

Simulation and Analysis of Content Delivery Network

CMPT885

Supervisor: Dr. Ljiljana Trajkovic

Steve (Wei) Shen

wshen@cs.sfu.ca

Sharon (Xiaohong) Zhao

xzhao2@cs.sfu.ca

November 13, 2003

Roadmap

- Introduction of CDN (content delivery network)
 - DNS Redirection
 - Local Load Balancing
- Implementation in ns-2 Simulator
- Verification Scenario
- Analysis Scenario
- Test Results
- Conclusion
- References

Victoria's Secret

- Once a year the Victoria's Secret Lingerie Company broadcasts their Fashion Parade
- 1,000,000+ viewers watching live @ 25Kbps
- The first year they tried it the enormous load crashed their centralized servers and many missed the show
- However, in 2001, as many as 2 million watched the show without any hiccups
- Why?

Secret of Show Success

- They have started using Yahoo and Akamai for their CDN.

November 13, 2003

What is a CDN?

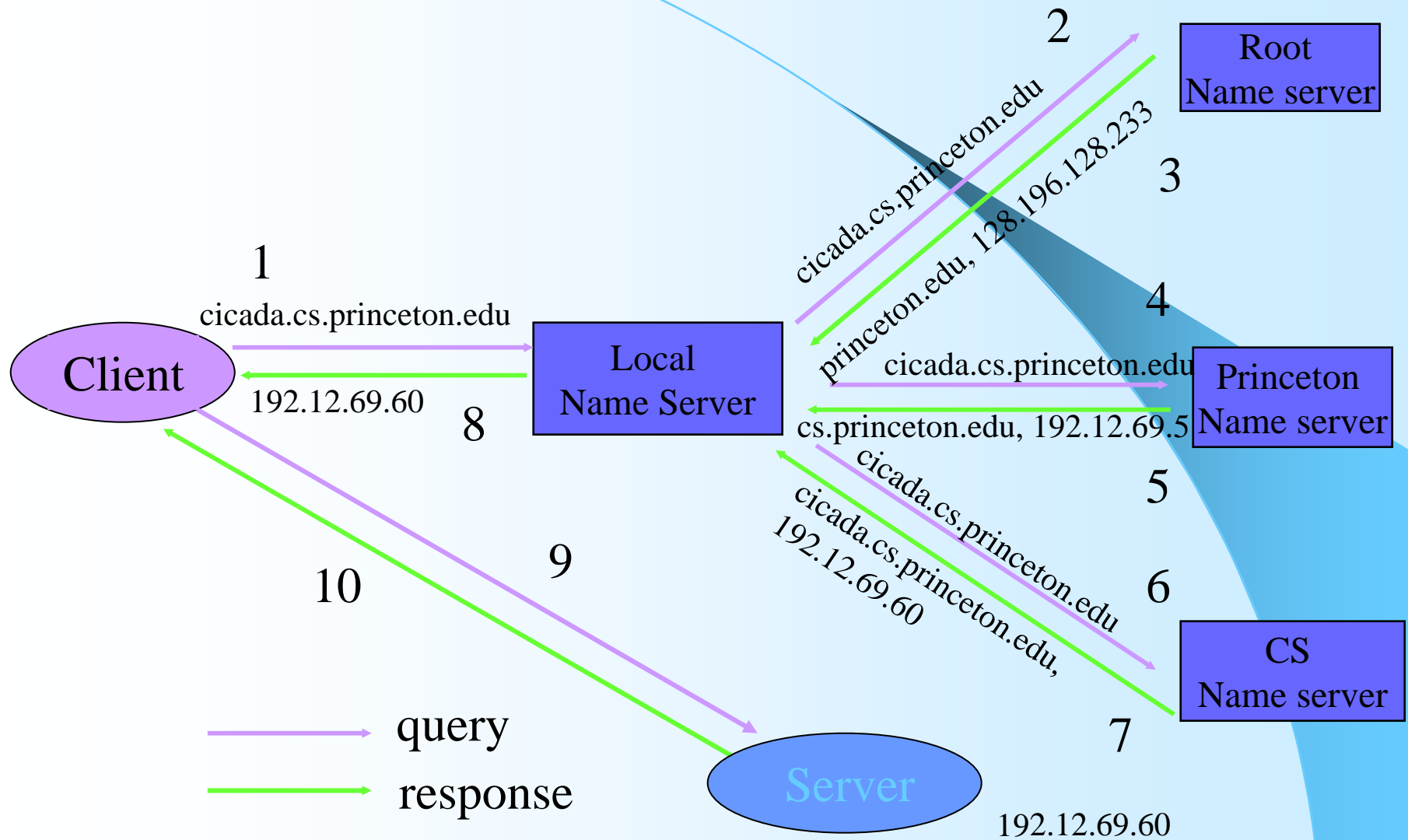
- A Content Delivery Network (CDN)
 - maintains multiple locations with mirrors of the same content (known as surrogates)
 - Redirects clients' requests to the most appropriate content locations.
- Advantages of CDN
 - Distributes the load of the central server
 - Moves the content closer to the user. Reduces response time.
 - Avoids potential congestion.

