Ensc 427 Final Project

"Analysis of BitTorrent Protocol, and Its Effect on Networks"

Group 11

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Road Map

- Overview
- Project Goals
- Implementation Details
- Result Analysis
- Conclusion / Discussion
- Difficulties

Overview: Peer-to-Peer Protocol

- The concept of P2P **(**Peer-to-peer) file sharing protocol began with the invention of the Napster Protocol in 1999.
- The client itself is the server.
- There are 2 types of P2P protocol that dominates the internet. The first one is Gnutella protocol (LimeWire, ShareAza) and the other one is BitTorrent protocol (BitTorrent, Vuze).
- P2P is a easy way for sharing files.
- Inefficient protocol and congests network.

Overview: BitTorrent Protocol

- BitTorrent is a peer-to-peer file sharing protocol used for distributing large amounts of data.
- Every client is capable of to preparing, requesting, and transmitting any type of data over a network, using the protocol.
- The clients that provide the files are called Seeds while the client that downloads the file are called Peers.
- Every peer who downloads a part of the data also makes the data available for other peers.
- After a peer completed downloading data, it may continue to make the data available and becomes additional Seeds.

Overview: Tracker

- A BitTorrent tracker is a server that assists in the communication between peers using the BitTorrent Protocol.
- Tracker provides the list of the clients participating in the file sharing.
- Clients are required to communicate with the tracker to initiate downloads.
- Replaces query flooding method.

Overview: Rarest First Algorithm

- The rarest first algorithm is the piece selection strategy used in BitTorrent.
- It may lead to the scarcity of some pieces.
- Each peer maintains the number of copies in its peer set of each piece. The algorithm uses this information to define a rarest pieces set.
- The rarest pieces set of a peer is updated each time, a copy of a piece is added to or removed from its peer set.
- Each peer selects the next piece to download at random in its rarest pieces set.

Overview: Choke Algorithm

- The choke algorithm is the peer selection strategy used in BitTorrent.
- Prevent free riders
- Peers that never upload, should be penalized.
- Leading to an equilibrium in the peer selection.
- To guarantee a reasonable level of upload and download reciprocation.

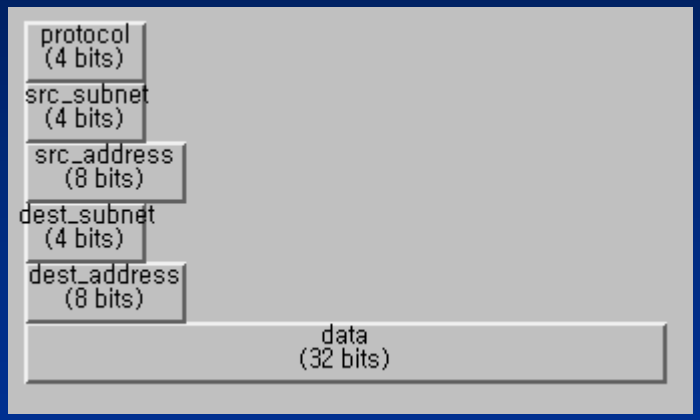
Project Goals

- To figure out how peer-to-peer file sharing congests various types of network .
- Building a small network containing a server and several clients.
- Introducing a few p2p nodes to the network and observe the effect.
- Replacing the p2p nodes with the BitTorrent nodes and observe if there are improvements.
- Do same with a large network.

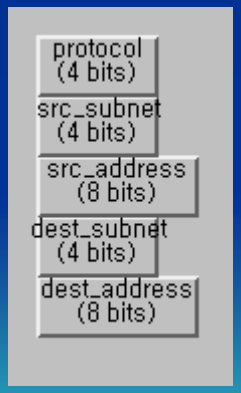
Implementation: Introduction

- In this project, we used the OPENT 14.0 to do the simulation.
- We built two types of packet formats:
  - Normal Packet
  - P2P Packet
- Four types of nodes:
  - Normal Client / Server Users
  - P2P User
  - Improved P2P User - BitTorrent
  - Routers
- Two types of networks:
  - Small Network
  - Large Network

