



Reflexive Forwarding Implementation in Cefore

Cefore project

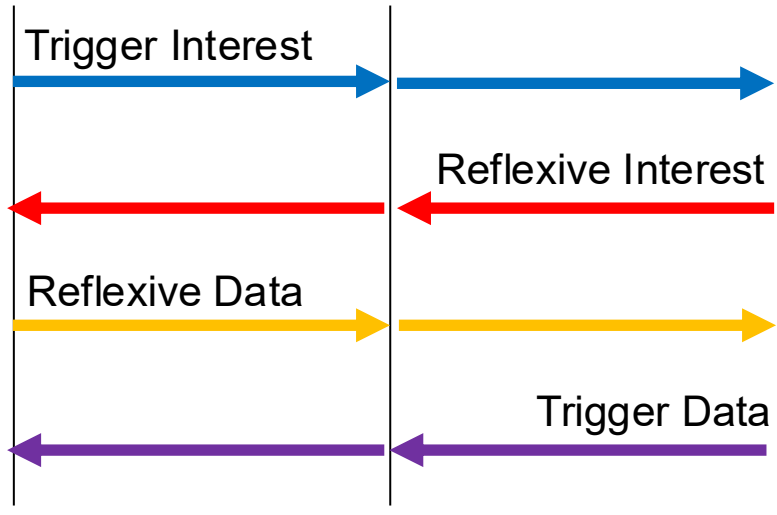
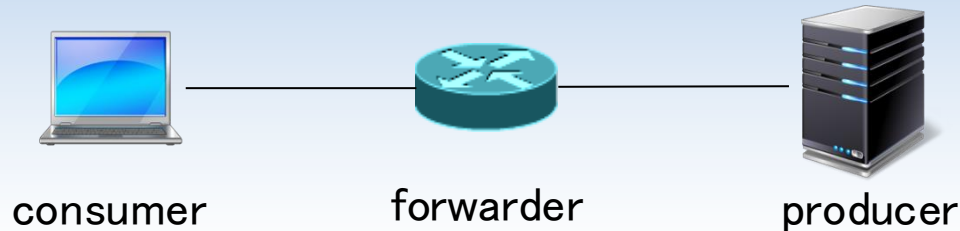
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Outline

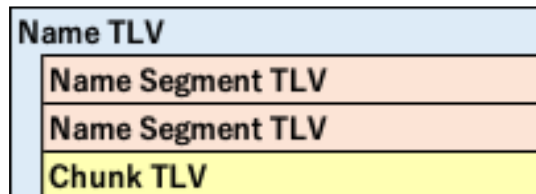
- Technical specifications
 - CCNx message format
 - Reflexive forwarding operations
- Pub/Sub operations using Cefore
 - Push (publish) small data
 - Push (publish) video data divided by chunks

CCNx Messages and TLVs

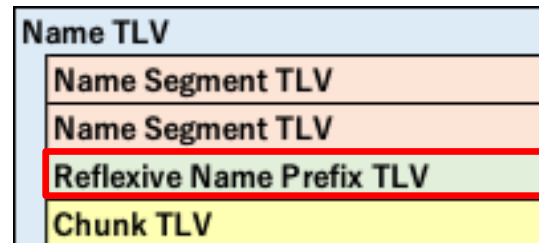


- **Trigger Interest (TI)**
 - An Interest message sent from a consumer to a producer to trigger one or more Reflexive Interests sent by producer
- **Reflexive Interest (RI)**
 - An Interest message sent from the producer back towards the consumer to fetch data
- **Reflexive Data (RD)**
 - A Data message pushed by the consumer to the producer in response to a Reflexive Interest
- **Trigger Data (TD)**
 - A Data message returned by the producer in response to a Trigger Interest to terminate the Reflexive Forwarding operation