Main Techniques in CDN

- Distributing and storing replica copies
- Keeping all the replica copies up to date
- Directing incoming requests to the right replica server (surrogate).

- In our project, we deal with the third one. Two main techniques involved:
 - DNS Redirection
 - Local load balancing

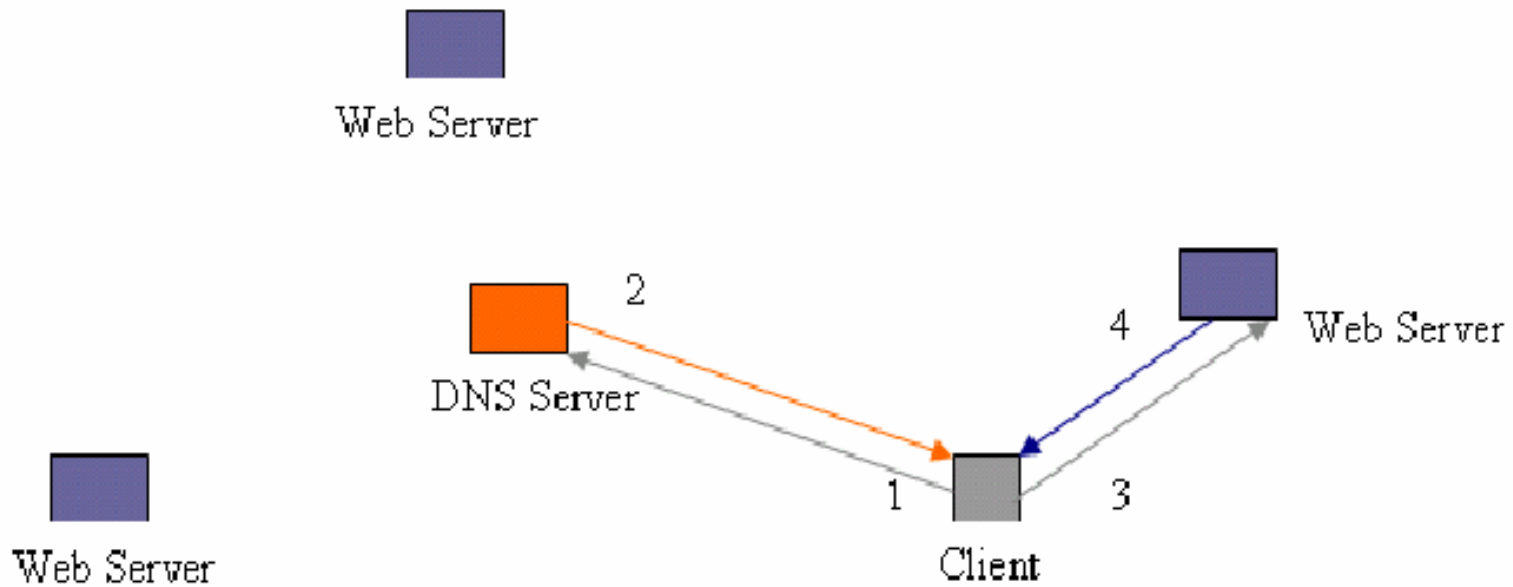
How Traditional DNS Works



DNS Redirection in CDN

- What is DNS Redirection:
Specialized DNS server redirects client request by resolving the original server to IP address of one content server (surrogate), based on resource location, network conditions, content type, etc.
- What our project simulates:
 - DNS Redirection based on resource location, content type.

