UCLA ENGINEERING Henry Samueli School of Engineering and Applied Science

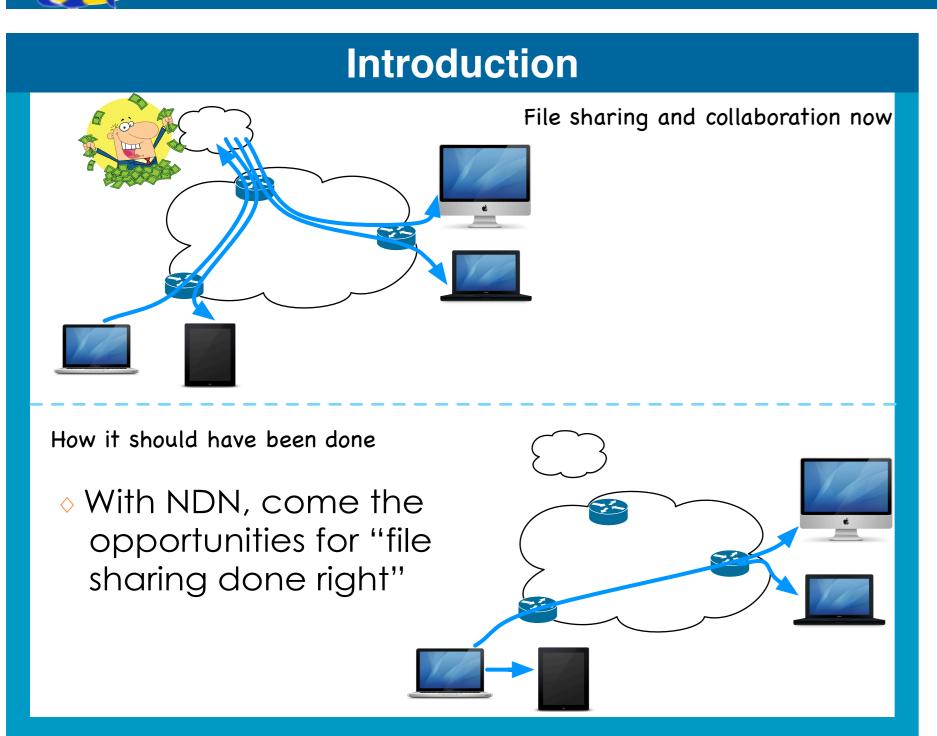
ChronoShare: a new perspective on effective collaborations in the future Internet

Birthplace of the Internet

Zhenkai Zhu, Alexander Afanasyev, Lixia Zhang

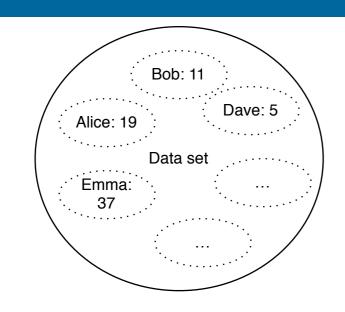


Internet Research Laboratory



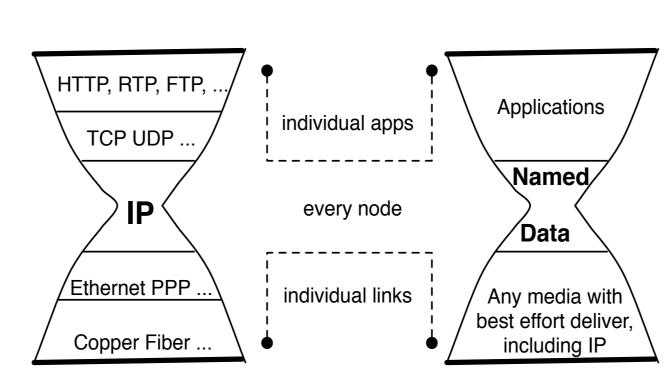
State of a data set

A data set is the union of all subsets produced by users



- By naming data sequentially, a user's data subset can be represented as {name prefix, max(SeqNo)) pair
- The state, or knowledge, of the data set consists of all such pairs

NDN: a new Internet architecture



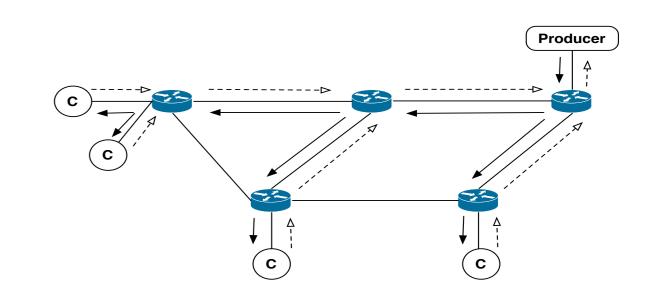
- Two packet types
- Every piece of data has a name
- Security is built into data
- Name Selectors

Nonce

Content Signed Info

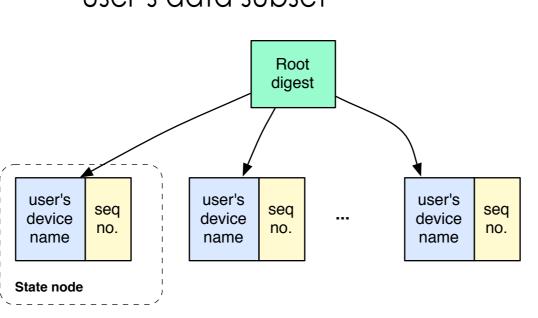
Signature

- Receiver-driven communications
- Send Interest to retrieve Data
- One Interest brings at most one Data packet
- Intelligent data plane
- Router maintain "Pending Interest Table"
- Aggregation of Interests by routers
- Natural support for data multicast