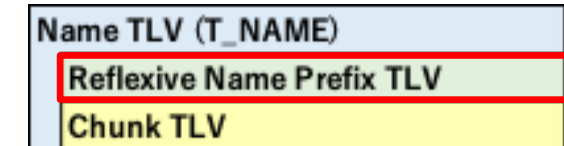
• Ordinary Interest/Data



• Trigger Interest/Data

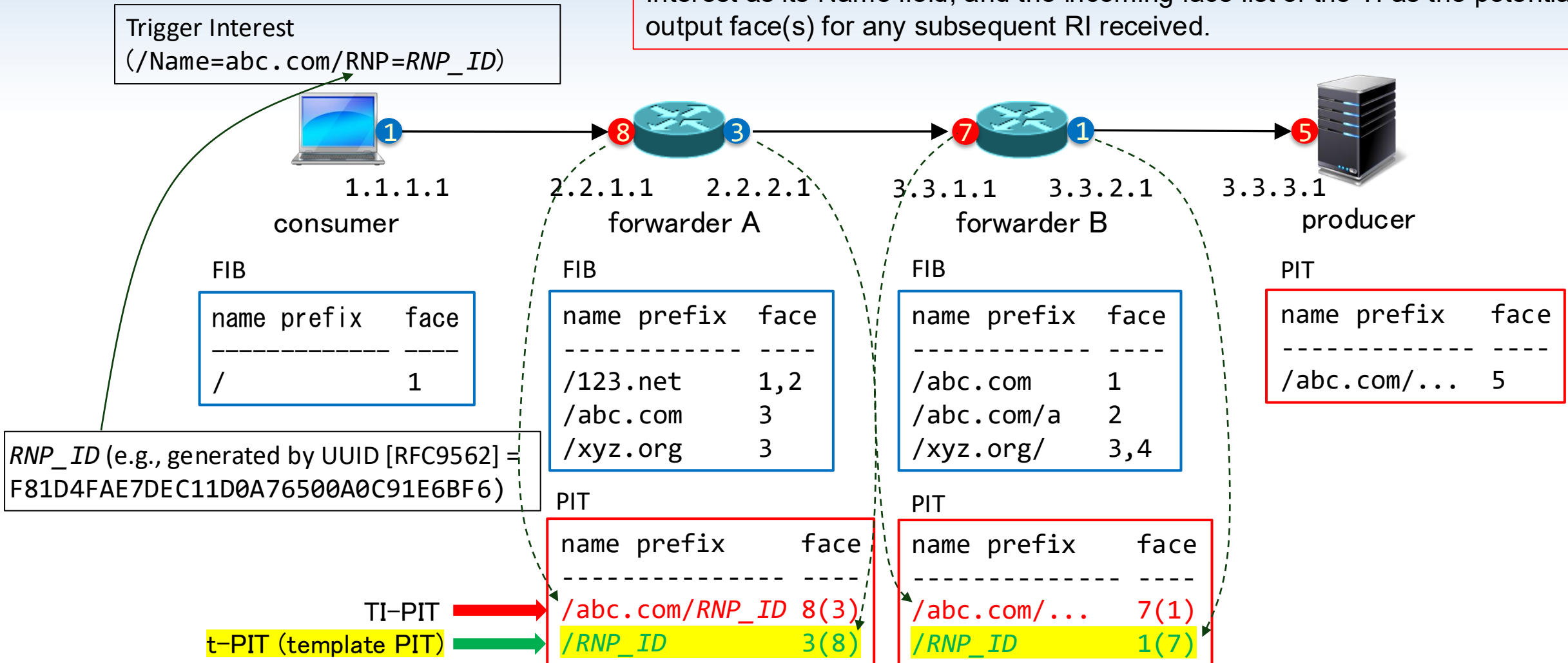


• Reflexive Interest/Data



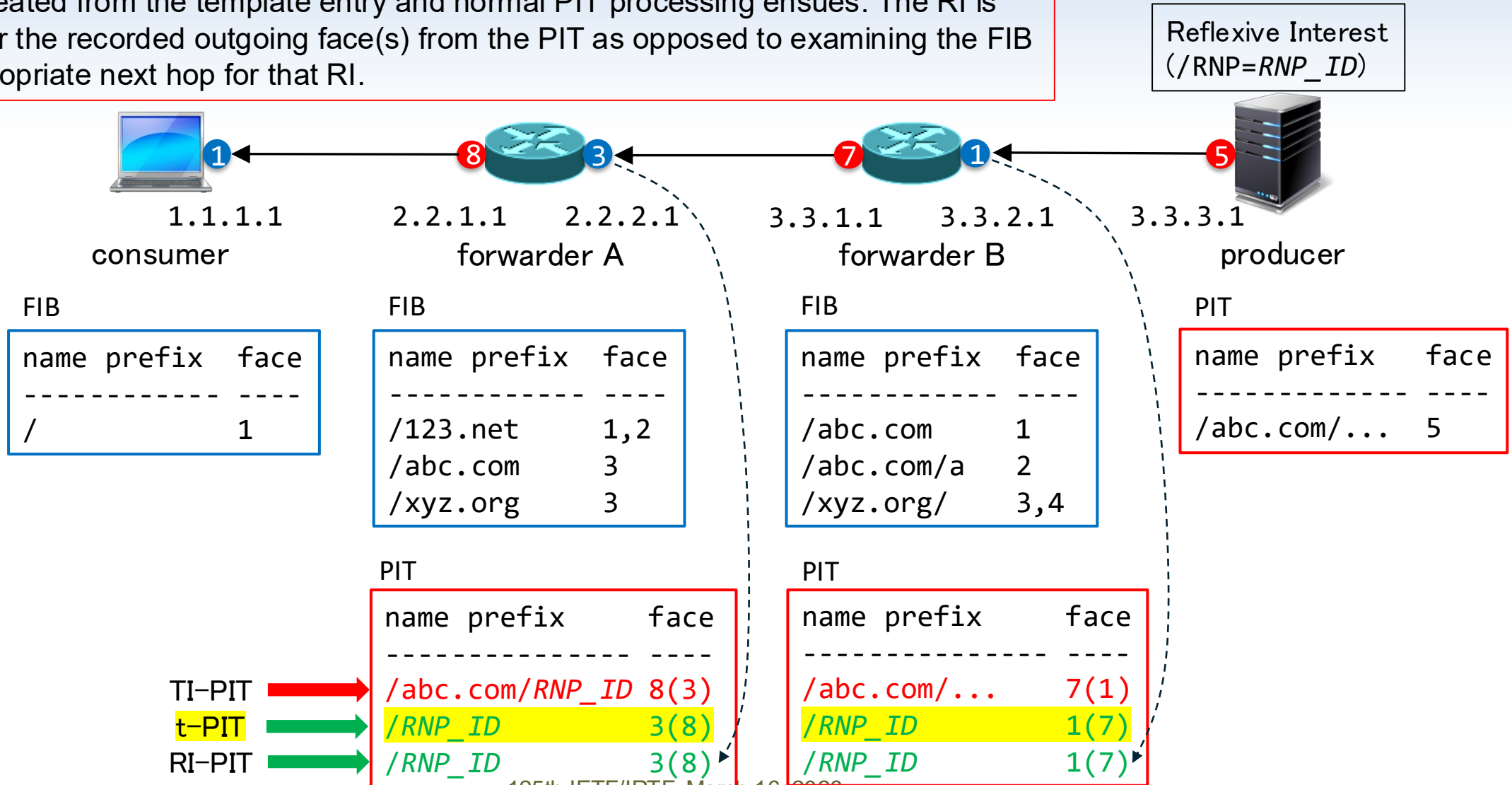
Reflexive Forwarding Operation – Trigger Interest

t-PIT (template PIT) entry has the Reflexive Name Prefix from the Trigger Interest as its Name field, and the incoming face list of the TI as the potential output face(s) for any subsequent RI received.

