

# Supporting Climate Applications over Named Data Networking (NDN)

Christos Papadopoulos

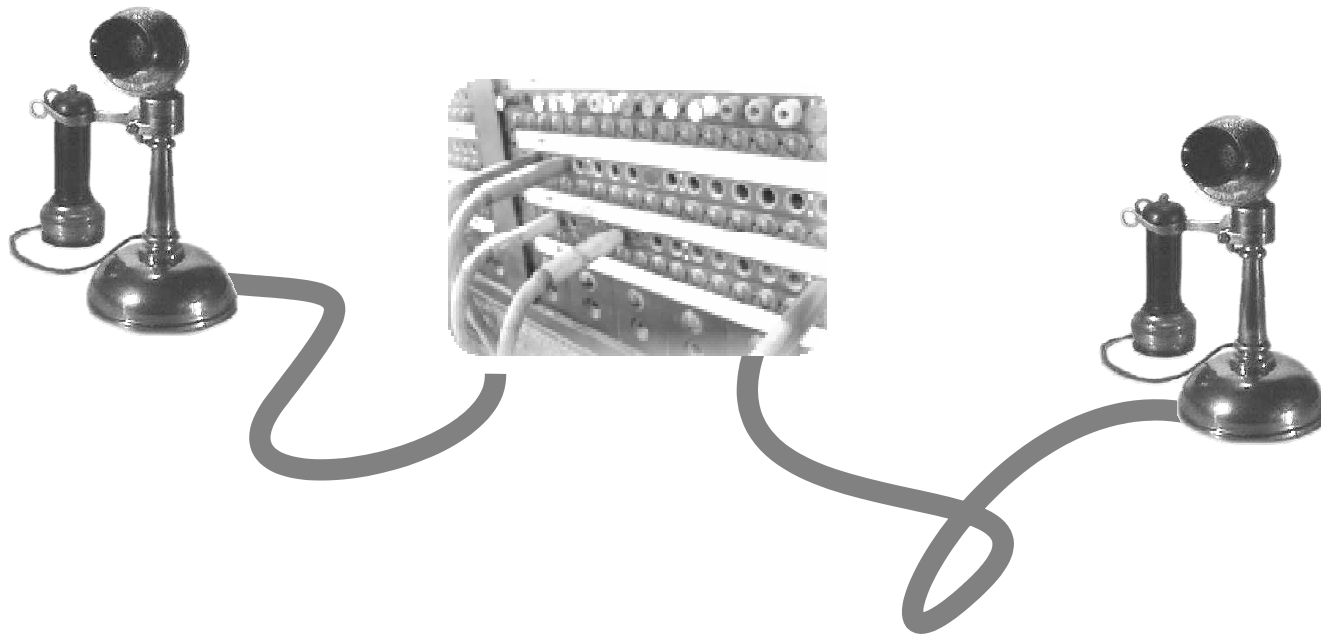
Cathie Olschanowsky

David Randall

Susmit Shannigrahi

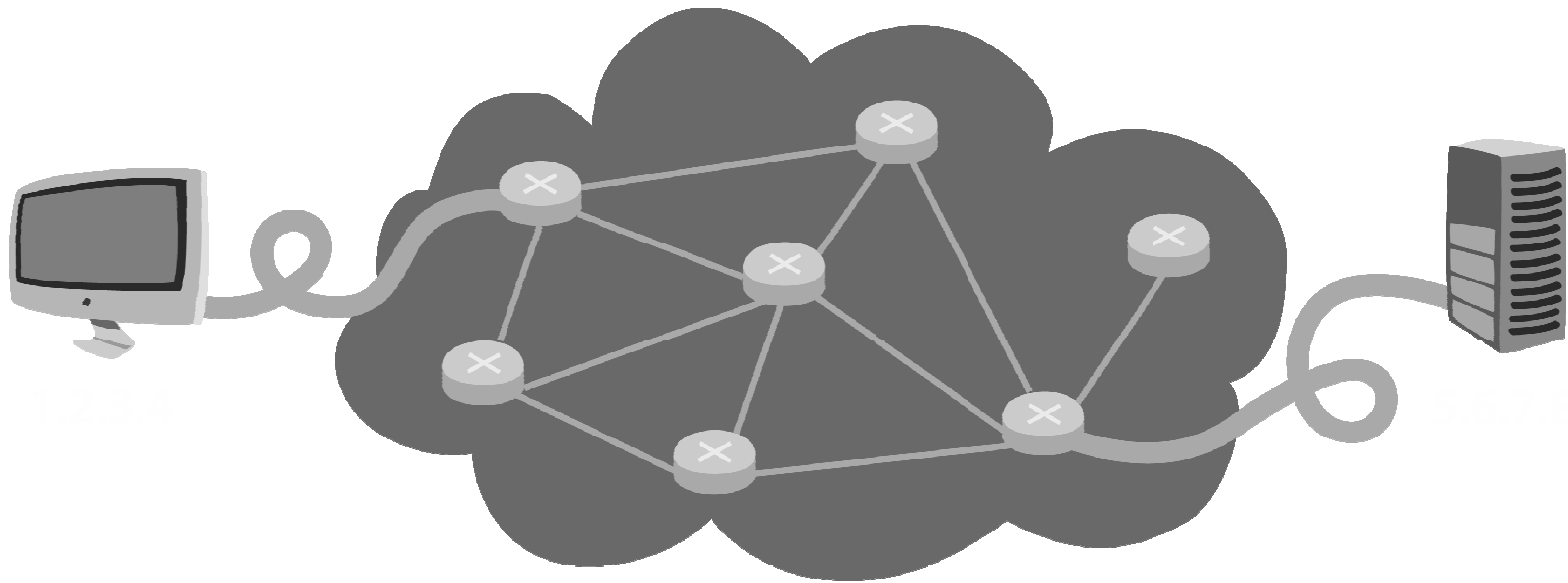