ChronoSync: efficient state synchronization

- Represent state as a digest tree
- The root digest summarizes the state of the whole set
- Each child node corresponds to a user's data subset



ChronoShare app

Shared folder actions,

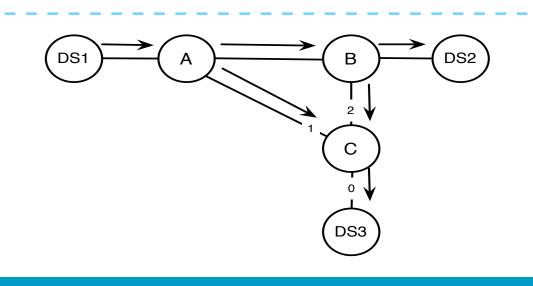
- Interest Name sync-prefix/state-diges
- Users exchange root digests with broadcast Interests
- All Interests are identical in steady state

ChronoShare design components

State hash

00a12..

- Whoever produces new data can reply the interest With his new {name prefix, SeqNo.}
 - Receivers update their hash tree and send out Interests with new root hash



Digest Log

State tree modification

<update /zhenkai to seq number 2>

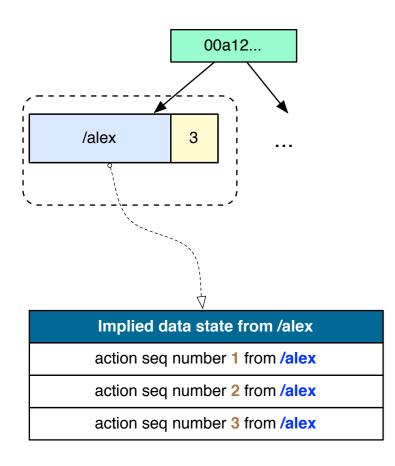
File action

<update /a.jpg to b873... with

<update /alex to seg number 3>

From ChronoSync to ChronoShare

- The state of the shared folder can be determined by the actions applied to the files
- Actions can be delete, create, update
- ChronoSync tracks the actions of each user
- The SeaNo is the number of actions from the user

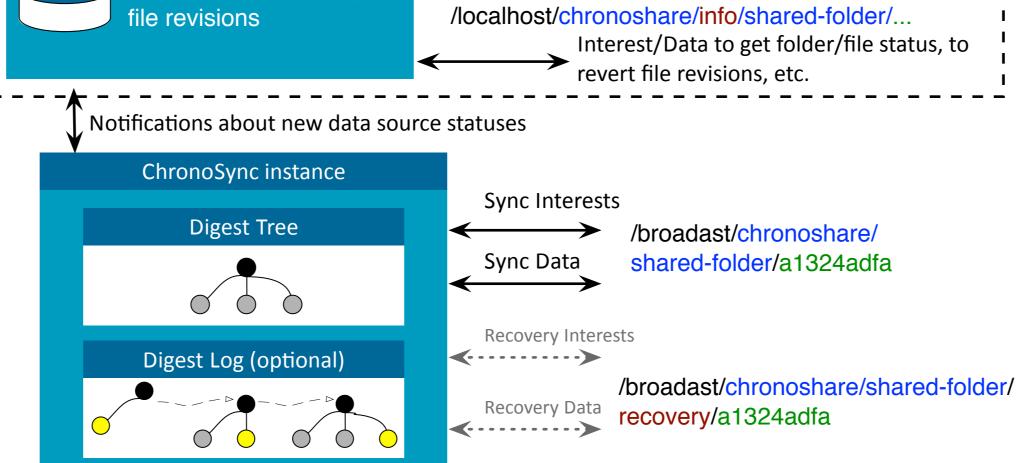


- Users request for missing actions once ChronoSync detects state change
- Actions are applied in the same order by all users
- Each action result in a new version of a file
- The same set of actions results in the same shared folder
- Users may decide whether to fetch the new version of a file or not

ChronoShare design overview

/username/chronoshare/action/shared-folder/10

/username/chronoshare/file/shared-folder/<file>/7



Interest/Data to fetch actions and files

Digest Tree node properties <update /zhenkai to seq number 1: Device name | Seq number | Current hint <update /alex to seq number 2> /ndn/ucla.edu «ubdate /alex to seq number 1> /ndn/ucla.edu /zhenkai **Shared Folder Tree Action Log** Key/SeqNo <update /sub/c.jpg to 1234</pre> a.jpg b873... 0644 2 <delete /b.txt> /zhenkai 1234... 0644 <update /b.txt to ff01... with c.jpg /zhenkai File properties <update /b.txt to bba1... with Name | Content hash | Permissions a.jpg

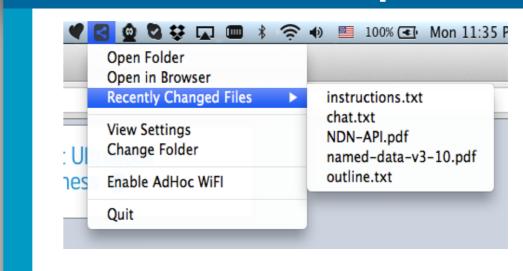
/zhenkai °

Digest Tree

Features

- Efficient multicast data distributed
- Local communication is truly local
- Device mobility is supported
- Files are available even if the producer is offline
- Version control is supported
- Encryption based access control
- Data Provenance guarenteed

Implementations



- Open source native app in Mac OS X and Linux
- Dropbox-like user interface
- https://github.com/named-data/ChronoShare
- Binaries also available
- NDN-JS based web interface for history and version control