

Named Data Networking (Part 1)

Intel/NSF ICN-WEN Kickoff Workshop Tutorial

June 21, 2017, Hillsboro, OR

Topics

- NDN Introduction
 - ▣ NDN in one slide
 - ▣ How Does it Work?
 - ▣ Community & Activities

Main Point of NDN in One Slide

NDN is based on a simple, coherent idea

IP's communication abstraction: **channel between two endpoints**

- Invented for telephones

- No packet-level authentication

- Abstraction is root cause for many Internet problems

NDN's communication abstraction: **request for named data**

- Invented for the web

- Packets are signed by publisher, binding name to data

- Much better fit for today's networks, new future possibilities

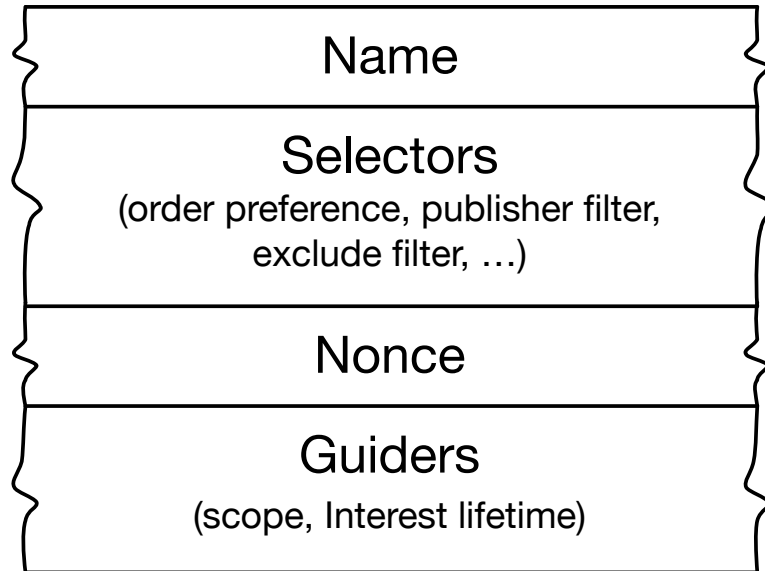
NDN is a general-purpose protocol built on requests for named data



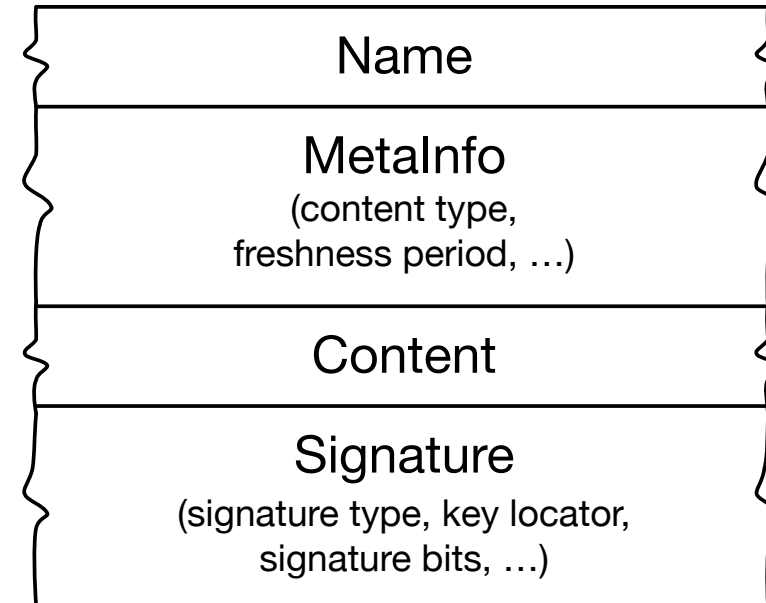
How does NDN work?

Two Packet Types

Interest Packet



Data Packet



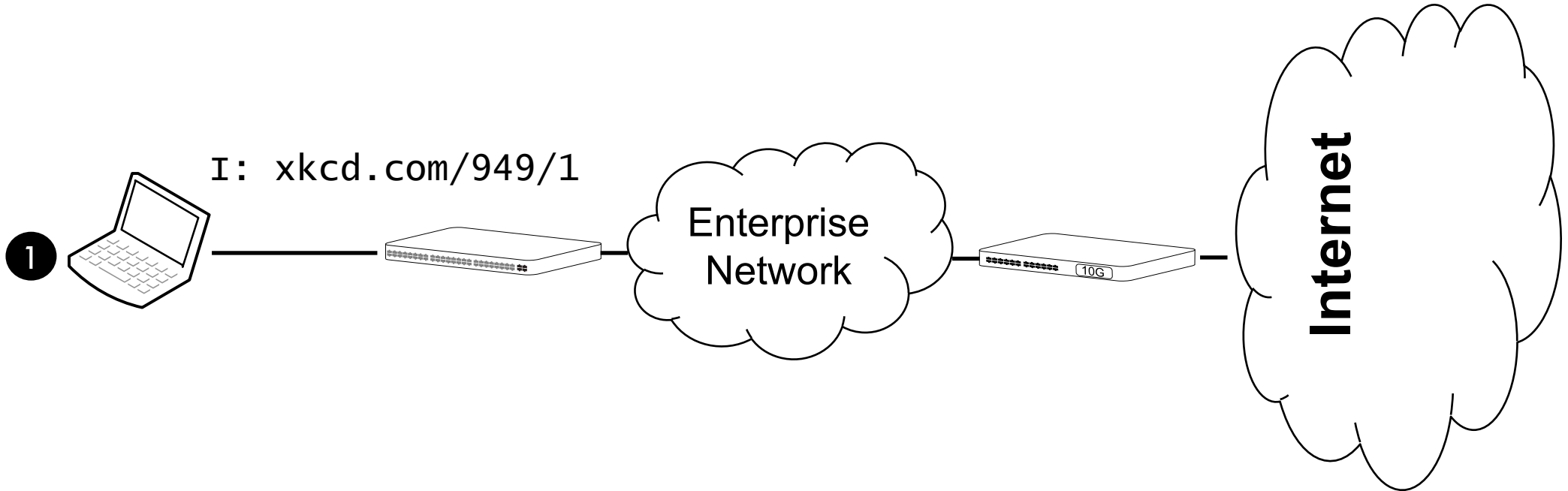
- ❑ No addresses
- ❑ **Publishers bind names to data; receivers verify**

