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P2PRG: ALTO simulations on ns-3

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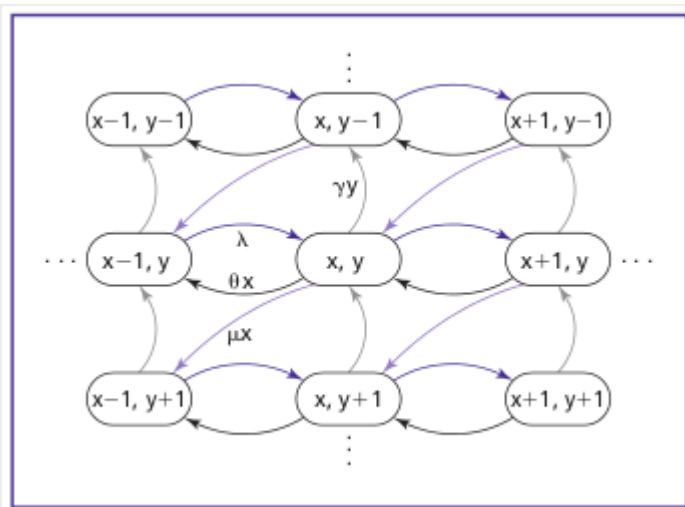
(Joint work with: Ivica Rimac and Bill
Roome, Bell Labs)

Introduction

- Develop a ns-3 Bittorrent model to study effects of ALTO in a controlled simulated environment.
- Chose packet level discrete event simulator for completeness.
- Complete Bittorrent model (Wireshark recognizes traffic produced from model as Bittorrent protocol).

Stability equations

- Steady state behavior based on fluid model in [1].

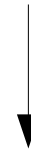


2-D Markov state transition chain

$$\frac{dx}{dt} = \lambda - z(t) - \theta x(t)$$

$$\frac{dy}{dt} = z(t) - \gamma y(t)$$

λ : Arrival Rate
 $z(t)$: rate of leeches becoming seeds
 θ : Leech abort rate
 γ : Seed churn rate
 x : Instantaneous leeches
 y : Instantaneous seeds