Implementation: Packet formats



P2P packet format

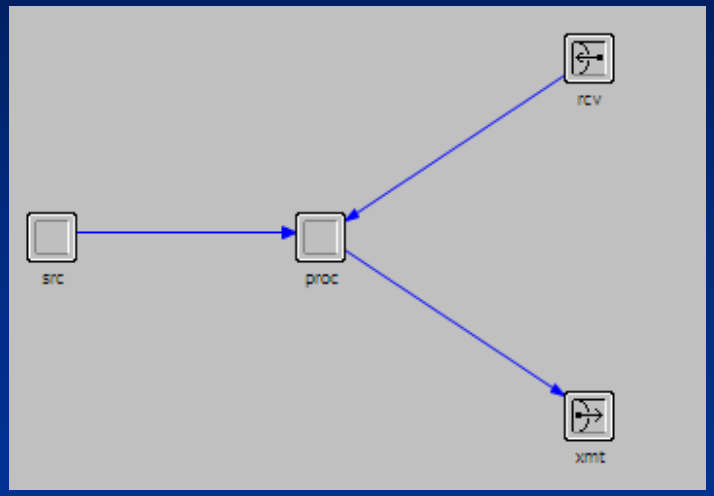


Normal packet format

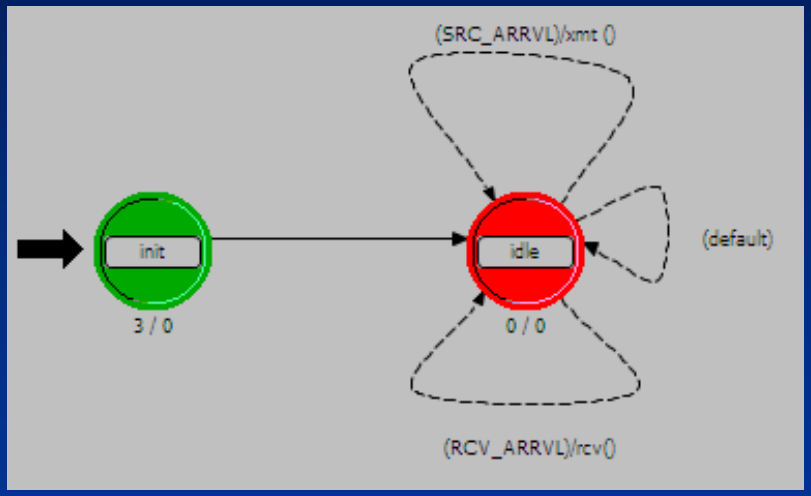
- Two types of packet formats are used in our simulation.

- Value stored in protocol indicates the packet type.
  - Request : protocol = 0
  - Reply : protocol = 1
  - Normal : protocol = 2

Implementation: Normal Users



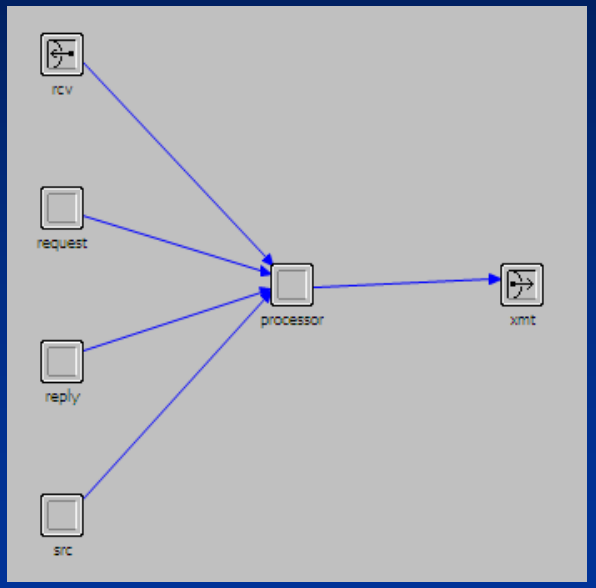
Normal user node model



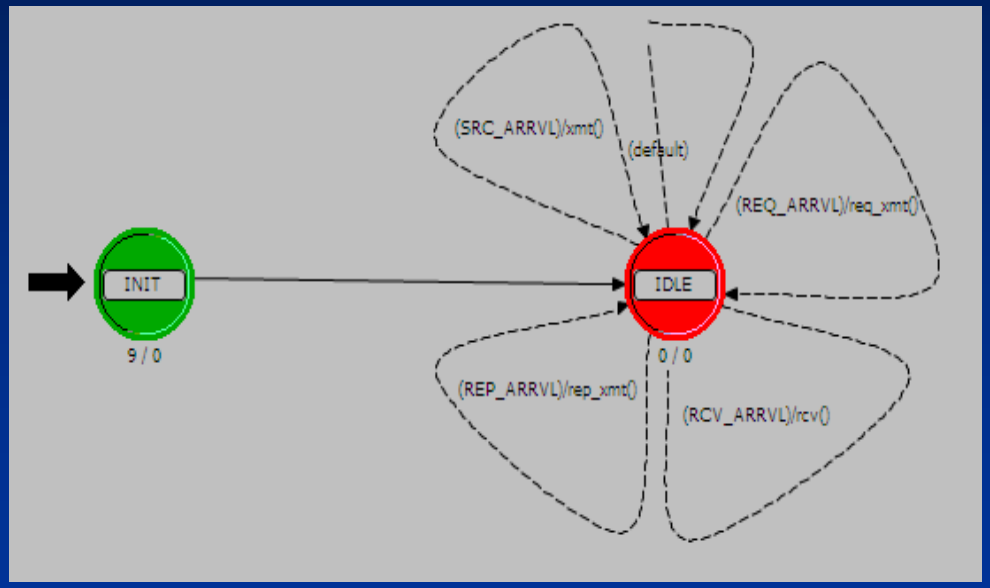
Normal user process model

- Simple server and client models.
- Constantly transmit and receive packets.
- End-to-end delay is calculated.