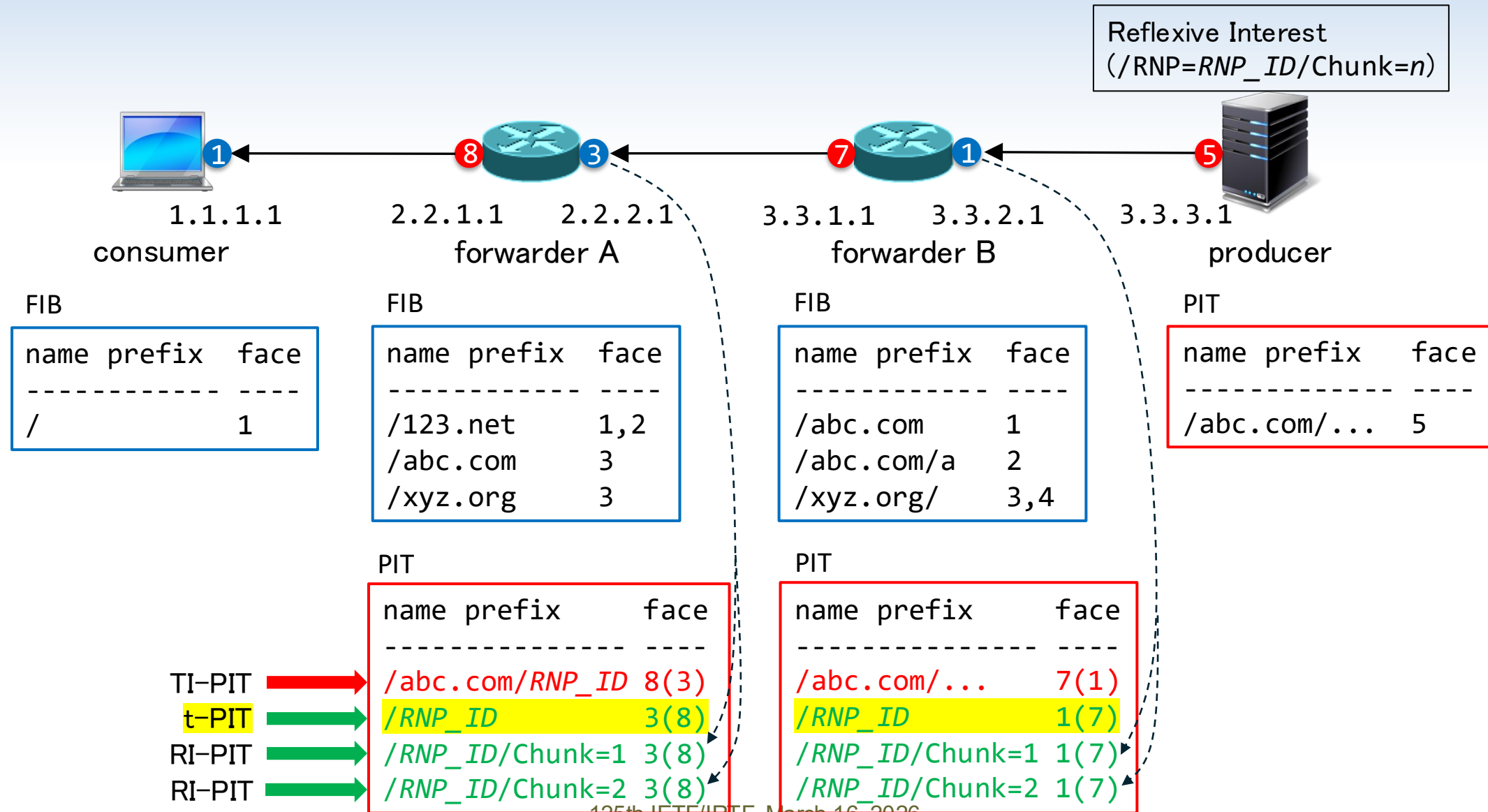


Reflexive Forwarding Operation – Reflexive Interest

On receipt of RI matching the Reflexive Name Prefix (RNP) of a template PIT entry, a full PIT entry is created from the template entry and normal PIT processing ensues. The RI is forwarded over the recorded outgoing face(s) from the PIT as opposed to examining the FIB to find an appropriate next hop for that RI.



