

# Performance Analysis Of Live Video Streaming Using Content Distribution.

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# Outline

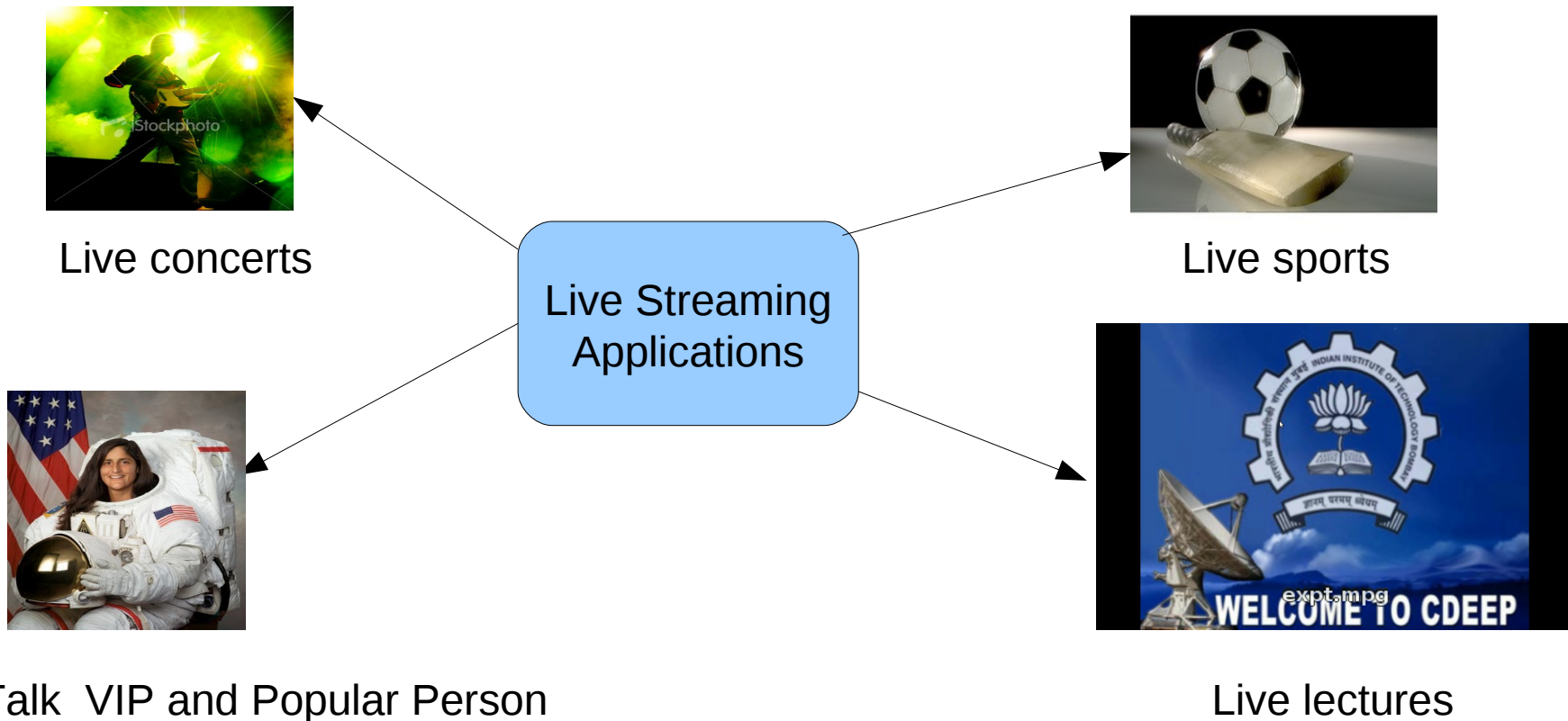
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- Introduction
- Problem Definition
- Approaches
- Proposed System Architecture
- IIT Bombay Network Architecture
- Experimental Methodology
- Performance Analysis
- Conclusions
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# Introduction

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## □ Growing Use of Live Video Streaming.

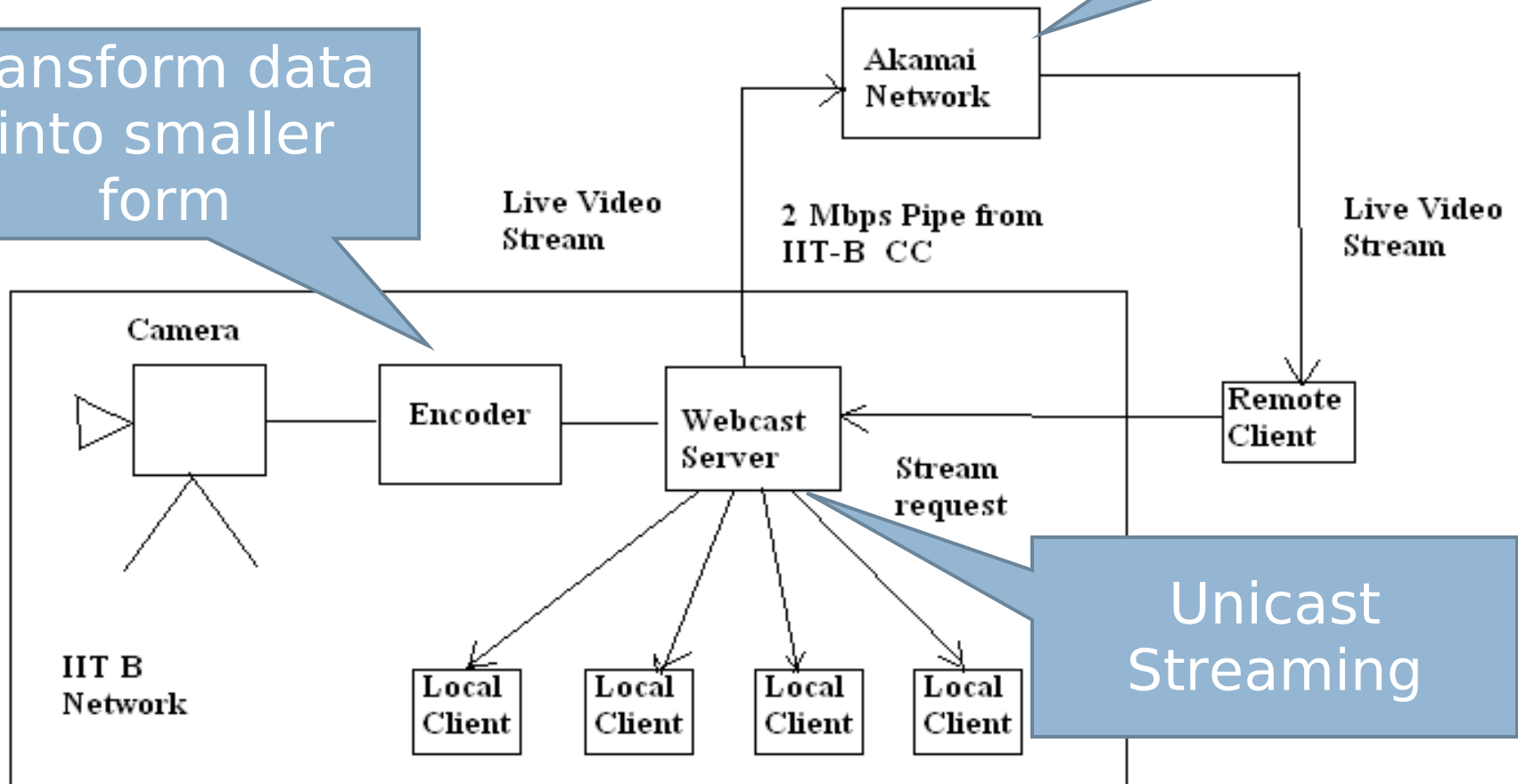


# CDEEP Webcasting Architecture

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Distributed Computing

Transform data into smaller form



# Requirement

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- User's Requirement
  - t Better perceived quality of video.
    - Bitrate, frame rate, resolution.
    - Availability of live streaming.
  
- CDEEP Server Requirement
  - Lower load on Server.
  - Lower load on IIT Bombay network.

# Problem Definition

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- Unicast streaming has scalability issue.
  - t Server overload
    - Packet delay , Video frame skips : video quality degrades
  
- Develop webcasting architecture for CDEEP such that it is more scalable (concurrent users) ensuring lower demand on the server and network also the better perceived quality of video.
  
- Verify the correctness of the solution.
  
