Multi-party Synchronization (Part 2)

NDN Tutorial – ACM ICN 2015
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Goals

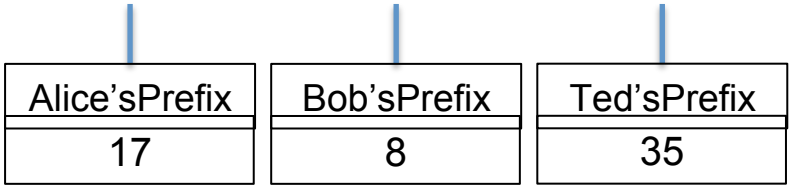
- See how to use ChronoSync in an application
- See how to use the sync API of the NDN client library

Overview

- Review the client library ChronoSync support
- Explore an example ChronoSync application: FireChat
- Deep dive: Follow code to “send” a chat message using ChronoSync

ChronoSync2013

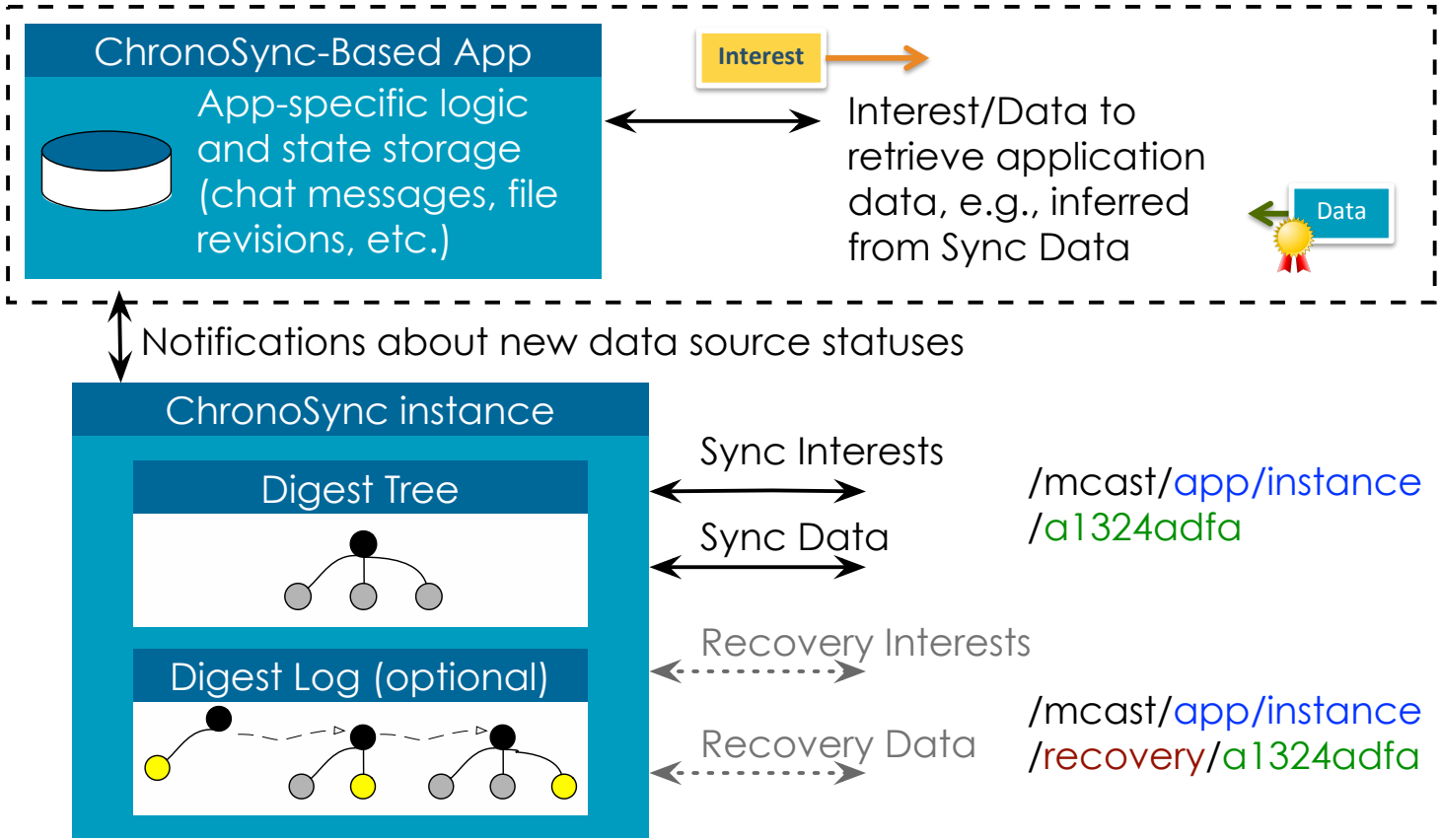
- "Let's ChronoSync" (2013) http://named-data.net/publications/chronosync
- Implemented in NDN client libraries for NDN-CPP, PyNDN, NDN-JS, jNDN
- General API: http://named-data.net/doc/ndn-ccl-api/chrono-sync2013.html
- Main functionality:
  - Maintain the latest "sequence number" for each user
  - Publish a new sequence number from me
  - Notify on a new sequence number from another user
- Separate application-specific messages based on the "sequence number"



