

ICN 2016 NDN Tutorial
**Exploring NDN Research through Real
World Problem Solving**

NDN Project Team

Alex Afanasyev, Jeff Burke, Davide Pesavento, Beichuan Zhang, Lixia Zhang

September 26, 2016

<https://named-data.net/icn2016-tutorial>

This tutorial is for *you*

Henry <hy2t010751@hotmail.com>

Mon, 12 Sep 2016 03:46:08 -0700 (PDT)

To: Lixia Zhang <lixia@cs.ucla.edu>

[About NDN programming tutorial materials](#)

Dear Professor Zhang,

I am a CS graduate student at XXXXX University, Taiwan. Recently, I am researching into Named Data Networking, and referring to your course learning NDN. However, *I have no idea how to get started with a NDN project*. Therefore, I am writing to inquire whether Professor Zhang could kindly provide some *NDN programming tutorial materials* to me.

Sincerely,

Henry

Computer Science Department at XXXX, Taiwan

Tutorial Outline

- NDN Architecture Overview (0.5 hour)
- A Day in NDN Development Wonderland (4.5 hours)
 - A Quick NDN Codebase Overview
 - Developing Simple NDN Applications
 - Experimenting with NDN Apps using Mini-NDN
 - Developing Simple Simulations with ndnSIM
 - How to contribute to NDN Open Codebase
- Q & A Session (1 hour)
 - Collect questions throughout the day: twit your question using [#icn16ndnask](#)
 - May break into a few groups, each addressing a specific area of collected questions

NDN Architecture Overview

NDN Tutorial – ACM ICN 2016

September 26, 2016, Kyoto, Japan

Lixia Zhang

University of California, Los Angeles

<https://named-data.net/icn2016-tutorial>

Share This Presentation?

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Can you *easily* get this deck of
slides *now*?

[/ucla.edu/lixia/talks/icn16-arch.pptx](http://ucla.edu/lixia/talks/icn16-arch.pptx)

What about the video?
What would happen if it
became popular?



The Exciting Connected IoT Environment



Trust This Message?

From: C. D. (Dan) Mote, Jr. <dmote@email.edu>

Date: Mon, May 13, 2013 at 7:39 PM

Subject: Congratulations!

To: Patrick Crowley pcrowley@wustl.edu

Dear Prof. Crowley,

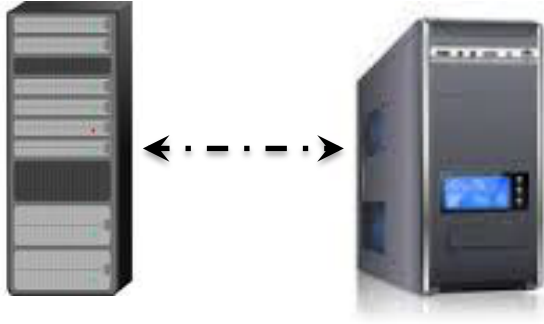
I write to inform you that you have been elected a Fellow to the National Academy of Engineering. As you may understand, this designation follows a process of nomination and subsequent vote by existing Fellows. Congratulations.

Sincerely,

C.D. Mote, Jr.

President-Elect, National Academy of Engineering

3 Challenges, 1 root cause



Internet Process

1. Find the **address/port** for the one you want to talk to.
2. Use the numbers to establish a **point-to-point connection**.
3. **Lack of intrinsic security**

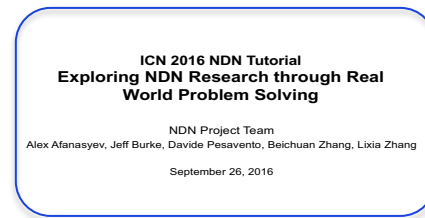
**Sharing
IoT
Trust**

*Must know address
assign addresses to all, know addresses for all
IPsec, TLS: Place trust on address*

A Much Simpler Way

Suppose your device could ask for what it wanted?