- Evaluate the performance of the system.
  
- Integrate it into CDEEP network.

# Approaches

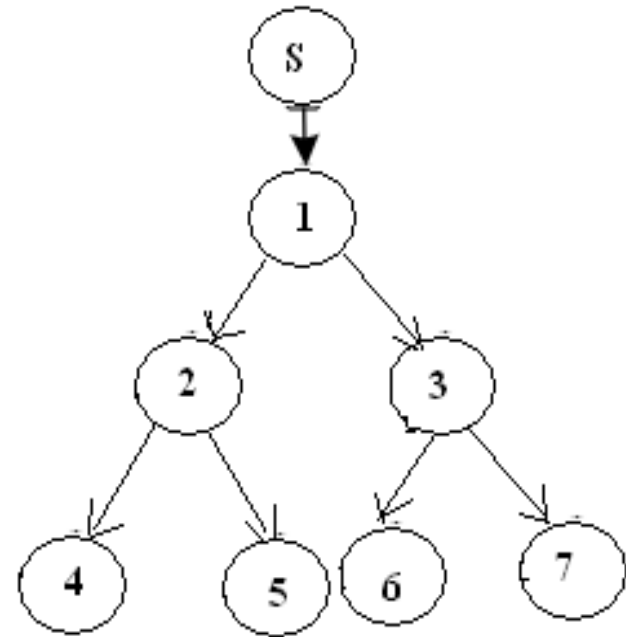
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- Increasing the network capacity.
  - † Expensive: change in infrastructure.
  
- Transcoding and Variable bit-rate streaming.
  - Encoding rate can be downscaled for more scalability.
  - Compromize with video quality.
  
- IP multicast
  - † Packet replication at router level. (e.g DVMRP)
    - Need multicast supporting routers. (stateful routers)
    - load on router.
    - Unwanted traffic.
    - Change in infrastructural level (costly).
  
-

# Application Level Multicast

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- Packet replication at end system.  
e.g. ALMA (tree), NARADA (mesh)
- Construct distribution tree containing all the receivers.
- Subset of nodes get the live stream directly. Others get the stream from receivers 1 level above them.
- Issues
  - t Highly dynamic behaviour (connection/disconnection) of receivers.
  - Complex Mesh/Tree maintenance algorithm.



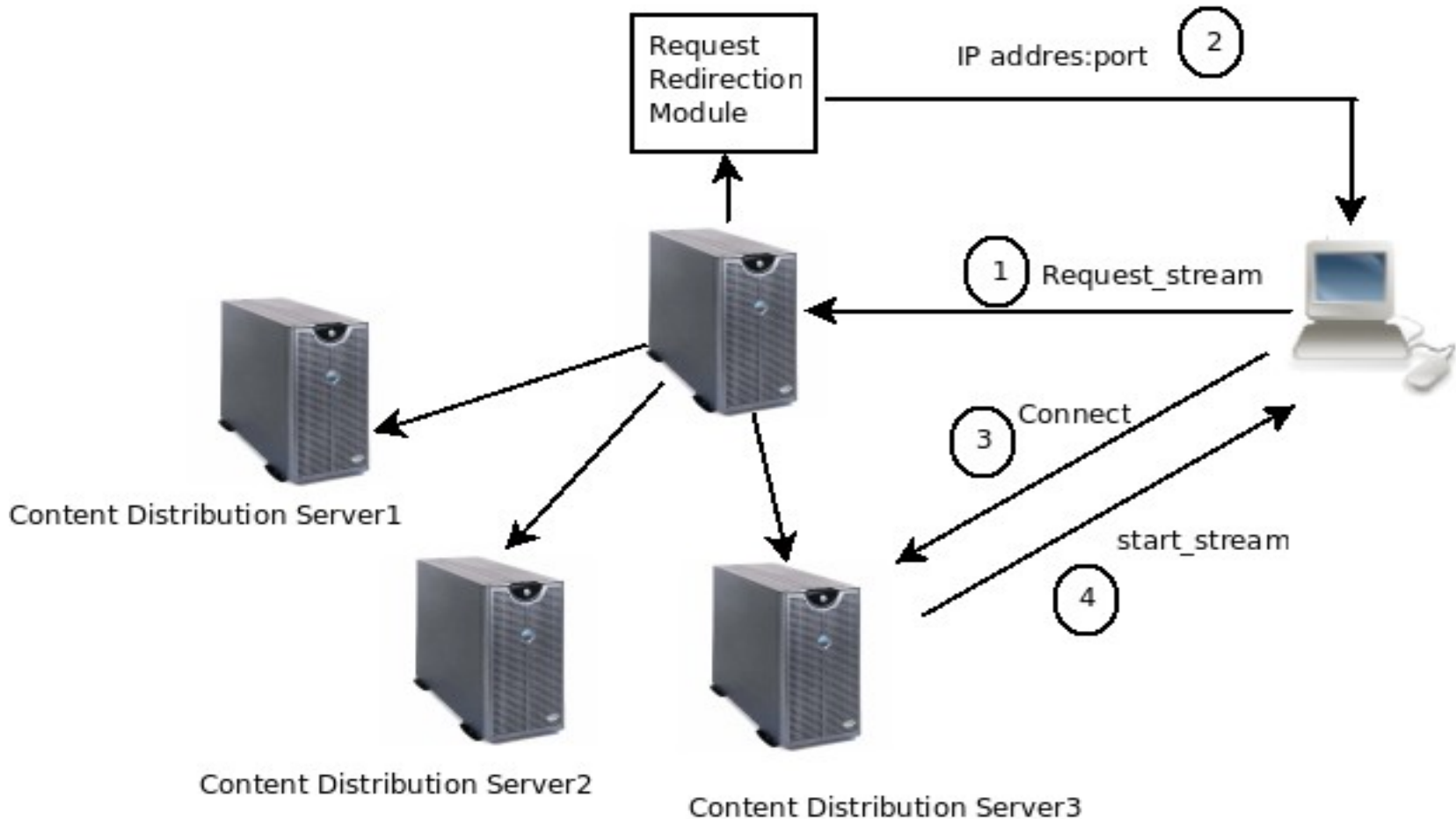


# Approach cont..

- P2P Streaming.
  - Split video stream into chunks.
    - Distribute it using bittorrent-like protocol.
    - e.g PPLive, SopCast, GoalBit.
- Content Distribution Based.
  - Clients are redirected to best server.
  - Internally use load balance algorithms.
    - e.g Round Robin, least-connection etc.

# Proposed Architecture

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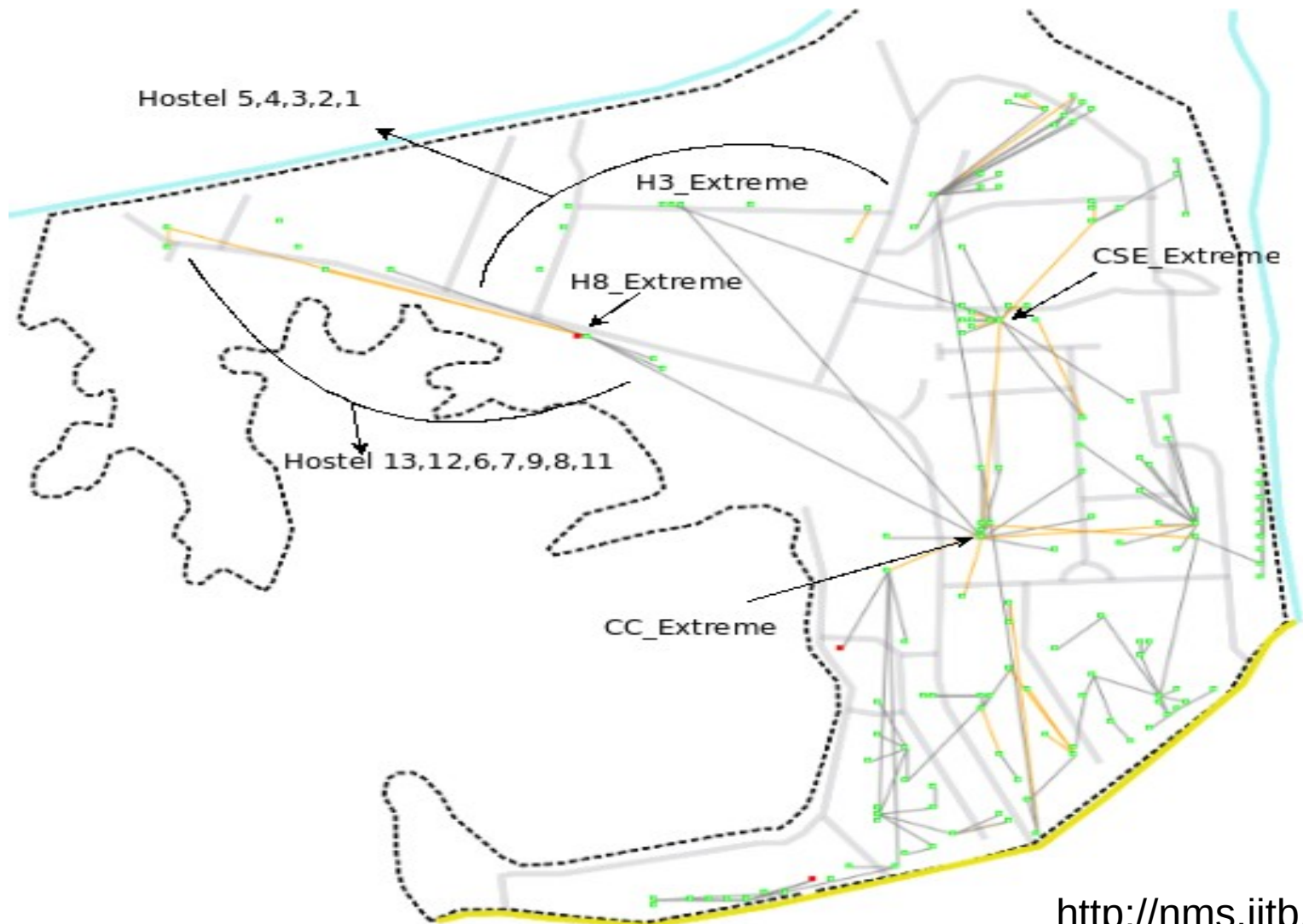
# Request Redirection module

