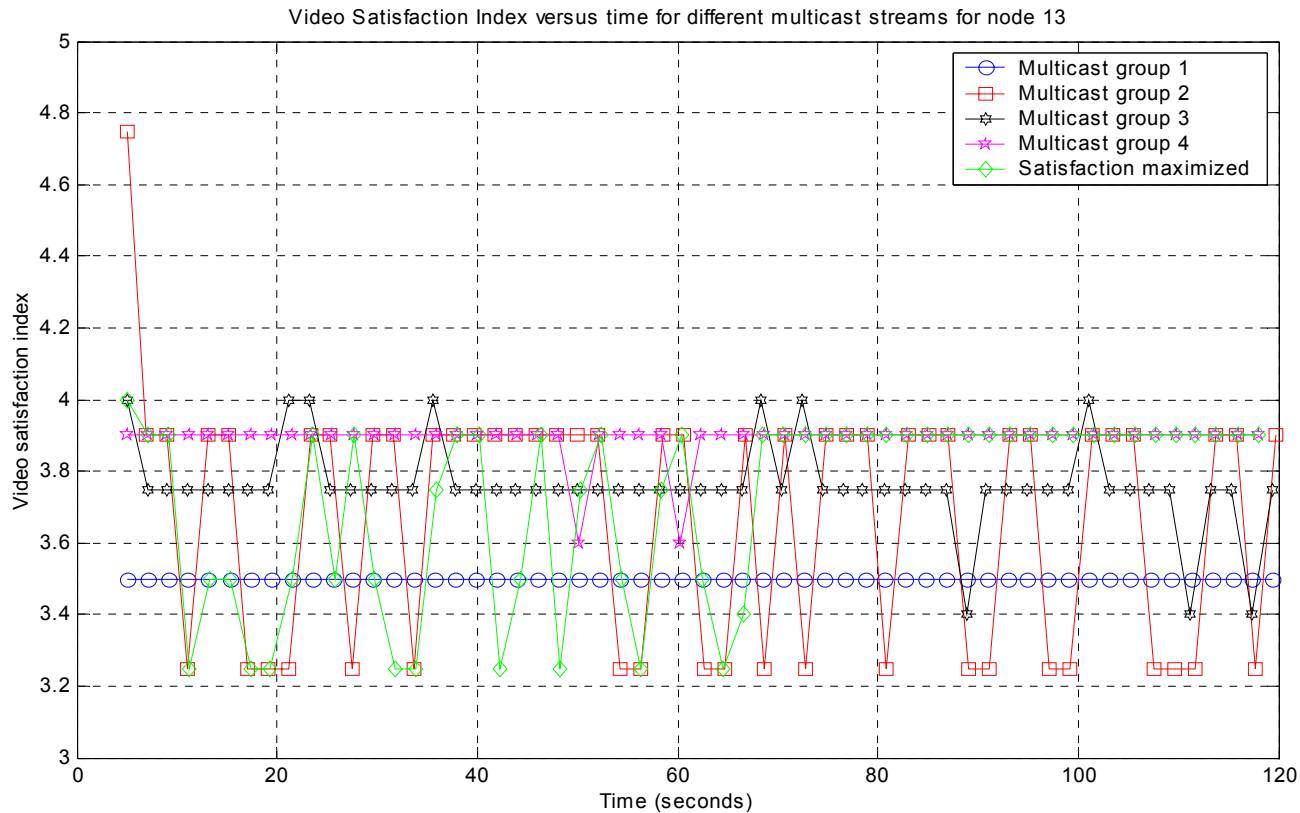
# Short term average BER for client 13 (d $\sim$ 300 m.)