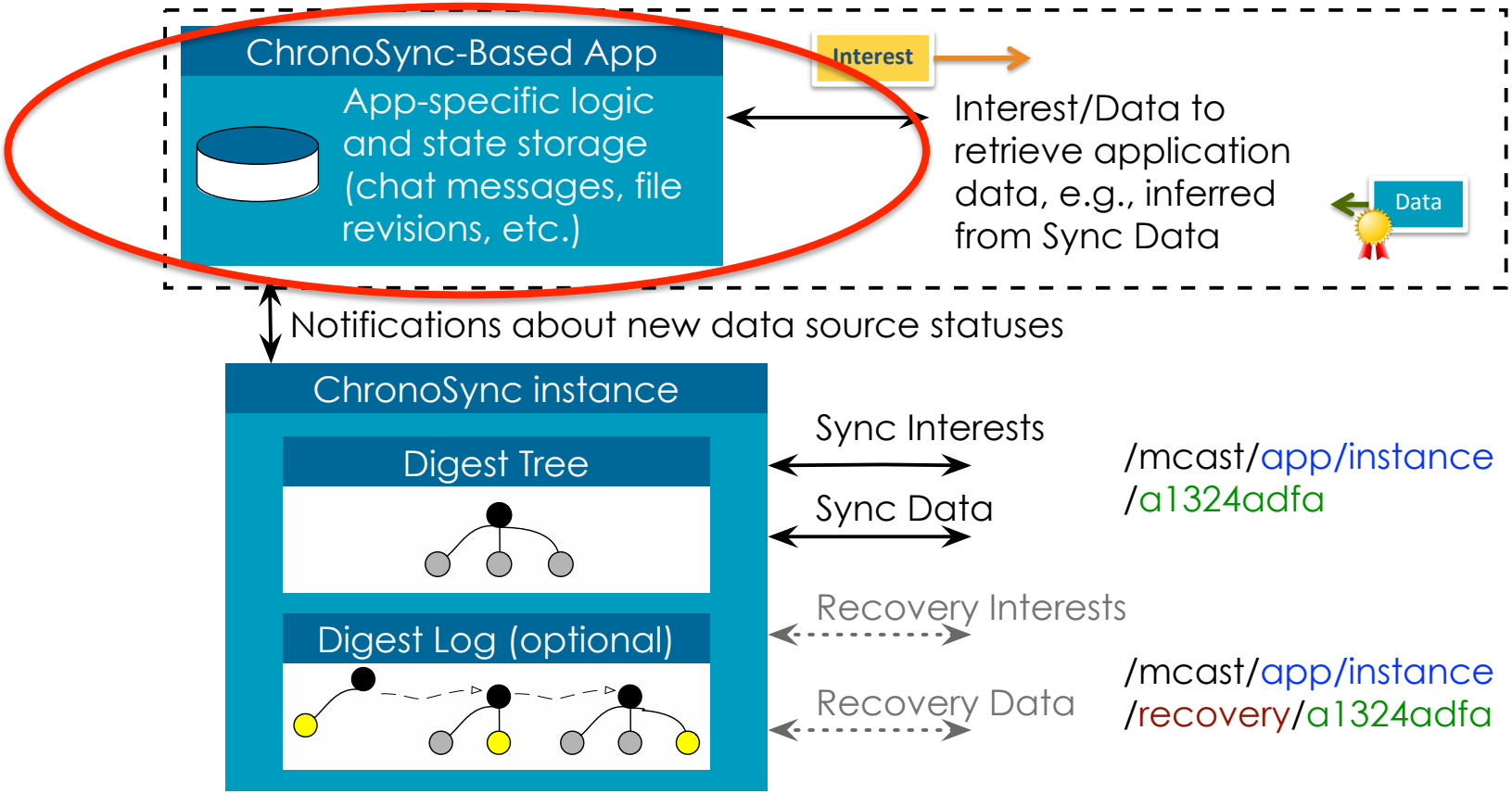
Names

- Sync data name to represent the dataset status:
  - Multicast_prefix/ApplicationName/digest
  - /ndn/multicast/CHAT/CHANNEL/tutorial/
    d04f8183fe685488a5ba6763869fc93e19a6c5e5038518e3e5818516b307bba6
- Application data name:
  - Participant_prefix/ApplicationName/msg_seq
  - /ndn/org/icn/USER/bob%40ucla.edu/CHAT/CHANNEL/tutorial/SESSION/1442864410/3