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- t Round Robin- Incoming requests redirected round robin fashion.
  - Drawback: - Clients behavior dynamic.
    - Server capacities are different.
- Subnet Level Based : Static redirection
  - Load may not be balanced among servers.
- Instantaneous Number Of Connection : Dynamic Redirection
  - No guarantee of redirection to local server
- Network utilization of servers balancer: Dynamic redirection
  - Server use multiple streaming or some other (network) application.

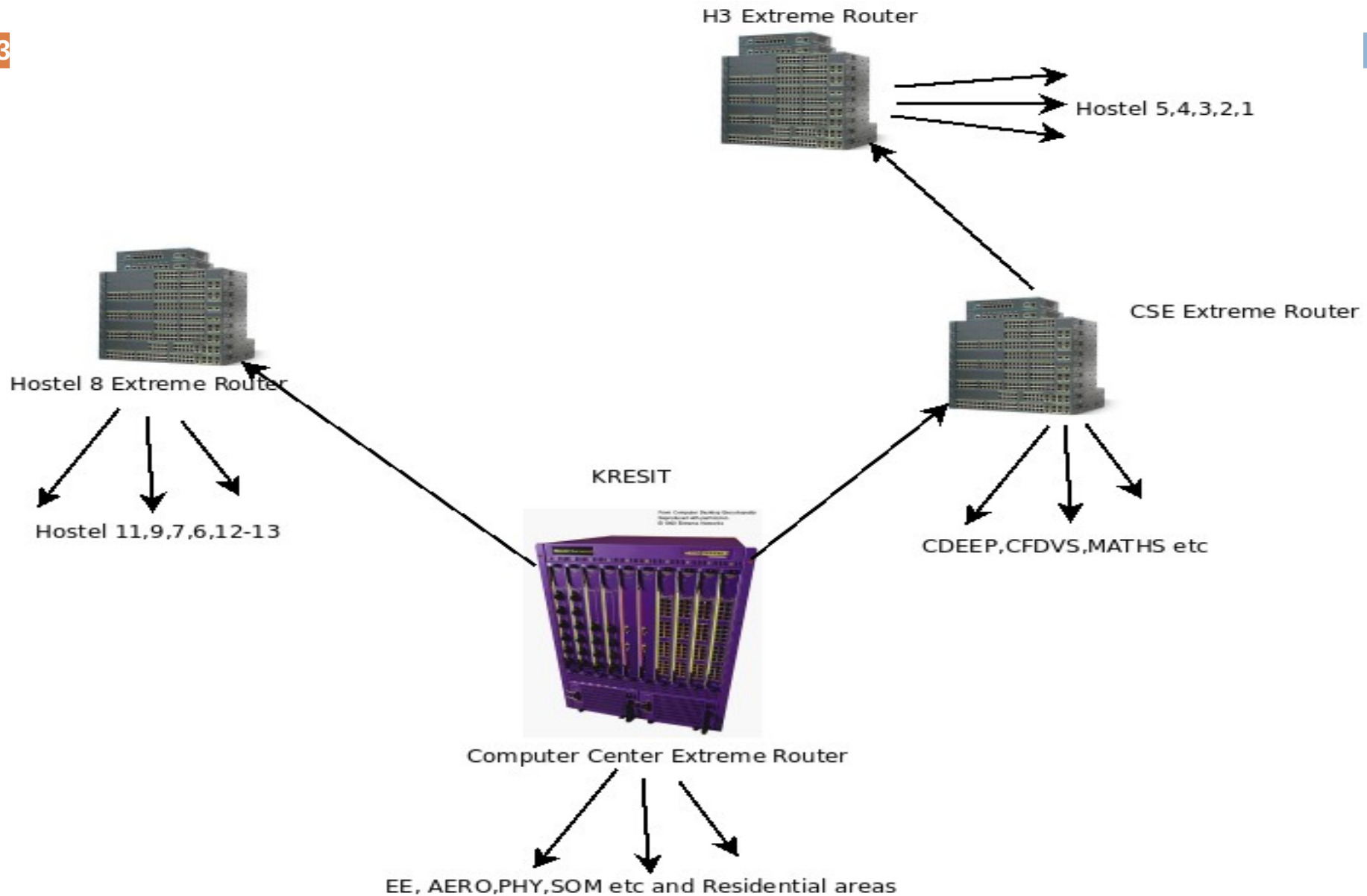
# Campus Network Architecture

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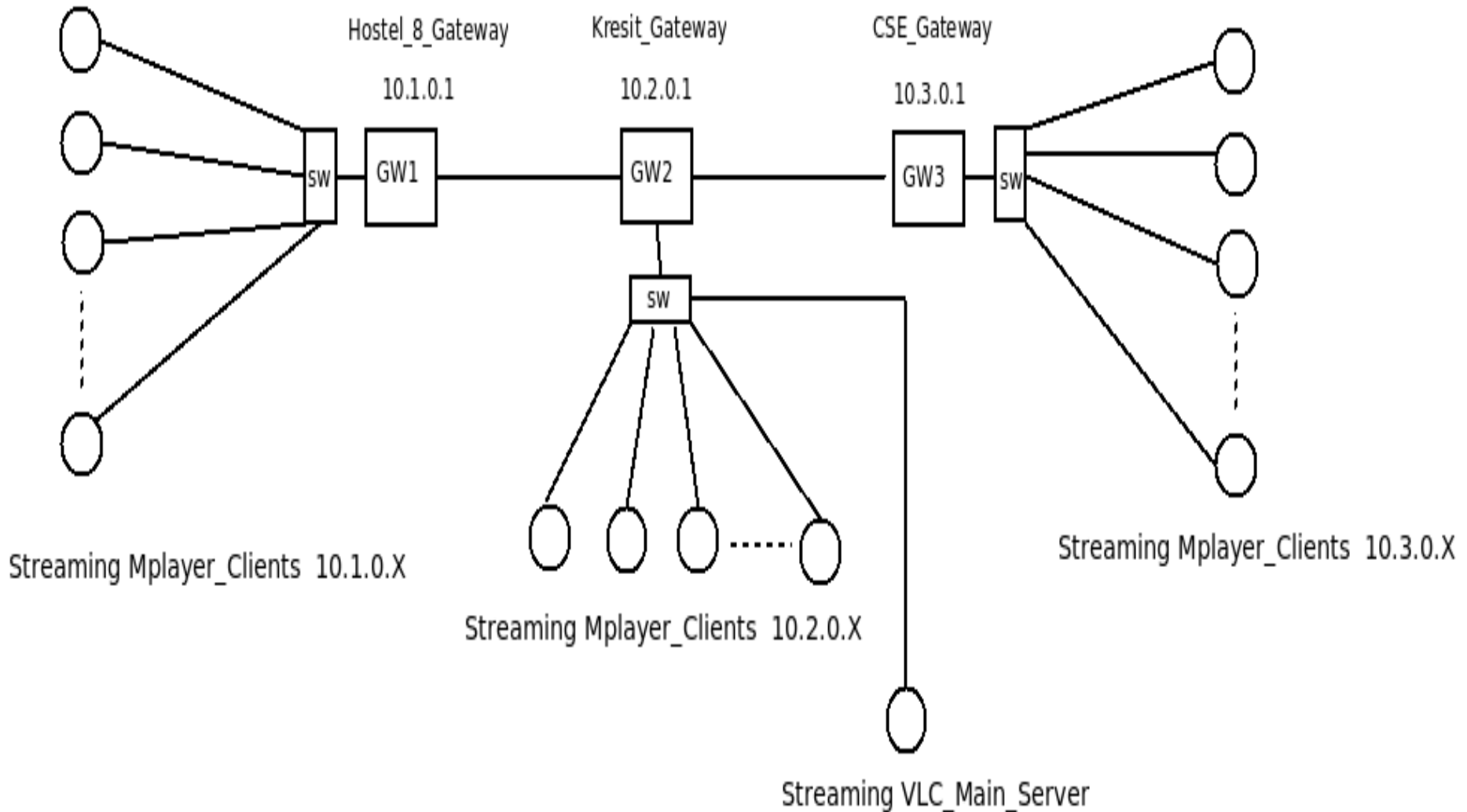


