

# Opportunities for R&D in Named Data Networks



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My code is at: <http://github.com/mohittahiliani>

# Outline of the presentation

- ❑ Overview of Named Data Networks
- ❑ NDN terminologies
- ❑ NDN Forwarding and Transport
- ❑ Our contributions: BCON and GCPiN
- ❑ ndnSIM: ns-3 based Named Data Networking Simulator
- ❑ NFD: NDN Forwarding Daemon
- ❑ NDN Applications: ChronoChat
- ❑ Next goals

# Overview of Named Data Networks

- ❑ *IP architecture*: communication oriented, difficult to scale
- ❑ *Why*: it is IP (location) centric, not suitable for one-to-many applications
- ❑ *Today's demand*: efficient architecture to do content distribution
- ❑ *Potential solution*: focus more on content than the location of content
- ❑ *Ongoing discussions*: Information Centric Networking (ICN)
- ❑ *NDN*: a specific architecture design under the umbrella of ICN
- ❑ *NDN Project*: Funded by NSF, led by UCLA and Van Jacobson
- ❑ *Project website*: <http://named-data.net/>

# Overview of Named Data Networks

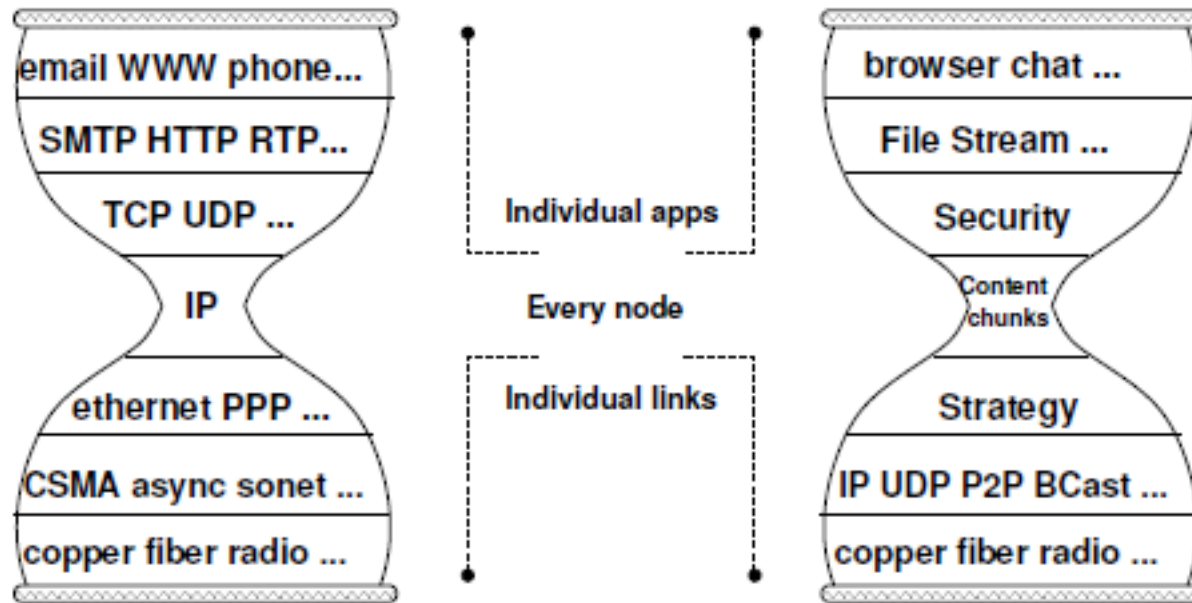


Image credits: Jacobson, Van, et al. "Networking named content." Proceedings of the 5th international conference on Emerging networking experiments and technologies. ACM, 2009.

# NDN terminologies

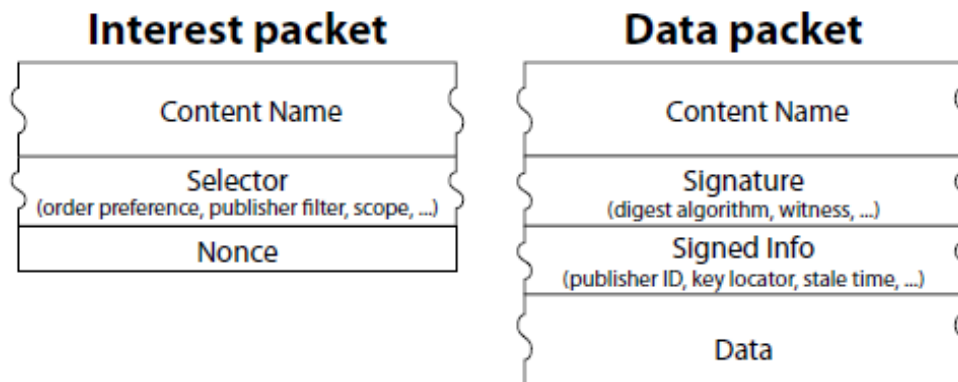
❑ Two types of packets in NDN:

- *Interest* packet (= *request* packet)
- *Data* packet (= *reply* packet)

❑ Two end entities:

- *Consumer*: asks for content
- *Producer*: provides content

❑ NDN router: different from a traditional IP router



# NDN Forwarding and Transport

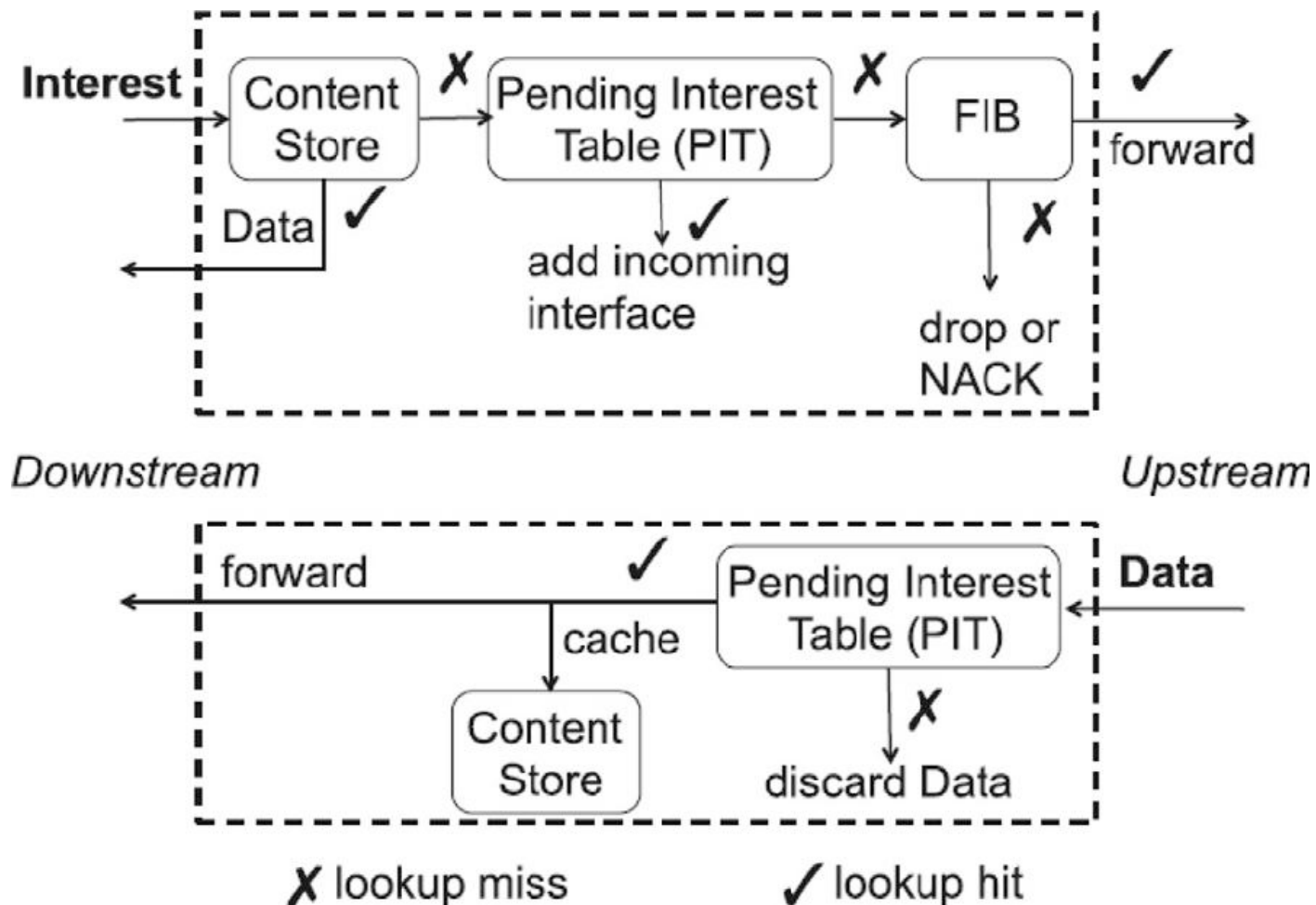


Image credits: Jacobson, Van, et al. "Networking named content." Proceedings of the 5th international conference on Emerging networking experiments and technologies. ACM, 2009.