ChronoSync-Based App Design Overview



ChronoSync-Based App Design Overview



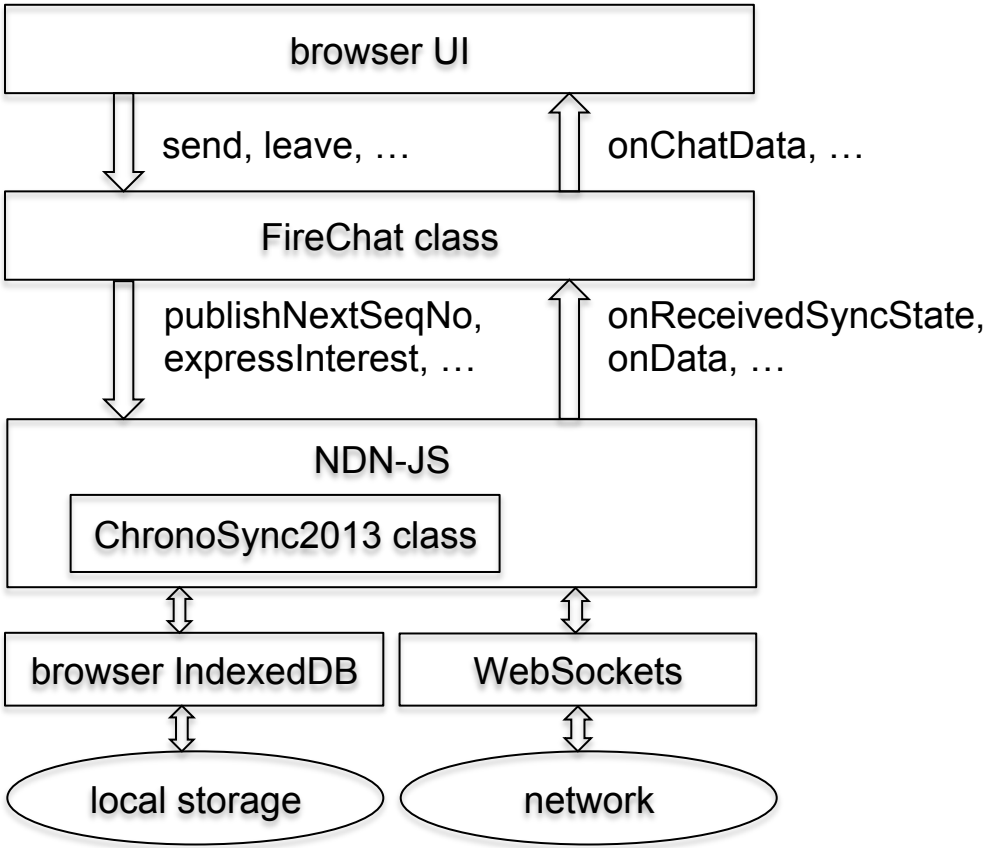
FireChat

- Use ChronoSync2013 with assumptions for our chat app
- Inspired by the simple interface of Firebase http://firebase.com
- Peer-to-peer
- `new FireChat(screenName, username, chatRoom, …);`
- Simple methods and JavaScript callbacks
- https://github.com/zhehaowang/icn-tutorial-app