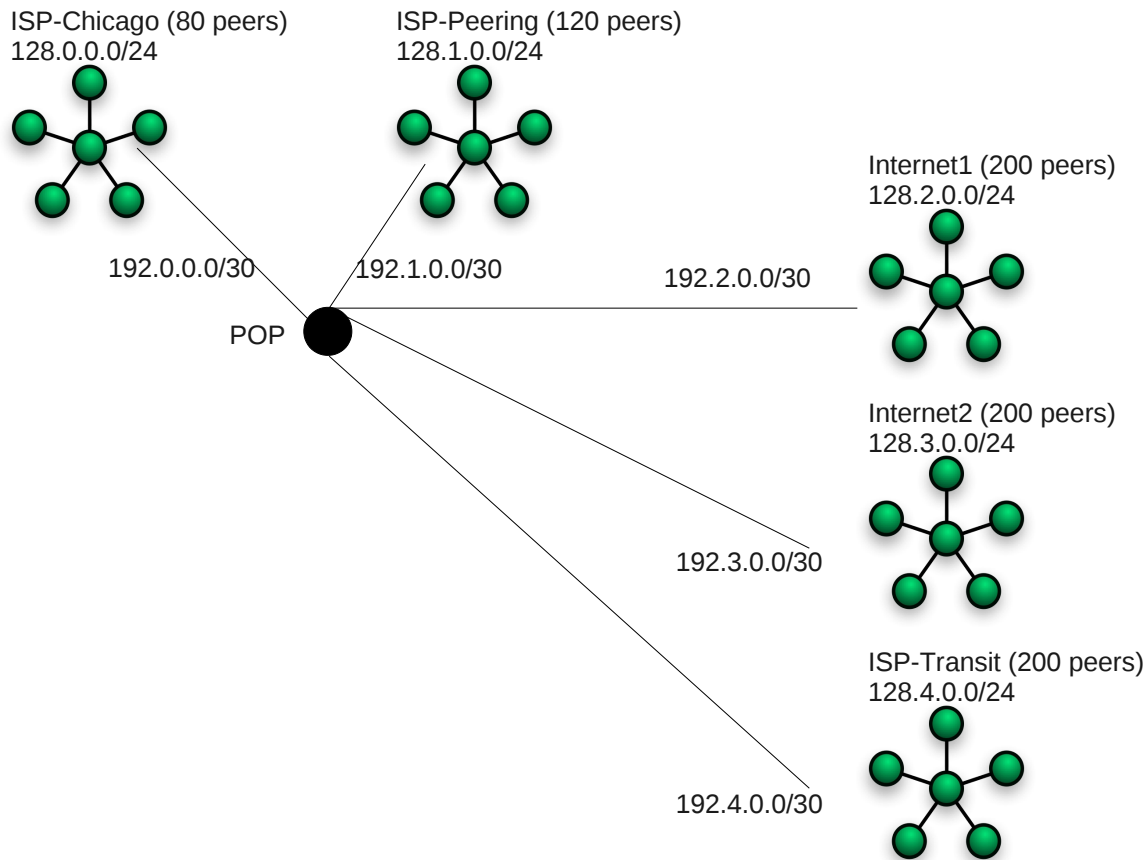


$$x_{\infty} = \frac{\lambda l - c\lambda/\gamma - C_S}{\theta l + c(\eta - \theta/\gamma)}$$

$$y_{\infty} = \frac{\lambda}{\gamma} - \frac{\theta}{\gamma} \frac{\lambda l - C_S - c\lambda/\gamma}{\theta l + c(\eta - \theta/\gamma)}$$

$$z_{\infty} = \lambda - \theta \frac{\lambda l - C_S - c\lambda/\gamma}{\theta l + c(\eta - \theta/\gamma)}$$

ALTO simulation topology



BitTorrent tracker started on Internet1.

ALTO server in ISP-Chicago.

No constraints on data rate, except that the upload speed for all peers is fixed at 50kbps.

Delay on the links is approximately 0.20 ms.

Steady state calculations done with 500 peers; although swarm can grow to 800.