NDN Interest Forwarding

1. Do I have this data?
2. Is a request already pending?
3. Which next hop might lead to the source?

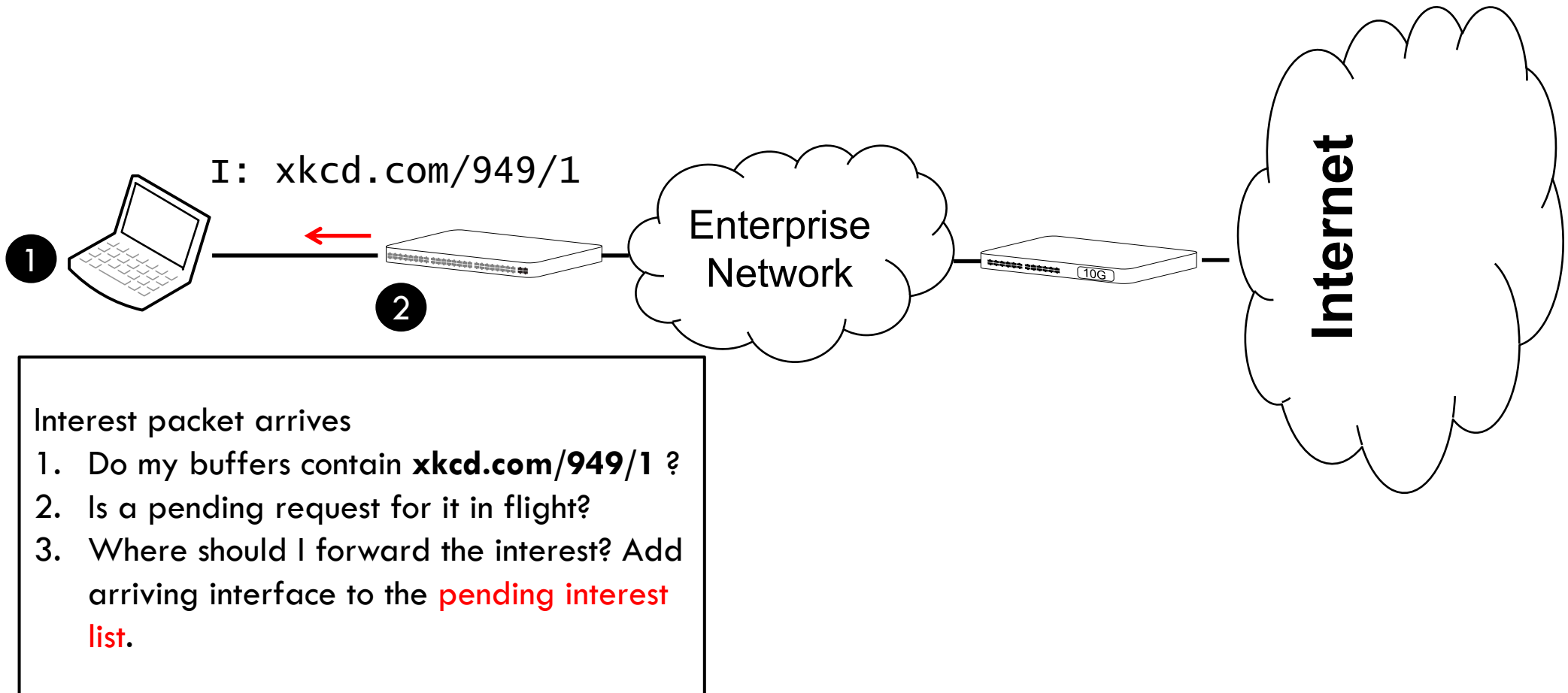
NDN Forwarding Illustrated

1 Emit Interest: xkcd.com/949/1



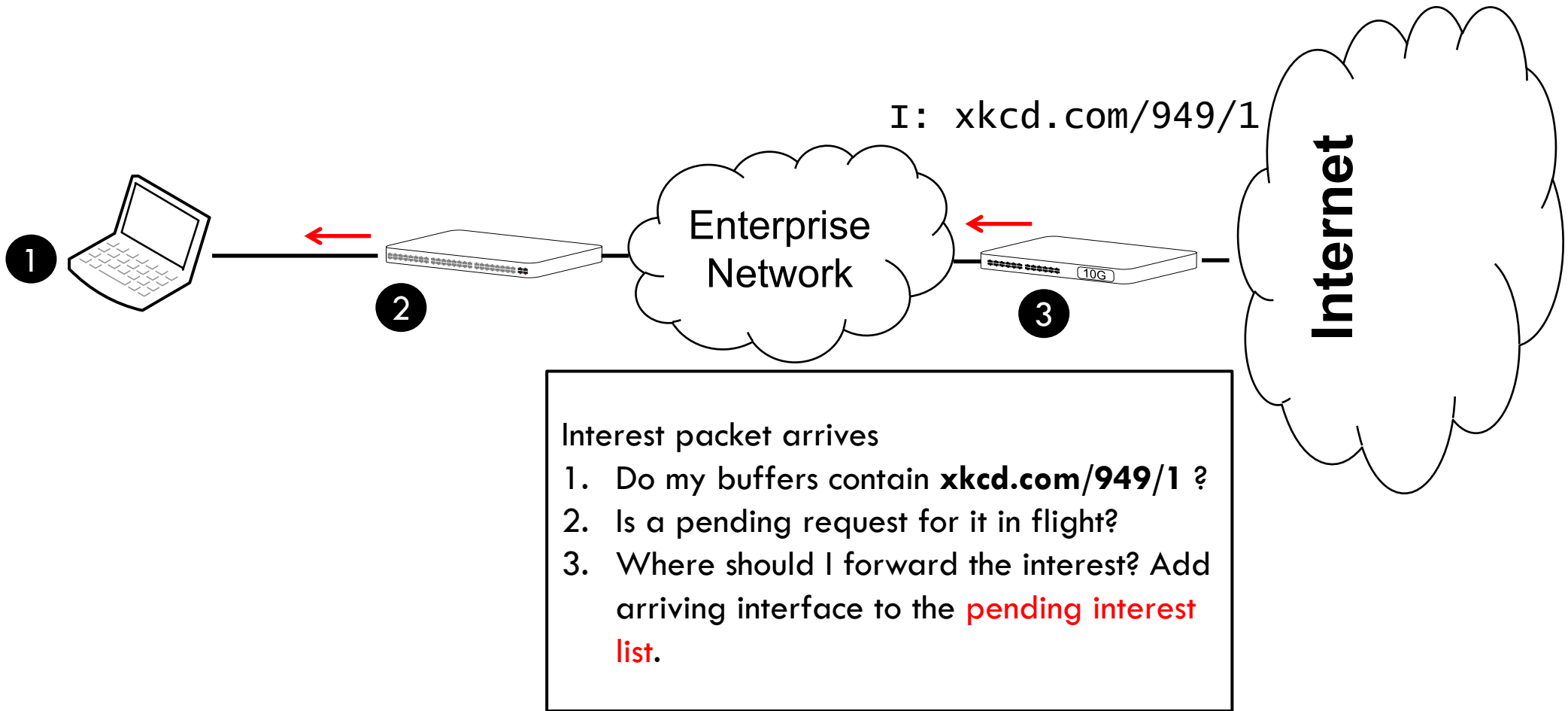