[/ucla.edu/lixia/talks/icn16-arch.pptx](http://ucla.edu/lixia/talks/icn16-arch.pptx)



[/ICN2016/tutorial/video/ndn-programming](http://ICN2016/tutorial/video/ndn-programming)

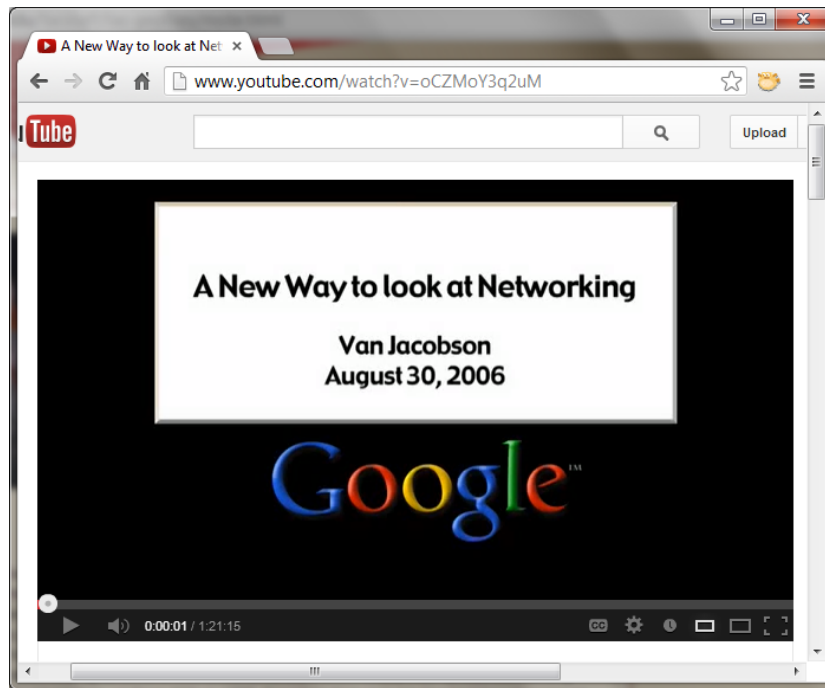


[/yourhome/bedroom/thermostat/temp](http://yourhome/bedroom/thermostat/temp)



The Web Has Named the World's Data

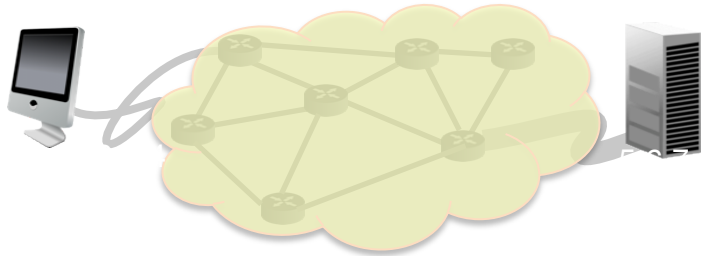
[/www.youtube.com/watch?v=oCZMoY3q2uM](http://www.youtube.com/watch?v=oCZMoY3q2uM)



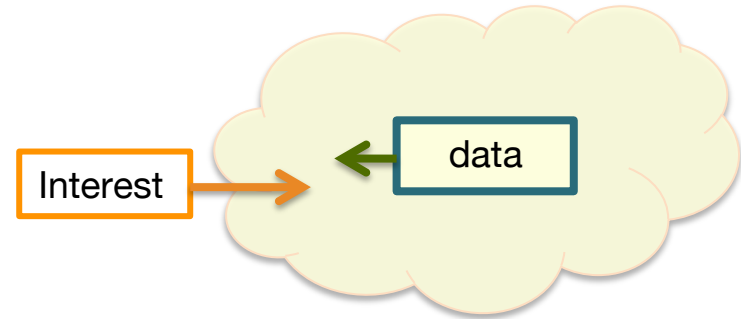
[/www.youtube.com/watch?feature=player_detailpage&v=oCZMoY3q2uM#t=1736s](http://www.youtube.com/watch?feature=player_detailpage&v=oCZMoY3q2uM#t=1736s)