#13410999: NSF CC-NIE Integration award

# Telephone Network was the 1<sup>st</sup> Communication System



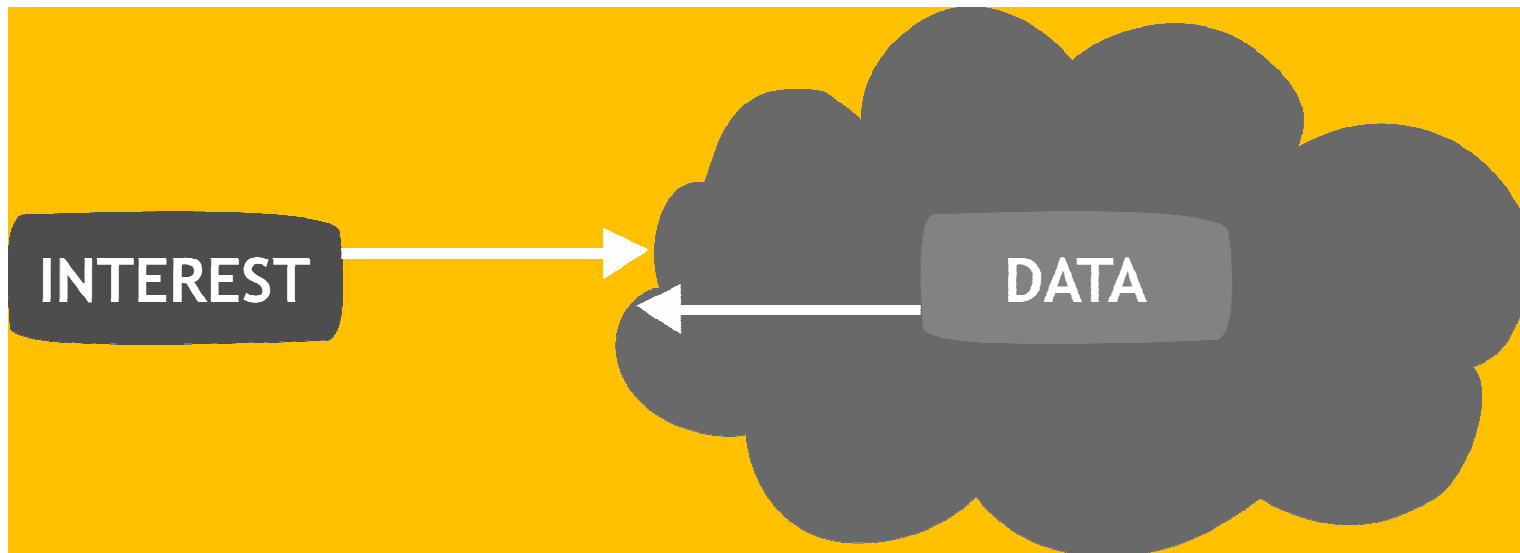
Focus on building and connecting the wires

