

CCN Networking Architecture for Mobile Applications

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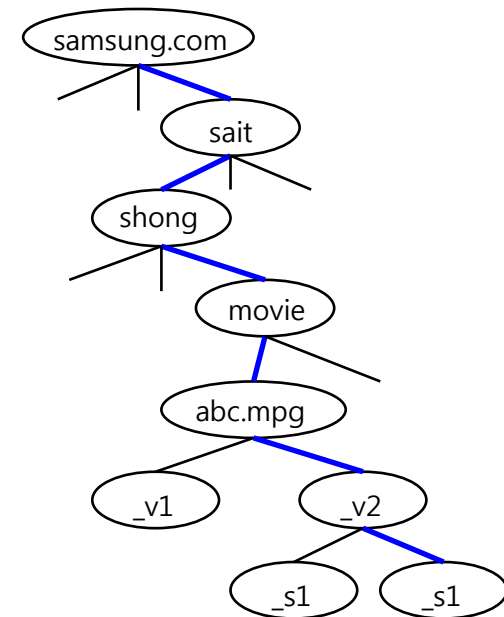
- Content-Centric Networking (CCN)
 - ✓ Definition
 - ✓ IP vs. CCN
- Virtual Private Community (VPC)
- Problem Statement
 - ✓ How to discover Information in different broadcast domain?
 - ✓ How to support video streaming?
- Solution
 - ✓ CCN-based Information Discovery
 - ✓ CCN-based Video Streaming Service
- Summary

* VPC (Virtual Private Community)

Content Centric Networking (CCN)

- Packet types
 - Interest: used to send request for content
 - Data: Any node having the corresponding data can respond with a Data packet
- 3 components
 - Forwarding Information Base (FIB)
 - ✓ used to forward Interest packets toward potential source(s) of Data.
 - Content Store (CS)
 - ✓ used to store contents with appropriate replacement policies
 - Pending Interest Table (PIT)
 - ✓ keeps track of Interests forwarded upstream toward content source(s) so that returned Data can be sent downstream to its requester(s)