Core Idea

Today's networks are based on host-to-host connections



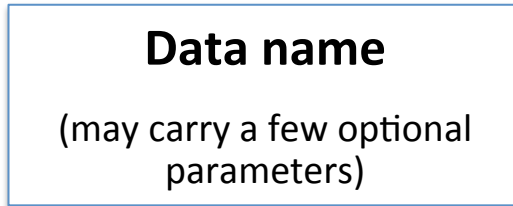
Modern communication consists of requests for named data



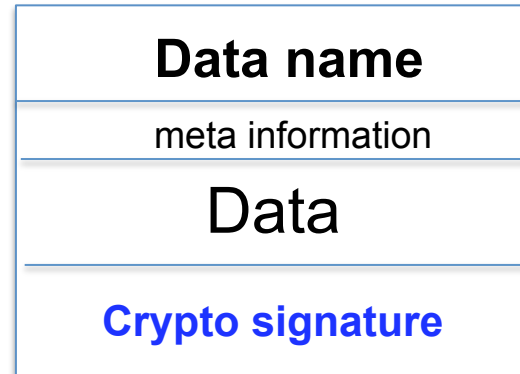
NDN: a general-purpose network protocol supporting requests for named data

Two Packet Types

Interest packet



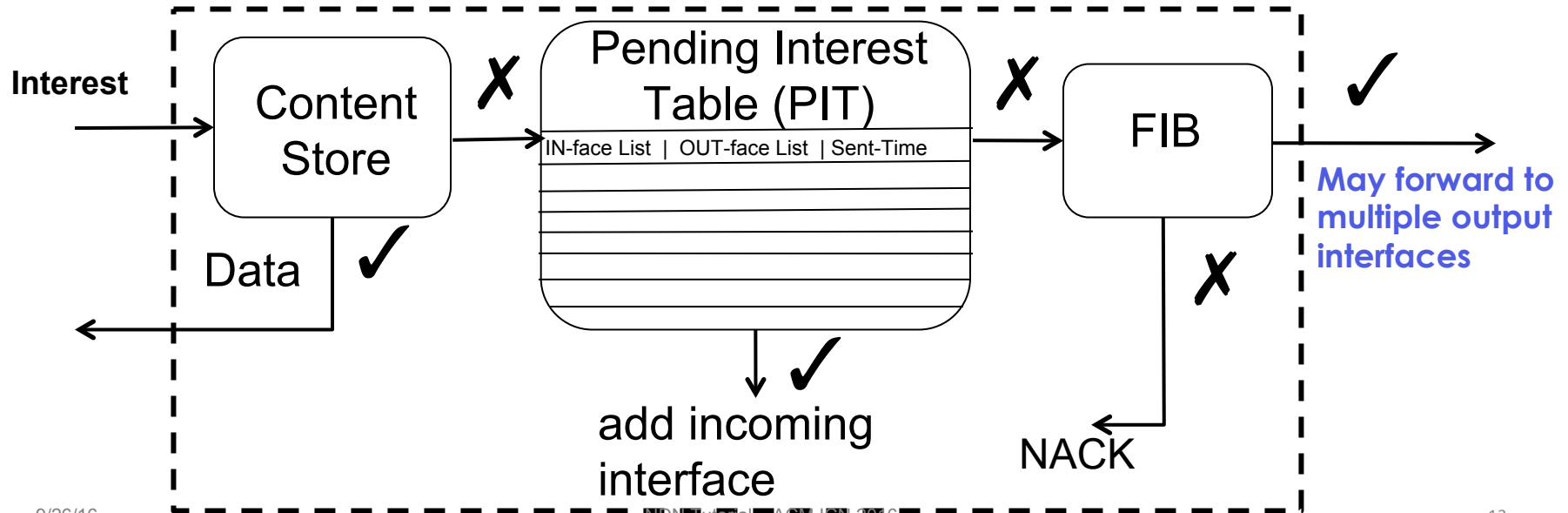
Data packet



- **Publisher binds name to data; receivers verify**
- **No address !**

NDN Interest Forwarding

1. Do I have this data?
2. Is a request already pending?
3. Which next hop(s) may lead to the requested data?



NDN: Just 3 Simple Ideas