# NDN Forwarding and Transport

- ❑ *TCP*: is being considered for use in NDN
- ❑ *Issues*: RTT and RTO measurements might be highly inaccurate
- ❑ *Interest Rate Shaping*: controlling the sending rate of Interest packets
- ❑ *Three categories of Interest Rate Shaping algorithms*:
  - receiver (*or consumer*) driven
  - hop-by-hop
  - hybrid

# Our contributions: BCON

- ❑ *Designed a new model for congestion avoidance in NDN*

*Result* - Back pressure based Congestion Avoidance Model (BCON)

*Goal* - minimize packet drop rate and enhance link utilization

*Proof of concept* - by using ARED, CoDel and PIE AQM algorithms

- ❑ *Compared BCON model with traditional NDN-AIMD approach*

*Tools used* - ndnSIM

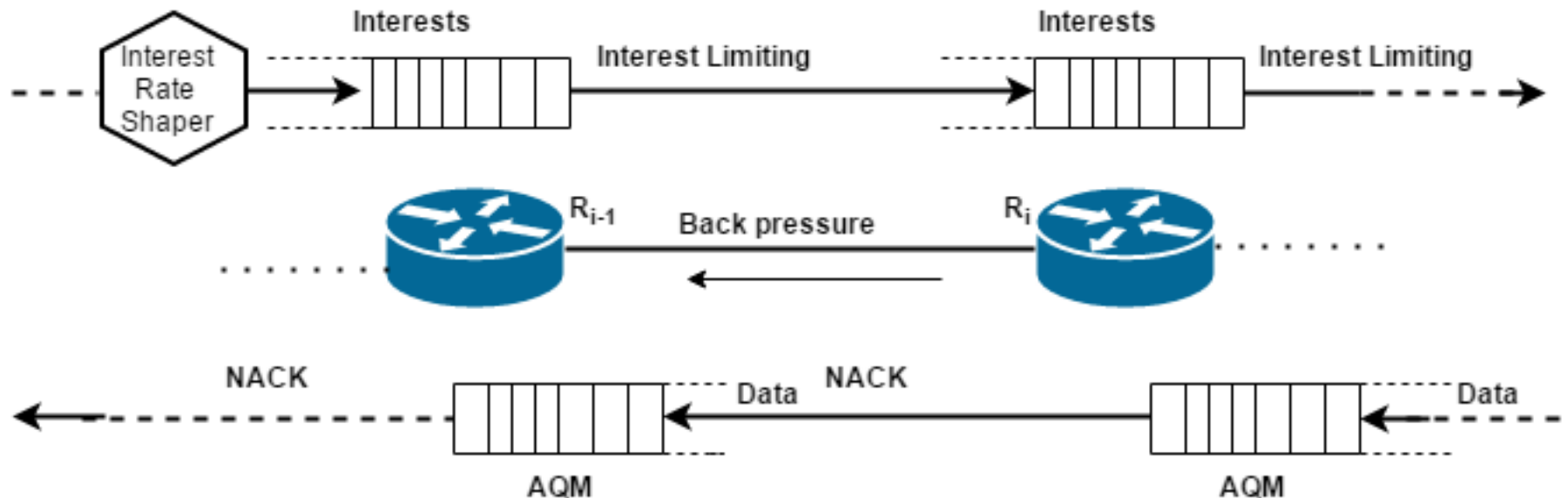
*Performance metrics* - packet drop rate, link utilization

- ❑ *Extended ndnSIM to support Adaptive RED and PIE algorithms*

# BCON: Model overview

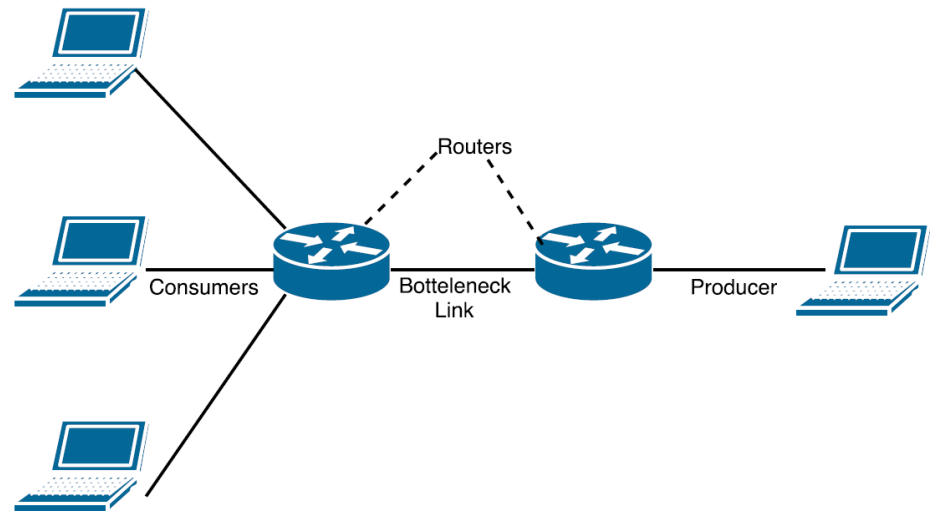
□ Three main components:

- *Queue monitoring using AQM*
- *Interest limiting using Back pressure technique*
- *Interest window decrement at the consumer*

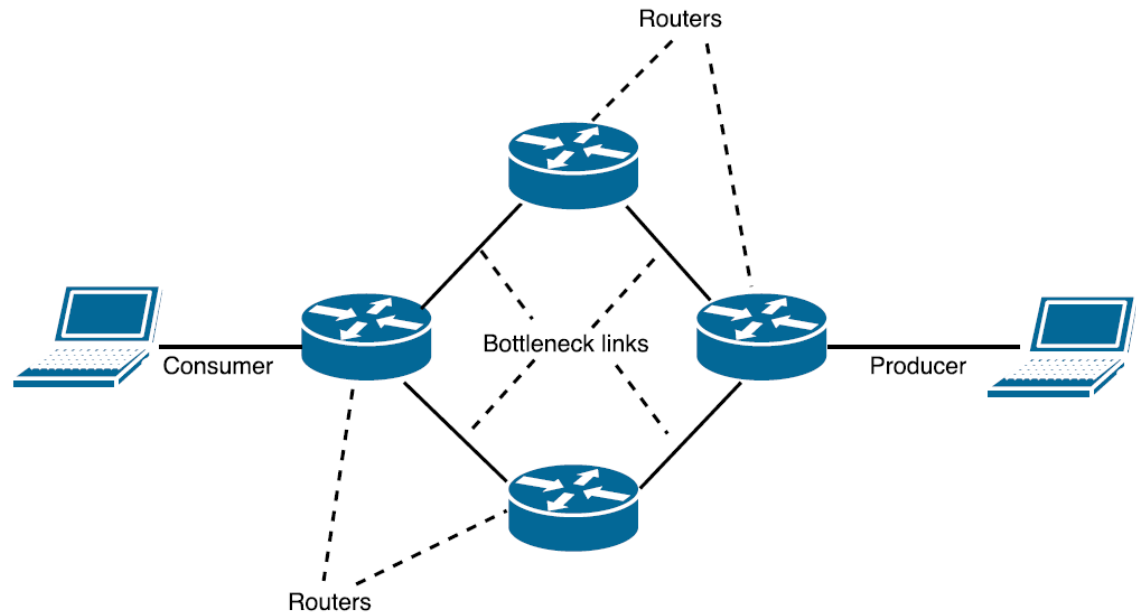


# BCON: Performance evaluation

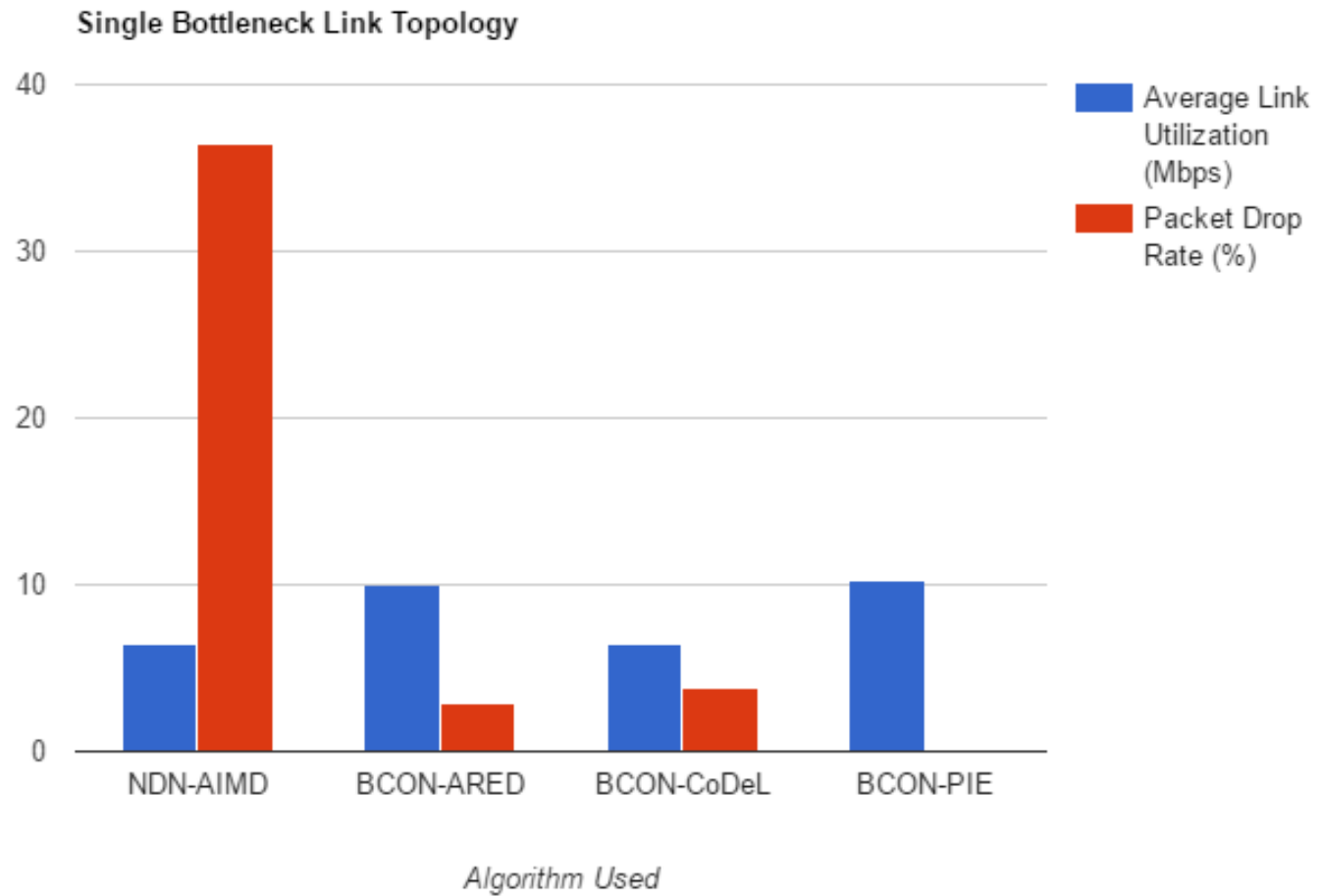
Single bottleneck topology



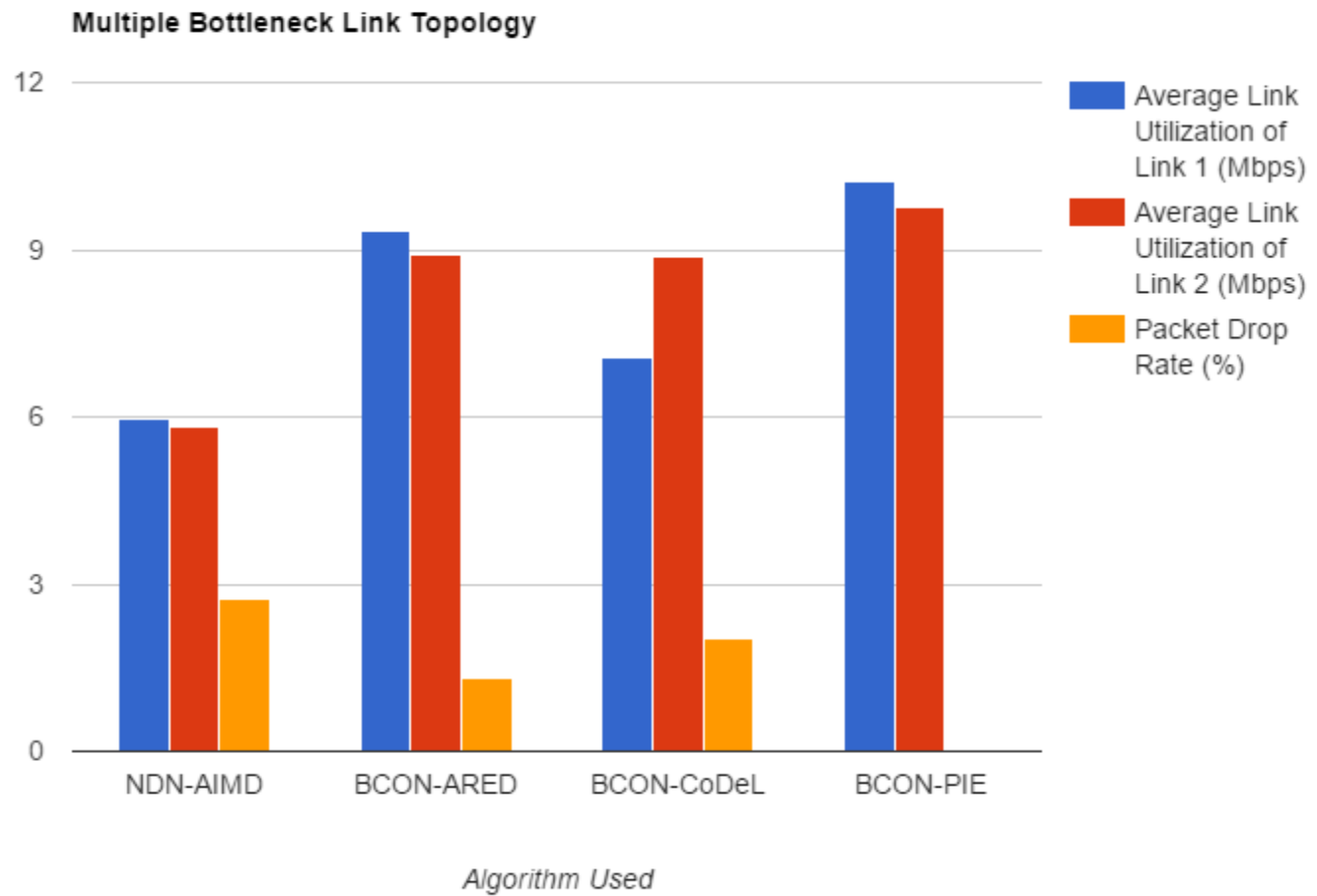
Multiple bottleneck topology



# BCON: Results



# BCON: Results



# BCON: Summary and the next goals

- ❑ BCON seamlessly integrates AQM in the NDN architecture
- ❑ BCON reduces the packet drop rate and enhances link utilization
- ❑ Initial results of BCON model are promising

## Next goals:

- ❑ Test the performance of BCON model in the presence of bursty traffic
- ❑ Check the feasibility of using NACK in a real NDN setup
- ❑ Setup a small testbed using NFD to evaluate the working of BCON

# Our contributions: GCPiN

## ❑ *Designed a new model for Privacy in NDN*

*Result* - Group Caching for Privacy in NDN (GCPiN)