Implementation: P2P Users



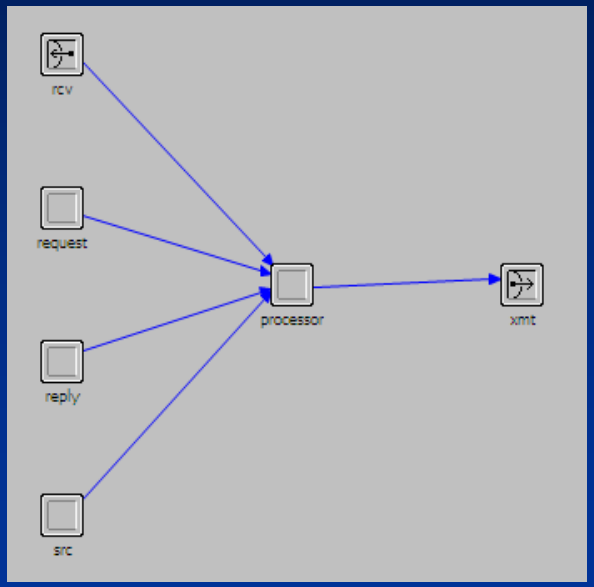
P2P user node model



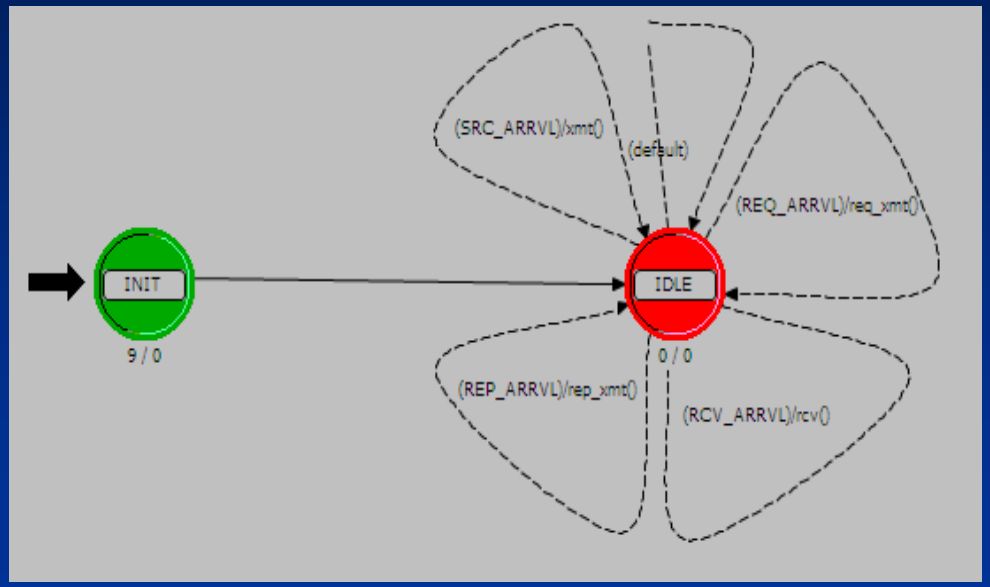
P2P user process model

- Simplified P2P user models.
- Constantly transmit two additional packets, REQUEST and REPLY to random address.