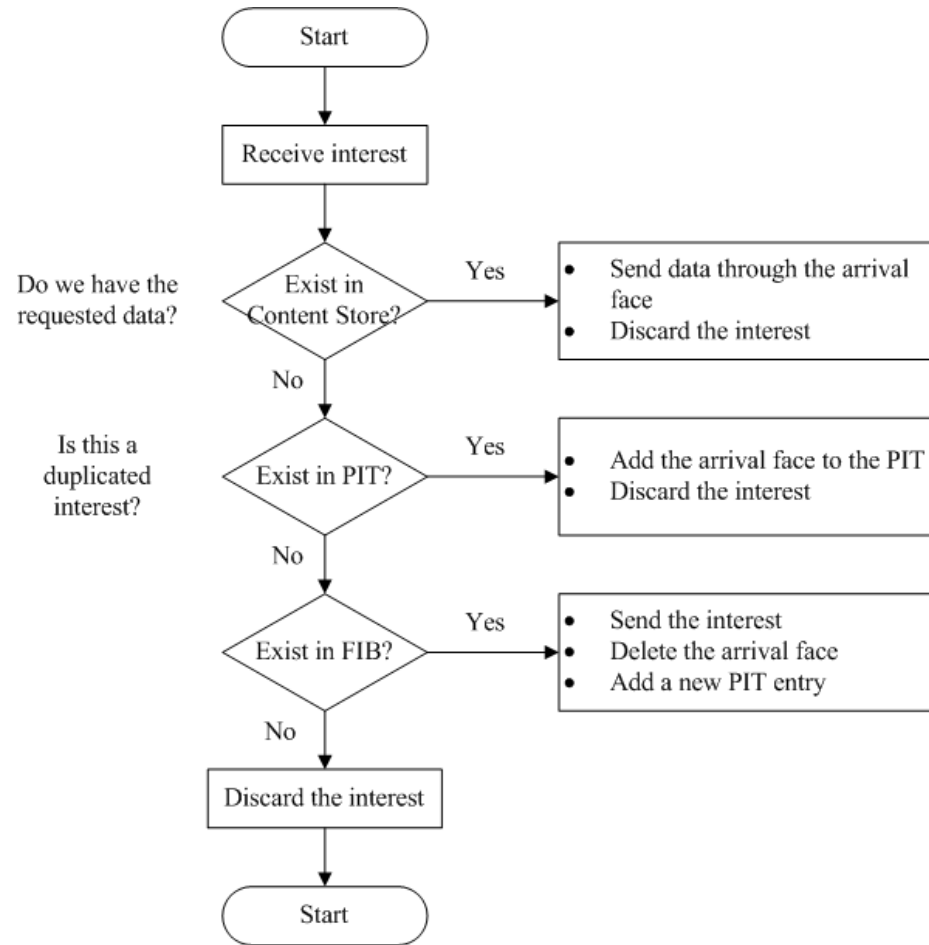
- Hierarchical naming rule



User/App supplied name **Versioning & Segmentation**

`/samsung.com/sait/shong/movie/abc.mpg/version#/segment#`

● Interest processing



● Data processing

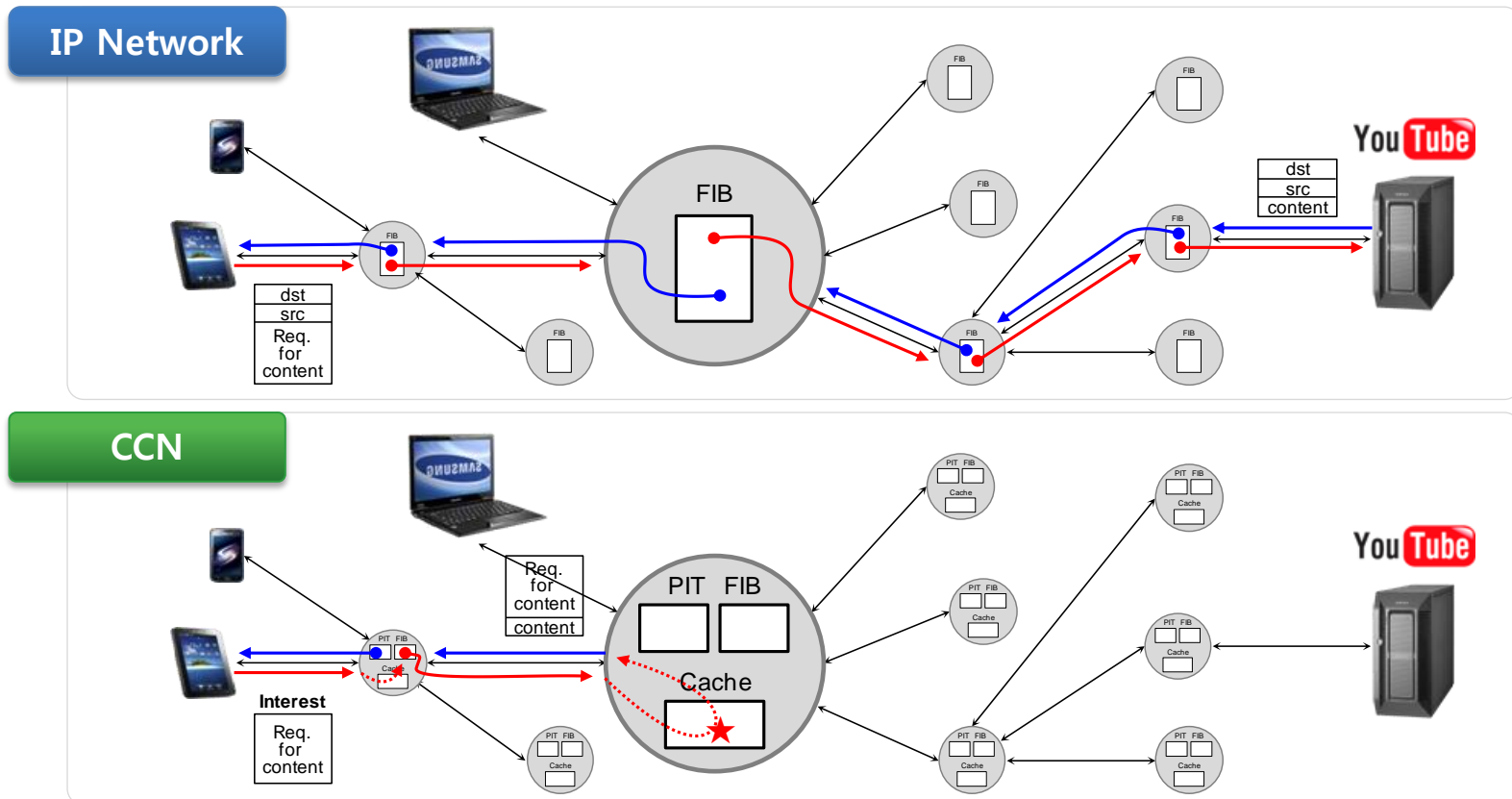
- Data follows a chain if PIT entries exist back to the source
- Duplicate and unsolicited Data is discarded