FireChat assumptions

- Stuff we won't have to worry about…
- Connect to an NFD host at UCLA over WebSockets
- Fixed name prefix for chat messages
- JSON for the chat message content
- User keys stored locally in-browser with IndexedDB
- User certificates issued by an automated authority at UCLA
- Hard-wired certification trust root for the automated authority

FireChat application design



Create session

```
var username = ”alice@ucla.edu";
var screenName = ”alice";
var chatroom = ”tutorial";
var chronoChat = new FireChat
   (screenName, username, chatRoom,
    onChatData, onUserLeave, onUserJoin, updateRoster,
    onChatDataVerified);
```

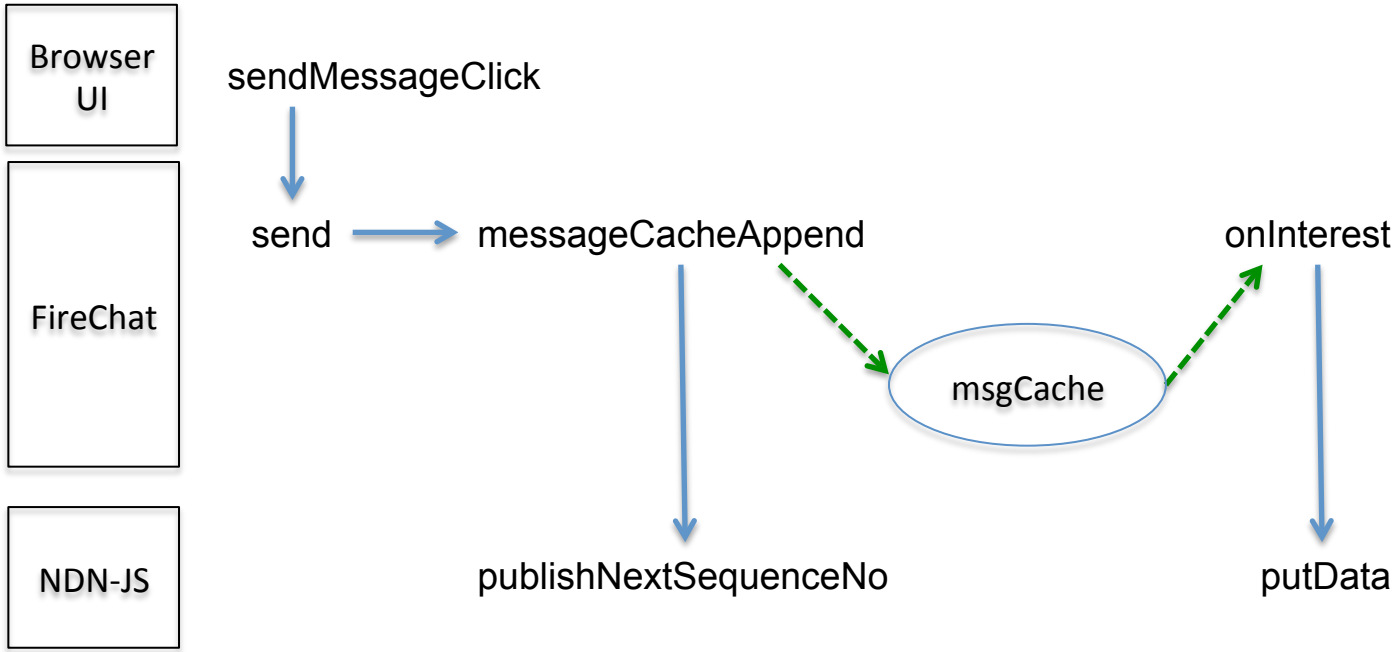
- If needed, generate user keys
- Register with NFD to receive interests
- Join the chat room
- Sync to the latest chat message “sequence number” from other users
- Set up “heartbeat” timer - missed heartbeat from another means “leave”