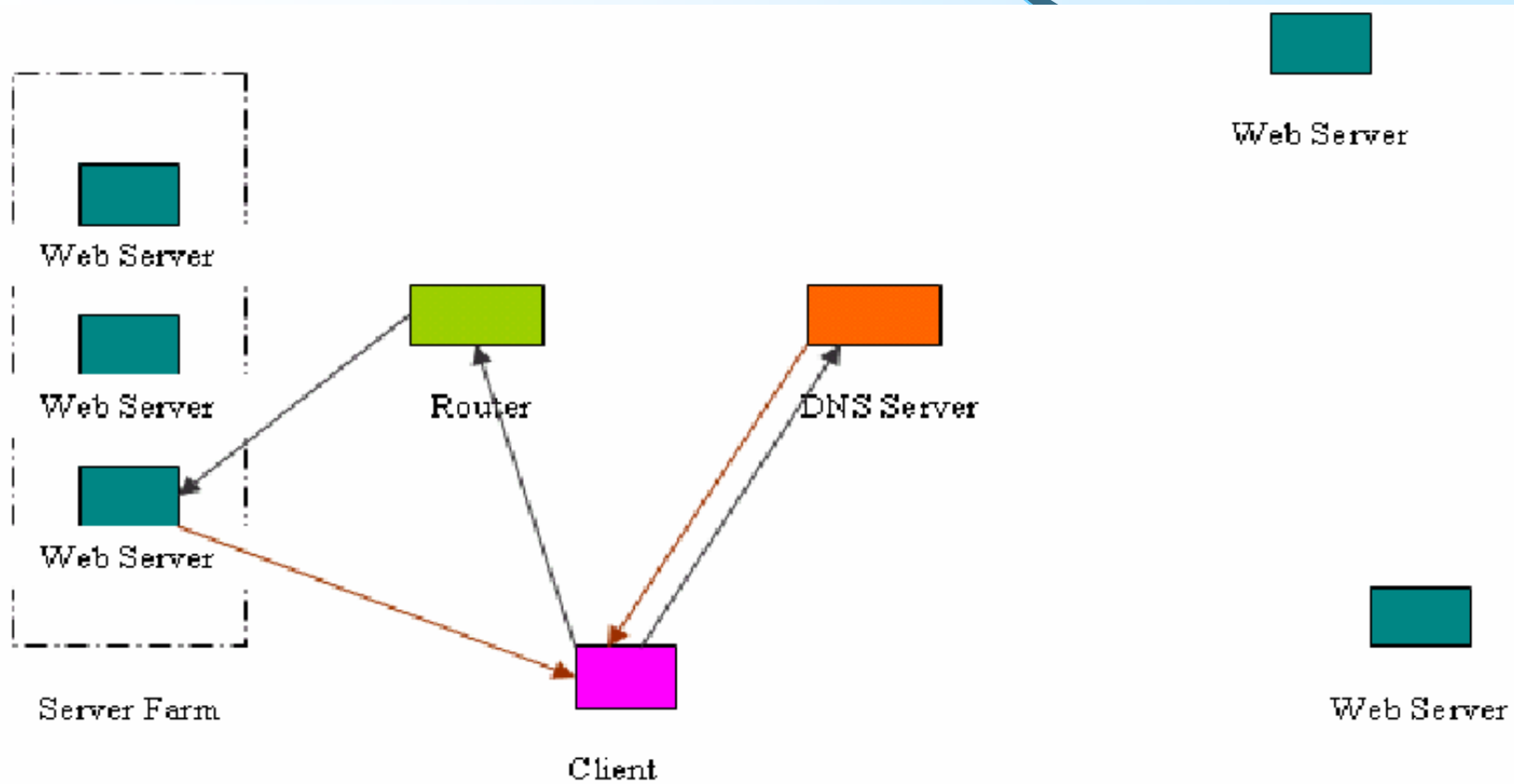
DNS Redirection (Cont.)



Local Load Balancing

- Sending traffic to various servers in a server farm to balance load of servers.
- Existing methods including:
 - Round Robin
 - Weighted Round Robin
 - Difficult to estimate the weight;
 - Traffic changes over time.
 - Dynamic Weighting-Least Connections
 - The server which has the fewest connections, should serve the next request.√

Local Load Balancing (Cont.)