Implementation: BitTorrent Users



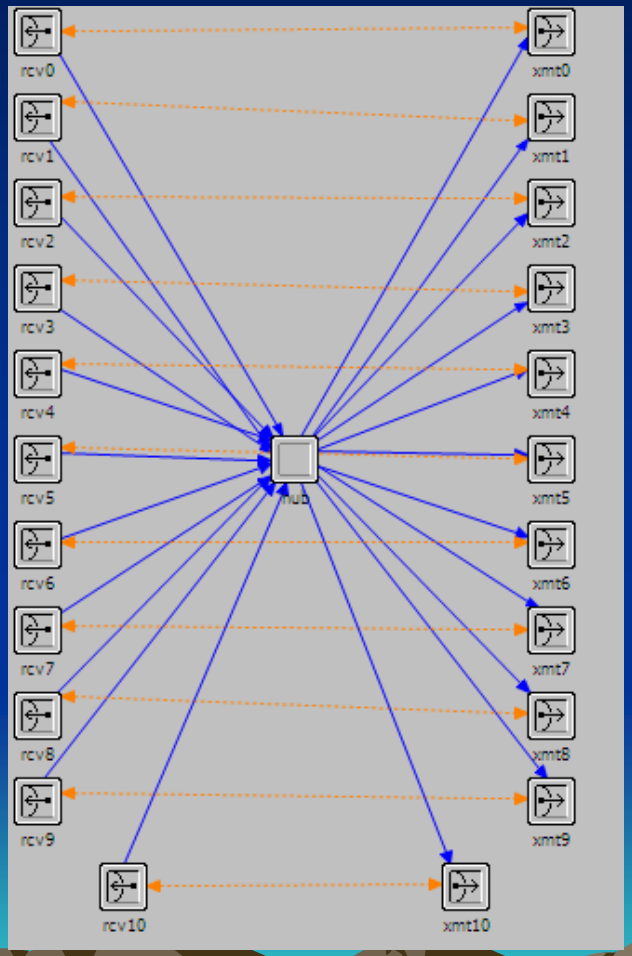
BitTorrentuser node model



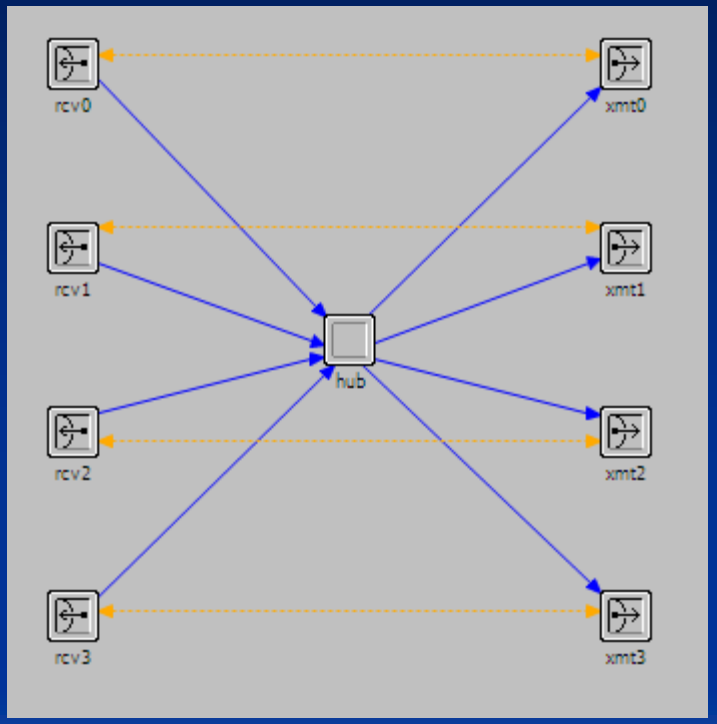
BitTorrent user process model

- Simplified BitTorrent user models.
- Transmit REQUEST to other BitTorrent Users only.
- Transmit REPLY to limited number of clients.

