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Contrace: Traceroute Facility for Content-Centric Network

draft-asaeda-icnrg-contrace-04

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Motivation

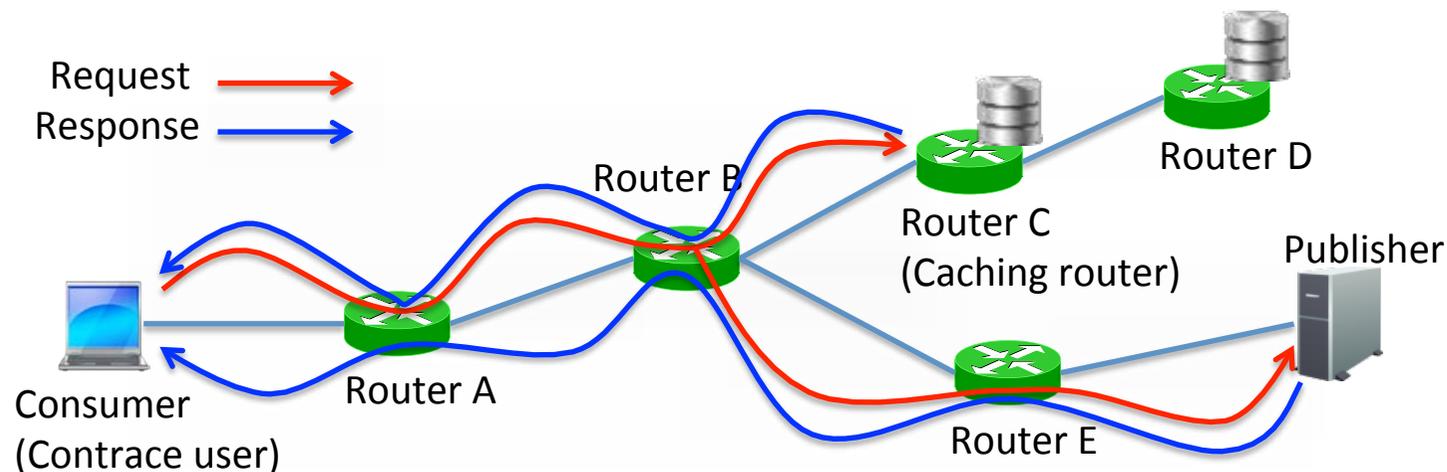
- Protocol analysis tool
 - Caching point/publisher, path stretch
 - Hop count/RTT for content retrieval
 - Cache distribution, cache hit ratio
- Operations, Administration, and Maintenance (OAM) tool
 - Operation
 - Cache lifetime or expiration time
 - Monitoring
 - CS usage at router, num of rcvd interests per cache
 - Multipath forwarding
 - Trouble shooting
 - Availability of caching routers and publishers

Contrace Messages

- Contrace Request Message
 - Request message consists of a fixed header, Request block TLV, Report block TLV(s), and Name TLV
- Contrace Reply Message
 - Reply message consists of a fixed header, Request block TLV, Report block TLV(s), Name TLV, and Reply block/sub-block TLV(s)
- Compatible with CCNx-1.0 TLV format