# IP Revolutionized the Communication System



**Internet Protocol (RFC791):** Focused on delivering packets to destination *host*

# NDN: Focus on Data



Abstracting away the notion of “host”

*Superset of host-to-host communication model*

IP



Host-centric  
addressing

NDN



Data-centric  
addressing

# Two Problems with Current Internet

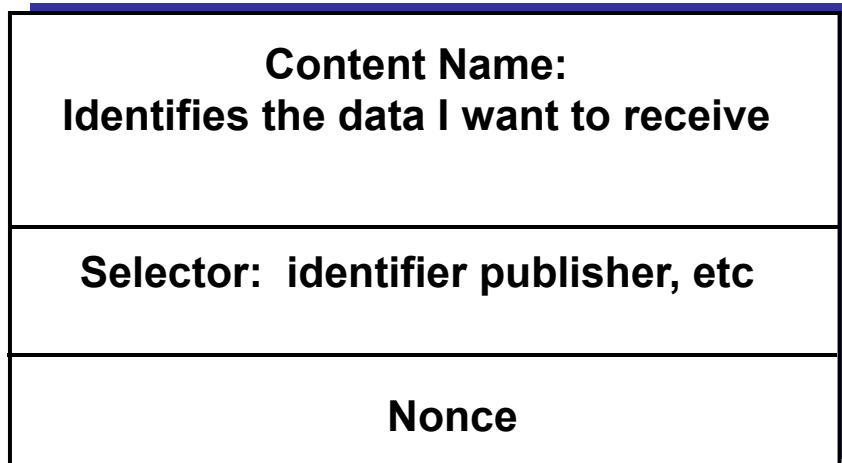
- Focus is on end-point communication
  - Artifact of original thinking: share resources, not content
  - Login to fast machine, access to the tape drive, the printer, etc.
- Security
  - To get data, you build a secure path
  - Once you authenticated with the server, you trust the content

# Two Focal Points in NDN

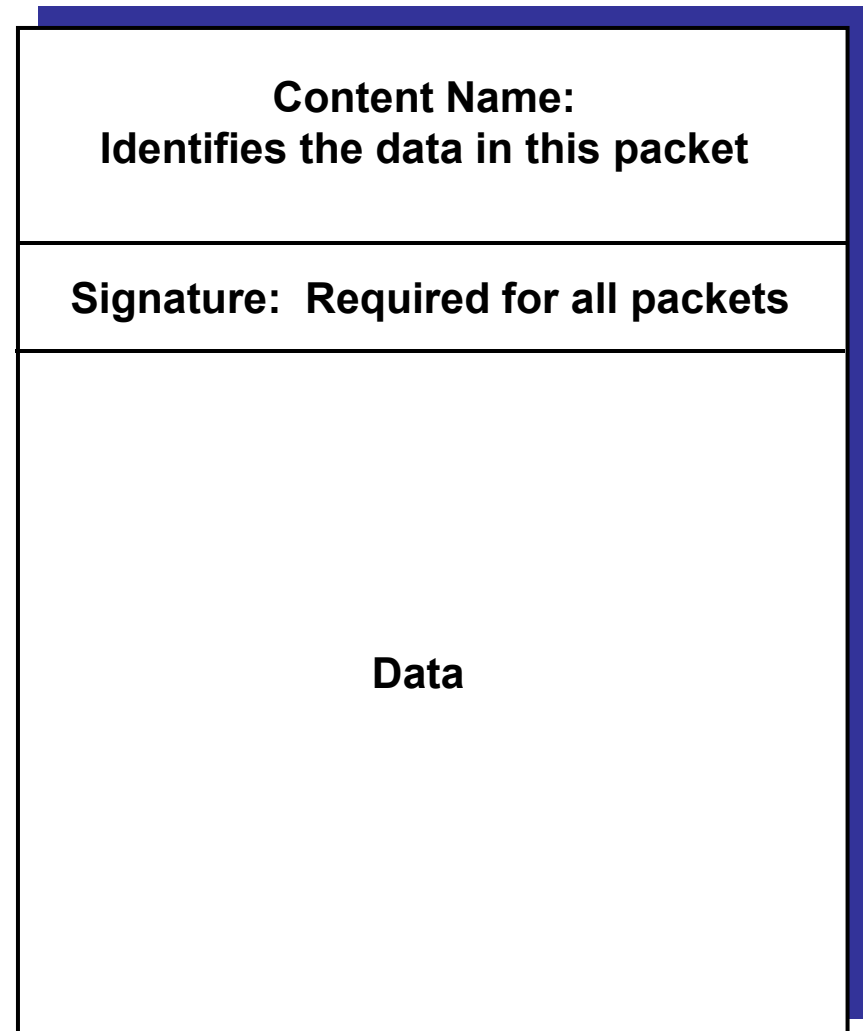
- Focus on the what not the where
- Secure the data not the container