Implementation: hub models

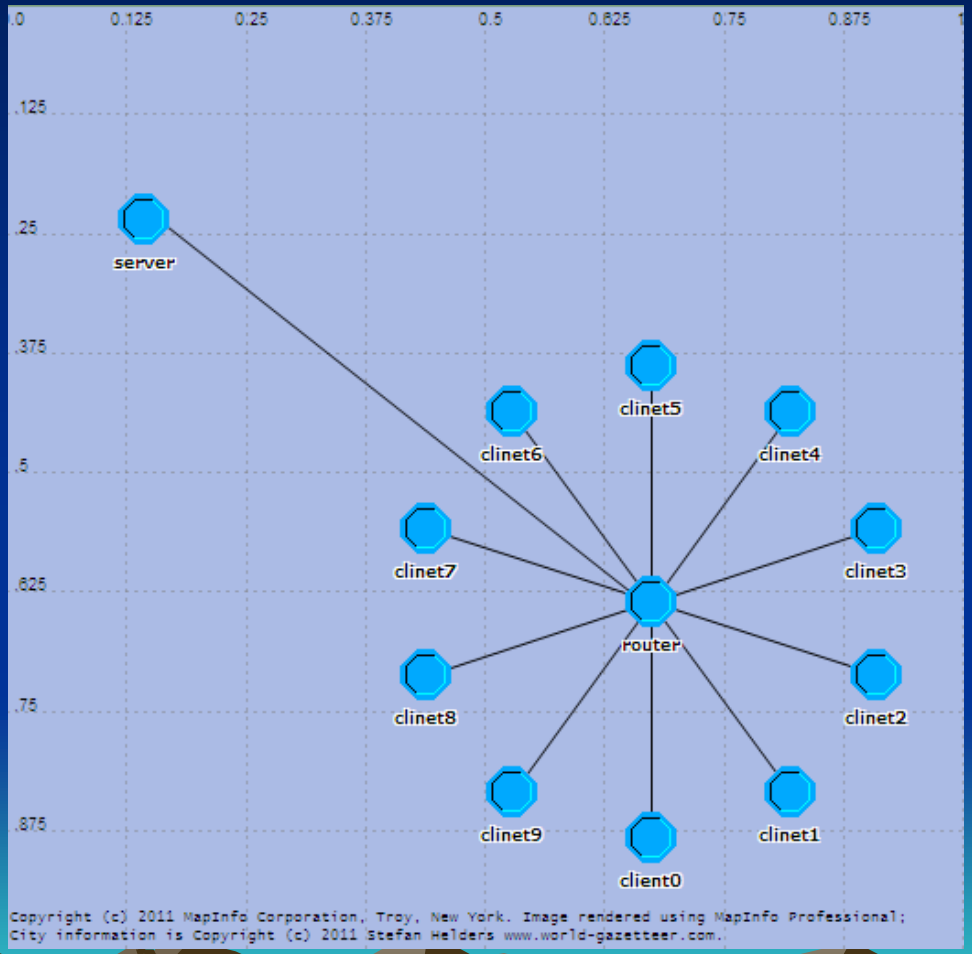


Hub with 11 receivers and transmitters



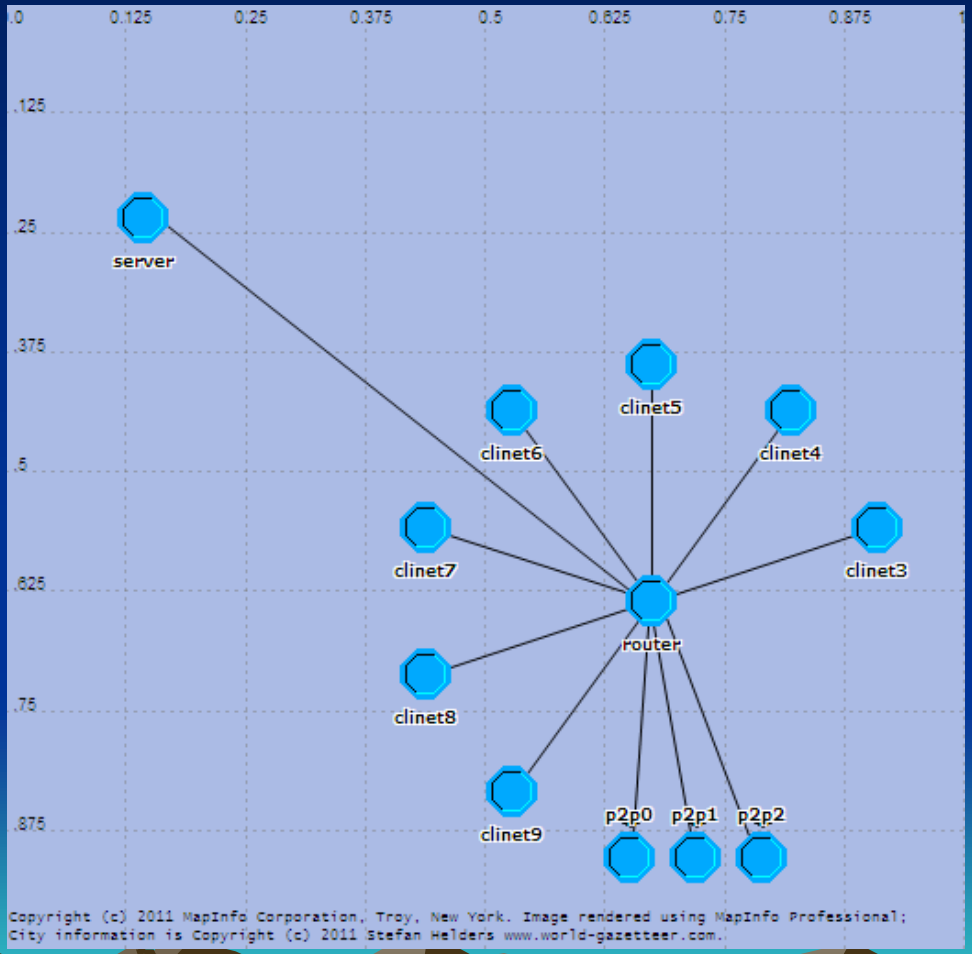
Hub with 4 receivers and transmitters