NDN Forwarding Illustrated

- 1 Emit Interest: xkcd.com/949/1
- 2 Interest arrives at switch



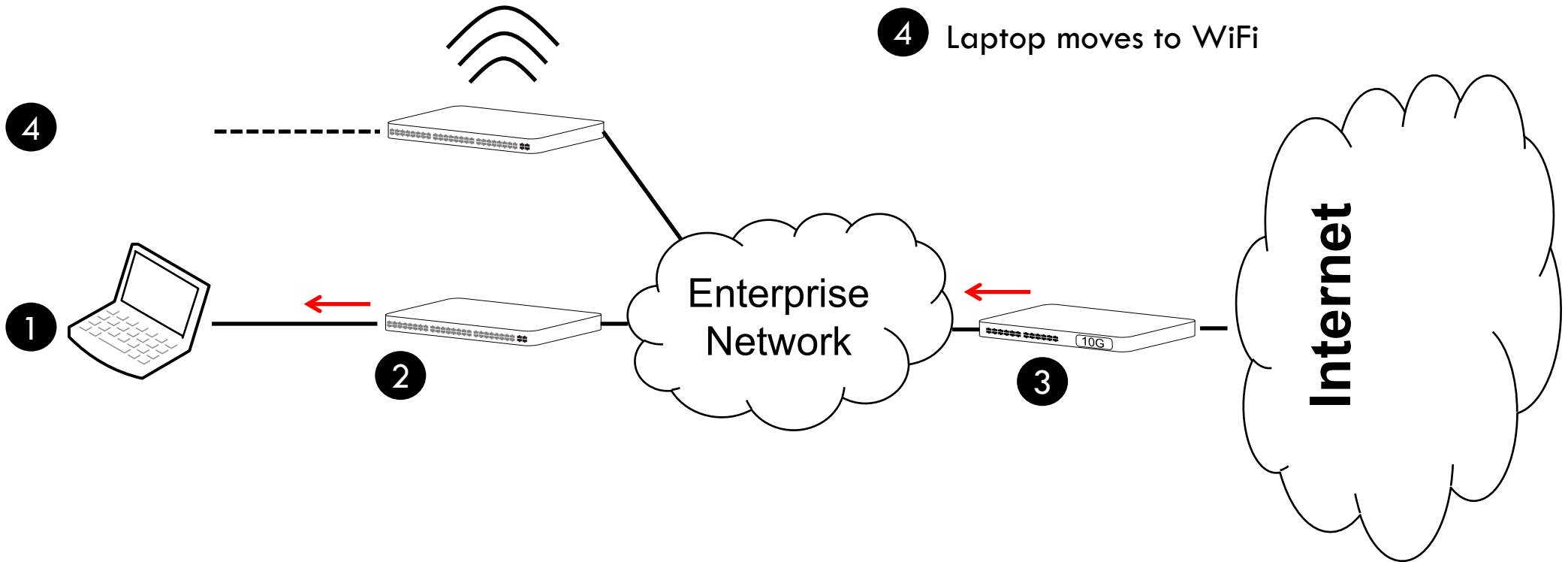
NDN Forwarding Illustrated

- 1 Emit Interest: `xkcd.com/949/1`
- 2 Interest arrives at switch
- 3 Interest arrives at gateway