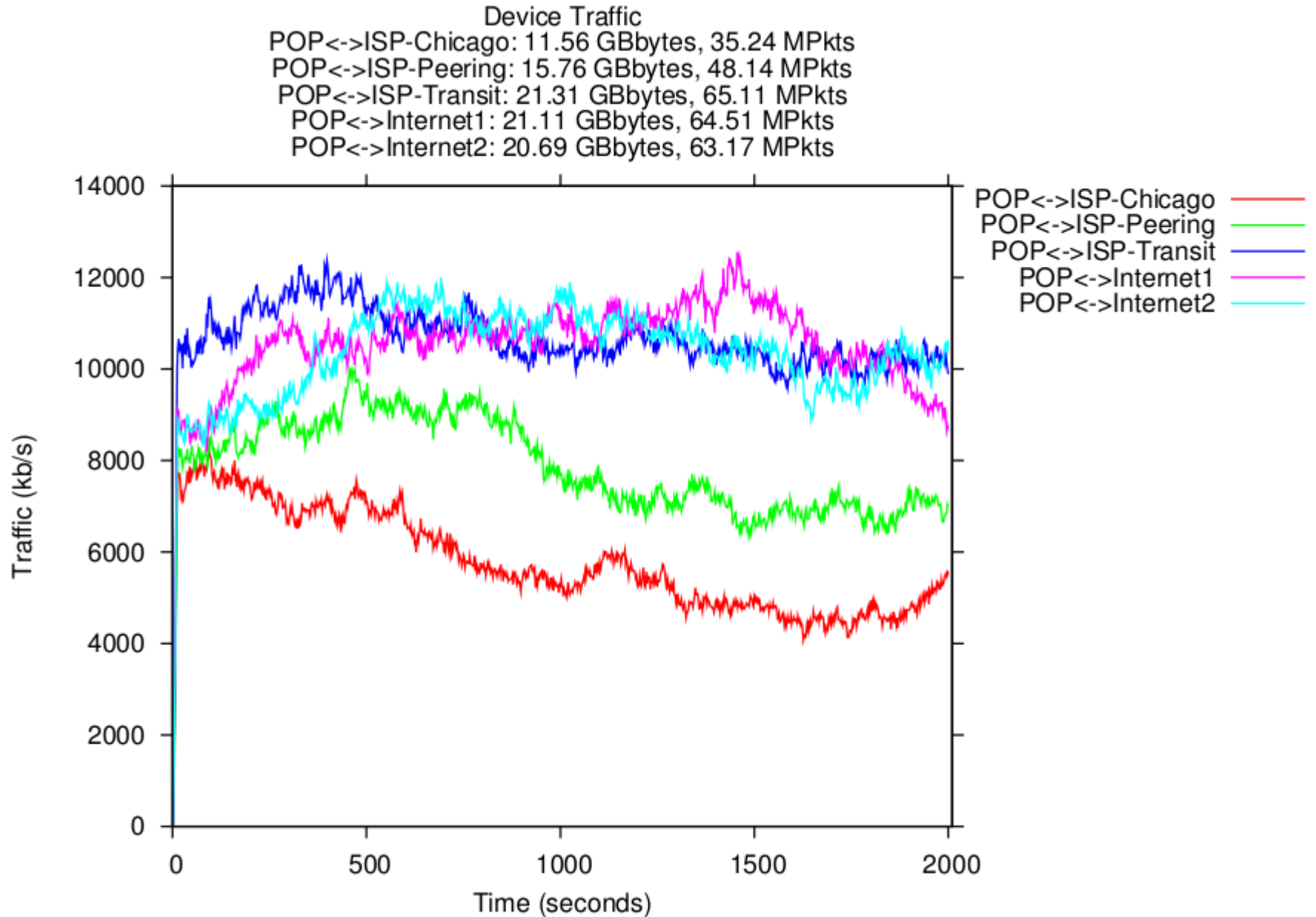
Peers arrive with pre-loaded content drawn from a uniform distribution of [0-100]