November 13, 2003

Implementation in ns-2 Simulator

4 new types of agents (subclass of Agent) are created:

- ❖cdn_client
- ❖cdn_server
- ❖cdn_dns
- ❖cdn_router

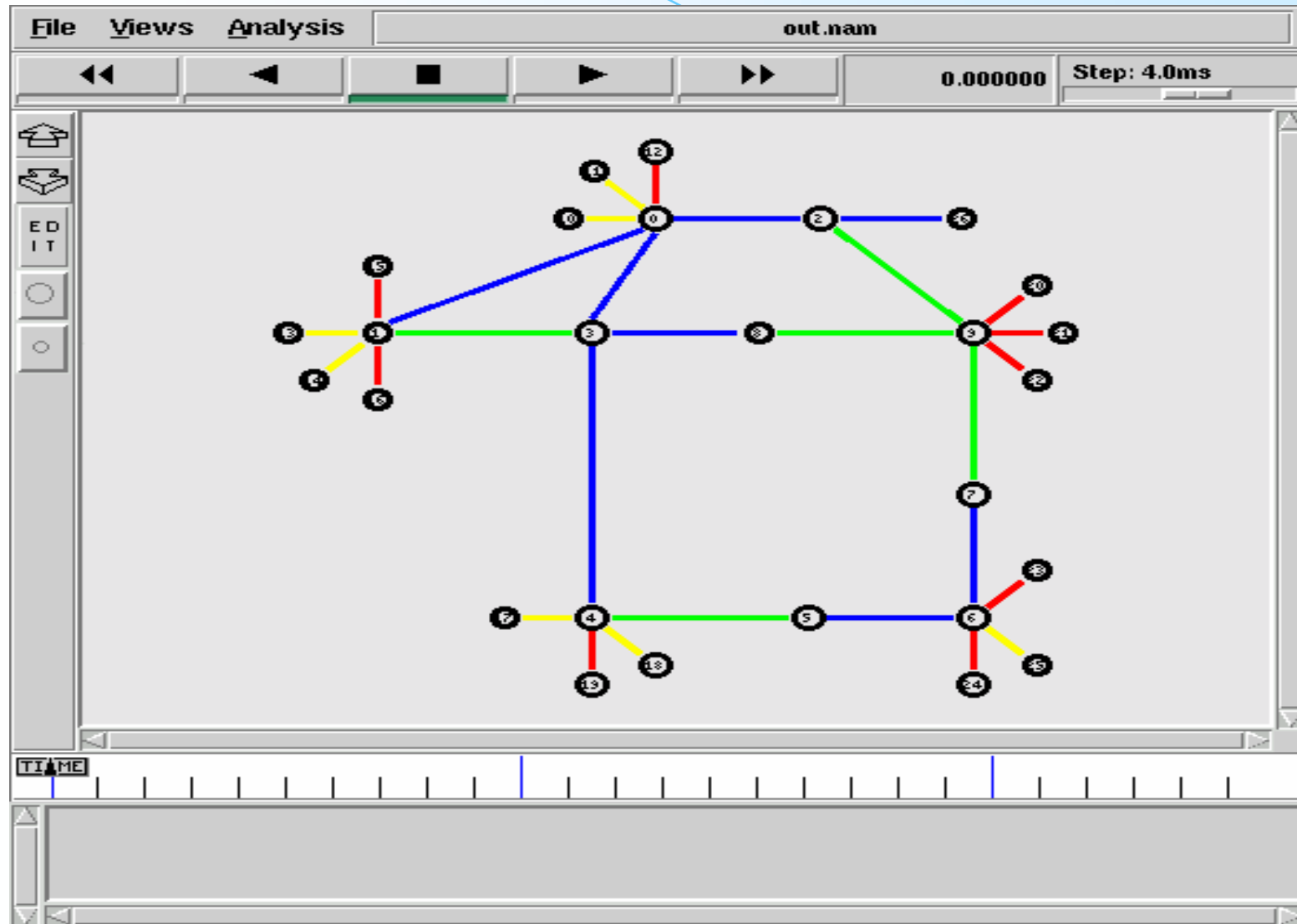
Functionality

- `cdn_client`
 - send a query to `cdn_dns`
 - when receiving the IP address resolved by the `cdn_dns`, send request to the address
 - when receiving packets from a `cdn_server`, simply free the packets
- `cdn_server`
 - when receiving a request from `cdn_client` (either directly or through a `cdn_router`), send the required contents to the `cdn_client`

Functionality (Cont.)