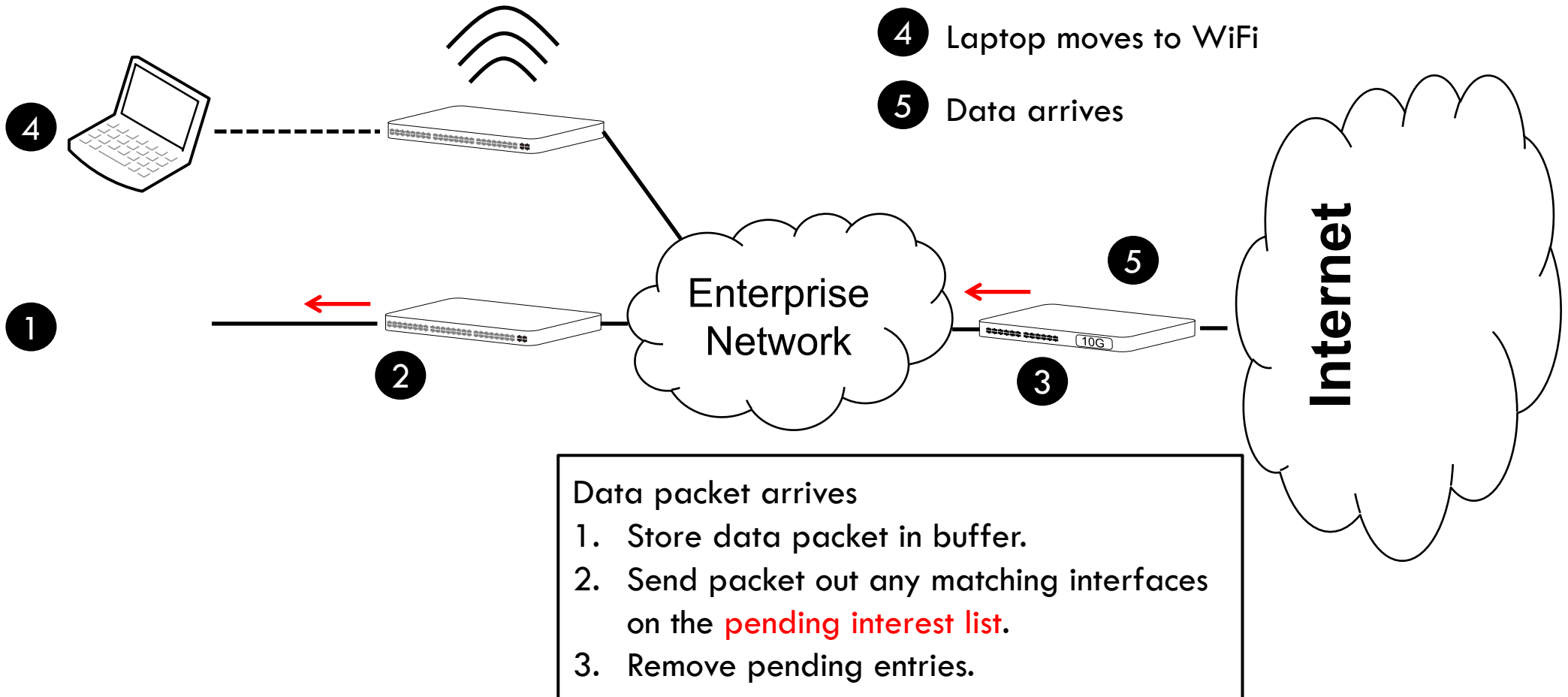


NDN Forwarding Illustrated

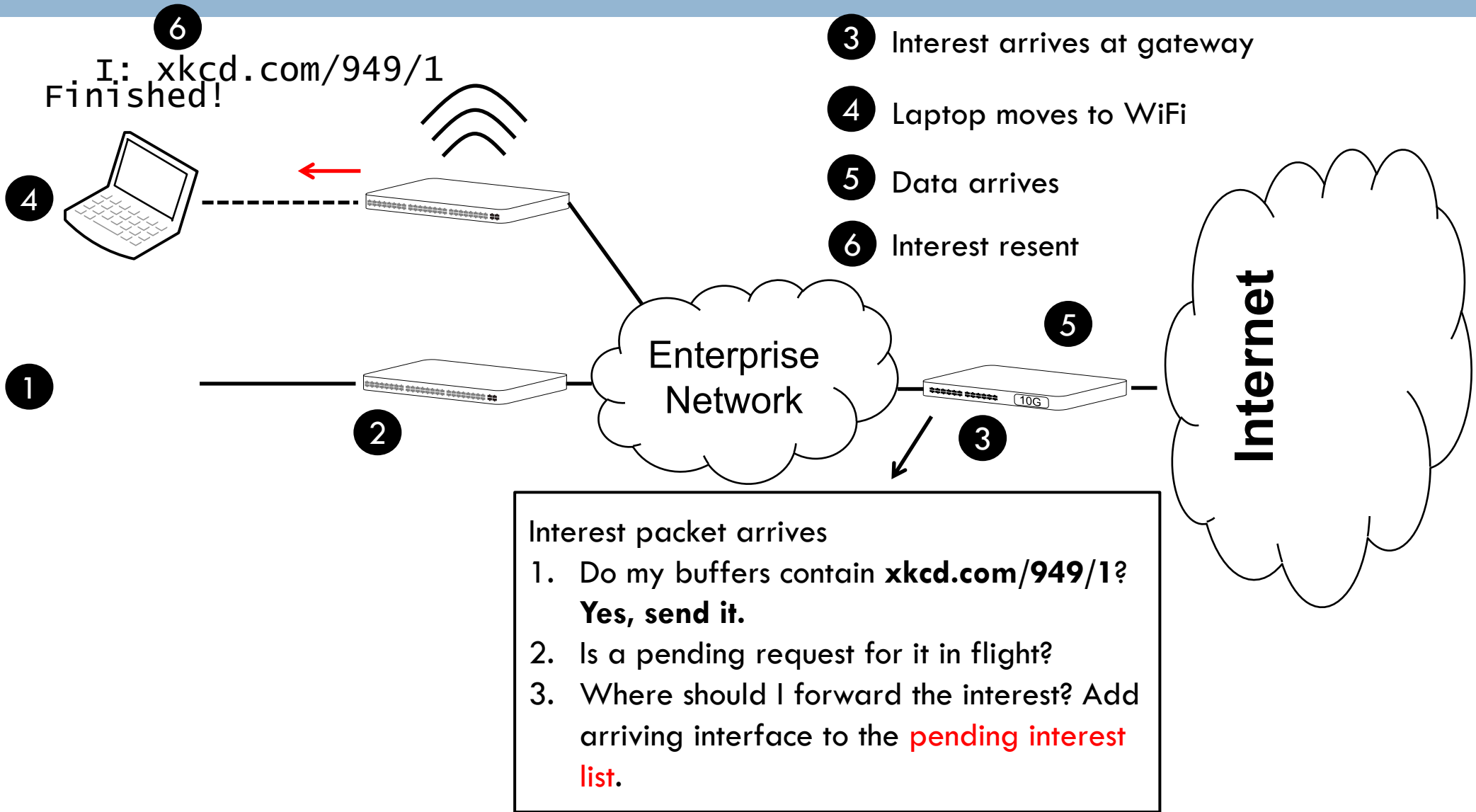
- 1 Emit Interest: `xkcd.com/949/1`
- 2 Interest arrives at switch
- 3 Interest arrives at gateway
- 4 Laptop moves to WiFi