*Goal* - Enhance the privacy of content cached inside the Content Store

*Proof of concept* - a basic analytical proof

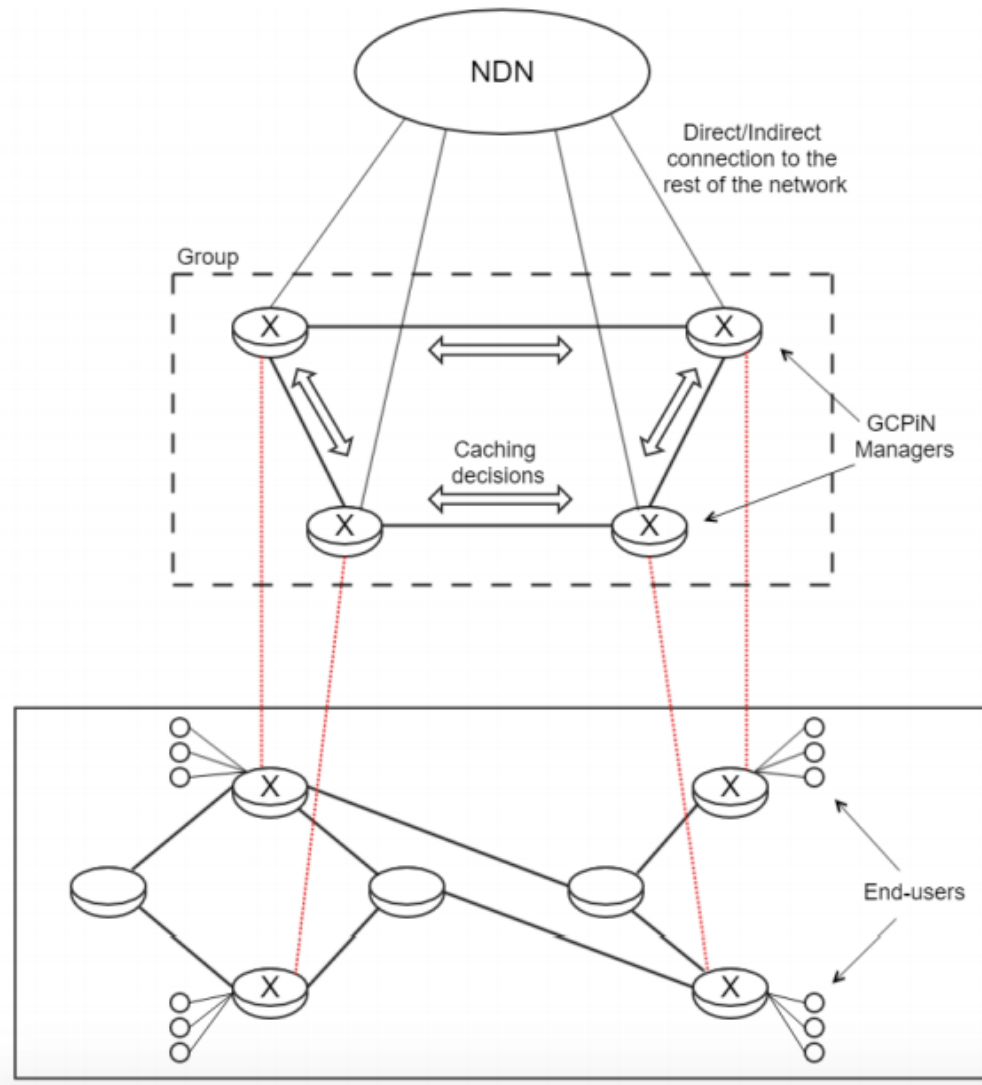
## ❑ *Ongoing work on this project*

*Implementation* - using ndnSIM

*Tentative Performance metrics* - Cache hit and Cache miss times

## ❑ *Extend ndnSIM to support Distributed Content Store*

# Our contributions: GCPiN



# ndnSIM: ns-3 based Named Data Networking Simulator

NS-3 based Named Data Networking (NDN) simulator  
ndnSIM: simulation of NDN, ICN, Information-Centric Networking

ndnSIM documentation

[Getting started](#)   [Research papers](#)

## ndnSIM documentation

This website includes the ndnSIM documentation and is intended to help the community use the simulator for NDN experimentation. It is not intended to present the principles or the design of the NDN architecture and communication model. We invite you to [join our mailing list](#) to see and participate in discussions about ndnSIM implementation and simulations in general ([mailing list archives](#)).

### Getting Started

#### Introduction

*what is ndnSIM, how to get support, and what is in the package*

#### Downloading and Compiling ndnSIM

*requirements, downloading, compiling, simulating*

#### FAQs

*frequently asked questions (with answers!)*

#### Simulation examples

*basic tutorial examples*

#### Best practises

*best practises on using ndnSIM*

### Advanced Topics

#### ndnSIM API documentation

*generated documentation of ndnSIM API*

#### Parallelize simulations using OpenMPI

*how to use OpenMPI to parallelize execution of simulation scenarios*

#### Simulating real applications

*guide on how to simulate real application that are written against ndn-cxx library*

### ndnSIM tutorial

#### ndnSIM helpers

*very important components of ndnSIM for writing simulation scenarios*