Implementation: Small Network



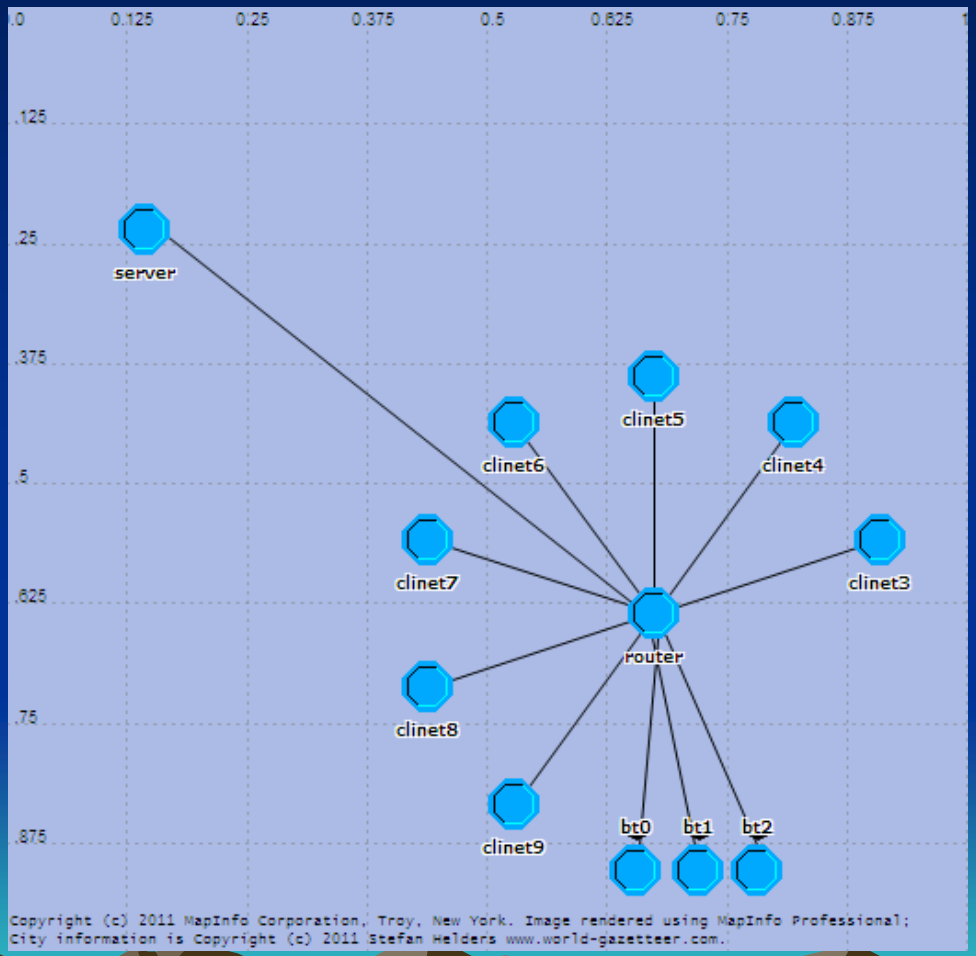
Small network: normal users only

Implementation: Small Network



