Washington University in St. Louis

Evaluation in Named Data Networking

Patrick Crowley & the NDN Team

2014 FIA-NP PI Meeting

Arlington, VA

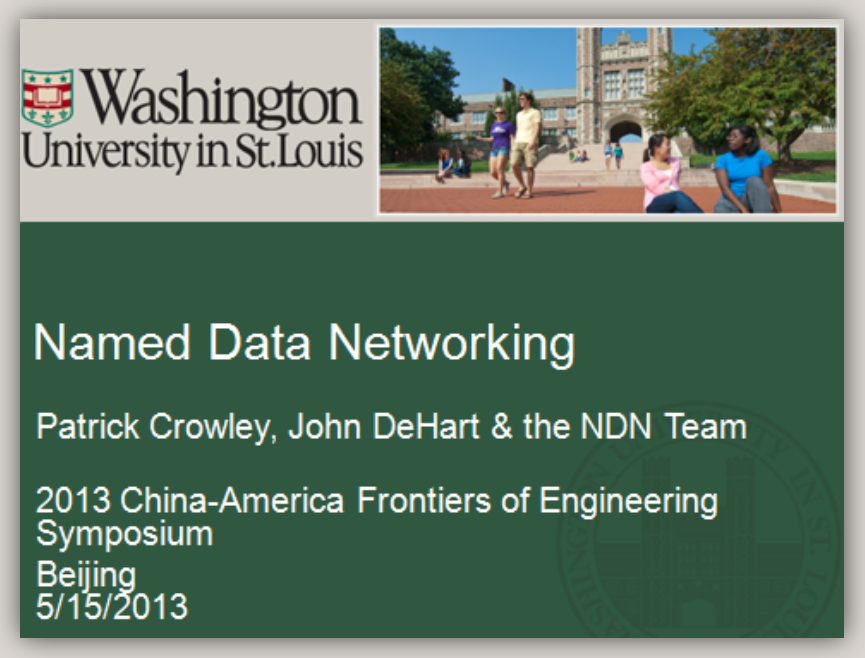
5/20/2014

Aim of Evaluation

To answer: how well does the NDN architecture solve problems?

First, a sanity check, are there problems in networking?

Share This Presentation?



What is the best way for me to share these slides with you right now?