● Face

- A face is a term describing both hardware interfaces and logical interfaces application processes use in a machine

Brief Summary: IP vs. CCN

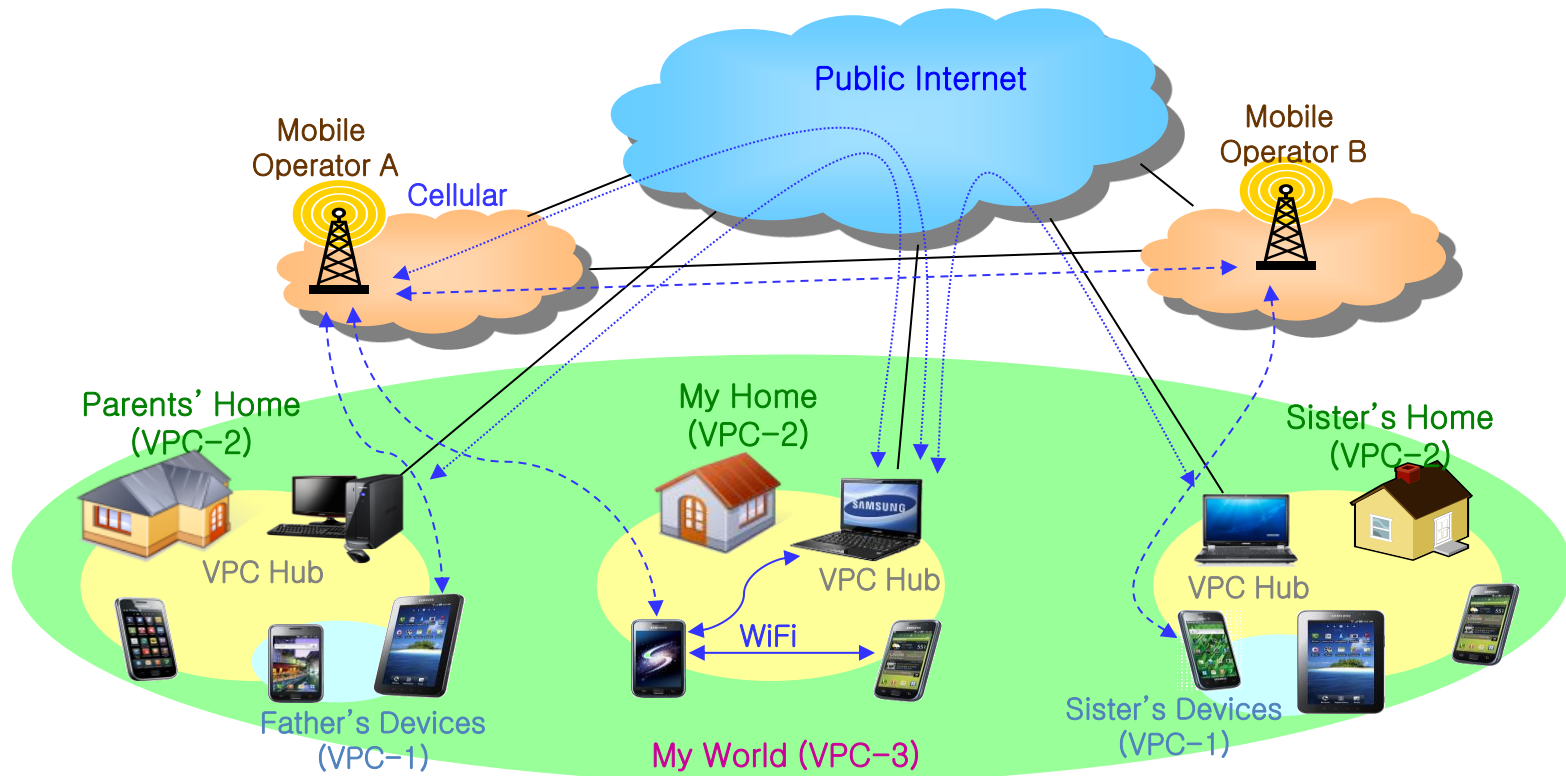
- IP router forwards a packet received to a selected interface by performing **lookup of the destination address** in the FIB
- CCN router checks first its **content cache** with a content request message (Interest) received. If the requested content exists, it directly returns the content. Otherwise, it forwards the message to a selected interface by performing **lookup of the content name** in the FIB