Simulations

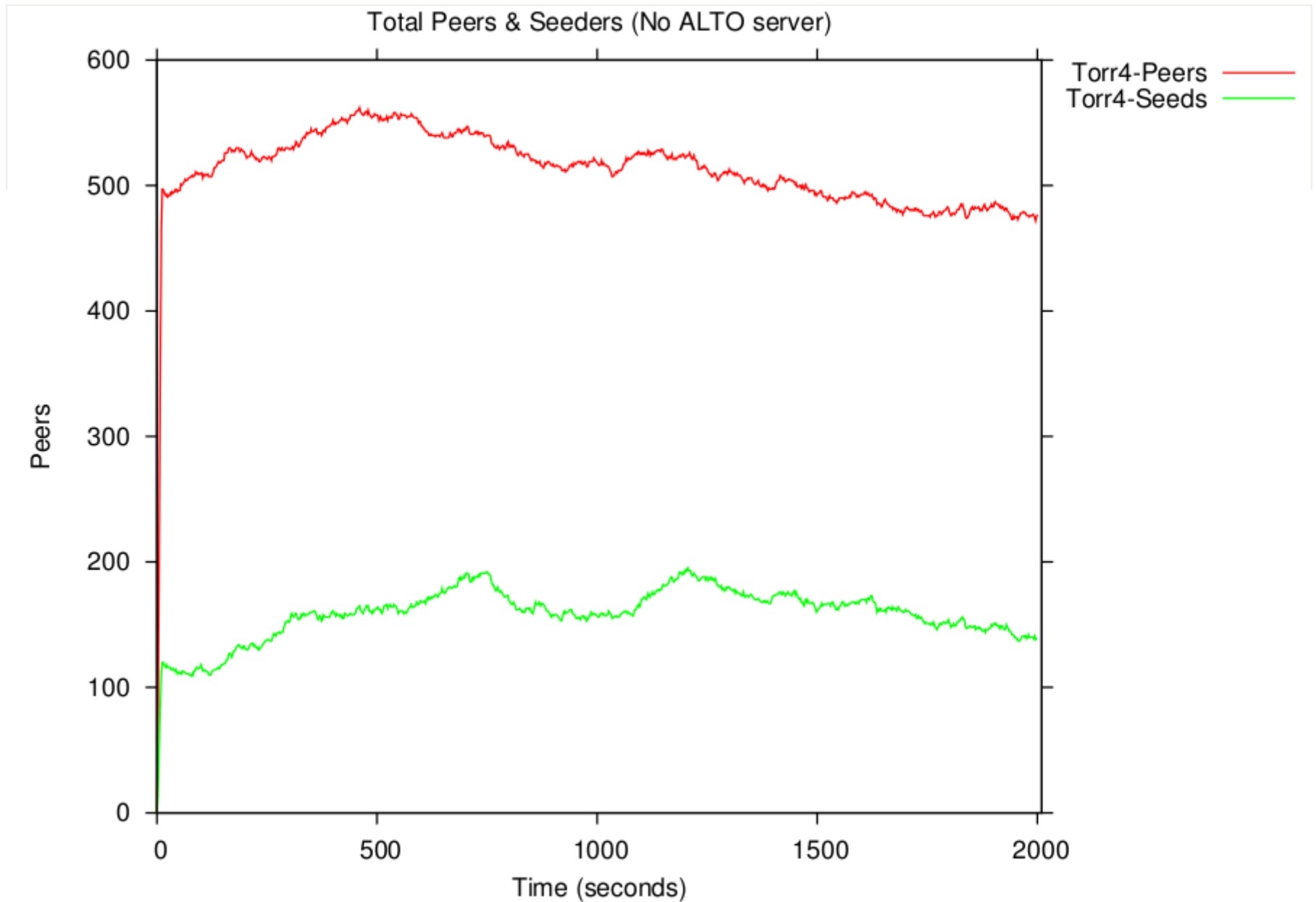
- Ran two simulations:
 - Normal run --- No ALTO server. Only BitTorrent tracker.
 - Simulation 1: ALTO server + BitTorrent tracker.
- Cost Map:

Source	Destination	Cost
PID 1	PID 1, PID 2	0
PID 1	PID 3, PID 4	1
PID 1	PID 5	10

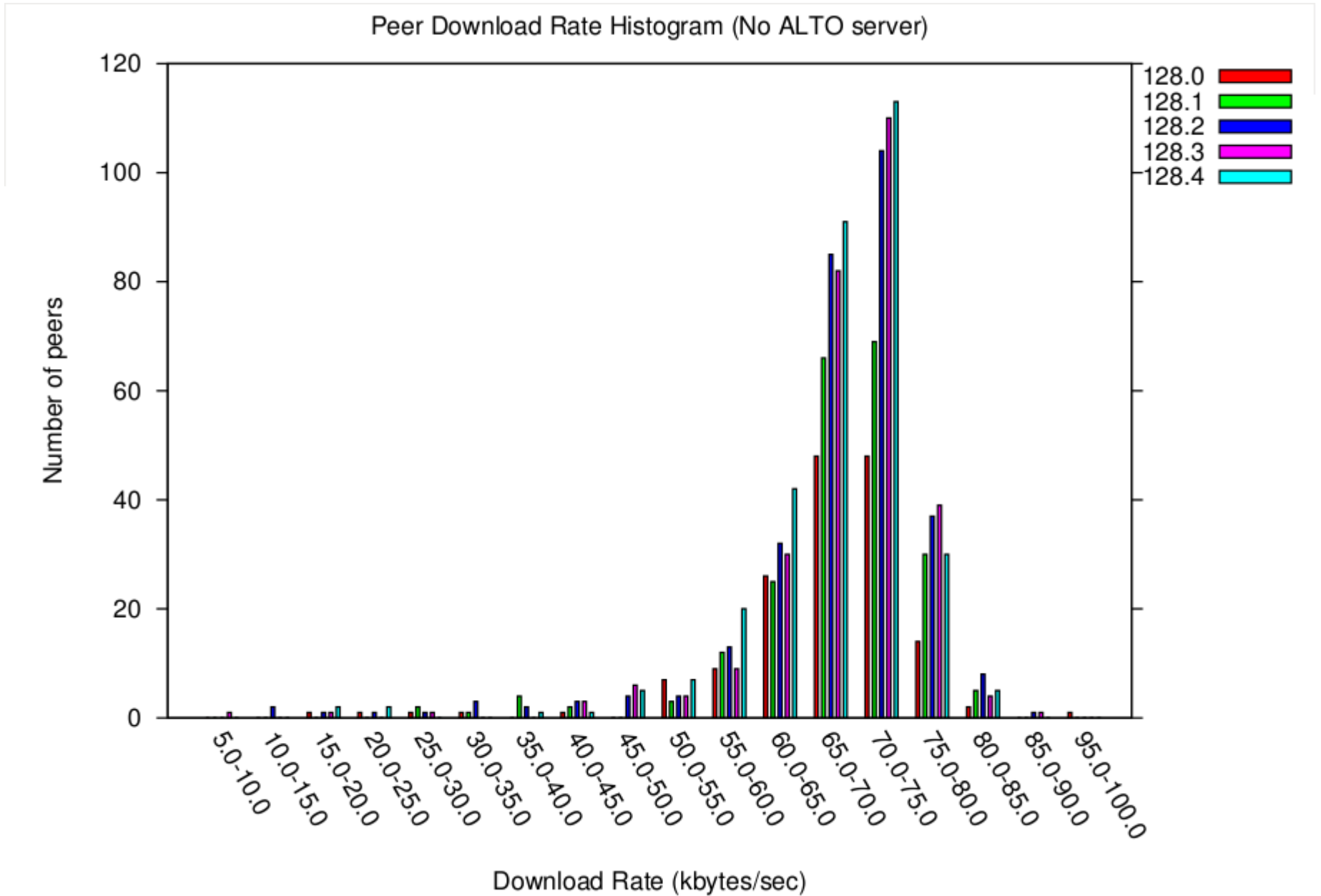