# NDN Packets

## Interest Packet

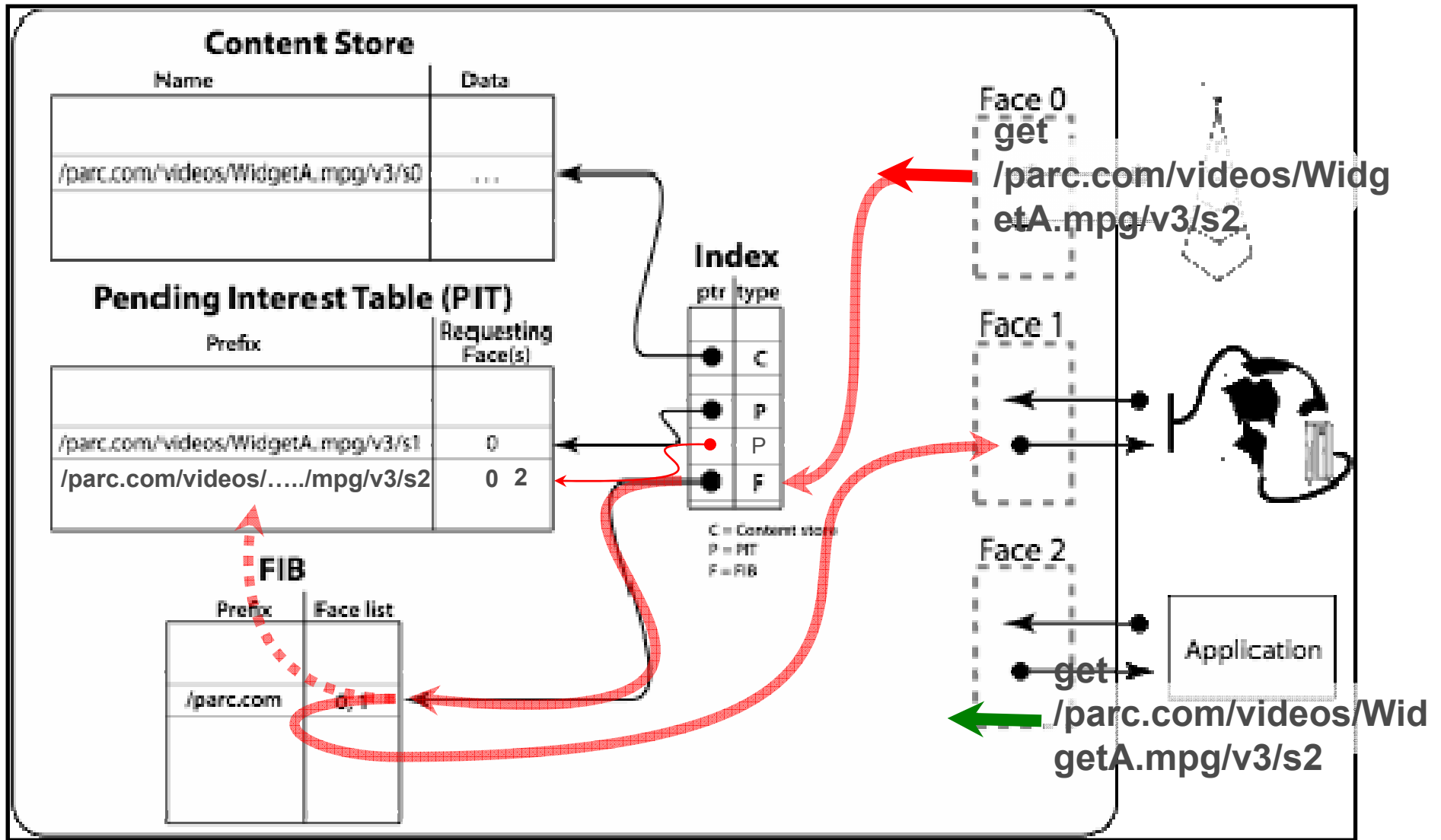


## Data Packet

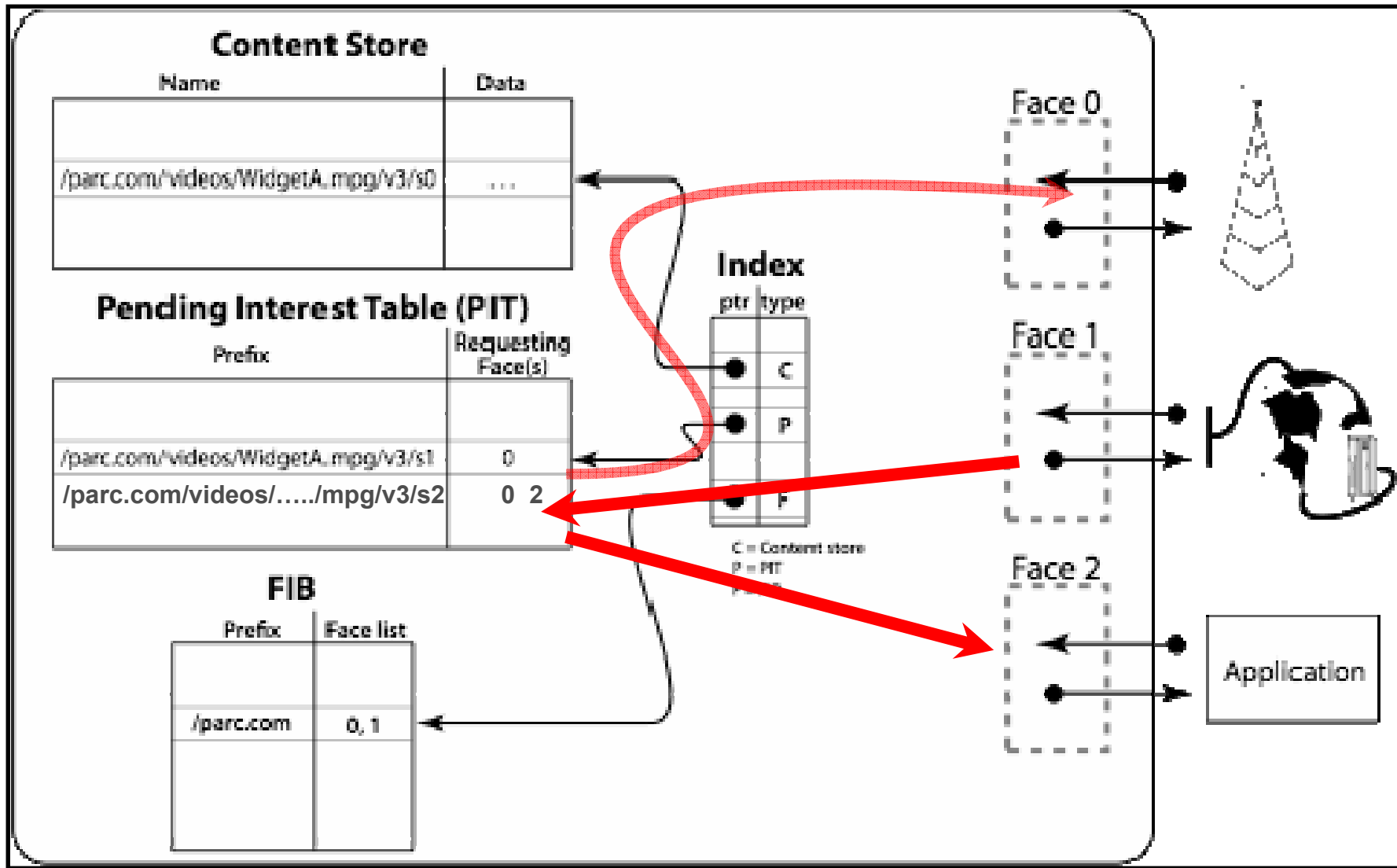




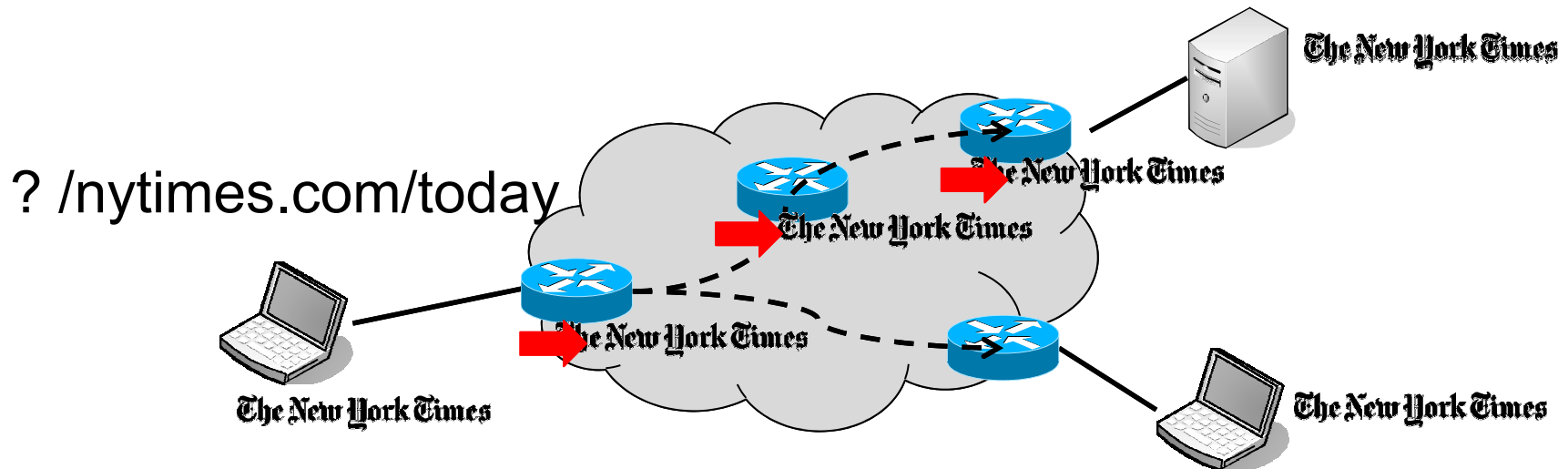
# NDN Interest Forwarding



# NDN Data Forwarding



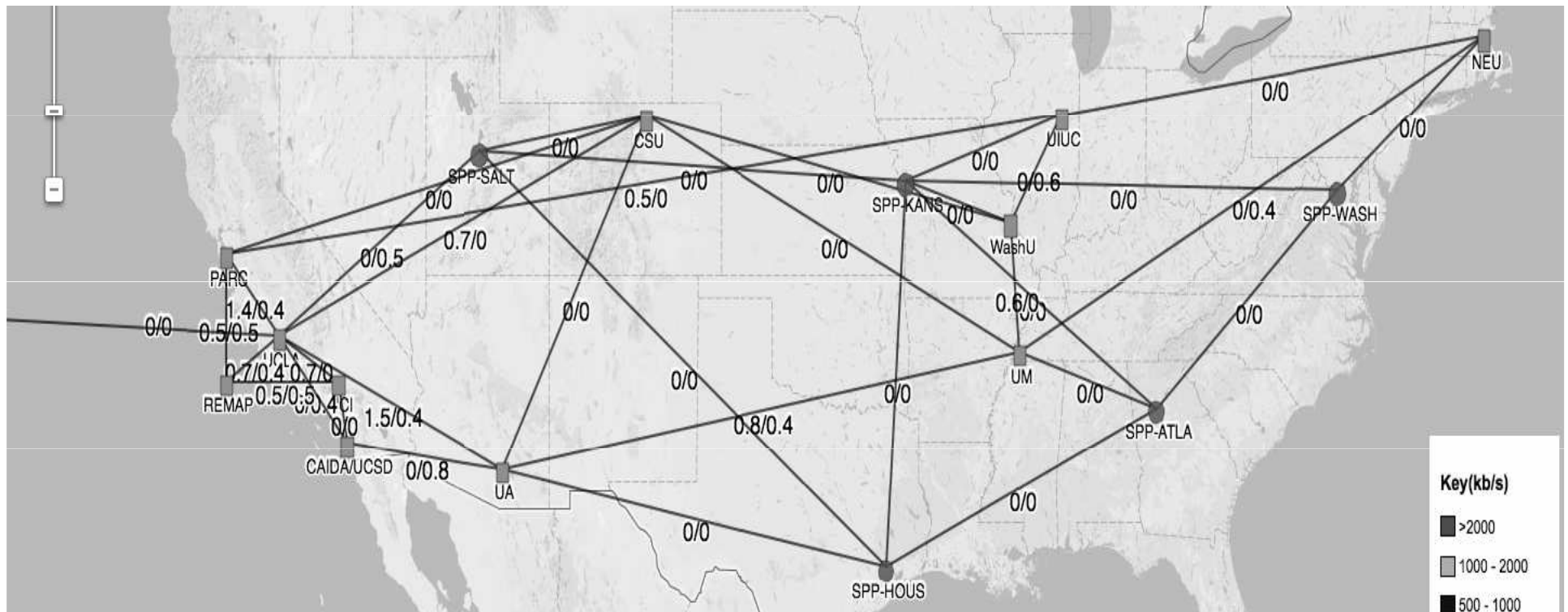
# Summary



- Route on content names
- Content from anywhere: not just the producer
- “Breadcrumbs” & de-duplication of requests
- Cache retrieved data in Content Store (CS)

# Is NDN Deployed?

- Deployable now as an overlay (TCP, UDP) or on Layer 2 transport
- C, Java, Python, Javascript libraries
  - <http://github.com/named-data>
- Testbed of 15 routers, including 5 on Internet2 / GENI
- <http://ndnmap.arl.wustl.edu/>



# Naming In Climate Applications

- Climate community has recognized the importance of structured naming
- Reference documents are beginning to appear
- Mostly targeted to file and dataset naming
  - Including dataset publication
- Provide consistency across distributed archives

# Example: CMIP5: Coupled Model Inter-comparison Project, phase 5

- “.. standard experimental protocol for studying the output of coupled atmosphere-ocean general circulation models.”
- International effort, started in 1995
- “CMIP5 is meant to provide a framework for coordinated climate change experiments.”

# CMIP5 Data Reference Syntax (DRS) and Controlled Vocabularies

- “.. a common naming system to be used in files, directories, metadata, and URLs to identify datasets wherever they might be located within the distributed CMIP5 archive. It defines controlled vocabularies for many of the components comprising the data reference syntax (DRS).”
- Current version is 1.3.1, June 2012