- `cdn_dns`
 - when receiving a request from a `cdn_client`, perform a lookup in its database and then reply by sending to the `cdn_client` the IP address of the appropriate `cdn_server`
- `cdn_router`
 - when receiving a request from a `cdn_client`, find from its server pool an appropriate server (based on such measure as the number of connections a server maintains, etc.), and then redirect the request to the `cdn_server` found

Verification Scenario

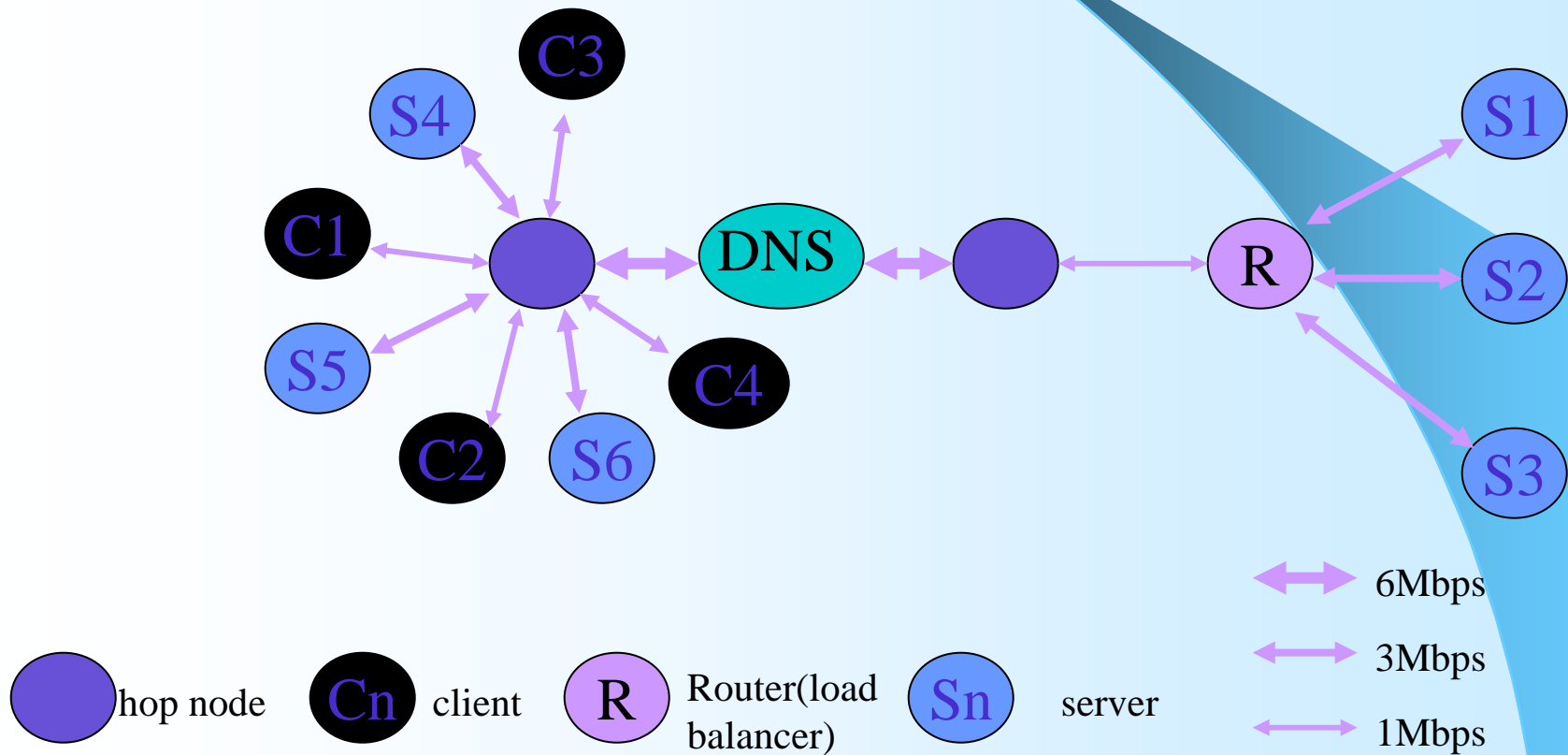


November 13, 2003

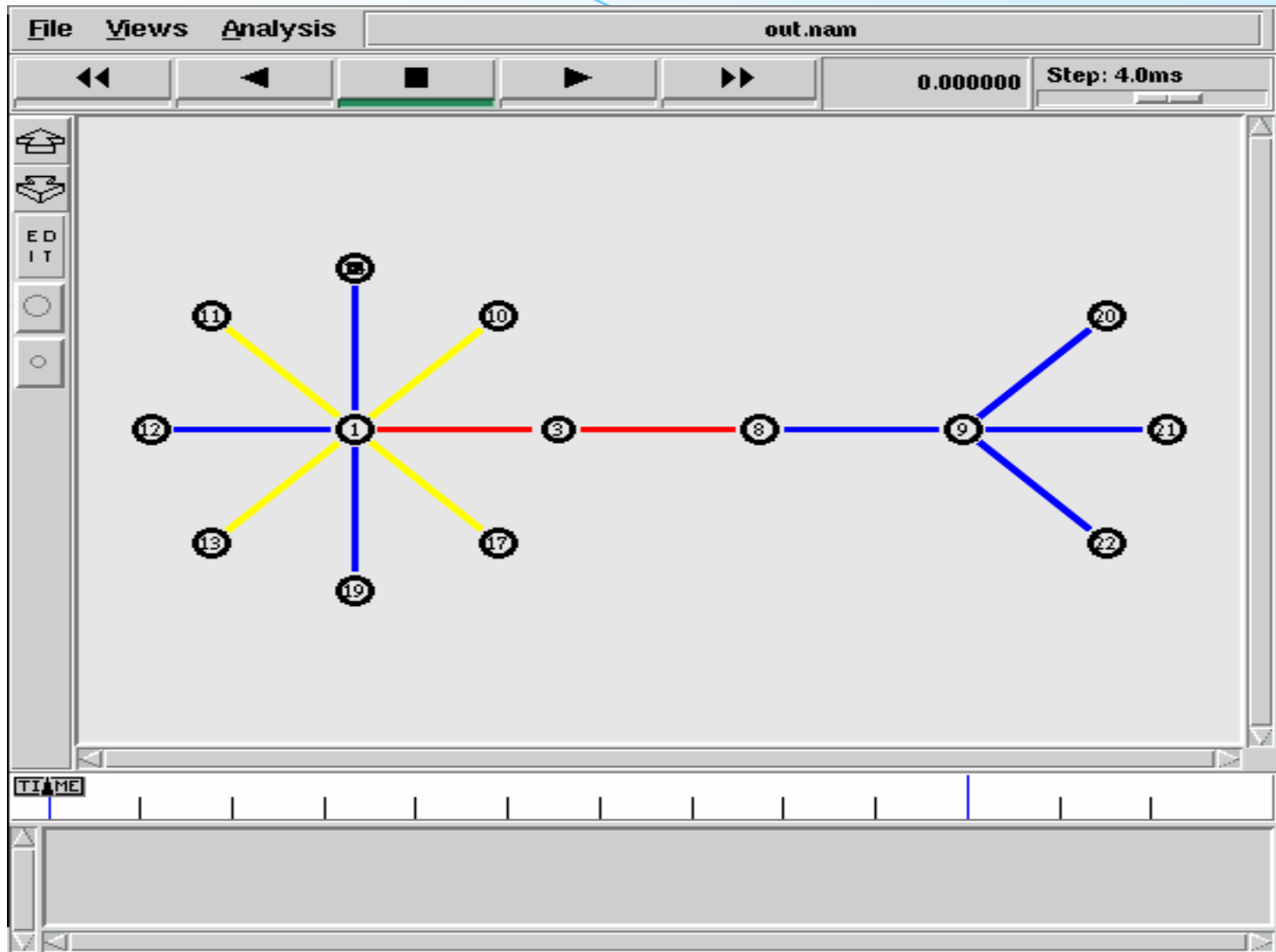