* CCN:Content-Centric Networking, FIB: Forwarding Information Base, PIT: Pending Interest Table

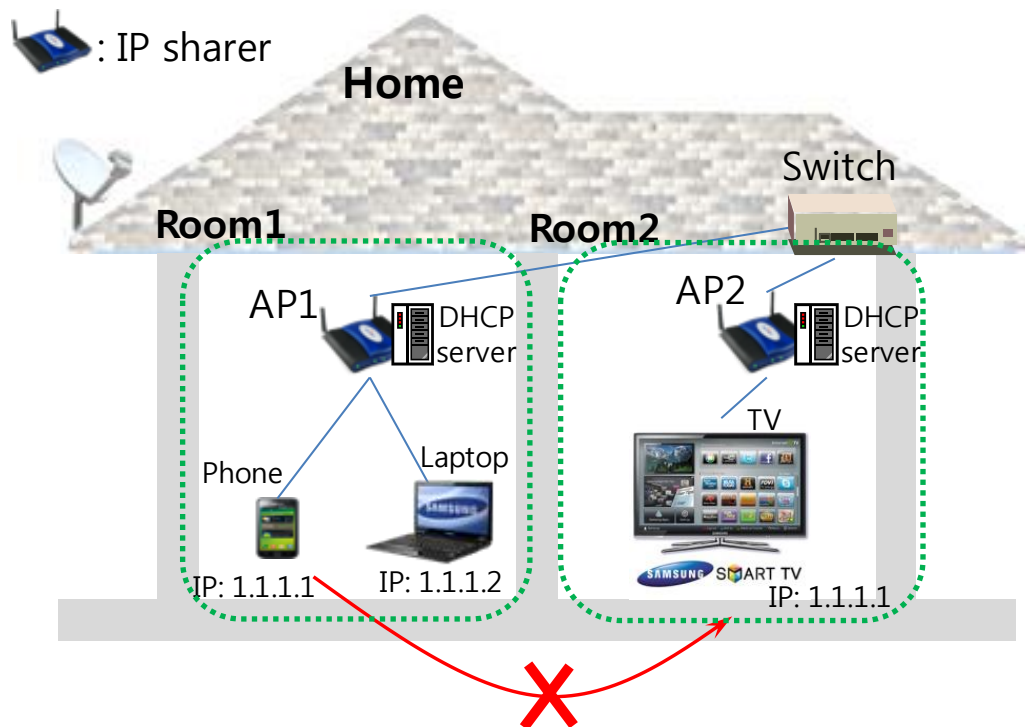
Virtual Private Community (VPC)

- VPC: Hierarchical community structure
- Secure Information sharing among communities possible, but ...
 - How to discover information in different broadcast domains?
 - How to share streaming data?



IP-based Information Discovery

- Device discovery protocol such as SSDP relies on multicast or broadcast which has the following drawbacks:
 - Boundaries/scopes are fixed: subnets, broadcast domains or VLAN are set by equipments or operators
 - IP packets cannot specify a scope that it can reach
 - Multicast address space is limited



- The phone cannot find the TV since all the discovery messages using multicast are dropped by APs

IP packet

Source Address (IP)		Destination Address (IP)		

No field exist to indicate the scope to reach!!

* SSDP: Simple Service Discovery Protocol

CCN: Architectural Principles

Architectural Principles

- **Named data**
 - No notion of host location
 - Content name becomes network address
- **In-network storage**
 - Any router can reply the request packet as long as it contains the requested contents in its storage
- **Built-in security**
 - CCN provides basic security building block at the network layer by signing all named data
- **Hop-by-hop transport**
 - CCN doesn't need end-to-end session management

Discussion on traffic reduction using in-network storage and security features are popular !!