Results: Normal



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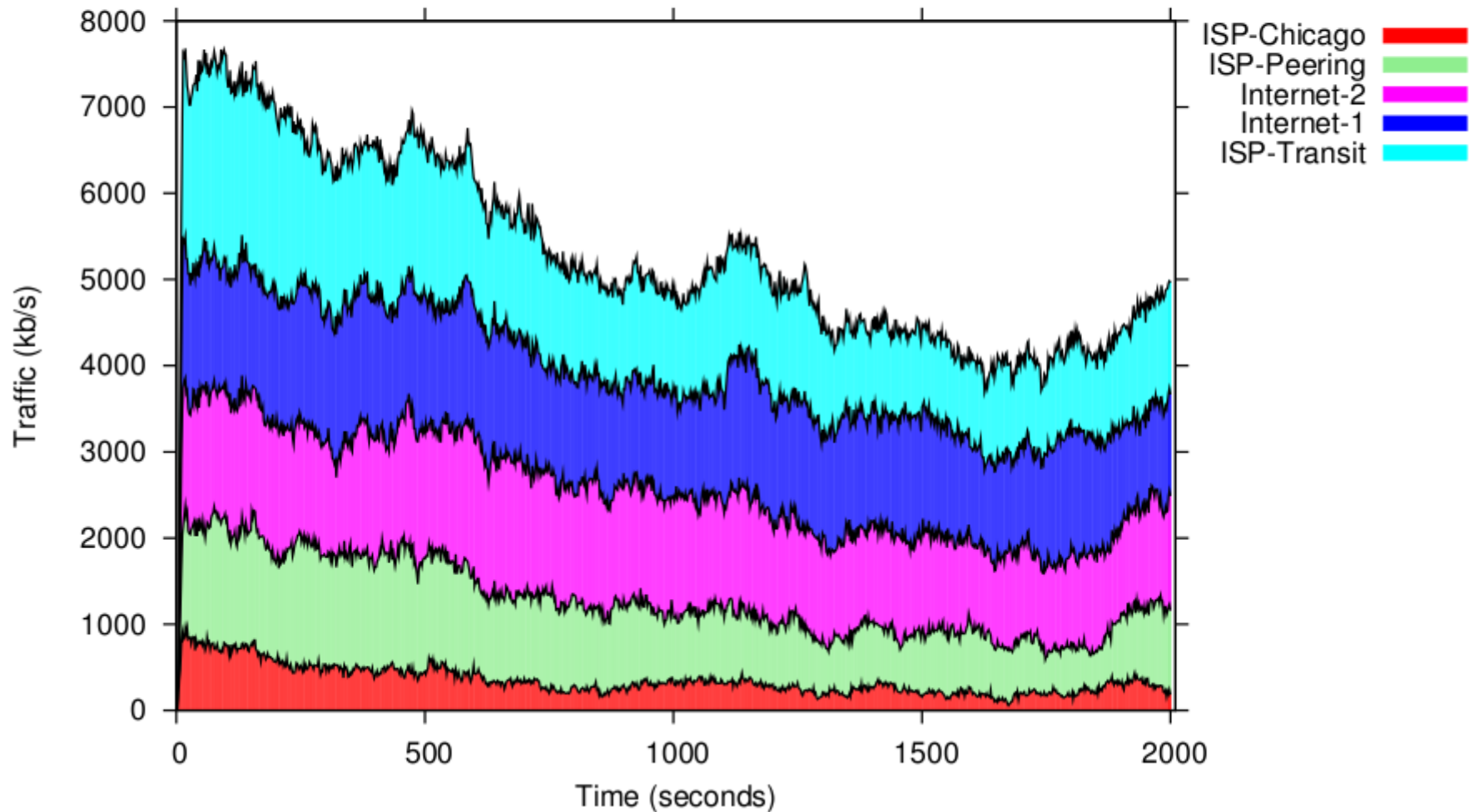