Send chat messages

```
var message = "Funny &amp;amp; true pic <img … />";
chronoChat.send(message);
```

- Get my next chat message sequence number, update the digest tree
- Reply to sync messages with the new sequence number
- Put the chat message in the in-memory log, ready to reply to interests
- Put the chat message in persistent storage for “recovery” from other users
- `message` is HTML, suitable for
- Can link to images or content (not part of the chat message)
- (deep dive follows)

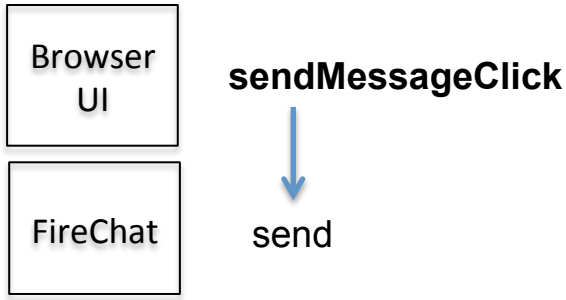
Deep dive: Follow code for send



Deep dive: page.js click SUBMIT

```
$("#chatBtn").click(function() { sendMessageClick(); });

function sendMessageClick() {
  var chatMsg = $("#chatTextInput").val();
  var escaped_msg = $('<div/>').text(chatMsg).html();
  chronoChat.send(escaped_msg);
  …
}
```



Deep dive: FireChat.send

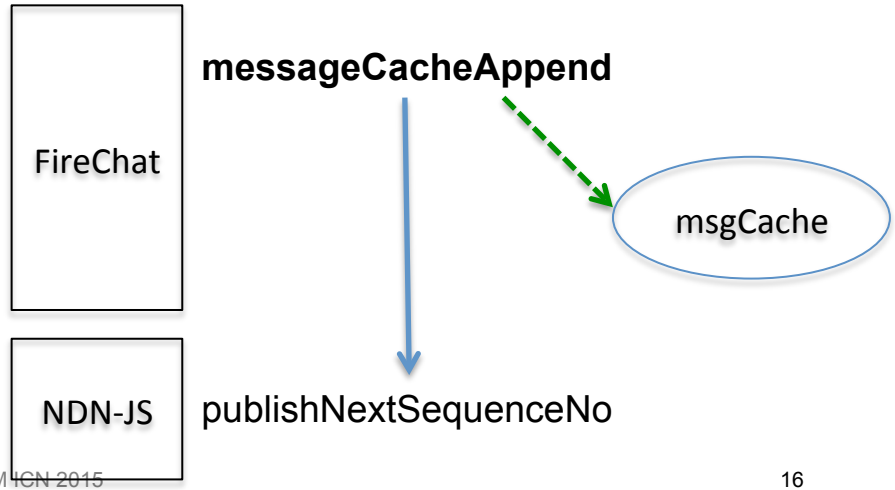
```
FireChat.prototype.send = function(msg) {
  …
  this.messageCacheAppend("CHAT", msg);
  this.onChatData(this.screenName, new Date().getTime(), msg);
};
```

- `messageCacheAppend` does most of the work (next slide)
- Call `onChatData` so the application also displays its own chat messages