Contrace Basic Behavior

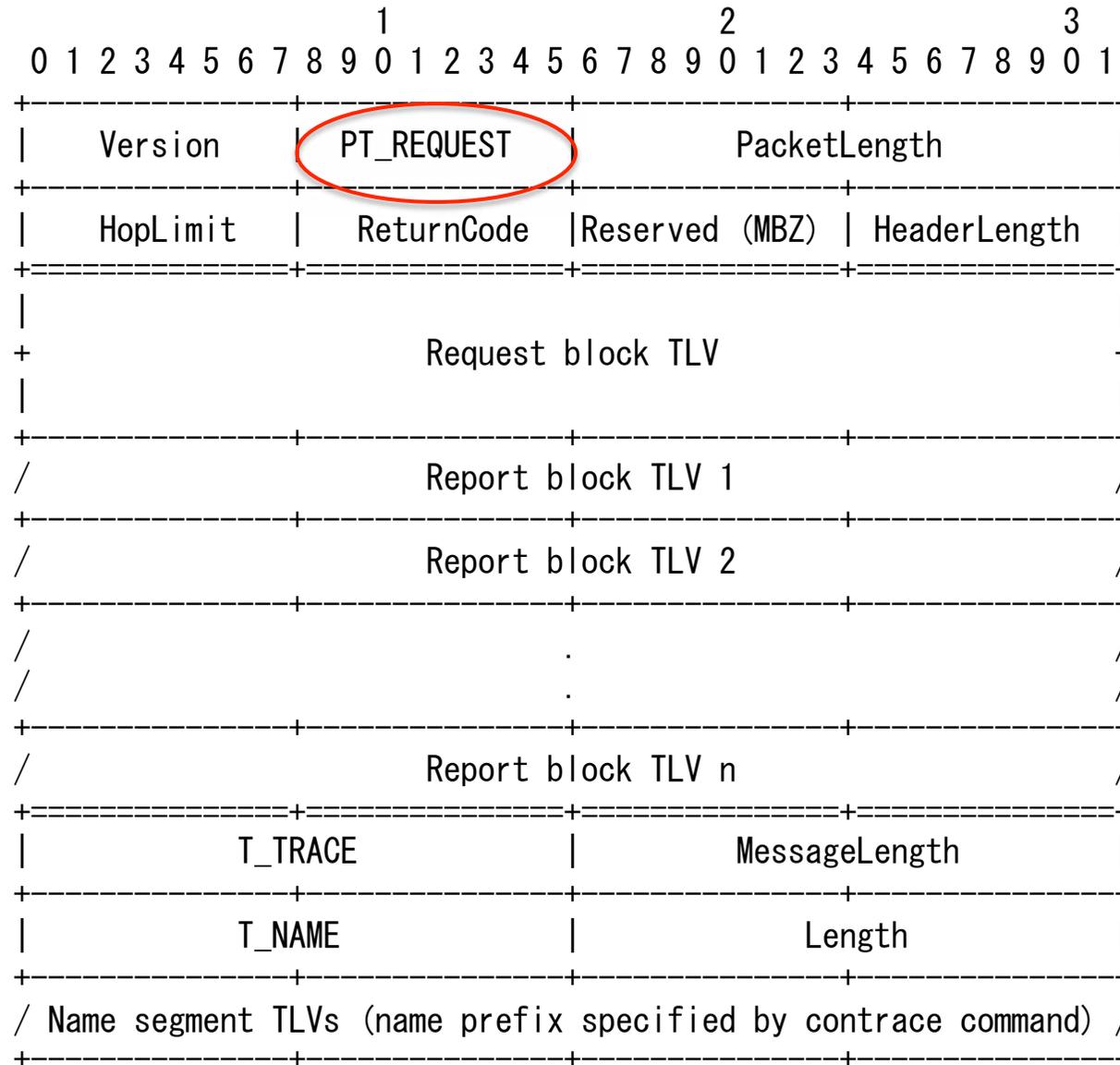
- **Request message** is initiated by Contrace user and forwarded toward caching router or publisher based on the FIB in a hop-by-hop manner
- Request message includes **Request block** and **Report block(s)**
- **Reply message** is initiated by caching router or publisher and forwarded toward Contrace user based on the PIT entry
- Reply message includes **Reply block** and **Reply sub-block(s)**



