The NDN Project

- Part of the NSF Future Internet Architecture initiative
- One of four multi-institution projects funded in 2010-13, ~$8M
- Now in the second round of funding, 2014-16, ~$6M
- Goal: design the next generation Internet Architecture
NDN Institutions — Past and Present

http://named-data.net • http://github.com/named-data
Today’s Internet

☐ To find content in the network
☐ ..you have to learn where the content is
☐ ..and then ask the network to take you there
☐ ..so you can tell the server what you want

☐ In other words, the Internet is like an old GPS!

Latitude:26.212424°
Longitude:127.680932°
But Things Often Fail

Often the content is not there..

..or the path is too congested!
What if the Network was Smarter

And you could tell it what you want!

- Instead of taking you where you think the content is..
- The network could get the content for you!
- In the most efficient way!

How do we make the network smarter?

Ask what you want by its name, not address.
Named Data Network (NDN)

- The new idea: **Name the data, not the hosts!**
- ..so you can ask the network directly for the data!
Named Data is Easy to Secure

- In the Internet you secure your path..
- But the server may still be hacked!

- In NDN you **sign** the data with a **digital signature**..
- So the users know when they get bad data!

Colorado State University
Named Data Can be Cached

Cache

Colorado State University
Named Data Can be Cached
Named Data Can be Cached
Named Data Can be Cached
Named Data Can be Cached
Named Data Can be Cached
Named Data Can be Cached
Named Data Can be Cached
Named Data Can be Cached

The network caches the data for you because it can answer similar questions later. Data is naturally cached to locations of high demand. **Caching becomes the network operator’s problem!**
Robustness to Site Failure
Robustness to Site Failure
Robustness to Site Failure
Robustness to Site Failure
Robustness to Site Failure
Robustness to Site Failure

Failover in a named data network happens **automatically** without application involvement.
This Sounds Awfully Complex..

It's not! It's actually quite simple:

- First, name your datasets with a hierarchical, community agreed name:
  - /store/mc/fall13/BprimeBprime_M_3000/GEN-SIM/POSTLS162_v1-v2/10000/<UUID.root>

- Then, advertise the prefix to the network:
  - I can answer any questions starting with:
    - /store/mc/fall13/BprimeBprime_M_3000/GEN-SIM/POSTLS162_v1-v2/*

- Finally, let users issue interests with the appropriate name or name prefix
Example: xrootd Cluster

Here is how xrootd works today:
Example: xrootd Cluster

Here is how xrootd works today:
Example: xrootd Cluster

Here is how xrootd works today:

Client

Manager
(a.k.a. Redirector)

Data Servers
Example: xrootd Cluster

Here is how xrootd works today:

Client

Manager
(a.k.a. Redirector)

Data Servers
xrootd under NDN

NDN Network

Data Servers
xrootd under NDN

NDN Network

Data Servers
xrootd under NDN

NDN Network

Client

Data Servers

A /my/file
B
C /my/file

Colorado State University
xrootd under NDN

Client

NDN Network

myfile?

Data Servers

xroot cmsd

A /my/file

xroot cmsd

B

xroot cmsd

C /my/file
xrootd under NDN

Client

Data Servers

NDN Network

myfile?

A /my/file

B

C /my/file

Colorado State University

32
xrootd under NDN

No manager, fewer steps, more robust

Client

myfile?

myfile?

myfile?

Data Servers
NDN Simplifies Networking

**IP**
- DNS
- Caching
- Load Balancing
- Failover
- Addressing
- Security
- Discovery

**NDN**
- Naming
NDN Simplifies Networking

NDN let’s you focus on the science not the plumbing!
NDN in Our Climate Testbed
Current State of NDN

- Climate testbed hardware: six state of the art Dell PE720xd servers with 10G fiber connections throughout
  - 20 cores, 128GB RAM, 48TB local storage
- Cisco and others currently building specialized routers
- Washington University implementing forwarding algorithms that support lookups at 1B prefixes at line speed
Optimized NDN for LHC Network

- NDN can automatically and dynamically cache “hot” files near users for lower delay
- VIP algorithm: optimal interest forwarding and cache placement/replacement
- 76% lower latency over no caching

Yeh et al. 2014
Conclusions

☐ In HEP, mistakes are expensive..
☐ ..hard to do course correction midstream..
☐ ..so better get it right the first time!
☐ NDN frees up resources for more intelligent networks..
☐ ..to reduce waste

No, I meant turn left.

contact: christos@cs.colostate.edu