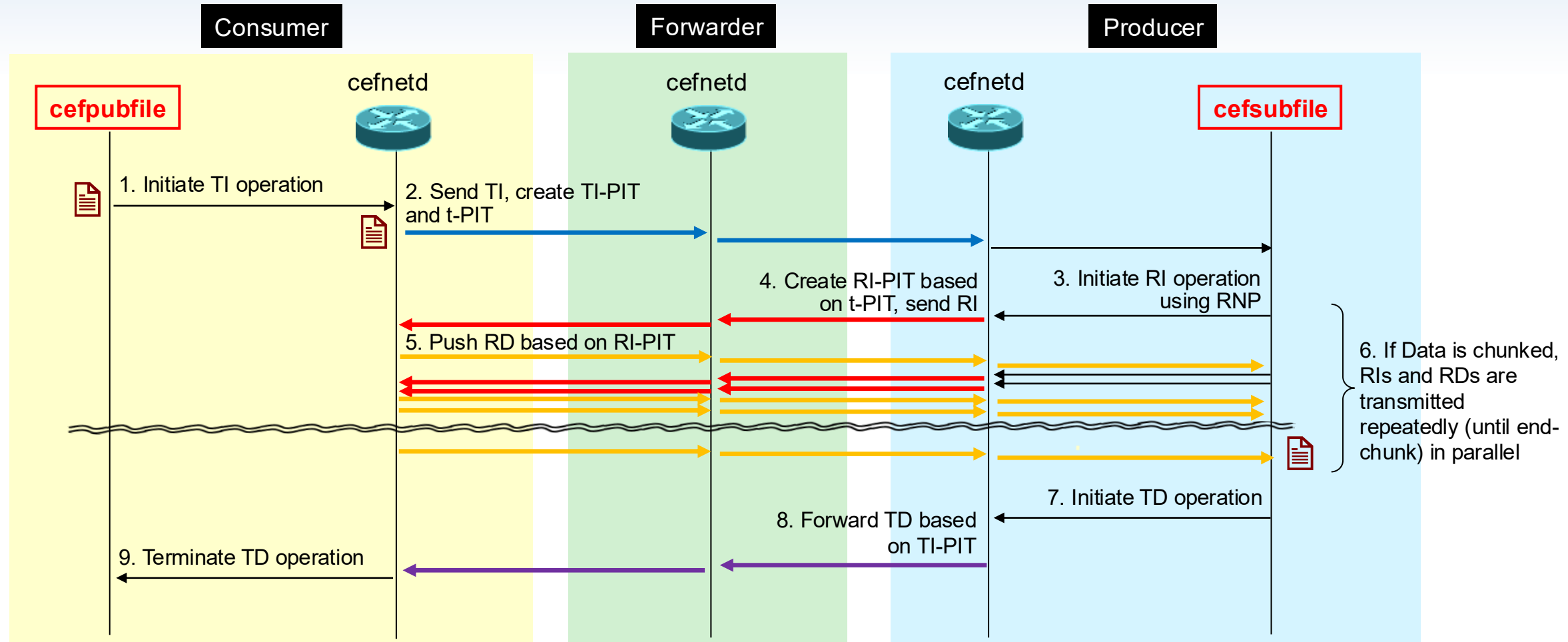
Reflexive Forwarding Operation – Reflexive Interest (with chunking)



Pub/Sub Operations using Cefore

- **Consumer (publish) command : cefpubfile**
 - TI : cefpubfile ccnx:/demo1 -f sample.txt

- **Producer (subscribe) command : cefsubfile**
 - RI : cefsubfile ccnx:/demo1 -f sample.txt



Demo (Small Data without Chunk)

PUSH a small sized file from the Consumer to the Producer.

Consumer: PUSH app (cefpubfile)

```
root@f101:/docker_data# cat sample1.txt
Reflective Forwarding.
root@f101:/docker_data# cefpubfile ccnx:/demo1 -f sample1.txt
[cefpubfile] Start
[cefpubfile] Parsing parameters ... OK
[cefpubfile] URI          = ccnx:/demo1
[cefpubfile] File         = sample1.txt
[cefpubfile] Rate         = 50.000 Mbps
[cefpubfile] Block Size  = 1024 Bytes
[cefpubfile] Cache Time  = 10 sec
[cefpubfile] Expiration  = 10 sec
[cefpubfile] Init Cefore Client package ... OK
[cefpubfile] Connect to cefnetd ... OK
[cefpubfile] Checking the input file ... OK
[RNP=0xcd65905f5b42493a8834281ae6593c1d]
[cefpubfile] Upload push data to cefnetd ... OK
[cefpubfile] Send Trigger Interest.
[cefpubfile] Receive Trigger Data, finish application.
root@f101:/docker_data#
```