Diagnosis and Analysis with Contrace

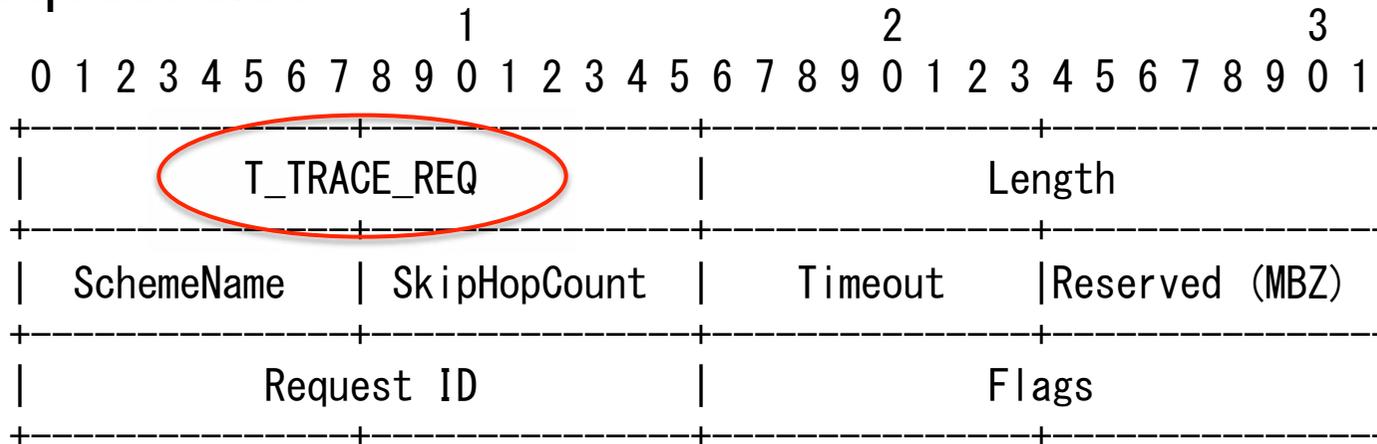
- Number of Hops
 - The hop-by-hop manner enables that the number of hops to reach the content forwarder can be verified
- Caching Router Identification
 - It is possible to identify the caching routers in the path from the Contrace user to the content forwarder
- TTL or Hop Limit
 - It is possible to discover the TTL or hop limit required for the content forwarder to reach the Contrace user
- Time Delay
 - It is possible to estimate propagation and queuing delay from the differences between the timestamps at successive hops
- Path Stretch
 - We can measure the improvement in path stretch in various cases, such as different caching and routing algorithms
- Cache Hit Probability
 - Contrace can show the number of received interests per cache or chunk on a router