NDN Forwarding Illustrated



NDN Forwarding Illustrated



IP Nodes and Routes

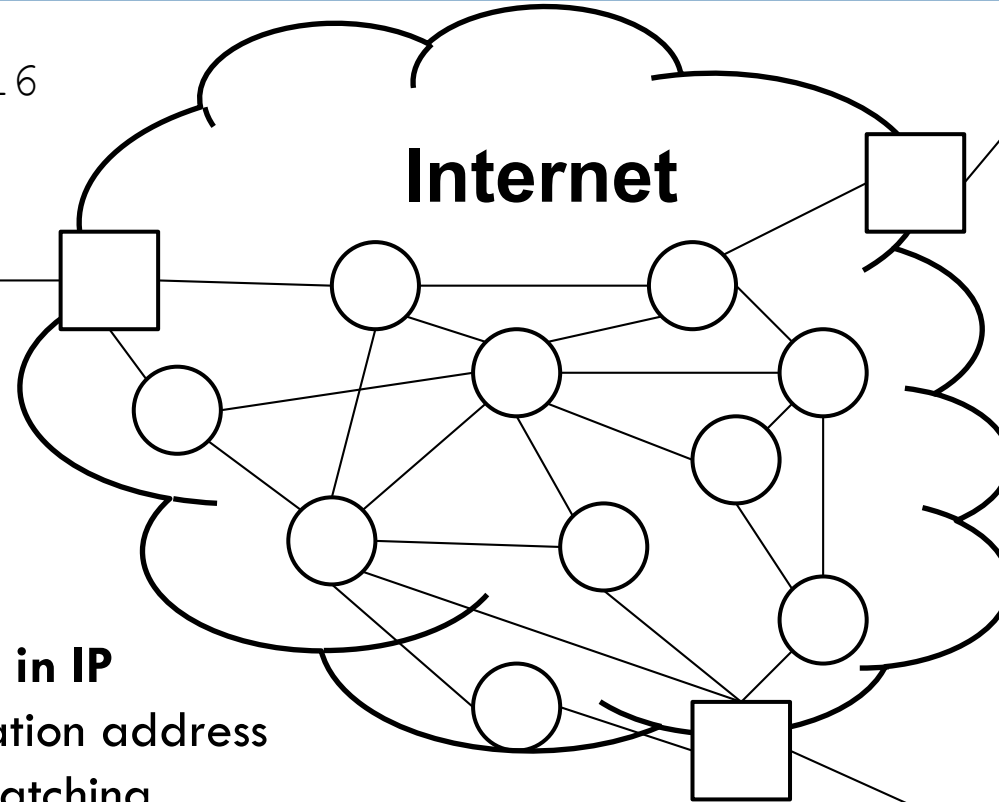
xkcd.com

72.26.192.0/19

hosted by voxel.net

wustl.edu

128.252.0.0/16



google.com

74.125.0.0/16



Forwarding logic in IP

1. Extract destination address
2. Find longest matching prefix in route table
3. Forward packet out matching interface

IP Nodes and Routes

xkcd.com

72.26.192.0/19

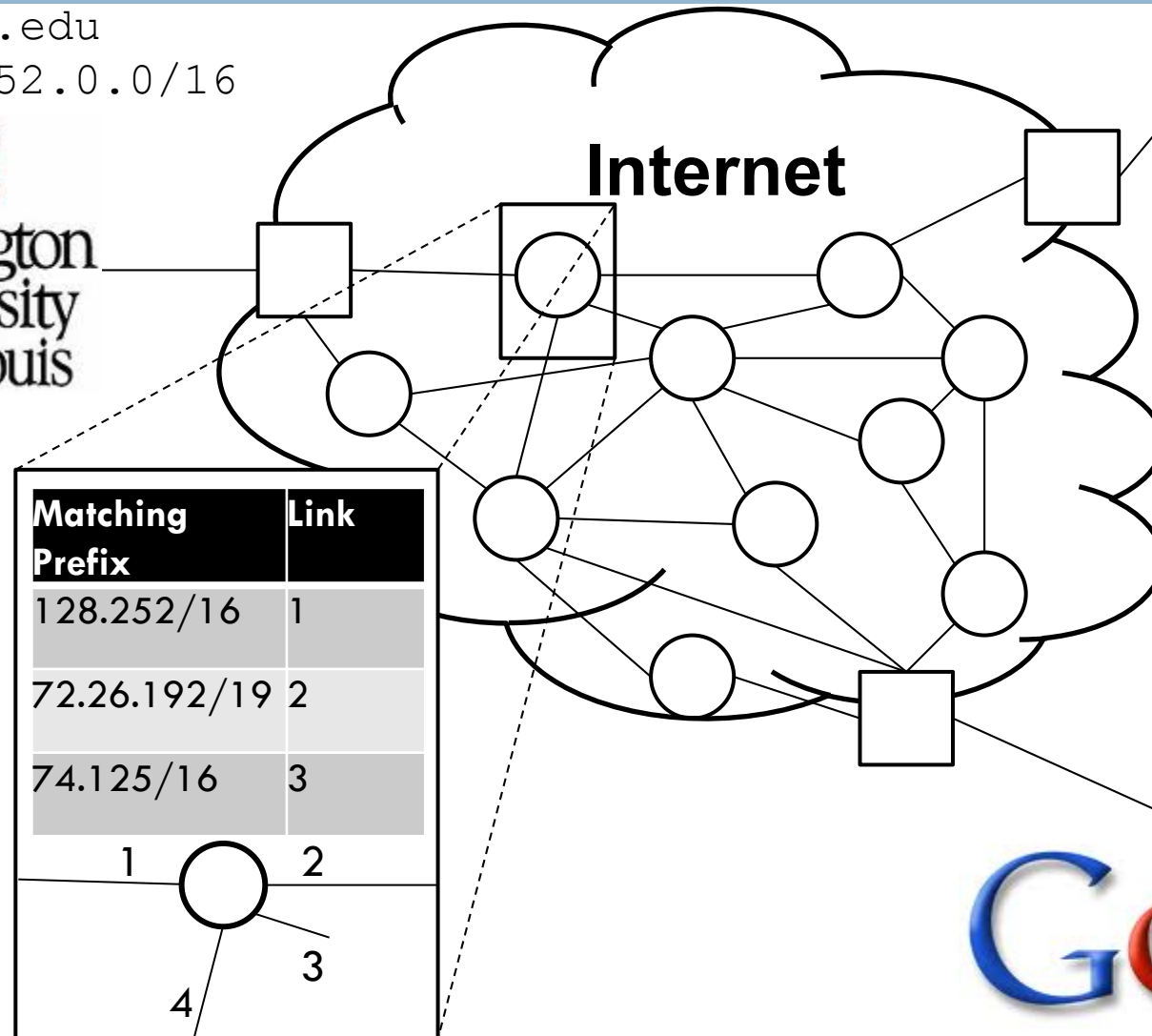
hosted by voxel.net

wustl.edu

128.252.0.0/16



Washington
University
in St. Louis



google.com

74.125.0.0/16



NDN Nodes and Routes

xkcd.com

72.26.192.0/19

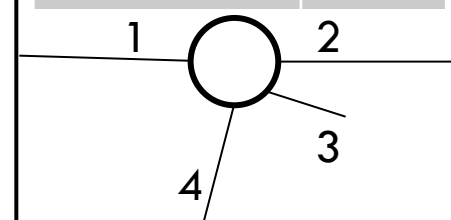
hosted by voxel.net

wustl.edu

128.252.0.0/16



Matching Prefix	Link
wustl.edu	1
xkcd.com	2, 3
google.com	1, 3, 4

A diagram of a node (circle) with four links (lines) labeled 1, 2, 3, and 4. Link 1 points to the top-left, link 2 to the top-right, link 3 to the bottom-right, and link 4 to the bottom-left.

Internet



google.com

74.125.0.0/16



Questions

- Can NDN efficiently support host-to-host patterns?
- Can NDN efficiently support user-specific data and services?
- Can you count clicks and ad impressions in NDN?

Yes!

- Can you efficiently route all those names?