But these are the only benefits ??

Efficient information discovery possible !!

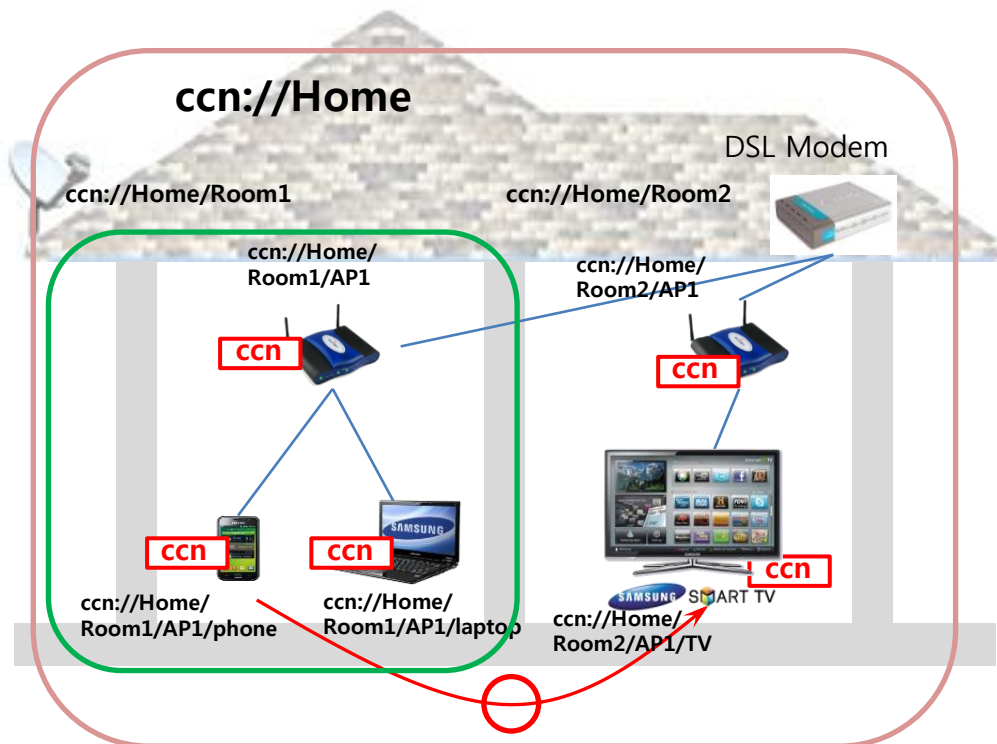
CCN-based Information Discovery

- Boundaries/scopes are fixed: subnets, broadcast domains or VLAN are set by equipments or operators
- IP packets cannot specify a scope that it can reach
- Multicast address space is limited

fix it!!



- Boundaries/scopes are set by users
- The scope that a packet can reach can be specified in its header
- Multicast address space is unlimited



CCN packet

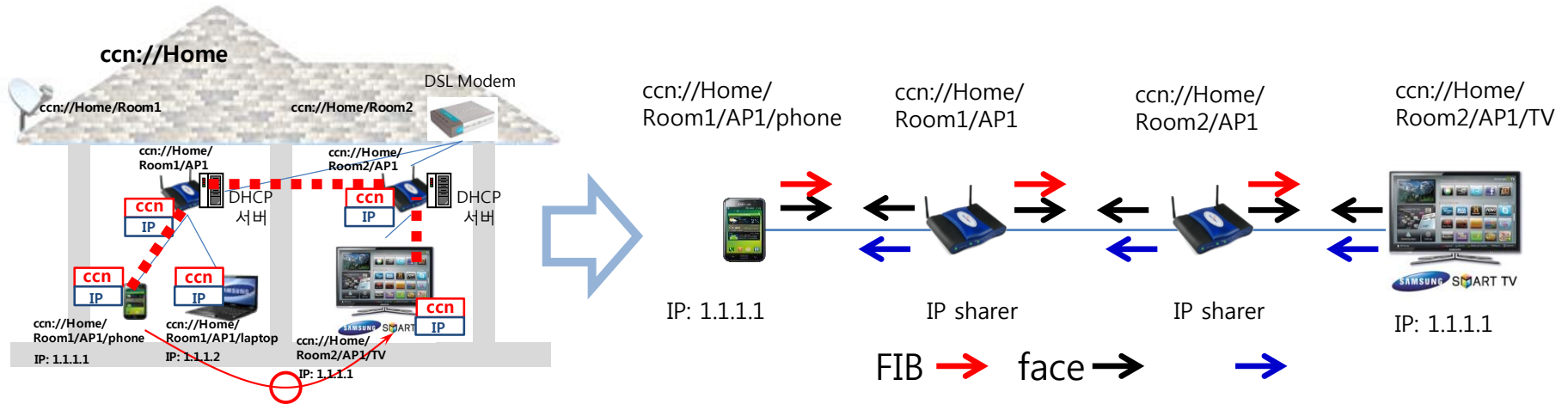
content name				
selector	nonce	Operation ID	Ad-area	Source AS