Results: Normal



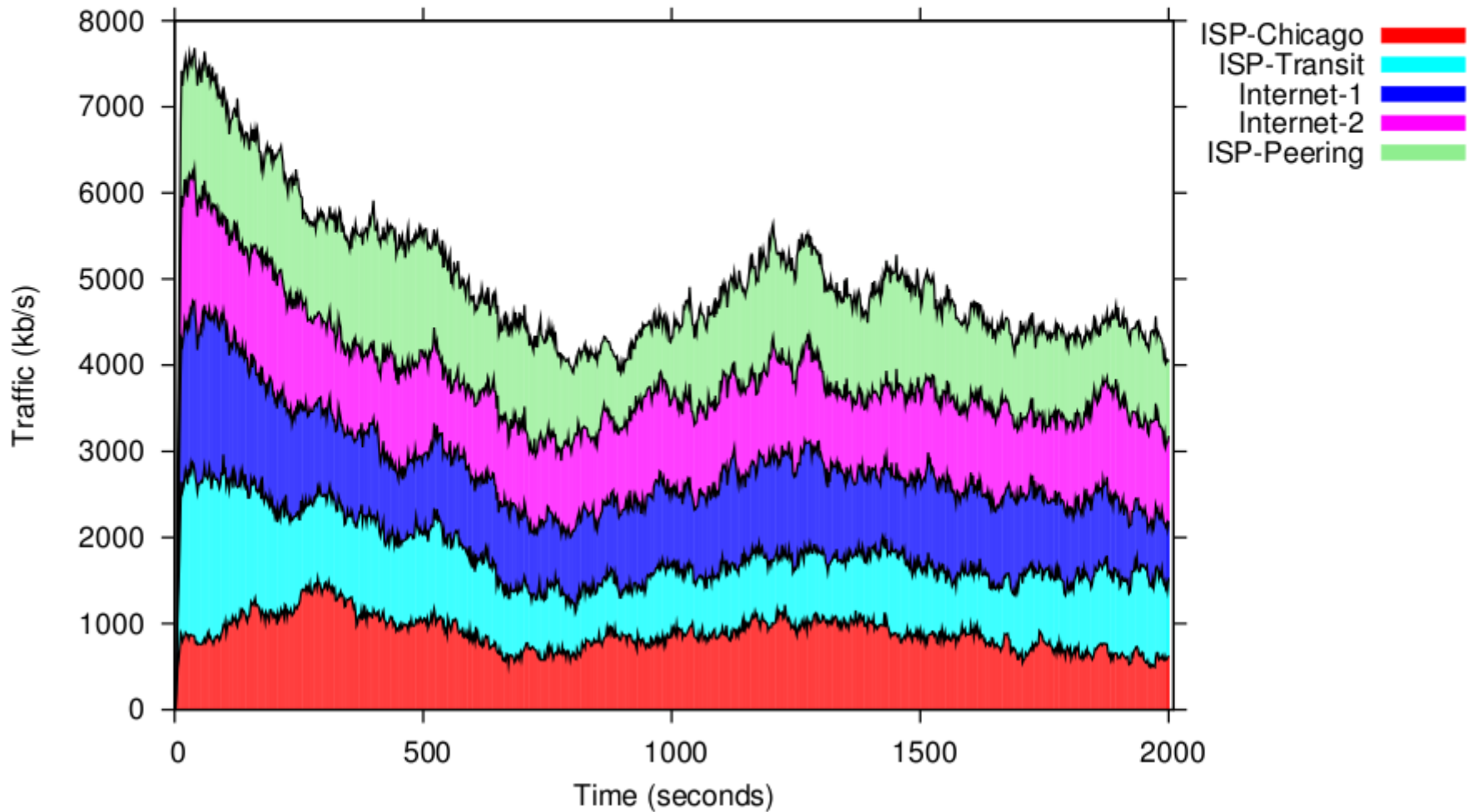
Results: Normal

No ALTO server
Traffic for ISP-Chicago
ISP-Chicago: 700.65 MBytes
ISP-Peering: 1.89 GBytes
Internet-1: 2.72 GBytes
Internet-2: 2.59 GBytes
ISP-Transit: 2.76 GBytes



Results: Simulation 1

ALTO server: Simulation 1
Traffic for ISP-Chicago
ISP-Chicago: 1.78 GBbytes
ISP-Peering: 2.26 GBbytes
Internet-1: 2.03 GBbytes
Internet-2: 2.12 GBbytes
ISP-Transit: 1.84 GBbytes



Results: Simulation 1

- Quality of Experience in Simulation 1 is approximately same as that of the Normal case.
 - QoE is a function of upload capacity, which is the same in both simulations.
- Total peer and seeder rate is the same as the Normal case (steady state and stable behavior).

Wrap up

- NS-3 Bittorrent model to be released at the following URL:

<https://open-innovation.alcatel-lucent.com/svn/ns-3-bittorrent>

- Questions: vkg@bell-labs.com