- Can you scale the forwarding plane?
- Can you prove security and privacy properties?

Yes, mostly!



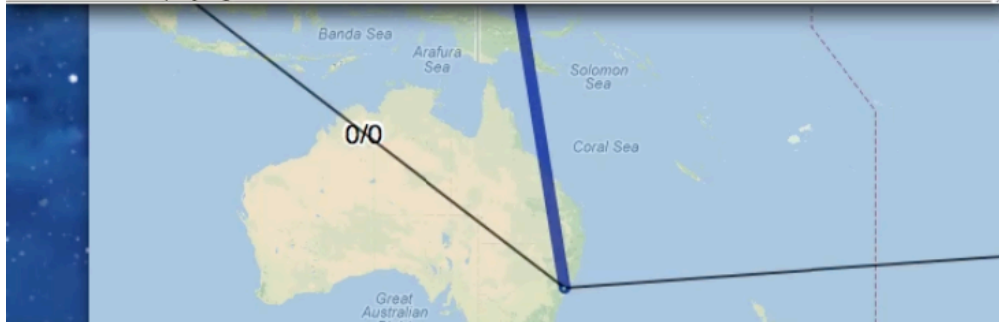
Use Case: Live Video Distribution

Without relying on Google, Facebook, or Twitter: how might we share live video to an audience of arbitrary size?

Webcam video feed
fanned out to 1,000
global clients in live
demo



0:00:07
Status
Video: PSize: 18/18 Segment: 304 Timeout: 2.281 (0.701, 0.277) Retries: 5 Drops: 0 Duration: 6077s
Audio: PSize: 3/3 Segment: 35 Timeout: 1.306 (0.551, 0.063) Retries: 5 Drops: 0 Duration: 6078s
Buffer: 100% (playing: Yes)



Server & link load
constant (1) as
global client count
grows from 1 to
1,000

Visualization app uses NDN to
gather data from devices



NDN Video Distribution

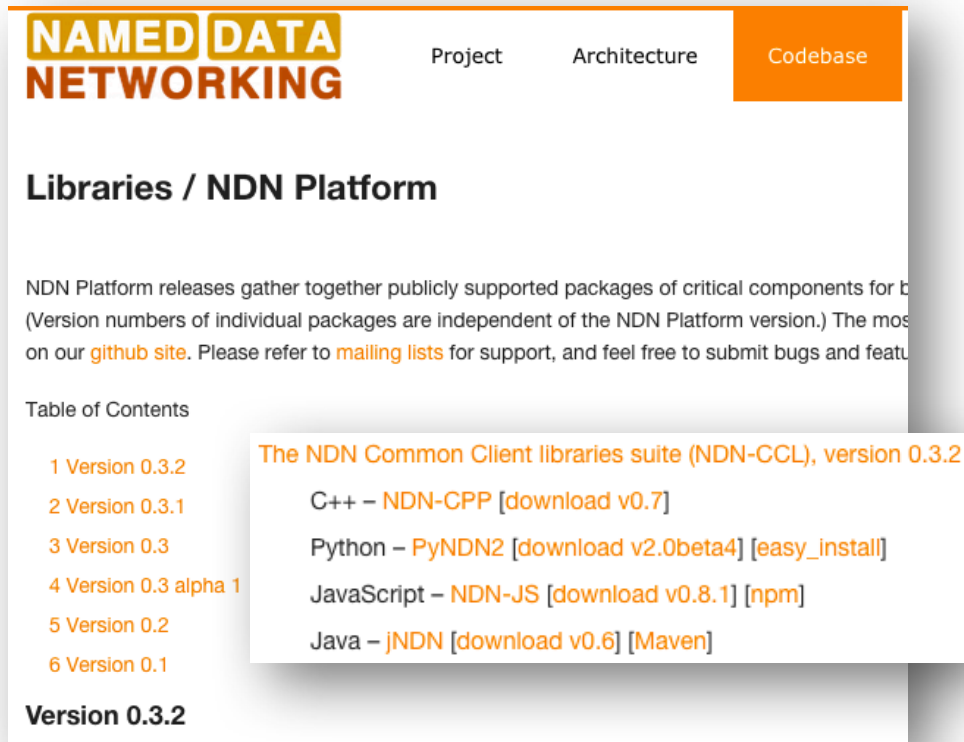
- A single video producer supported from 1 to 1,000+ simultaneous clients, while load everywhere was 1
 - ▣ ~100 clients homed off each of 15 gateways
 - ▣ Each client retrieving the same video stream
 - ▣ Only one copy of data on any link
 - ▣ Automatic multi-path route switching
 - ▣ On-site client shows video delivery
- **In total, video is shared with >1000 video clients spread across 5 continents**

How did we do it?