- Naming data

→ Routing & forwarding by names

- Securing every data packet

→ removing dependency on transport security

- Per Interest, per hop forwarding state

→ Creating closed feedback loop

- measure performance, detect failures

→ Enabling multi-path forwarding

- Add a strategy module to assist the forwarding decisions

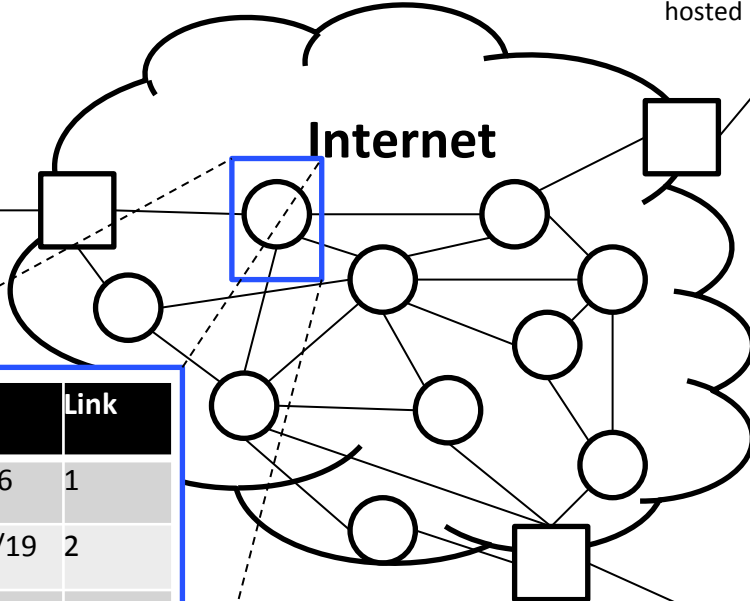
Enabling data caching

IP Nodes and Routes

UCLA.edu
131.179.128.0/16

UCLA

xkcd.com
72.26.192.0/19
hosted by voxel.net



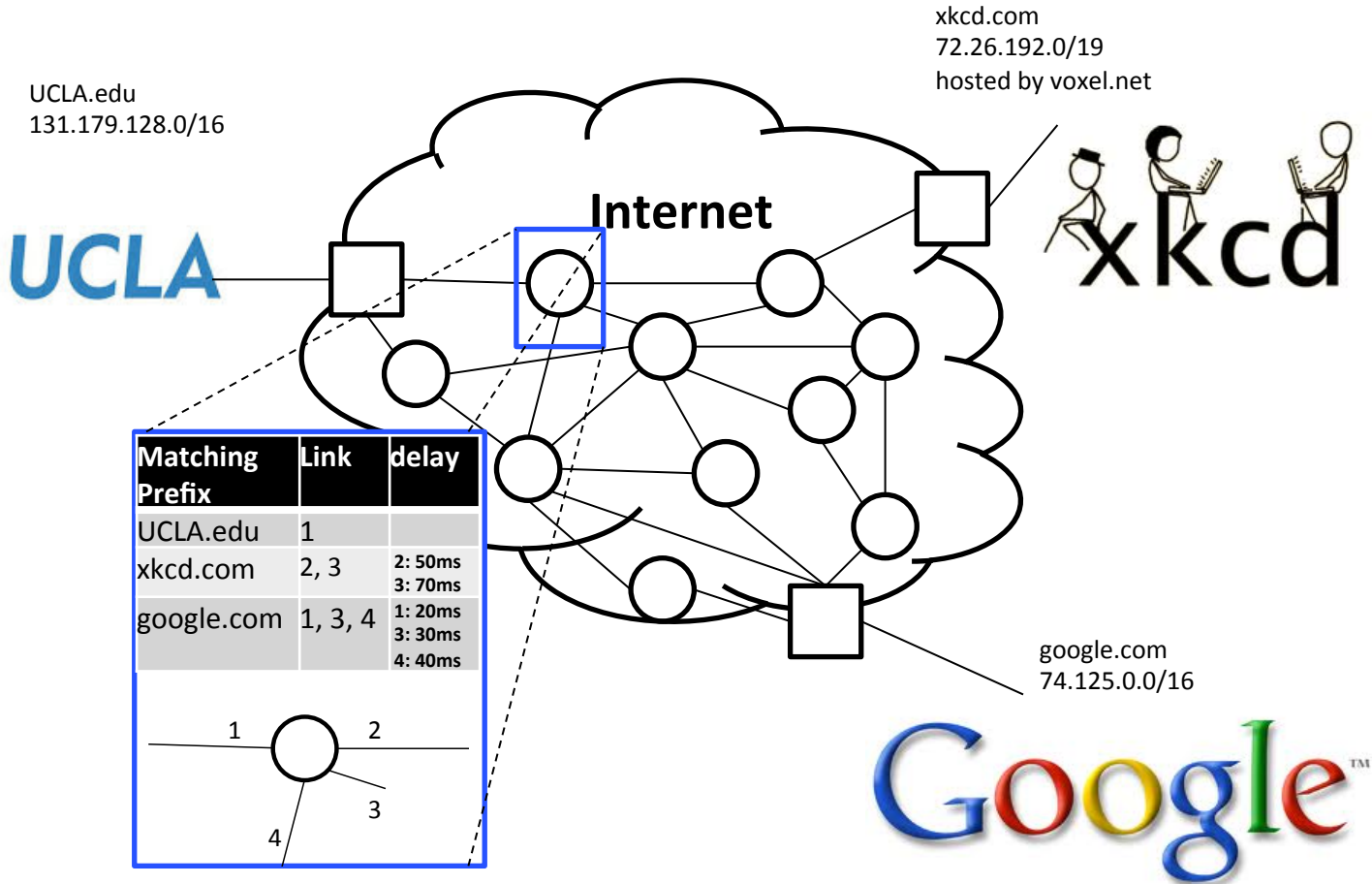
Matching Prefix	Link
131.179/16	1
72.26.192/19	2
74.125/16	3