Deep dive: FireChat.messageCacheAppend

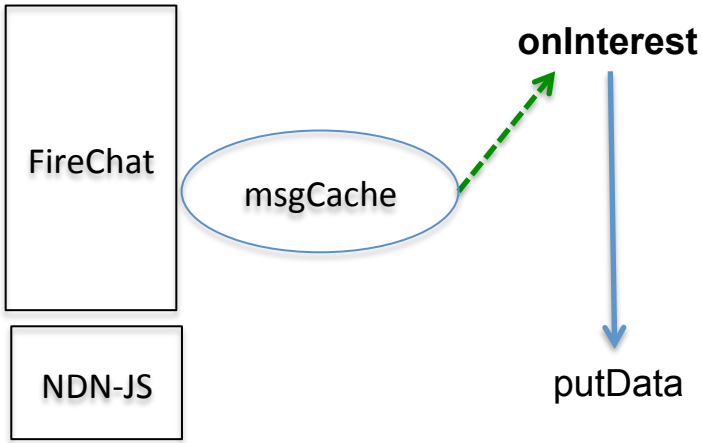
```
FireChat.prototype.messageCacheAppend = function(messageType, message) {
  this.sync.publishNextSequenceNo();
  var content = new FireChat.ChatMessage
    (this.sync.getSequenceNo(), this.username, this.screenName,
     messageType, message, new Date().getTime());
  this.msgCache.push(content);
  // Also put the message in the persistent chat storage.
  …
};
```

- Publish the next sequence number
- Save the `ChatMessage` JSON object and wait for interests from other users



Deep dive: FireChat.onInterest

```
FireChat.prototype.onInterest = function(prefix, interest, face, …) {
  var seq = parseInt(interest.getName().get(-1).toEscapedString());
  var chatMessage = findChatMessage(this.msgCache, seq);
  var data = new Data(interest.getName());
  data.setContent(chatMessage.encode());
  this.keyChain.sign
   (data, this.certificateName, function() {
    face.putData(data);
  });
};
```



- /ndn/org/icn/USER/alice%40ucla.edu/CHAT/CHANNEL/tutorial/SESSION/1442864410/5
- `keyChain.sign` explained later
- `face.putData` sends the data packet to the face of the incoming interest

Deep dive: Chat message content


```
{ "seqNo": 5,
  "fromUsername": "alice@ucla.edu",
  "fromScreenName": "alice",
  "msgType": "CHAT",
  "timestamp": 1442932978694,
  "data": "funny &amp;amp; true",
  "to": "" }
```

DeepDive: ChronoSync2013.publishNextSequenceNo

```
ChronoSync2013.prototype.publishNextSequenceNo = function() {
  this.usrseq++;
  var message = makeSyncMessage
    (this.applicationDataPrefixUri, this.usrseq, this.session);
  this.broadcastSyncState(this.digest_tree.getRoot(), message);
  this.digest_tree.update(message); // (actual code is more detailed)
  var interest = new Interest(this.applicationBroadcastPrefix);
  interest.getName().append(this.digest_tree.getRoot());
  this.face.expressInterest(interest, this.onData.bind(this), …);
};
```

- `broadcastSyncState` will reply to interests for the previous digest with the new usrseq
- Express interest for next digest root: /ndn/multicast/CHAT/CHANNEL/tutorial/d04f8183fe685488a5ba6763869fc93e19a6c5e5038518e3e5818516b307bba6

Receive join and leave notifications

```
function onUserJoin(from, time, msg, verified) { … }
function onUserLeave(from, time, msg, verified) { … }
```

- Notifies another user's screen name who joins or leaves
- Call the callback once for each join or leave

Receive chat messages

```
function onChatData(from, time, msg, verified) { … }
```

- Notifies another user's screen name and chat message
- Call the callback once for each message
- The message is HTML, suitable for
- /ndn/org/icn/USER/bob%40ucla.edu/CHAT/CHANNEL/tutorial/SESSION/1442864410/3

Leave

```
FireChat.prototype.leave = function() { … };
```

- Send the leave message
- Stop receiving other user's messages

Putting it together

- index.html:
  - Include ndn.min.js, page.js, fire-chat.js and indexeddb-storage.js
  - HTML for the chat page text areas, buttons, etc.
  - HTML for the initial prompt for email and screen name:
- page.js:
  - $("**#email-dialog**").close: Call **startFireChat**().
  - **startFireChat**(): new **FireChat**(screenName, username, chatroom, **onChatData**, onUserLeave, onUserJoin, updateRoster, …);
  - **onChatData**, onUserLeave, onUserJoin, updateRoster: Display messages
- fire-chat.js:
  - The **FireChat** class
- indexeddb-storage.js:
  - The IndexedDbChatStorage class, called from FireChat.messageCacheAppend

Goals recap

- See how to use ChronoSync in an application
- See how to use the sync API of the NDN client library