# Part of Campus Network

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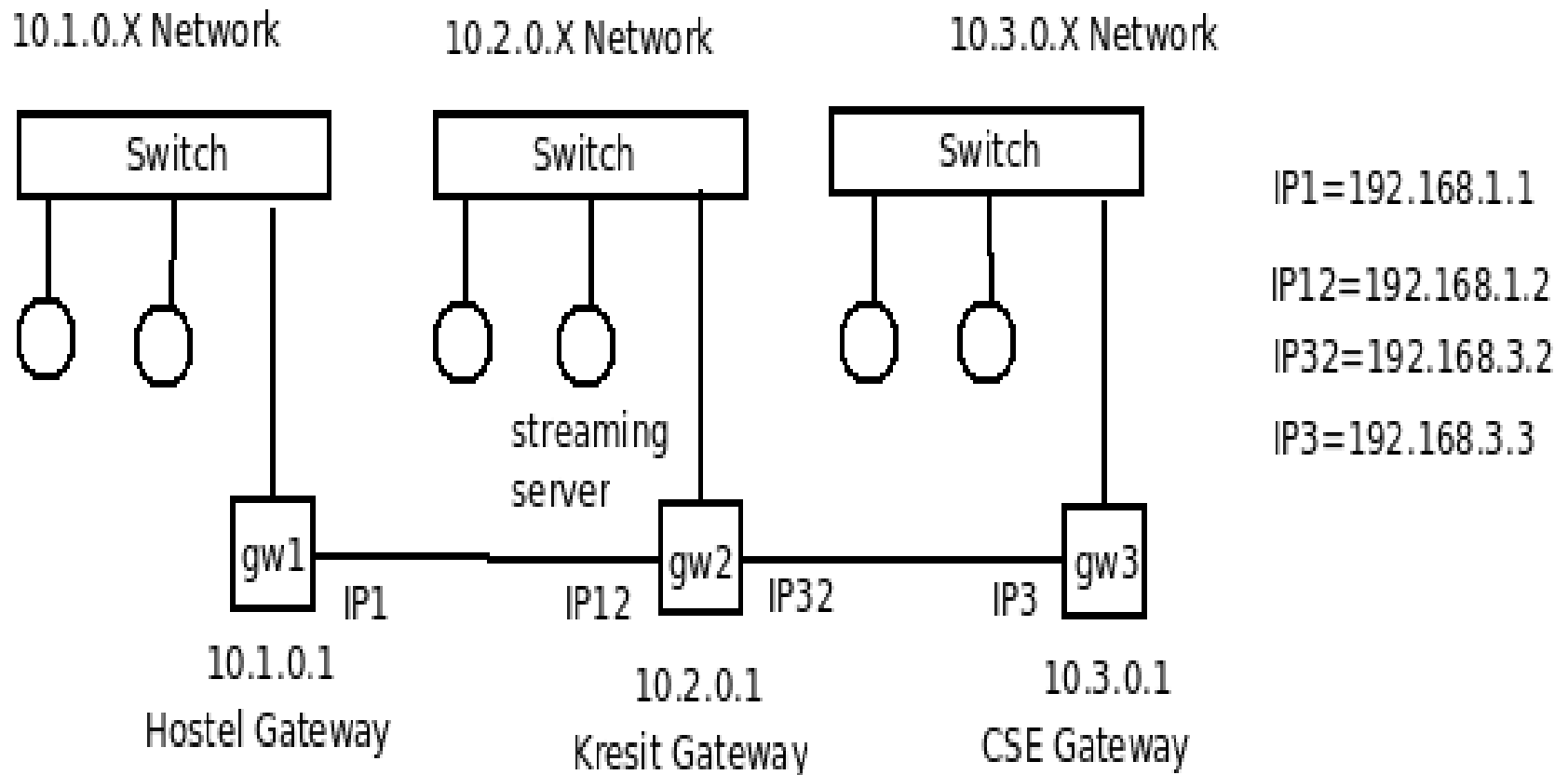


# Experiment Testbed



# Physical Setup

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# Experimental Setup

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- Media Streaming Server: VLC player
- Media Streaming Client : Mplayer
- Performance Metrics:
  - Server and router side:
    - I/O rate
    - CPU utilization of server
  - Client Side:
    - Frame Stats (Frame rate,delay,drop)
    - Packet stats (Packet delay,jitter)



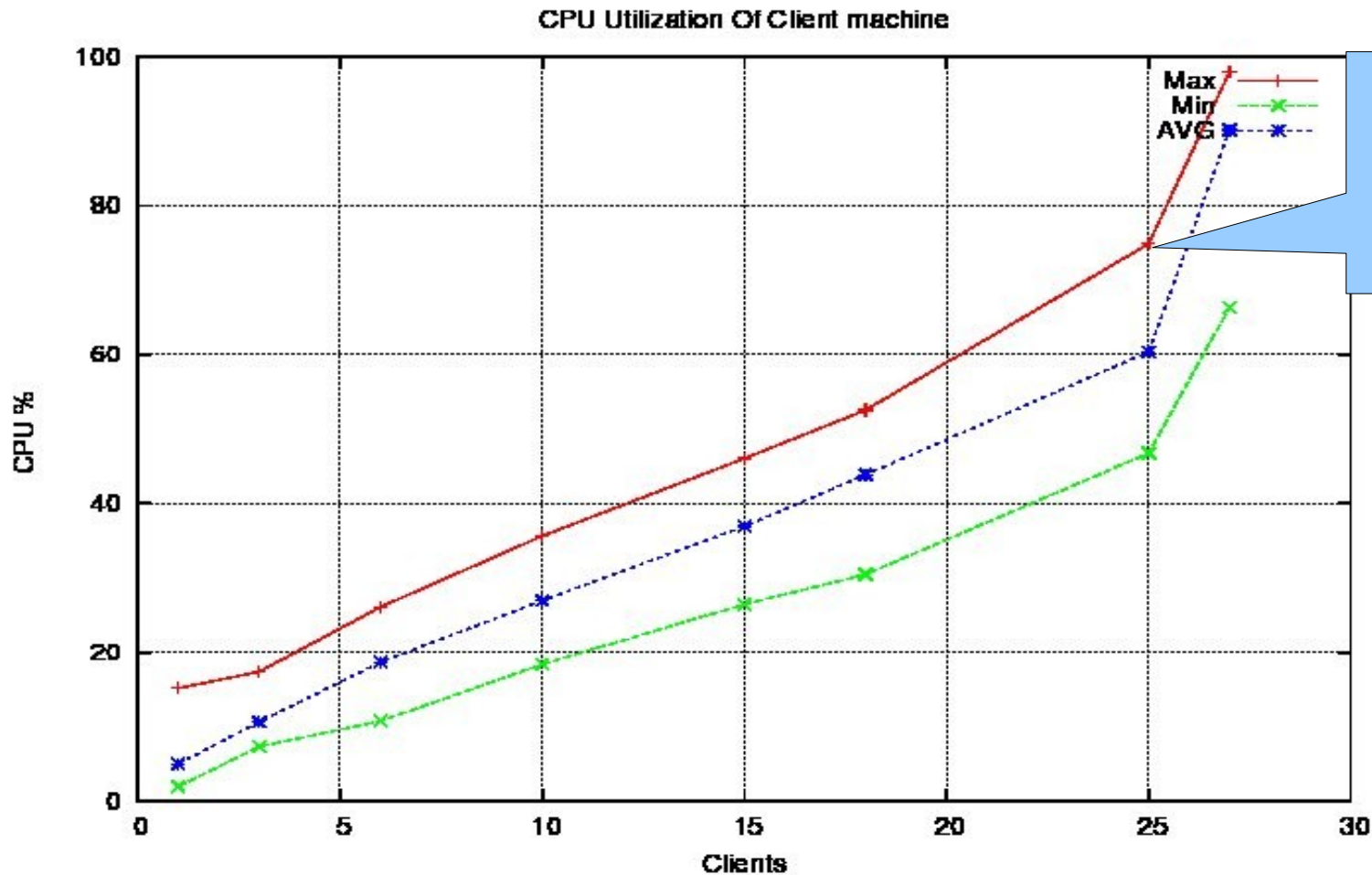
# Experimental Setup cont..