Analysis Scenario

-- RTT

-- packet loss



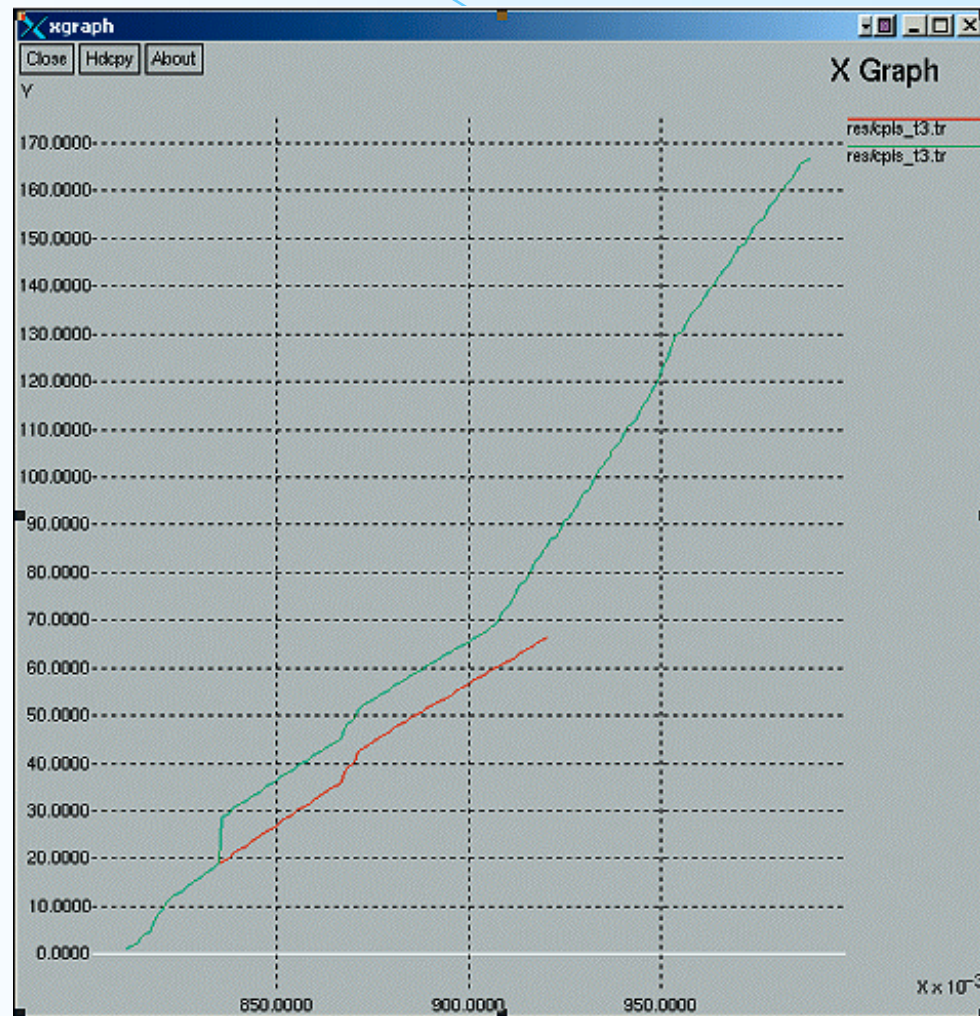
November 13, 2003



November 13, 2003

Test Results

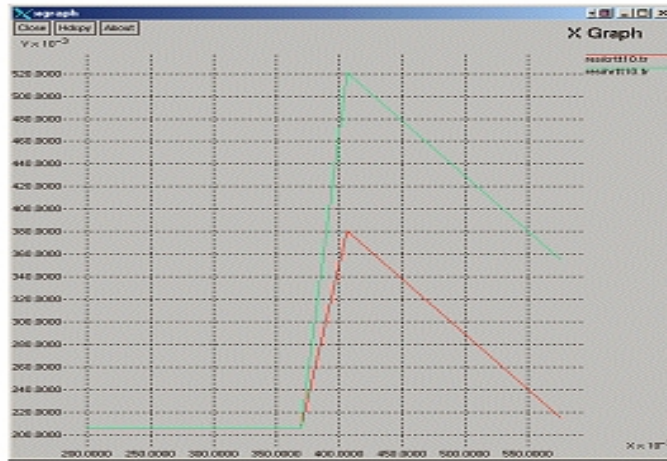
Packet loss



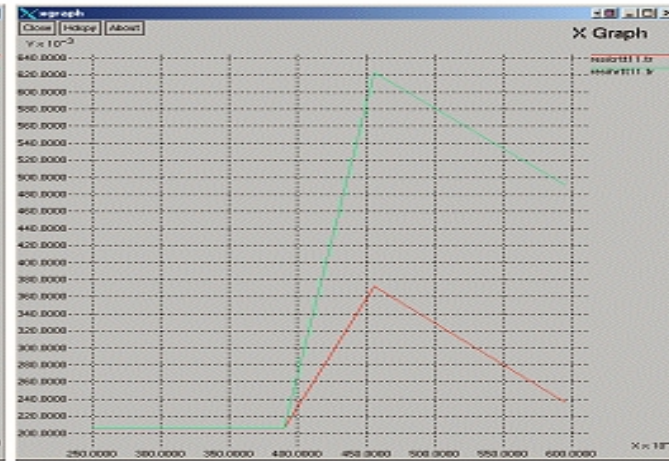
November 13, 2003

Test Results (Cont.)