Request Message

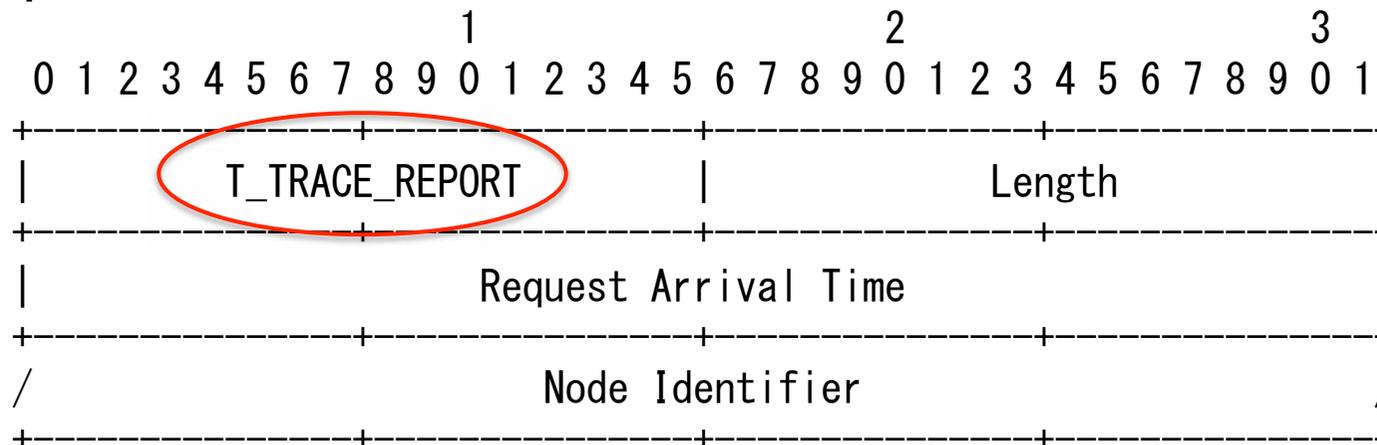


Request Block and Report Block

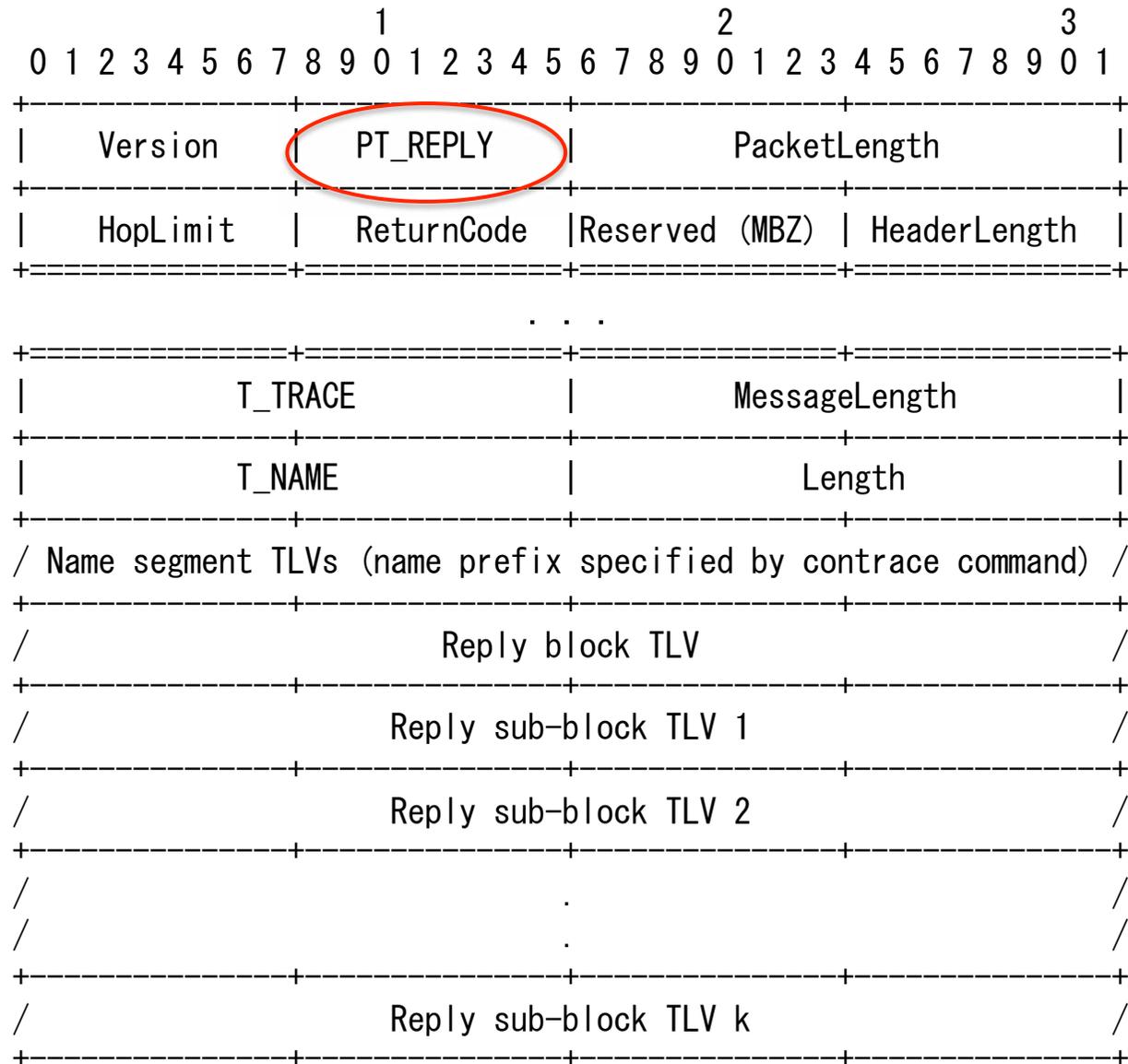
- Request block



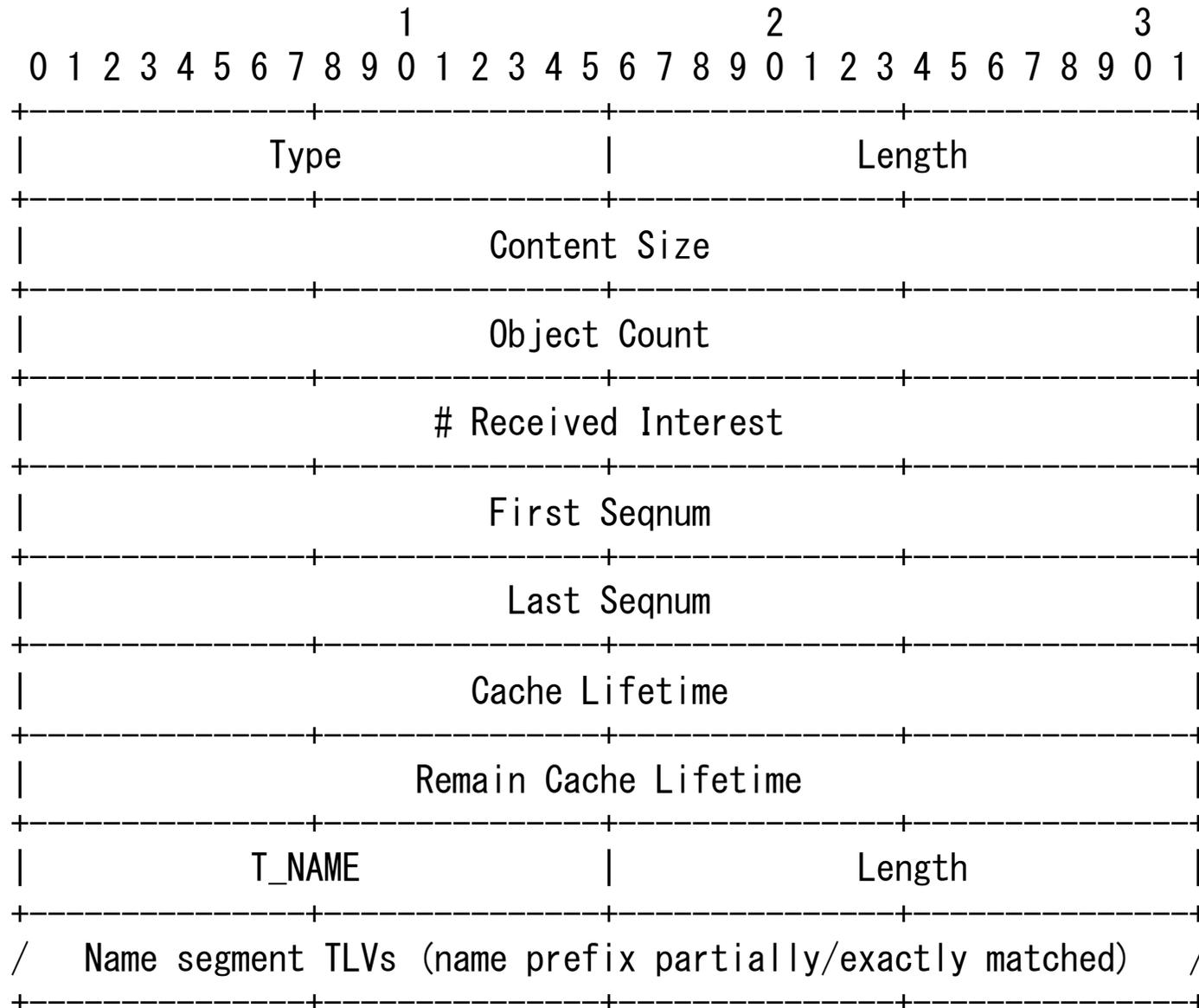
- Report block



Reply Message

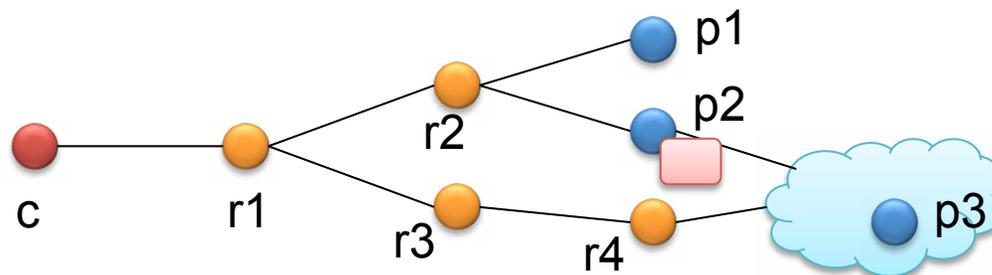


Reply Sub-Block



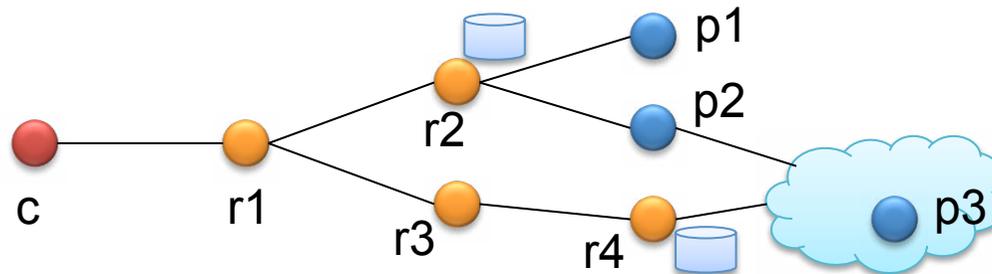
Ex.1. contrace ccnx:/news/science

```
cefuser@ceflab:~$  
cefuser@ceflab:~$ contrace ccnx:/news/science  
contrace to ccnx:/news/science with HopLimit=32, SkipHopCount=0, Flag=0x0000 and Request ID=142  
response from publisher2: no error, time=1.699000 ms  
  
route information:  
1 consumer          0.119 ms  
2 router1           0.442 ms  
3 router2           0.261 ms  
4 publisher2        0.376 ms  
  
cache information:  prefix      size      cobs      interests  start-end  lifetime  expire  