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- Streaming video
  - Length of video clip : 300 sec.
  - Frame rate : 25 fps.
  - Video bitrate:1000 Kbps, codec: H.264.
  - Audio bitrate: 192 Kbps, codec: mpga.
  - Streaming Protocol: HTTP\_streaming.
  
- Equipment used:
  - 5 Laptops (2.2 Ghz C2D, 2 GB RAM)
  - 3 Server machines.
  - 3 Routers (cpu machines with multiple NICs).
  
- Client's Request rate= 5 clients per/sec

# Preliminary Experiment

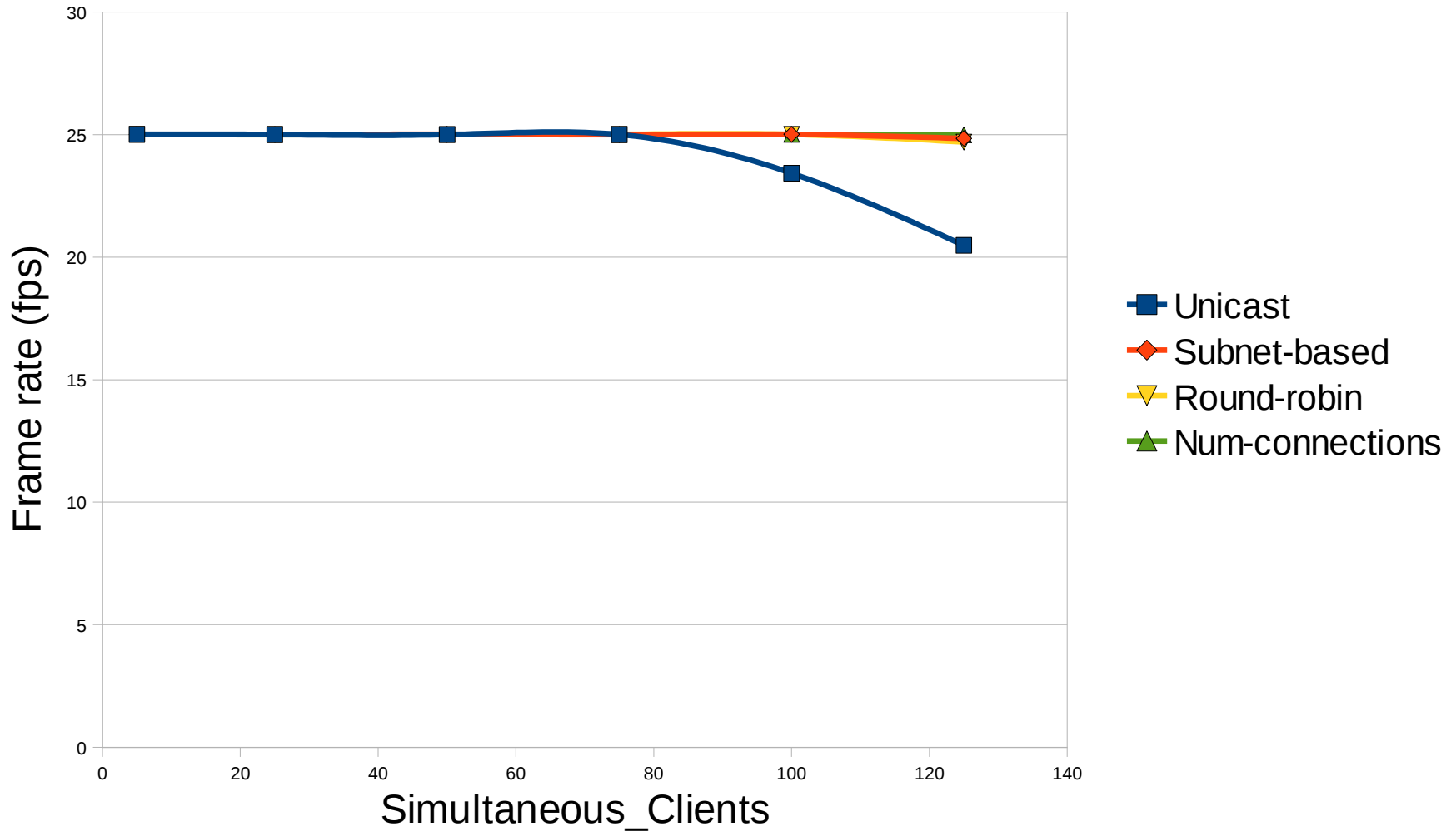
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74 % CPU  
25 mplayer  
instances  
on a machine