# DRS: Directory and File Structure

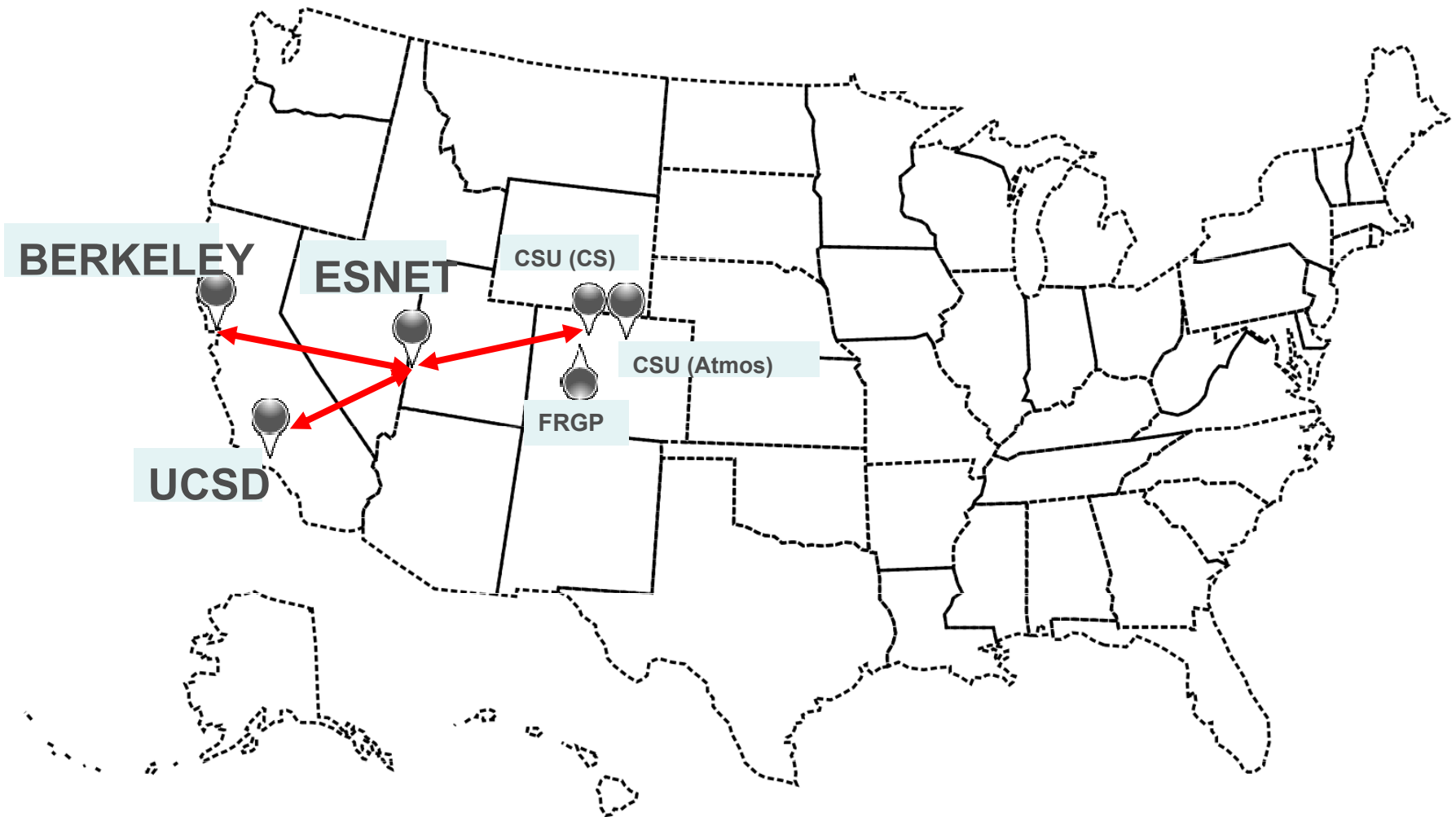
- **Directory encoding:**
  - /<activity>/<product>/<institute>/<model>/<experiment>/ <frequency>/<modeling realm>/ <variable name>/<ensemble member>
  - **Example:**  
/CMIP5/output/MOHC/HadCM3/decadal1990/day/atmos/tas/r3i2p1/
- **Filename encoding:**
  - filename = <variable name>\_<MIP table>\_<model>\_<experiment>\_<ensemble member>[\_<temporal subset>][\_<geographical info>].nc
  - Example: tas\_Amon\_HADCM3\_historical\_r1i1p1\_185001-200512.nc



# Observations

- CMIP5 DRS is NDN-compliant
  - Hierarchical
  - Clearly defined name components
  - Well-defined vocabularies
  - Organizes components from less specific to more specific
- Utilities to translate into DRS (CMOR)
- Ports readily into NDN names

# Planned Climate Testbed



# Moving Forward

- NDN offers two potential improvements to the scientific community:
  - Make data discovery far more convenient
  - Speed up data retrieval
- Data naming and discovery can be done now
- Speeding up data retrieval – forwarding, strategy layer, etc.
  - Real application to test congestion control

# Current Plan

- Deploy hardware
- Design appropriate namespaces
- Implement translators
- Integrate with existing workflow
  - Discovery and retrieval
- Investigate access controls
- Evaluate
- Extend to other domains