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

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
```

Easy to forge Internet communications!

Use Connected Environment/IoT?

3 Challenges Caused By 1 Problem

Telephony/Internet Process

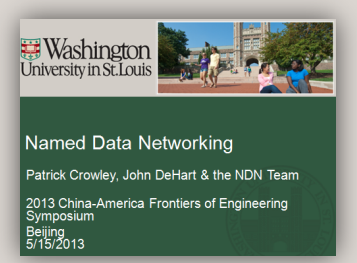
1. Find the **number/address** for the one you want to talk to.
2. Use that number to establish a **point-to-point connection**.
3. Communicate!

Sharing	*Must know address*
Trust	*Place trust in address*
IoT	*Know & trust all addresses*

A Simpler Way

Suppose your device could ask for what it wanted?

/wustl.edu/pcrowley/talks/CAFOE_2013.pdf



/wustl.edu/pcrowley/video/thinkpad

/room/thermostat/1/status

The Web Has Named World's Data!

/www.youtube.com/watch?v=oCZMoY3q2uM

/www.youtube.com/watch?feature=player_detailpage&v=oCZMoY3q2uM#t=1736s

Core Idea

Modern **communication** consists of
requests for named data

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

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

Performance & Evaluation

At the previous FIA PI meeting, we shared our view via 3 simple questions

How does the NDN team

… think about evaluation ?

… demonstrate progress and capabilities ?

… compare to the fast-moving real-world ?

Evaluation: We focus on use cases

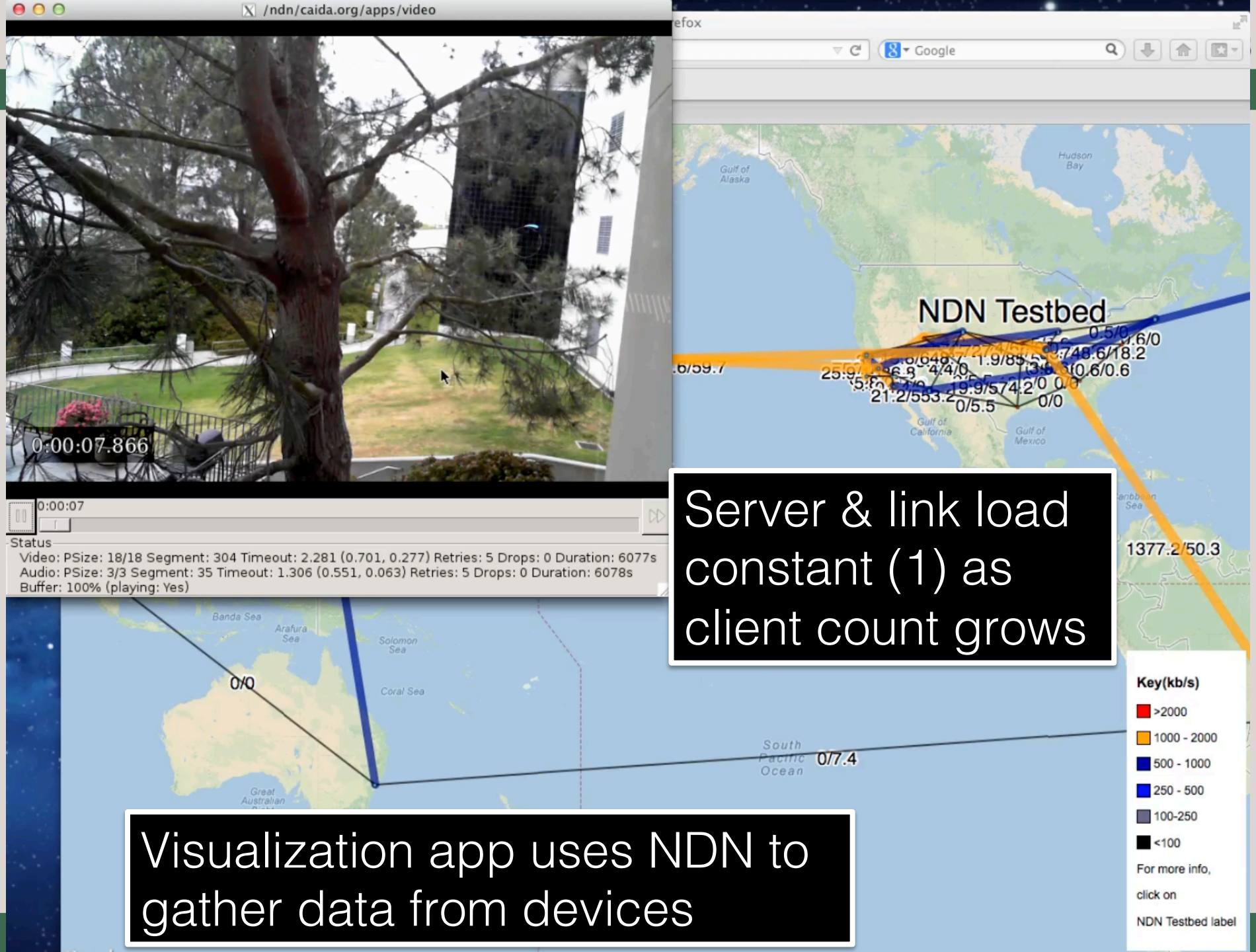
- Team includes two app-focused PIs
  - Jeff Burke (UCLA), Tarek Abdelzehar (UIUC)
- NDN-NP agenda includes two focus environments
- Developed a growing collections of apps
  - HD Audio/Video player, “DropBox”, decentralized group chat, building automation, stage lighting, …
- We conduct annual, real-world demonstrations
- We compare to the Internet’s state-of-the-art

End-to-end Focus is Primary

- Do NDN applications and services work, given real-world contexts?
- Many lower-level mechanisms are important to evaluate, but have **secondary** significance
  - Focused evaluations of: routing protocols, forwarding, transport-level synchronization, …
- The value of end-to-end demonstrations
  - They help the team focus on the right issues
  - They help dispel misunderstandings about the architecture
  - Real code in real environments keeps the team honest

Annual Demonstrations

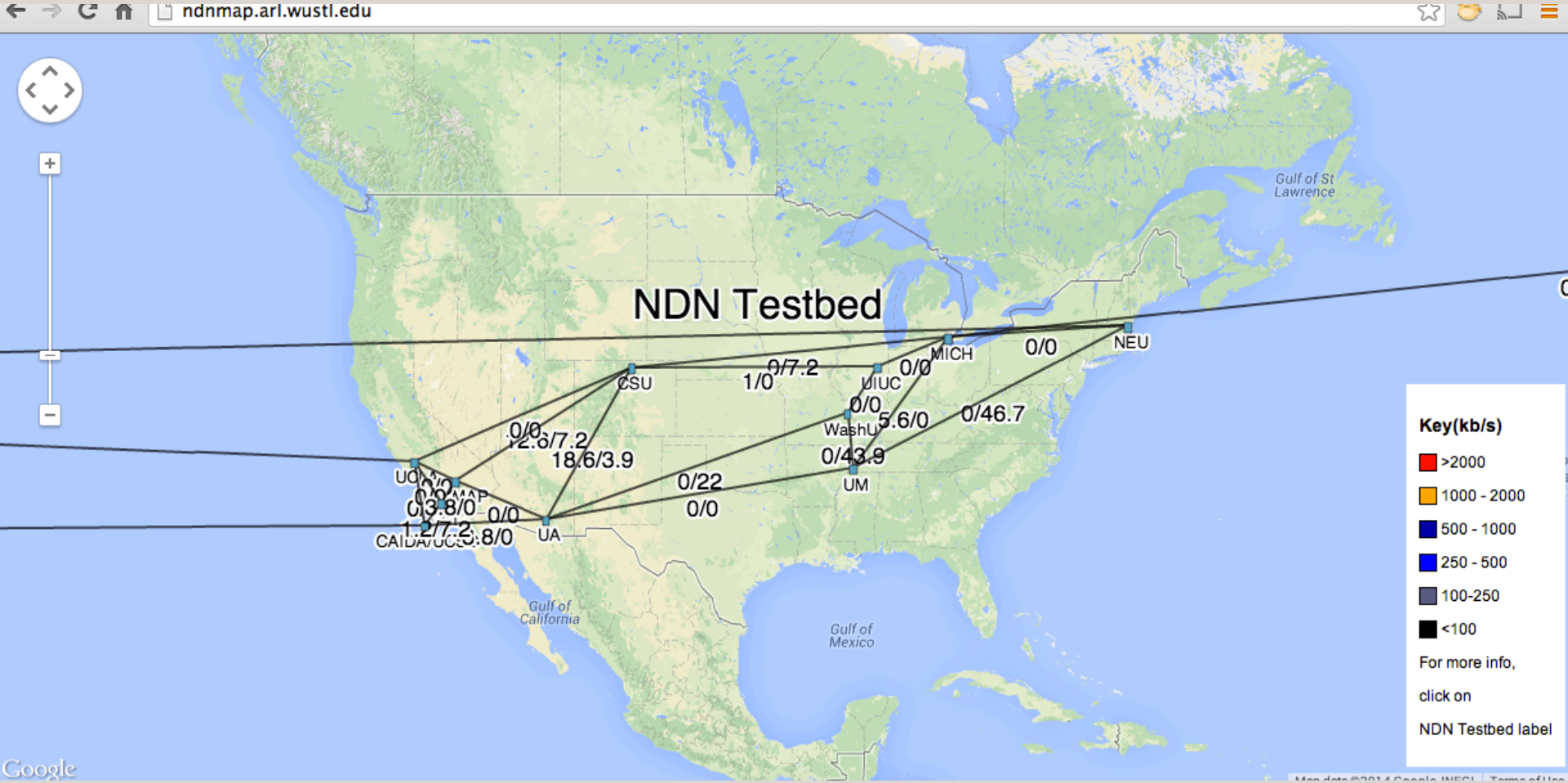
Demo Feature	2012 Demo	2013 Demo