#### Content Store

*several different build-in content store implementations: LRU, LFU, and*

### ndnSIM Versions

#### ndnSIM 2.7

*latest version*

#### ndnSIM 2.6

URL: <https://ndnsim.net/2.7/index.html>

# NFD: NDN Forwarding Daemon

## NFD - Named Data Networking Forwarding Daemon

NFD is a network forwarder that implements and evolves together with the Named Data Networking (NDN) [protocol](#). NFD is a core component of the [NDN Platform](#).

### NFD Documentation

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- [NFD Overview](#)

A brief overview of NFD and its major modules.

- [Getting Started with NFD](#)

Instructions for obtaining, installing, and running NFD.

- [FAQ](#)

Suggestions for configuring and running non-standard NFD setups.

- [Manpages](#)

### Additional documentation

- [NFD Developer's Guide](#)

A comprehensive guide to the design and implementation of NFD. The developer's guide also contains suggestions and hints for anyone wanting to modify or extend NFD.

- [NDN Software Contributor's Guide](#) (guide for newcomers to the NDN community of software)

- [NFD Wiki](#)

- [NFD Management protocol](#)
- [NFD Configuration file format](#)

The NFD Wiki contains detailed protocol specifications and information for building on unsupported platforms.

- [API Documentation \(doxygen\)](#)

- [NFD Release Notes](#)

- [NFD Versions](#)

URL: <http://named-data.net/doc/NFD/current/>

# NDN Applications: ChronoChat

named-data / ChronoChat

Watch 8 Star 9 Fork 6

Code Issues 4 Pull requests 0 Projects 0 Wiki Insights

A simple but interesting demo to visualize how ChronoSync library works

308 commits 2 branches 3 releases 12 contributors

Branch: master New pull request Create new file Upload files Find file Clone or download