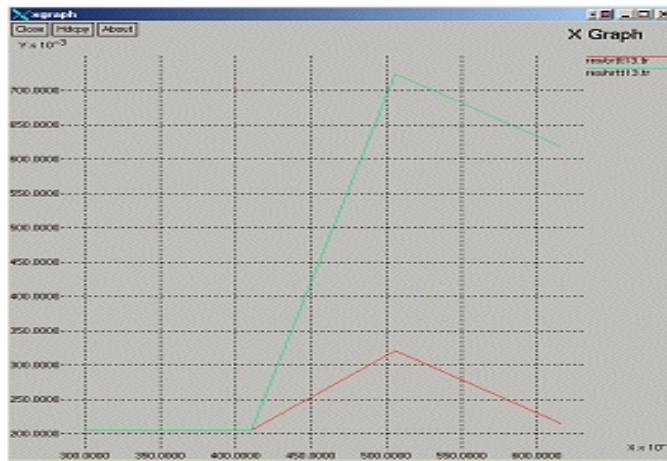
RTT



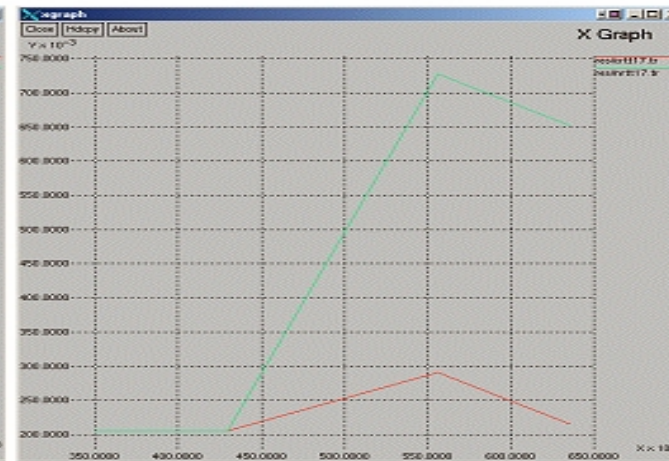
(a) RTT for C1



(b) RTT for C2



(c) RTT for C3



(d) RTT for C4

November 13, 2003

Test results show that CDN network performs better than Non-CDN network in terms of less packet loss and lower RTT. We have particularly noticed that some low-bandwidth links in the network could cause more packet loss in Non-CDN network than in CDN network as traffic in CDN tends to be distributed.

Conclusion

- A CDN makes transfer of large amount of hot data in a short response time possible by:
 - moving content to the edges of the Internet where it is closer to content consumers
 - Avoiding backbone network traffic congestion.
- This project aims to simulate two main techniques:
 - DNS Redirection
 - Local load Balancing

Future Work

- How to implement in ns-2 a local content table in CDN DNS server to store up-to-date information of all the content servers, and how to query the table efficiently.
- Implement better algorithms for the router to deal with server load in a server farm?

References

- [1] Kapil Agarwal and Vijay Radhakrishnan, "Content Switching", <http://www.ece.arizona.edu/~vijayr/ece678/678project.doc>
- [2] B.Cain, A.Barbir, R.Nair and O.Spatscheck, "Known CN Request-Routing Mechanisms", <http://www.ietf.org/internet-drafts/draft-ietf-cdi-known-request-routing-02.txt>
- [3] M.Day, B.Cain, G.Tomlinson, and P.Rzewski, "A Model for Content Internetworking(CDI)", <http://www.ietf.org/internet-drafts/draft-ietf-cdi-model-02.txt>
- [4] F.Douglis, I.Chaudhri, and P.Rzewski, "Known Mechanisms for Content Internetworking", <http://www.watersprings.org/pub/id/draft-douglis-cdi-known-mech-00.txt>
- [5] James Ryan, Aurangzaib Kaleem, and Brian Green, "Improving Web Content Delivery", <http://www.ee.vt.edu/~ee5984ld/ryan.pdf>.
- [6] Chenming Zhao and Wei Li, "Survey of Content Delivery Networks(CDNs)", <http://netlab1.bu.edu/~staro/546projects/CDN/CDNs/CDNs.doc>
- [7] "An Introduction to Content Distribution & Delivery", <http://www.cddcenter.com/101/index.htm>