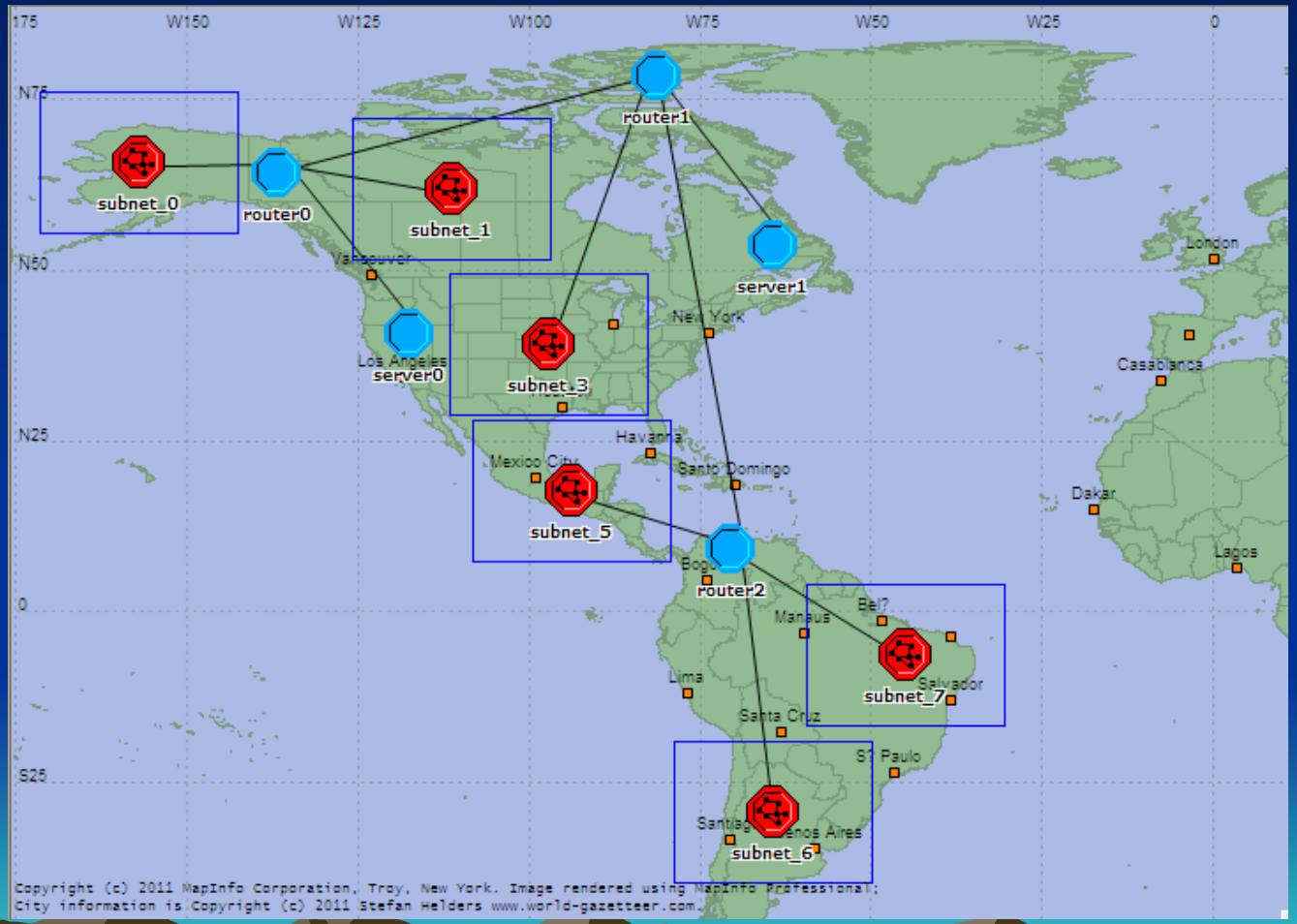
Small network: p2p peers introduced

Implementation: Small Network



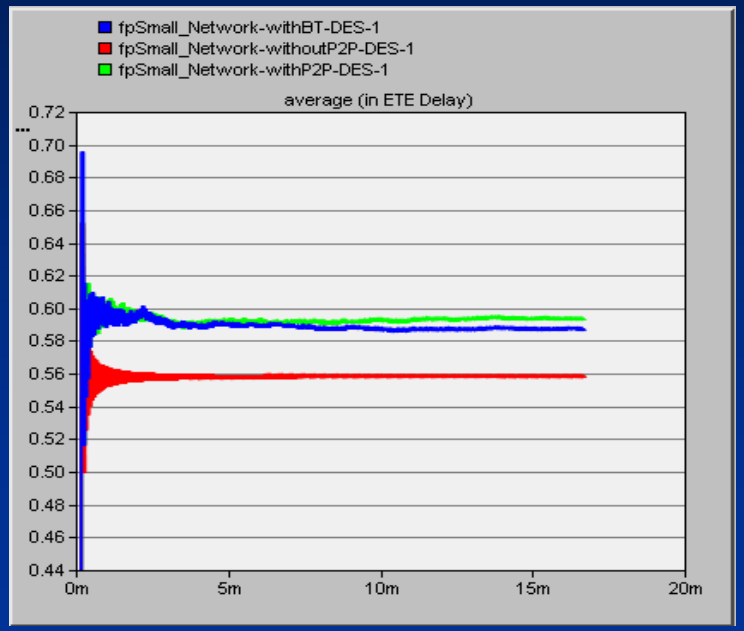
Small network: BitTorrent peers introduced