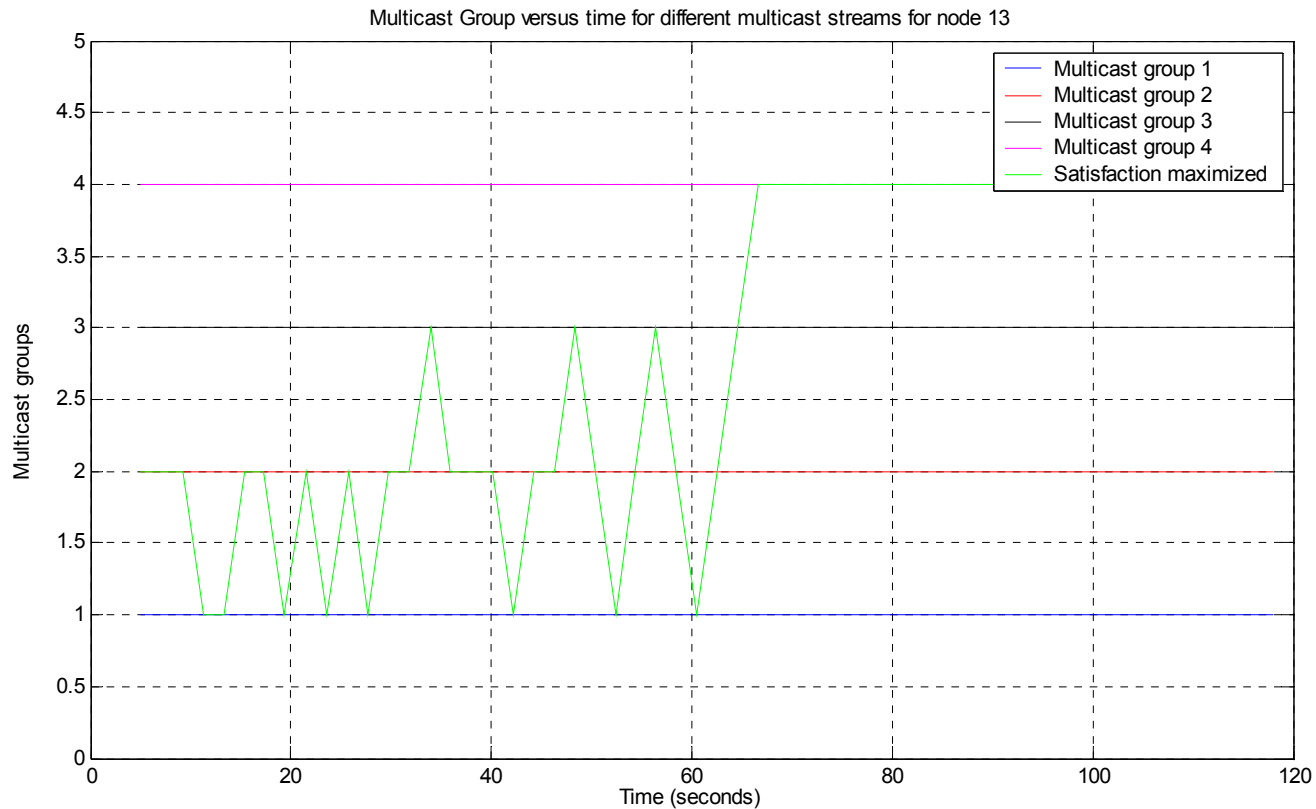
# Long term average BER for client 13



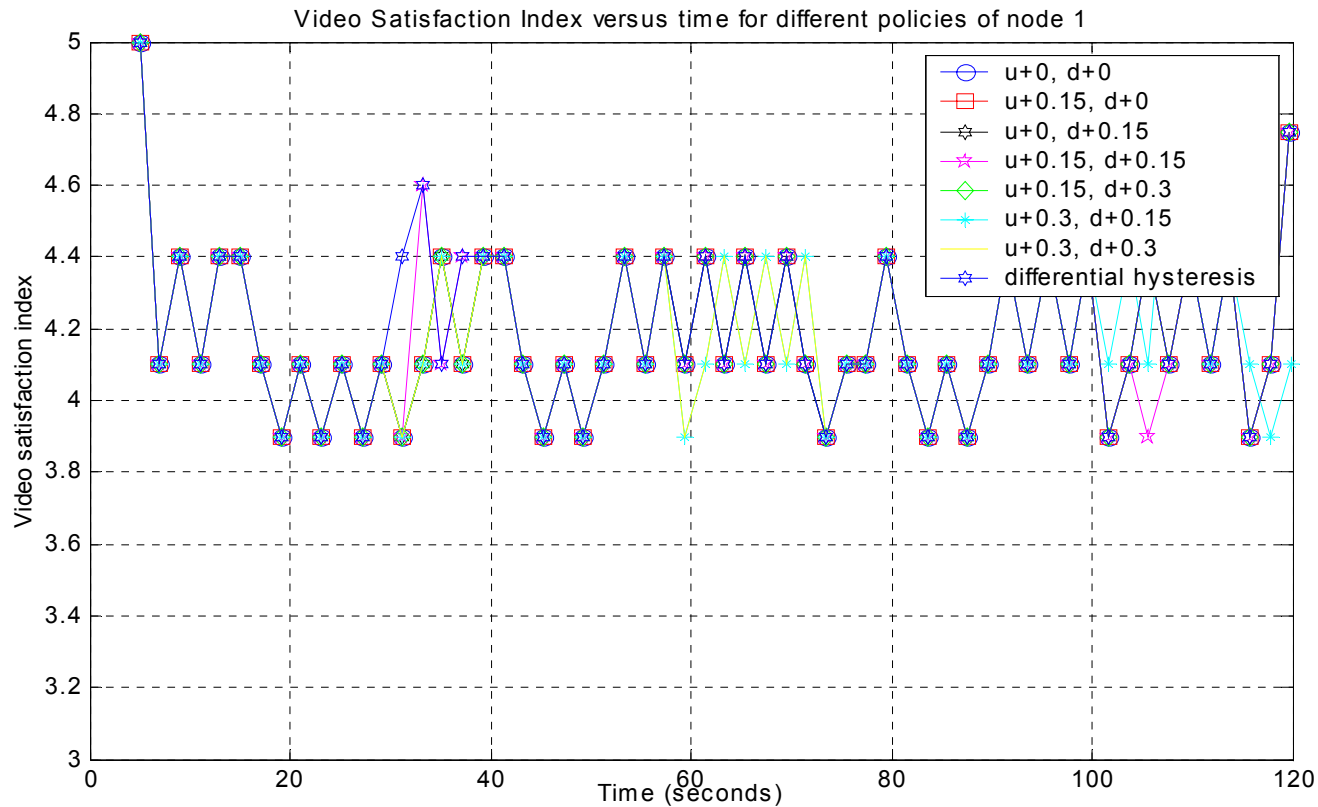
# Satisfaction Index of client 13



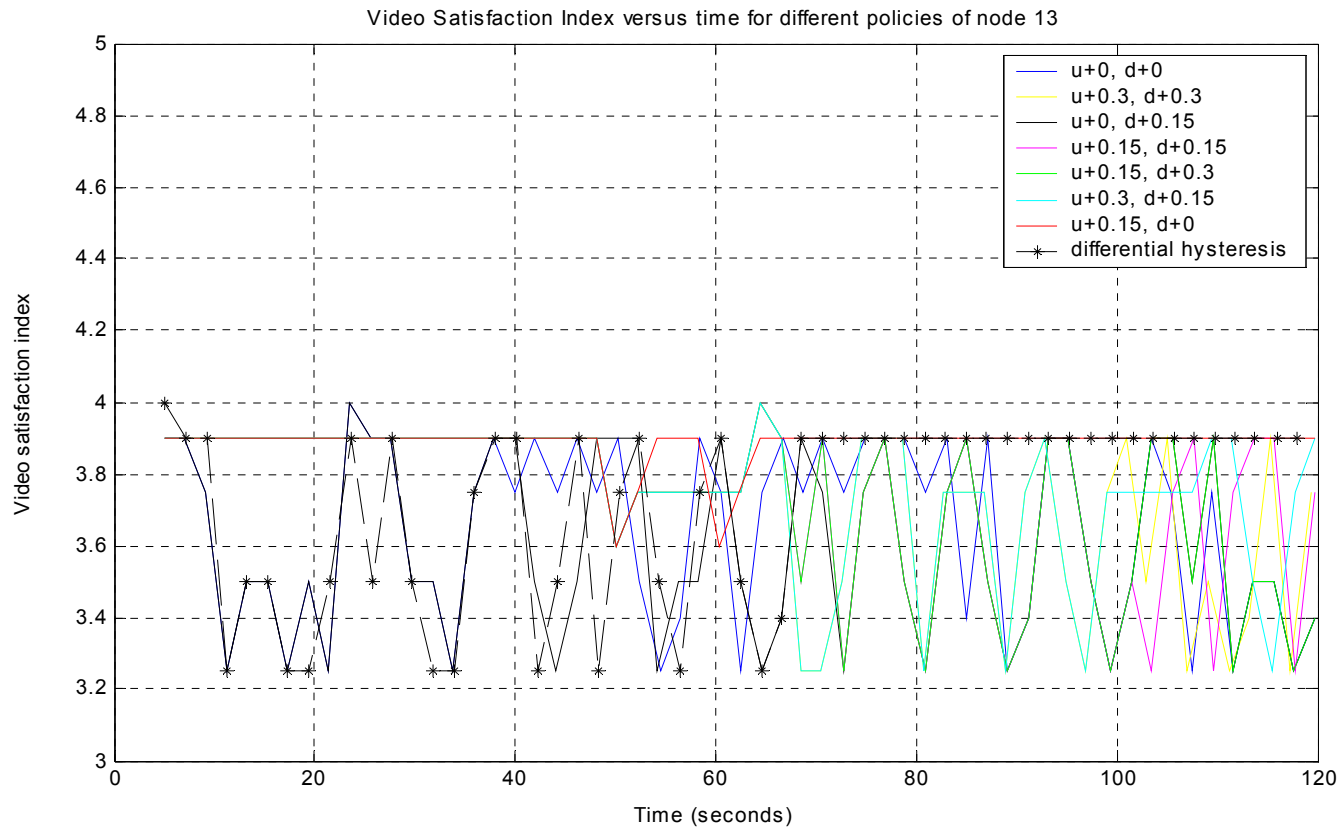
# Multicast groupings for client 13



# Satisfaction Index of client 1 for different policies:



# Satisfaction Index of client 13 for different policies:



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# Work in progress and Future Work:

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- Examining control policy and loop parameters to obtain stable satisfaction behavior of the clients
- Simulations with FEC
- Comparison of the receiver driven scheme (distributed) with the centralized scheme with feedback from clients
- Completion of this work as a technical report and paper by the end of semester

# Questions/Comments:

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