# Performance Analysis

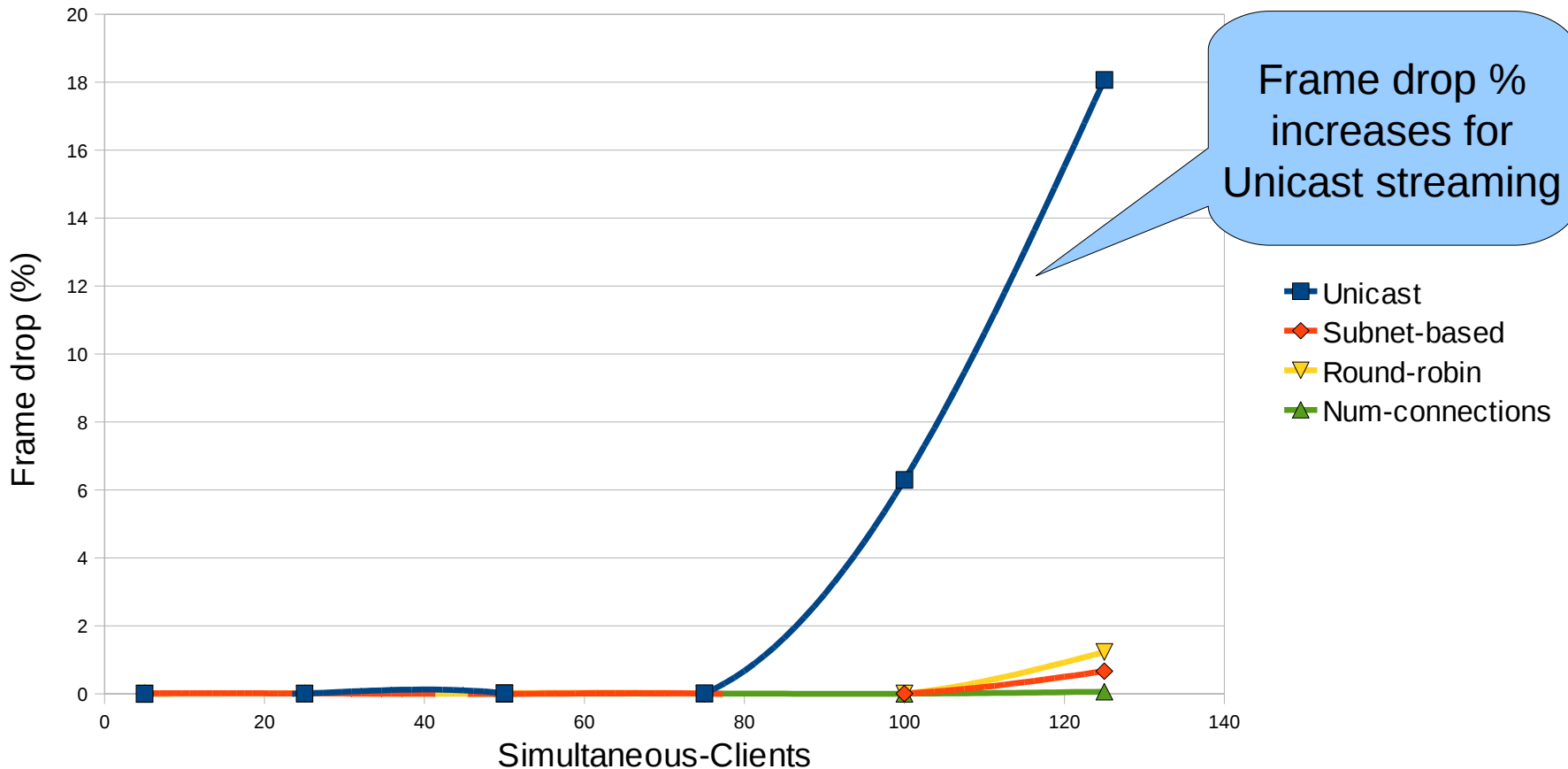
## Average Frame Rate



# Average Frame drop

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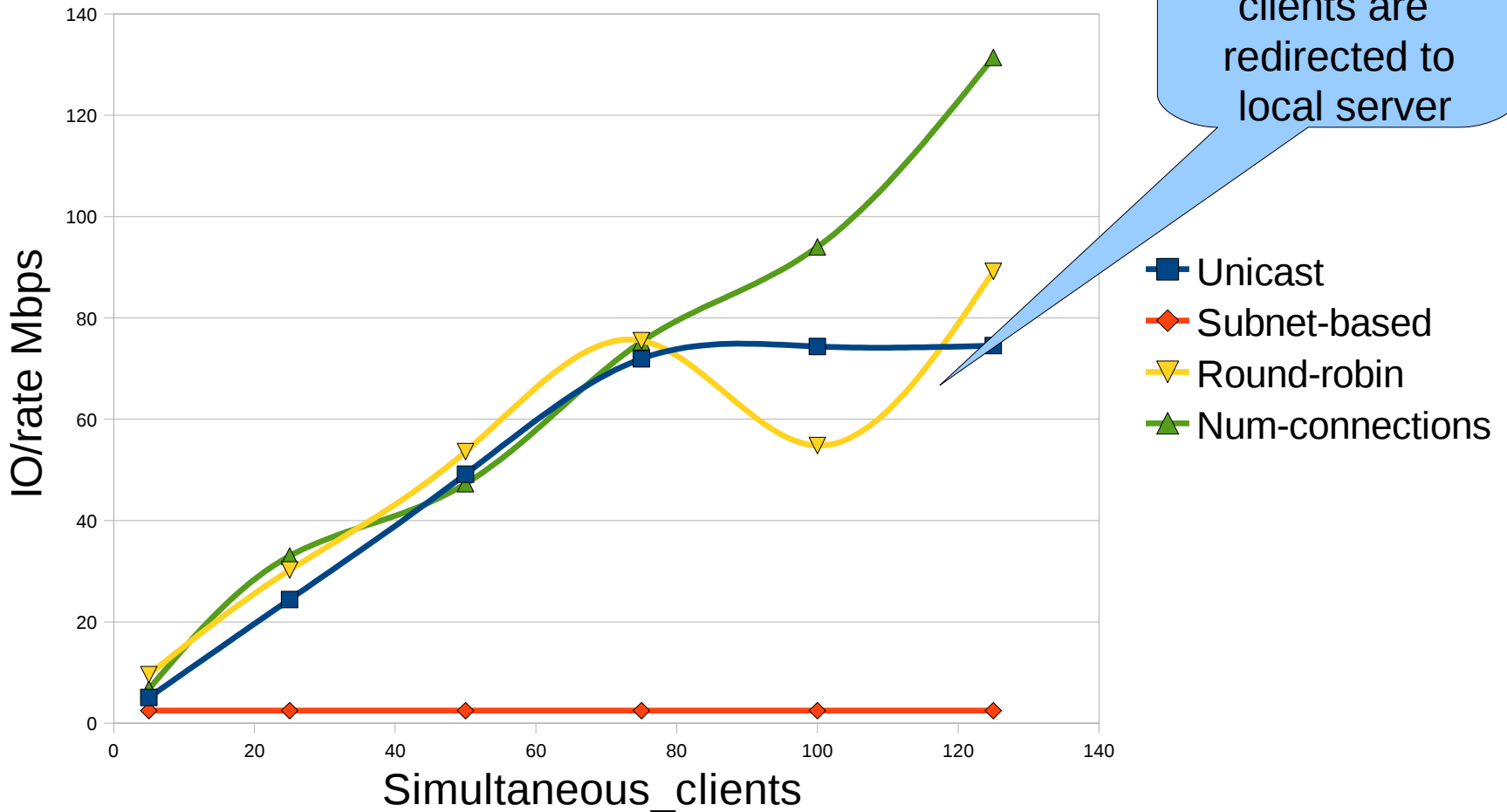
## Average Frame Drop %



# H8\_Extreme (GW1)

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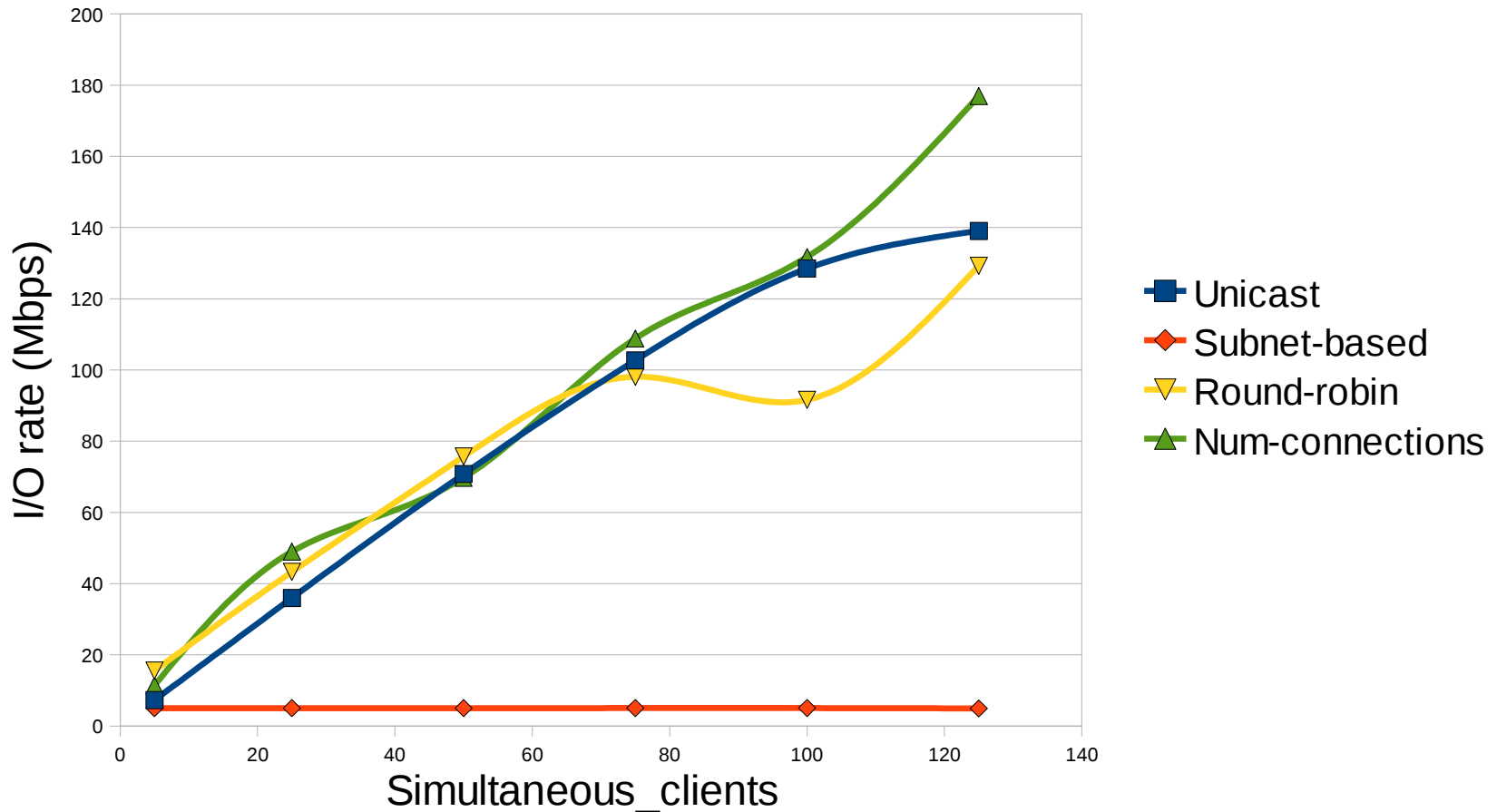
## Gateway 1 Router I/O rate