Specifies the scope that a packet can reach
e.g., /Home/Room1 or /Home

Specifies the purpose of the Interest packet, e.g.,
DEVICE_DISCOVERY

CCN over IP-based Information Discovery

- Proposed algorithm still works in CCN over IP environment, even with same IPs!!



How the phone discovers the TV?

- Names have been assigned to each device. APs have hierarchy in their names (`ccn://Home/Room1/AP1`, `ccn://Home/Room2/AP1`) but phones and TVs do not have any hierarchy in their names (phone, TV).
- Faces have been created between AP1 and AP2.
- During association between phone/TV and APs, full names of devices are determined. E.g., `'ccn://Home/Room1/AP1/' + 'phone' = 'ccn://Home/Room1/AP1/phone'`
- Faces have been created between devices and APs.
- The phone sends an Interest for device discovery in the entire Home by setting Ad-area `'ccn://Home'`. Then the Interest reaches every device at Home since every device sends out the Interest to every face except the incoming one.
- The TV replies the Interest and the reply packet reaches the requestor hop by hop.

Video Streaming Service Support

- Services can be considered as information or contents.
- RTSP (Real Time Streaming Protocol) is one of the most popular video streaming protocols. RTSP can be supported by CCN.
- Other protocols for video transport such as HTTP adaptive streaming or HTTP progressive download can be supported by CCN

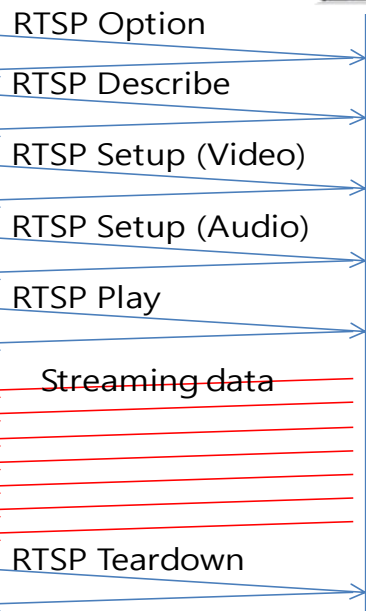
[Application layer]

How the RTSP messages can be converted to CCN messages?

User devices

laptop

[CCN layer]



```
[Interest] name: rtsp://a.com/stream/a.mpg, OID: OPTION
[Data] name: rtsp://a.com/stream/a.mpg, OID: OK

[Interest] name: rtsp://a.com/stream/a.mpg, OID: DESCRIBE
[Data] name: rtsp://a.com/stream/a.mpg, OID: OK

[Interest] name: rtsp://a.com/stream/a.mpg, OID: SETUP(VIDEO)
[Data] name: rtsp://a.com/stream/a.mpg, OID: OK

[Interest] name: rtsp://a.com/stream/a.mpg, OID: SETUP(AUDIO)
[Data] name: rtsp://a.com/stream/a.mpg, OID: OK

[Interest] name: rtsp://a.com/stream/a.mpg, OID: PLAY
[Data] name: rtsp://a.com/stream/a.mpg, OID: OK

[Data] name: rtp://a.com/stream/a.mpg/segment1
[Data] name: rtp://a.com/stream/a.mpg/segment2
[Data] name: rtp://a.com/stream/a.mpg/segment3

...

[Interest] name: rtsp://a.com/stream/a.mpg, OID: TEARDOWN
[Data] name: rtsp://a.com/stream/a.mpg, OID: OK
```

Longest prefix matching used for PIT entries

We have proposed the followings:

- Easy information discovery using CCN names
- Video streaming service support using CCN

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