Producer: PULL app (cefsubfile)

```
root@f103:/docker_data# cefsubfile ccnx:/demo1 -s 1 -f share/sub/
[cefsubfile] Start
[cefsubfile] Parsing parameters ...OK
[cefsubfile] Init Cefore Client package ... OK
[cefsubfile] Connect to cefnetd ... OK
[cefsubfile] Register fib entry to cefnetd ... OK (URI=ccnx:/demo1)
[cefsubfile] Completed to get all the chunks.
[cefsubfile] RNP=0xcd65905f5b42493a8834281ae6593c1d
[cefsubfile] Outputfile: share/sub//RNP0xcd65905f5b42493a8834281ae6593c1d.out
[cefsubfile] Rx Frames (All)          = 1
[cefsubfile] Rx Frames (ContentObject) = 1
[cefsubfile] Rx Bytes (All)          = 76
[cefsubfile] Rx Bytes (ContentObject) = 22
[cefsubfile] Duration                 = 0.000 sec
[cefsubfile] Jitter (Ave)             = 0 us
[cefsubfile] Jitter (Max)             = 0 us
[cefsubfile] Jitter (Var)             = 0 us
```

Consumer: Packet Capture

```
root@f101:/docker_data# ./share/capture.bash
tcpdump: listening on eth0, link-type EN10MB (Ethernet), snapshot length 262144 bytes
Running as user "root" and group "root". This could be dangerous.
cefore.lua is successfully loaded
  1 16:32:08.413800 172.20.11.101 → 172.20.11.102 CCN 93 INTEREST /demo1/RNP=0xcd65905f5b42493a..
  2 16:32:08.947023 172.20.11.102 → 172.20.11.101 CCN 89 INTEREST /RNP=0xcd65905f5b42493a../%0
  3 16:32:08.948977 172.20.11.101 → 172.20.11.102 CCN 138 OBJECT /RNP=0xcd65905f5b42493a../%0
  4 16:32:08.952991 172.20.11.102 → 172.20.11.101 CCN 111 OBJECT /demo1/RNP=0xcd65905f5b42493a..

```

Producer: Packet Capture

```
root@f103:/docker_data# ./share/capture.bash
tcpdump: listening on eth0, link-type EN10MB (Ethernet), snapshot length 262144 bytes
Running as user "root" and group "root". This could be dangerous.
cefore.lua is successfully loaded
  1 16:32:08.417578 172.20.12.102 → 172.20.12.103 CCN 93 INTEREST /demo1/RNP=0xcd65905f5b42493a..
  2 16:32:08.946682 172.20.12.103 → 172.20.12.102 CCN 89 INTEREST /RNP=0xcd65905f5b42493a../%0
  3 16:32:08.949617 172.20.12.102 → 172.20.12.103 CCN 138 OBJECT /RNP=0xcd65905f5b42493a../%0
  4 16:32:08.951798 172.20.12.103 → 172.20.12.102 CCN 111 OBJECT /demo1/RNP=0xcd65905f5b42493a..

```

Demo (Video Data divided by Chunks)

PUSH a large sized file from the Consumer to the Producer

Consumer: PUSH app

```
[cefpubfile] Start
[cefpubfile] Parsing parameters ... OK
[cefpubfile] URI = ccnx:/demo2
[cefpubfile] File = share/contents/demo2.mp4
[cefpubfile] Rate = 50.000 Mbps
[cefpubfile] Block Size = 1024 Bytes
[cefpubfile] Cache Time = 10 sec
[cefpubfile] Expiration = 10 sec
[cefpubfile] Init Cefore Client package ... OK
[cefpubfile] Connect to cefnetd ... OK
[cefpubfile] Checking the input file ... OK
[RNP=0xfe16bd052f5bb0347a87ee08e56816d]
[cefpubfile] Upload push data to cefnetd ... OK
[cefpubfile] Send Trigger Interest.
[cefpubfile] Resend Trigger Interest.
[cefpubfile] Resend Trigger Interest.
[cefpubfile] Resend Trigger Interest.
[cefpubfile] Receive Trigger Data, finish application.
root@f101:/docker_data#
```

Producer: PULL app

```
[cefsbfile] Parsing parameters ...OK
[cefsbfile] Init Cefore Client package ... OK
[cefsbfile] Connect to cefnetd ... OK
[cefsbfile] Register fib entry to cefnetd ... OK (URI=ccnx:/demo2)
[cefsbfile] Completed to get all the chunks.
[cefsbfile] RNP=0xfe16bd052f5bb0347a87ee08e56816d
[cefsbfile] Outputfile: share/sub//RNP0xfe16bd052f5bb0347a87ee08e56816d.out
[cefsbfile] Rx Frames (All) = 994
[cefsbfile] Rx Frames (ContentObject) = 994
[cefsbfile] Rx Bytes (All) = 1072825
[cefsbfile] Rx Bytes (ContentObject) = 1017417
[cefsbfile] Duration = 5.779 sec
[cefsbfile] Throughput = 1485475 bps
[cefsbfile] Goodput = 1408755 bps
[cefsbfile] Jitter (Ave) = 5812 us
[cefsbfile] Jitter (Max) = 119311 us
[cefsbfile] Jitter (Var) = 34876367 us
```