Implementation: Large Network

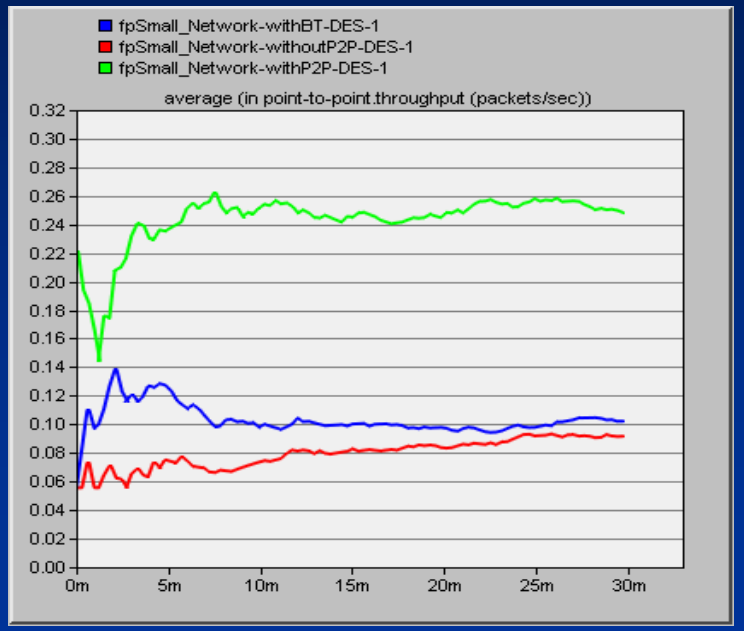


Large network

Result Analysis: Small Network



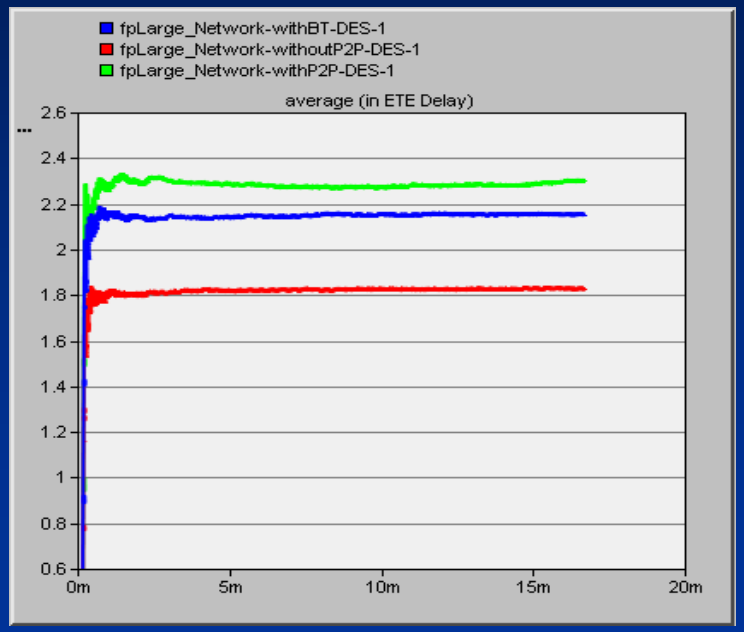
End-to-end delay graph



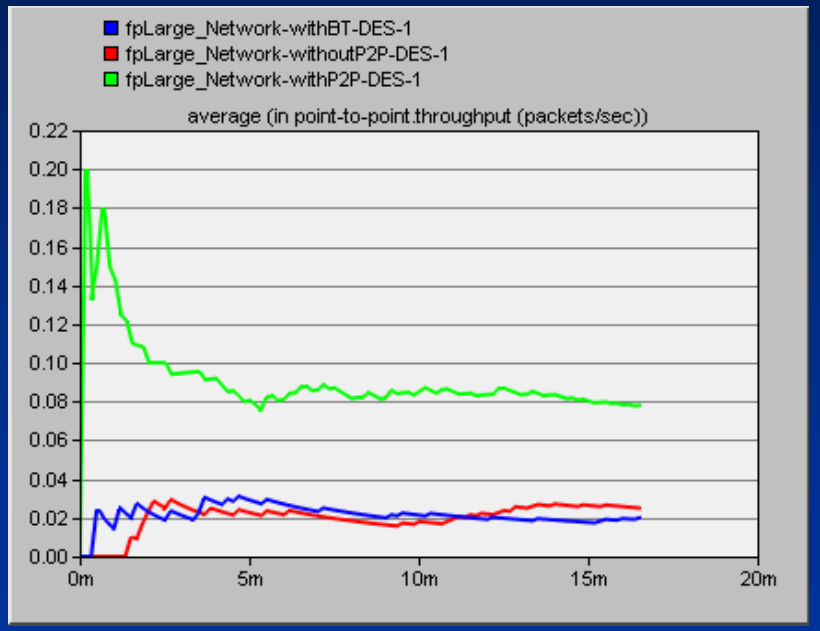
Throughput (packets/sec) graph

- Network *end-to-end delay* comparison:
  - Without p2p < with BitTorrent p2p < with normal p2p.
- Network throughput comparison:
  - Without p2p < with BitTorrent p2p < with normal p2p.

Result Analysis: Large Network



End-to-end delay graph



Throughput (packets/sec) graph

- Similar behaviour as the small network.

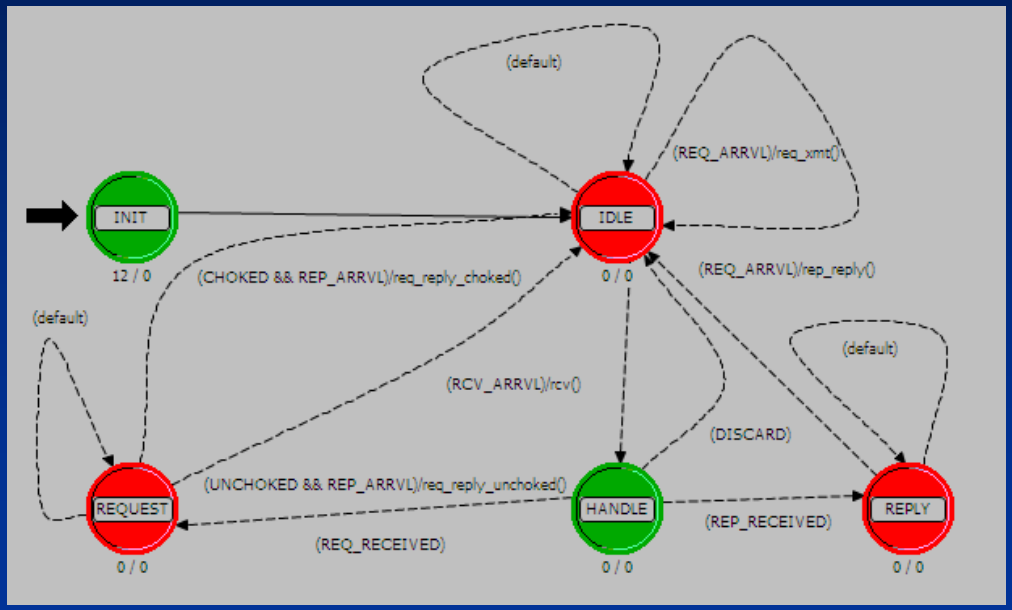
Conclusion

- P2P data communication increases end-to-end delay on the network.
- Non-P2P users receive unwanted packets.
- Introduction of tracker and choke algorithm reduces the network congestion but end-to-end delay on the network is still much longer compare to network without P2P.

Discussion

- Problems:
  - P2P communications are very common in these days.
  - Non-P2P users or services are experiencing network congestion caused by P2P users.
- Possible Solutions:
  - Improved P2P protocol.
  - P2P traffic detection algorithm [3].
  - P2P throttling [5].

Difficulties



- Learning how to use a new tool, OPNET.
- Not much resources available.
- Getting familiar with a new protocol, BitTorrent.

References

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Questions???

Thank you!