A diagram of a router node, represented as a circle with four ports labeled 1, 2, 3, and 4. Port 1 is at the top left, port 2 at the top right, port 3 at the bottom right, and port 4 at the bottom left. Dashed lines connect the router to the corresponding square gateway nodes in the Internet diagram above.

google.com
74.125.0.0/16



NDN Nodes and Routes



So far we have

- Sketched out the basic architecture
- Developed a functional codebase
- Built a set of pilot applications

“How Can I Contribute?”

- What/where are the remaining research problems?
- NDN team’s experience: application-driven architectural development

How to Design a New Internet Architecture

"The test of all knowledge is experiment. Experiment is the sole judge of scientific 'truth'.

But what is the source of knowledge? Where do the laws that are to be tested come from? Experiment, itself, helps to produce these laws, in the sense that it gives us hints."

“Where can I find cool applications?”

Slow start: try simple ideas?

- It is truly insane that packets have to travel 1000 miles when the producer and consumers are 20 feet apart
- It is truly insane that, with today's IOT system's dependency on cloud, one can be locked out of home if a cloud server fails
- It is truly useful to be able to sharing global content but China blocks www.ted.com
- Can one implement a locally scoped file sharing? A local twitter?
- Can one develop a home IoT system that does not depend on cloud?
 - Playing with NDN on R-Pi, RIOT, Android
- Can one design a Delay-Tolerant app that can bring TED talk recordings back to China to share with others?

Some Commonly Heard Questions

Can NDN efficiently support point-to-point communication like a phone call?

Can one really route all those names?

Can one allow one Interest packet to (more efficiently) retrieve multiple Data packets?

Doesn't NDN make security a lot harder?

Given how difficult it has been to roll out IPv6, wouldn't rolling out NDN be next to impossible?

When may NDN get deployed?

Twit your questions using #icn16ndnask”

- NDN: simple concepts, powerful functionality
- Use NDN to develop some cool applications
 - Get a real understanding of NDN
 - Identify new issues
 - Discover new solutions

Experiment, itself, helps to produce these laws, in the sense that it gives us hints.

- This tutorial: help you open the door to experiment with (and contribute to) NDN's open-source codebase