Large-scale, **wide-area operation**	All 4 US time zones, ~300 machines	5 continents, ~1000 machines
Mix of content distribution and **interactive apps**	4 distinct services	Multiple services
Visualization of both app-level and net-level activity	NDN map	NDN map
Demonstrate both steady-state and **react-to-change** modes	Drop links during app sessions	Forwarding strategy
Something IP+HTTP cannot do	Scalable video streaming*, multi-path routing	Scalable video streaming*, multi-path routing
Integrated PKI, better security		Show key auth
NDN-based device monitoring		Stage lighting ctrl



Server & link load constant (1) as client count grows

Visualization app uses NDN to gather data from devices

NDN Testbed Enables Evaluation



Case Study: Broadcast of Streaming Web Video (Real-World Comparison)

- Use case: how can I broadcast my laptop's video feed to a global audience ?

- Alternatives
  - NDN
  - **Build** an HTTP video streaming infrastructure
  - **Use** an HTTP video streaming service

- Evaluation
  - Use similar topologies and machines to compare

- Conclusions
  - Amazon's Cloudfront is easy to use but hard to deploy
  - NDN is easy to use and easy to deploy

Lessons from Applications

IP Challenge	NDN Improvement
Collaboratively developed	
Limited application semantics represented in the network architecture	Express application semantics in network naming, down to packet level
Iteratively deployed	
IP networks can be brittle to change or require NAT, etc. to scale	Reduce network brittleness to configuration change
Dynamically assembled	
Connection-/session-oriented models; address assignment requirement	Connection-less, session-less communication, leveraging storage in the network
Physically integrated	
IPv6 provides "room" but does not aid application development	Consistent and meaningful addressing for virtual and physical components
Asynchronously experienced	
Mobility and multicast not well-supported	Disruption tolerant and multipath-friendly
Globally integrated	
Perimeter- and channel-based security model presents challenges	Data-centric rather than perimeter-centric security

Conclusion

We seek to understand how well the NDN architecture solves problems

NDN evaluates via

- Focus on end-to-end effectiveness
- Frequent real-world demonstrations
- Compare against the best alternatives