- We put together an experiment that used 1 000+ machines, globally
- We used:
 - ▣ NDN software platform
 - ▣ NDN global testbed
 - ▣ AWS EC2

NDN Platform

Open-Source NDN software platform



NAMED DATA NETWORKING Project Architecture **Codebase**

Libraries / NDN Platform

NDN Platform releases gather together publicly supported packages of critical components for b (Version numbers of individual packages are independent of the NDN Platform version.) The mos on our [github site](#). Please refer to [mailing lists](#) for support, and feel free to submit bugs and featu

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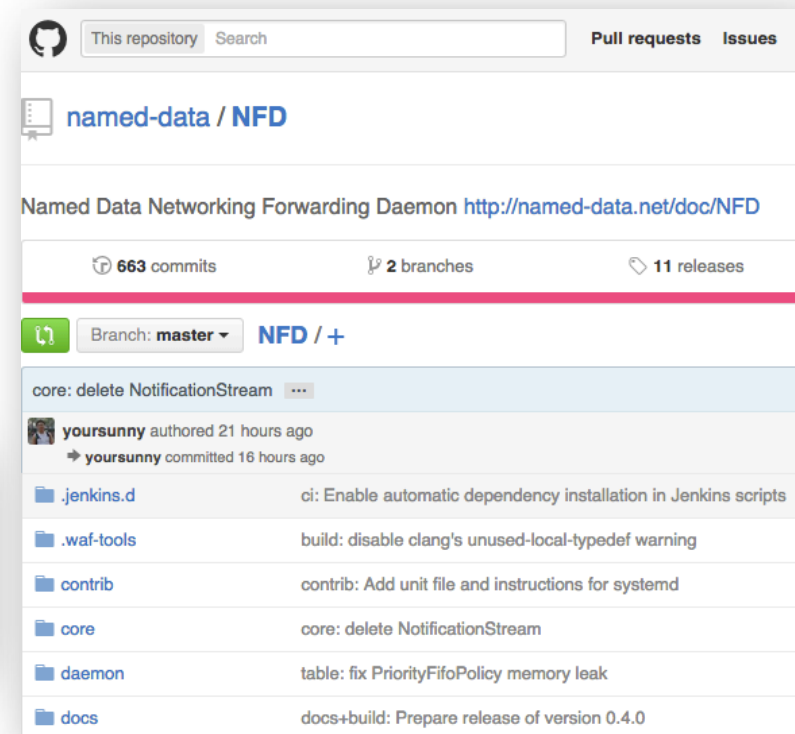
- 1 Version 0.3.2
- 2 Version 0.3.1
- 3 Version 0.3
- 4 Version 0.3 alpha 1
- 5 Version 0.2
- 6 Version 0.1

Version 0.3.2

The NDN Common Client libraries suite (NDN-CCL), version 0.3.2

- C++ – [NDN-CPP](#) [download v0.7]
- Python – [PyNDN2](#) [download v2.0beta4] [easy_install]
- JavaScript – [NDN-JS](#) [download v0.8.1] [npm]
- Java – [jNDN](#) [download v0.6] [Maven]

Support for Linux, Mac OS, Android;
Libraries for many languages



named-data / **NFD**

Named Data Networking Forwarding Daemon <http://named-data.net/doc/NFD>

663 commits 2 branches 11 releases

Branch: master NFD / +

core: delete NotificationStream ...

yoursunny authored 21 hours ago
yoursunny committed 16 hours ago

.jenkins.d	ci: Enable automatic dependency installation in Jenkins scripts
.waf-tools	build: disable clang's unused-local-typedef warning
contrib	contrib: Add unit file and instructions for systemd
core	core: delete NotificationStream
daemon	table: fix PriorityFifoPolicy memory leak
docs	docs+build: Prepare release of version 0.4.0

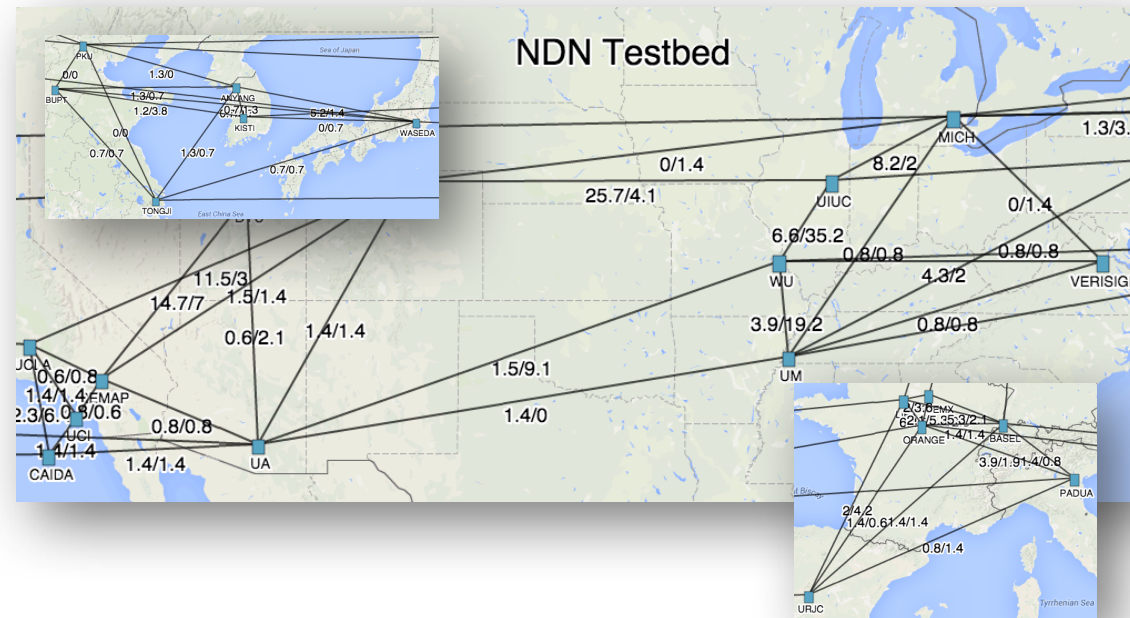
Active community development happens
at github

Global NDN Testbed

<http://ndnmap.arl.wustl.edu>

- **32 Gateway Router Nodes**
 - 9 at sites of the NDN PIs
 - 23 at sites of collaborators.
- **North America:** 13 in USA
- **South America:** 1 in Brazil
- **Asia (8):** 2 in China, 2 in South Korea, 2 in Japan, Indonesia, Thailand
- **Europe (10):** 3 in France, 2 in Portugal, 1 each in Spain, Switzerland, Germany, Italy & Norway

Testbed & routing rely on a fully worked trust model!