# CC\_Extreme (GW2)

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## Gateway 2 Router I/o rate



# CSE\_Extreme (GW3)

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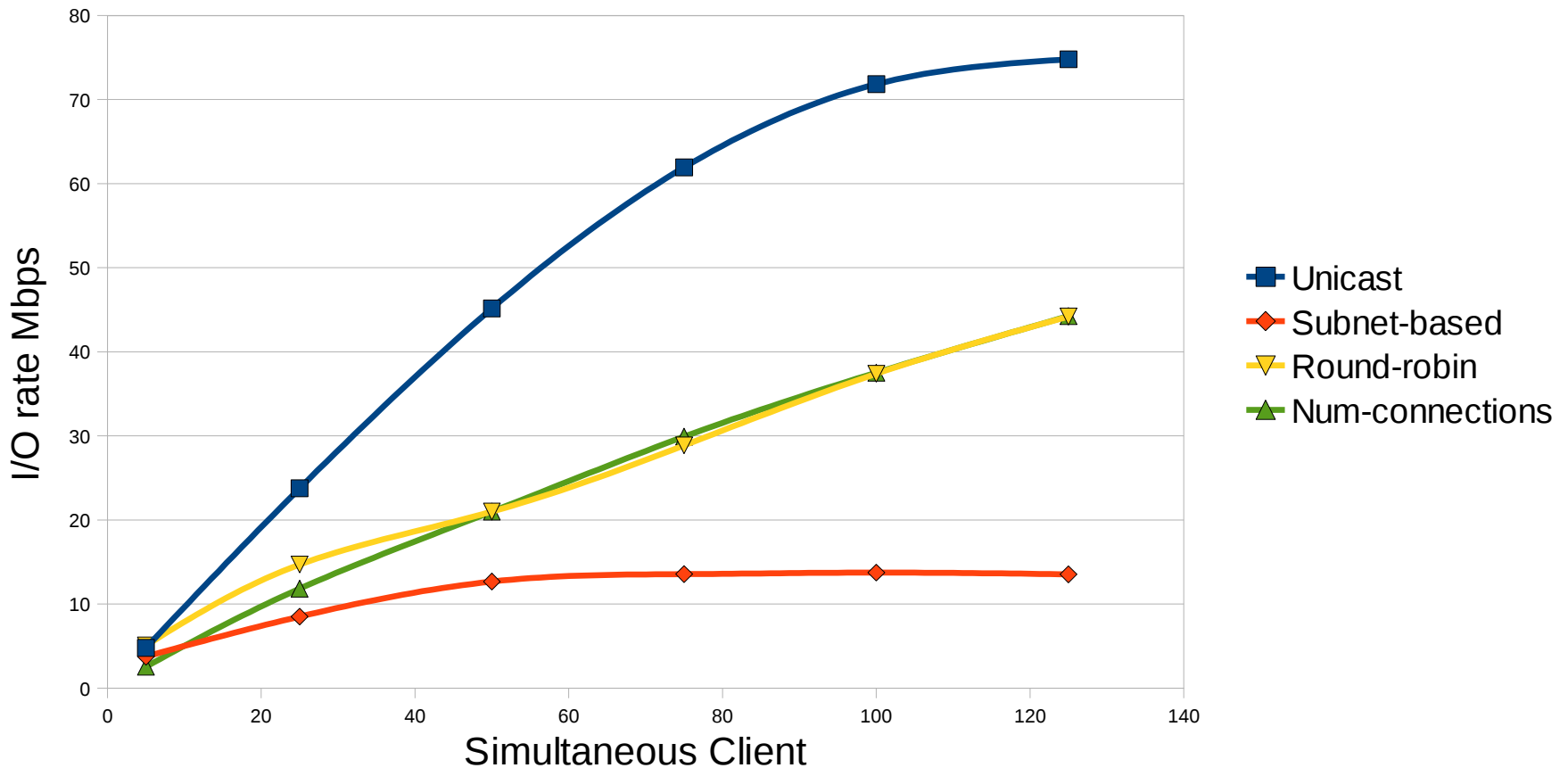
## Gateway 3 Router I/O rate