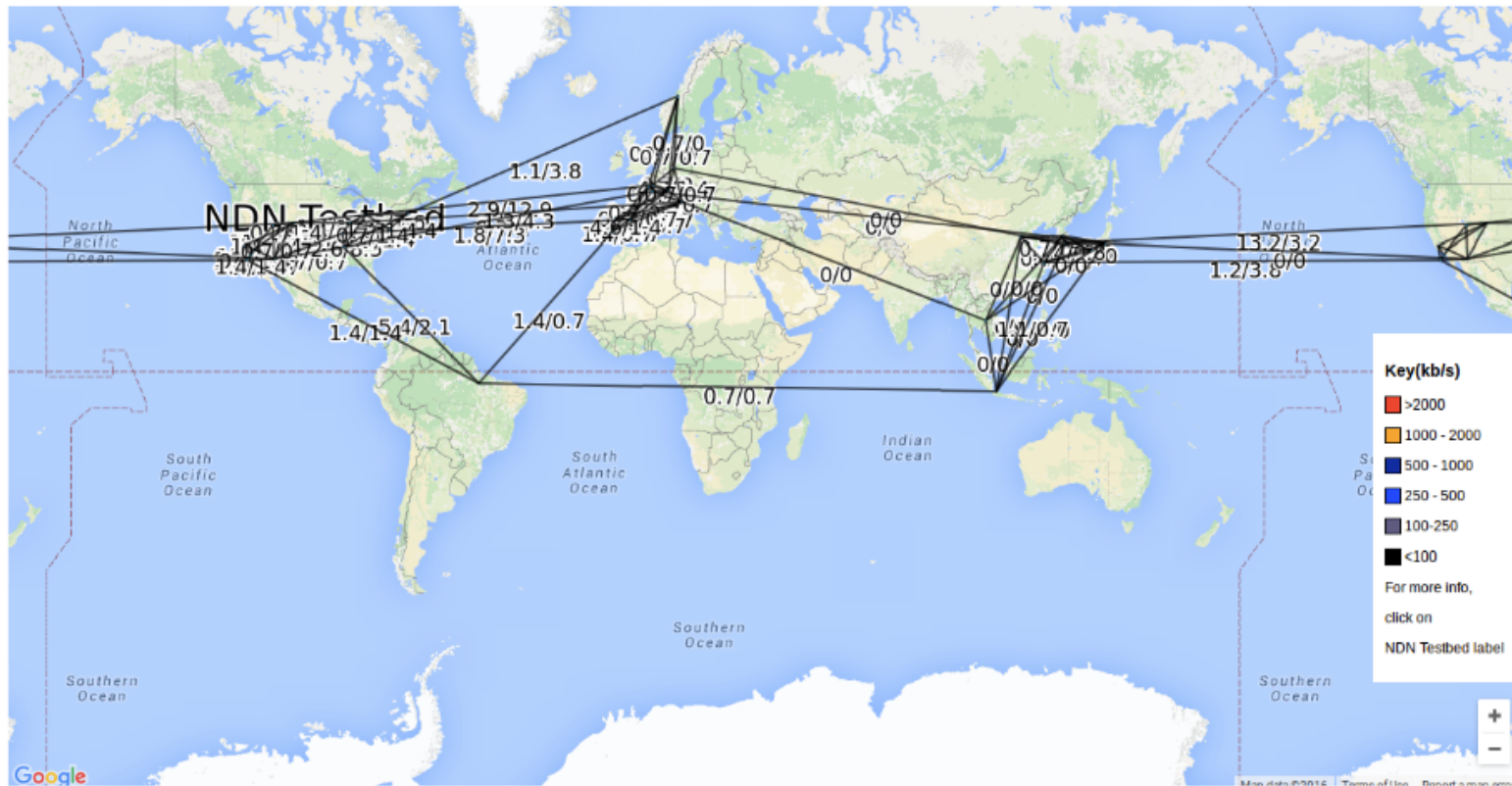
yoursunny and Gerrit Code Review Update git submodules Latest commit c09035e 20 days ago

.jenkins.d	build: Build ndn-cxx as a shared library	4 years ago
ChronoSync @ c490212	Update git submodules	20 days ago
contrib	dist: update OS X 10.10 bundle preparation script	4 years ago
debug-tools	bug: Fix local prefix discovery	5 years ago
disabled	Add chatroom discovery UI	5 years ago
docs	docs: add documentation for chatroom discovery	5 years ago
images	refresh prefix enabled	7 years ago
linux	Adding Linux supports	5 years ago
security	security: Introduce hierarchical validator	4 years ago
src	add proper #include lines for ndn::OBufferStream and Boost.lostreams	3 years ago

URL: <https://github.com/named-data/ChronoChat>

# Next Goals

- Create a NDN node at NITK, and add it to NDN live testbed



## ❑ *What are the best use-cases of NDN?*

*Vehicular Networking*

*Internet of Things*

*Secure Routing*

## ❑ *Is there an active consortium for NDN?*

Yes: <https://named-data.net/consortium/>

## ❑ *Is NDN active as of now?*

Yes: please see the testbed in previous slide.

Thank you.