Join at <http://named-data.net>



What's Next for NDN?

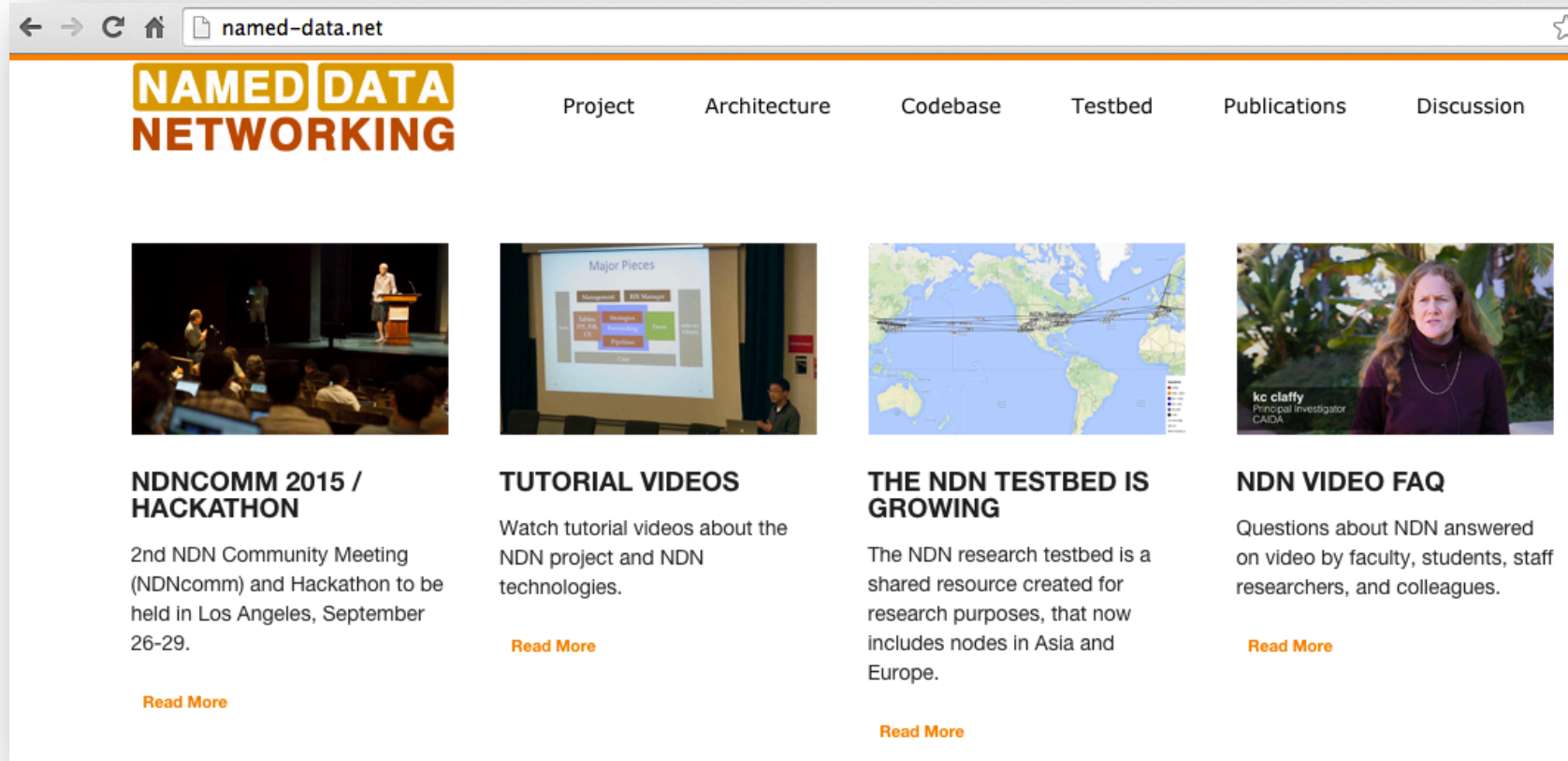
What authentic problems can NDN help solve?

Is there an advantage in using NDN for

- ❑ Live video distribution?
- ❑ Scientific data distribution?
- ❑ Software updates?
- ❑ IoT monitoring and control?
- ❑ Connectivity scenarios with intermitten links?

Join Us & Learn More!

`https://named-data.net`



The screenshot shows the homepage of the Named Data Networking project website. The browser's address bar displays "named-data.net". The website features a navigation menu with links to Project, Architecture, Codebase, Testbed, Publications, and Discussion. The main content area is divided into four columns, each with a video thumbnail, a title, a brief description, and a "Read More" link.

NAMED DATA NETWORKING

Project Architecture Codebase Testbed Publications Discussion

NDNCOMM 2015 / HACKATHON
2nd NDN Community Meeting (NDNcomm) and Hackathon to be held in Los Angeles, September 26-29.
[Read More](#)

TUTORIAL VIDEOS
Watch tutorial videos about the NDN project and NDN technologies.
[Read More](#)

THE NDN TESTBED IS GROWING
The NDN research testbed is a shared resource created for research purposes, that now includes nodes in Asia and Europe.
[Read More](#)

NDN VIDEO FAQ
Questions about NDN answered on video by faculty, students, staff researchers, and colleagues.
[Read More](#)