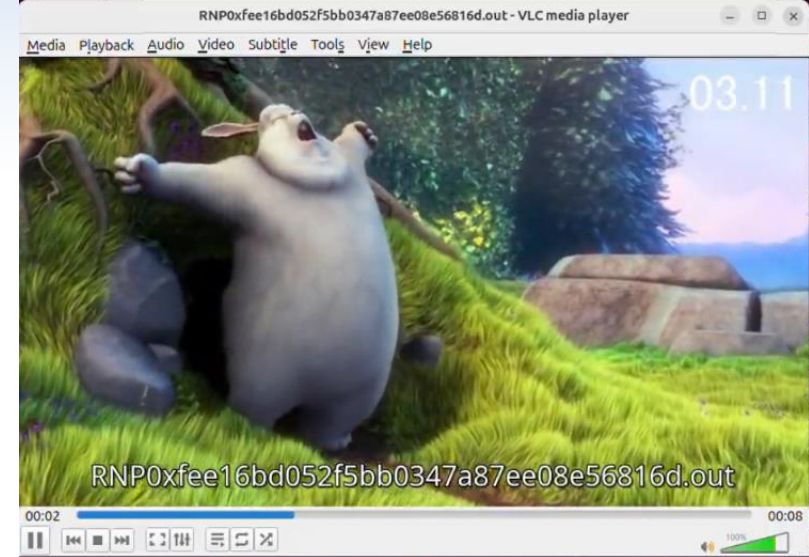
Consumer: PacketCapture

```
1992 16:43:50.837492 172.20.11.102 → 172.20.11.101 CCN 90 INTEREST /RNP=0xfe16bd052f5bb03.../%991
1993 16:43:50.841116 172.20.11.101 → 172.20.11.102 CCN 1142 OBJECT /RNP=0xfe16bd052f5bb03.../%991
1994 16:43:50.849152 172.20.11.102 → 172.20.11.101 CCN 90 INTEREST /RNP=0xfe16bd052f5bb03.../%992
1995 16:43:50.852361 172.20.11.101 → 172.20.11.102 CCN 1142 OBJECT /RNP=0xfe16bd052f5bb03.../%992
1996 16:43:50.859738 172.20.11.102 → 172.20.11.101 CCN 90 INTEREST /RNP=0xfe16bd052f5bb03.../%993
1997 16:43:50.860307 172.20.11.101 → 172.20.11.102 CCN 703 OBJECT /RNP=0xfe16bd052f5bb03.../%993
1998 16:43:50.872122 172.20.11.102 → 172.20.11.101 CCN 111 OBJECT /demo2/RNP=0xfe16bd052f5bb03...
```

Producer: PacketCapture

```
1992 16:43:50.836377 172.20.12.103 → 172.20.12.102 CCN 90 INTEREST /RNP=0xfe16bd052f5bb03.../%991
1993 16:43:50.842847 172.20.12.102 → 172.20.12.103 CCN 1142 OBJECT /RNP=0xfe16bd052f5bb03.../%991
1994 16:43:50.847981 172.20.12.103 → 172.20.12.102 CCN 90 INTEREST /RNP=0xfe16bd052f5bb03.../%992
1995 16:43:50.856885 172.20.12.102 → 172.20.12.103 CCN 1142 OBJECT /RNP=0xfe16bd052f5bb03.../%992
1996 16:43:50.858821 172.20.12.103 → 172.20.12.102 CCN 90 INTEREST /RNP=0xfe16bd052f5bb03.../%993
1997 16:43:50.860942 172.20.12.102 → 172.20.12.103 CCN 703 OBJECT /RNP=0xfe16bd052f5bb03.../%993
1998 16:43:50.869700 172.20.12.103 → 172.20.12.102 CCN 111 OBJECT /demo2/RNP=0xfe16bd052f5bb03...
```

Producer: Verify that the video data was received successfully.





Thank you