# Main Streaming server

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## Main Server I/O rate

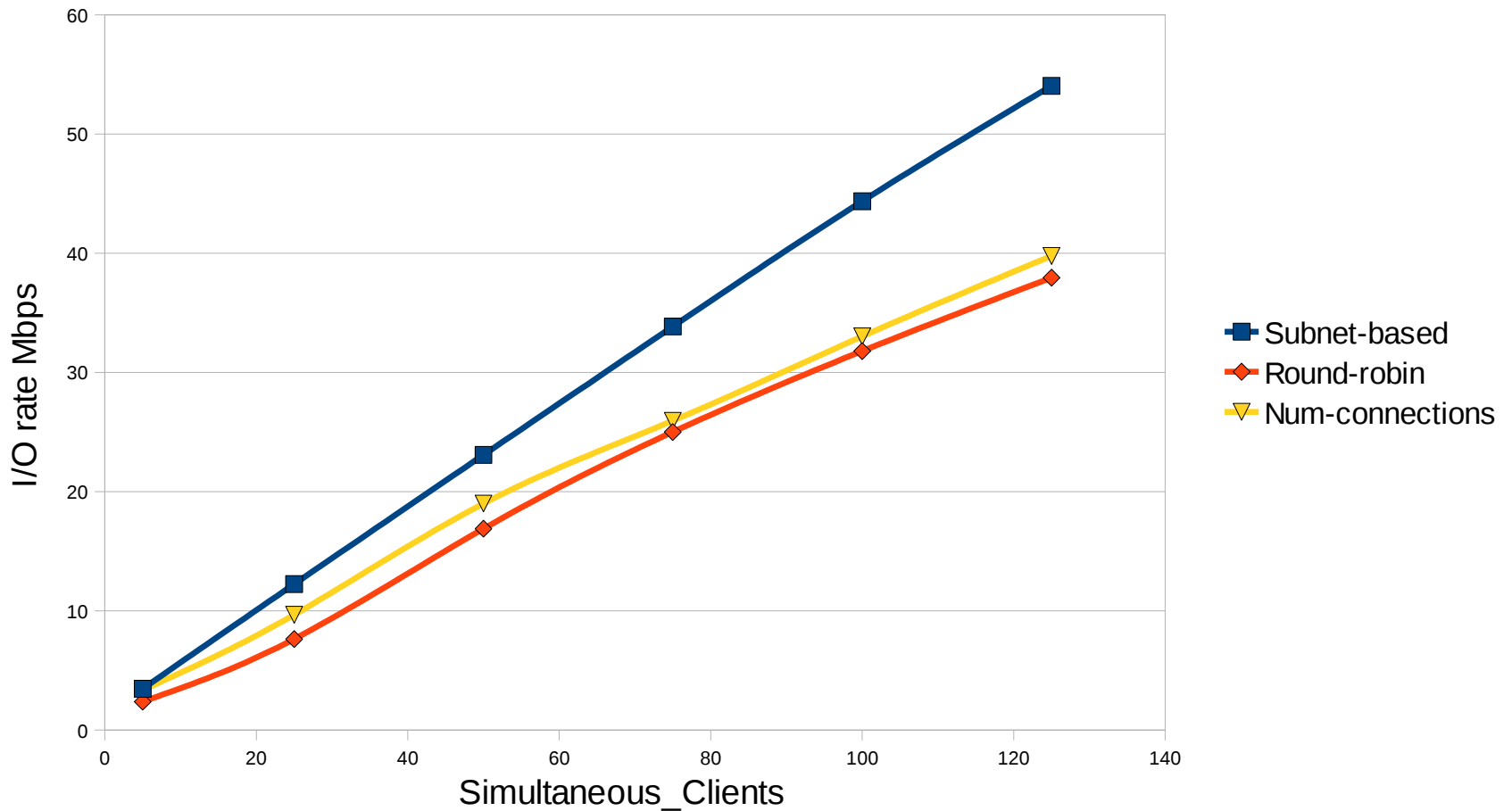




# Content Distribution Server 1

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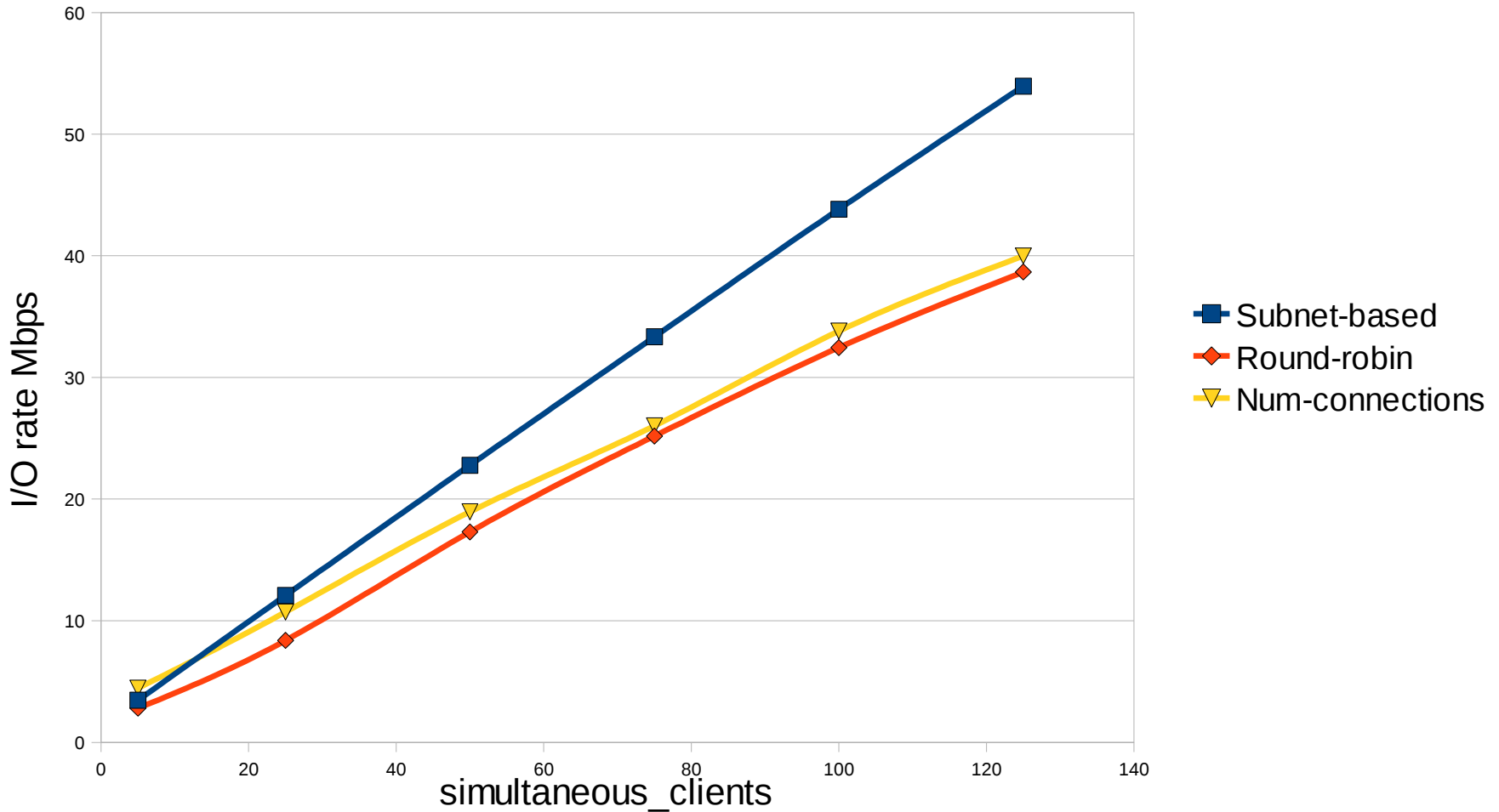
## Content Distribution Server 1 I/O rate



# Content Distribution Server 2

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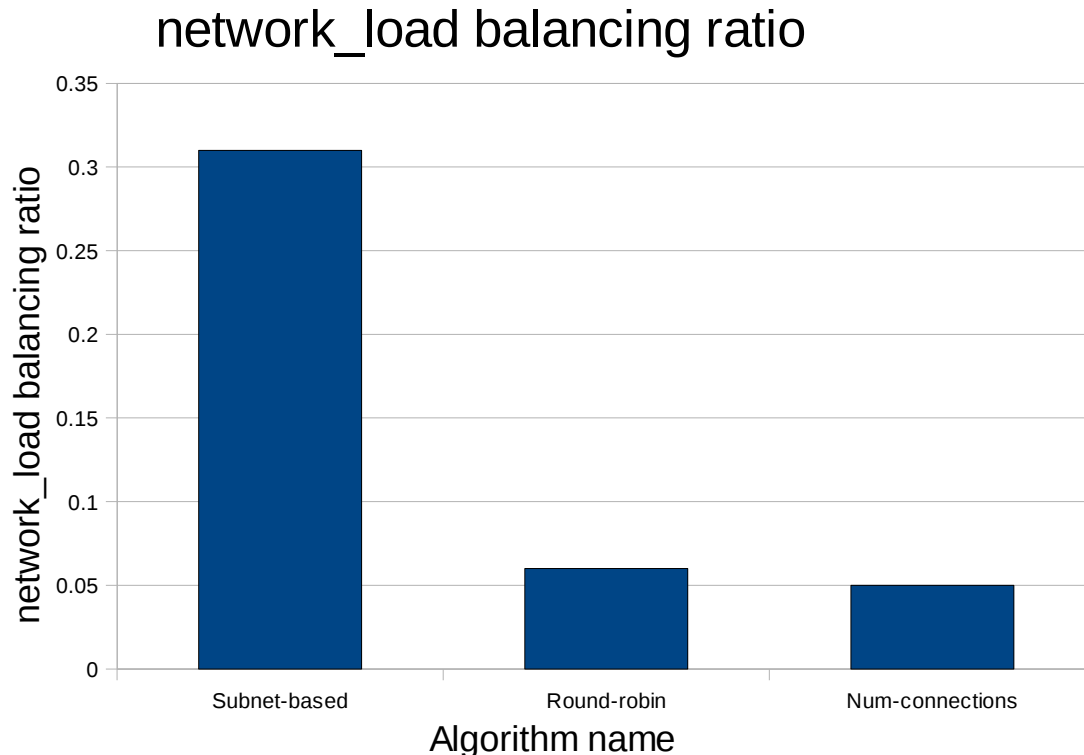
## Content Distribution Server 2 I/O rate



# Network Utilization balancing ratio

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- $b_1, b_2, b_3 \rightarrow$  network utilizations,  
 $total = b_1 + b_2 + b_3$  ,  
 $balancing\_ratio = Abs(b_1/total - 1/3) + Abs(b_2/total - 1/3) + Abs(b_3/total - 1/3)$



# Conclusions

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- Problem in existing unicast streaming.
  - t Not scalable.
- We implemented a tool for proposed content distribution architecture with various redirection algorithms.
- Evaluated unicast streaming, static as well as dynamic redirection algorithm.
- Dynamic redirection works better in terms of load balancing.
- Subnet level based : minimize campus network load.

# Future Work

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- In Request Redirection module
  - t CPU load balancer
    - Some hybrid redirection
- Create GUI or integrate code in VLC player.
- Integrate into CDEEP.

# References

- [1] CDEEP Website [www.cdeep.iitb.ac.in](http://www.cdeep.iitb.ac.in)
- [2] Akamai Technologies, [www.akamai.com](http://www.akamai.com)
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- [4] "A Case for End System Multicast" Yang-hua Chu, Sanjay G. Rao, and Hui Zhang Carnegie Mellon University.
- [5] Goalbit - open source p2p live streaming softwares. <http://goalbit.sourceforge.net/>
- [6] IIT Bombay network management service. <http://nms.iitb.ac.in>,

DEMO

Thank You