1 p ccnx:/news/science/ 8658 KB   8456      0          0-8455    634 secs  2951 secs  
cefuser@ceflab:~$
```



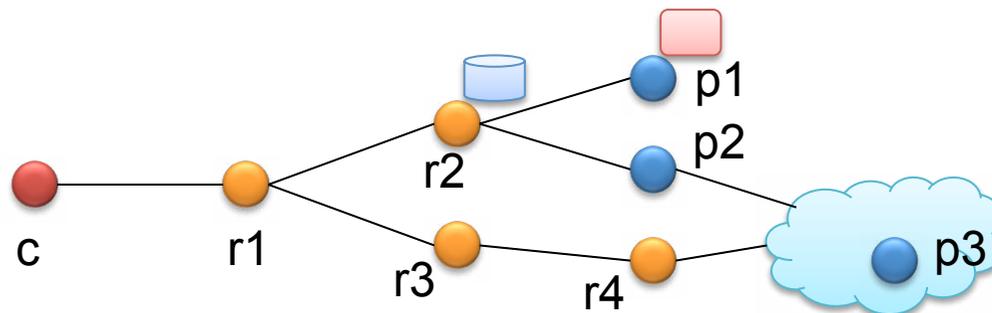
Ex.2. `contrace -n ccnx:/video/video1`

```
cefuser@ceflab:~$  
cefuser@ceflab:~$ contrace -n ccnx:/video/video1  
contrace to ccnx:/video/video1 with HopLimit=32, SkipHopCount=0, Flag=0x0002 and Request ID=11717  
  
response from router2: no error, time=1.516000 ms  
  
route information:  
1 consumer          0.715 ms  
2 router1           0.228 ms  
3 router2           0.275 ms  
  
response from router4: no error, time=2.136000 ms  
  
route information:  
1 consumer          0.715 ms  
2 router1           0.228 ms  
3 router3           -2.128 ms  
4 router4           3.231 ms  
  
cefuser@ceflab:~$
```



Ex.3. `contrace -o ccnx:/news/today`

```
cefuser@ceflab:~$  
cefuser@ceflab:~$ contrace -o ccnx:/news/today  
contrace to ccnx:/news/today with HopLimit=32, SkipHopCount=0, Flag=0x0004 and Request ID=29932  
  
response from publisher1: no error, time=1.888000 ms  
  
route information:  
1 consumer          0.142 ms  
2 router1           0.357 ms  
3 router2           0.340 ms  
4 publisher1        1.198 ms  
  
cache information:  
1 p ccnx:/news/today/ 1565 KB 1529 5 0-1528 204 secs 3319 secs  
cefuser@ceflab:~$
```



Summary

- Contrace, which is compatible with CCNx-1.0 TLV format, is a powerful network tool providing various information, e.g.,
 - Caching point/publisher, path stretch
 - Hop count/RTT for content retrieval
 - Cache distribution, cache hit ratio
 - Cache lifetime or expiration time
 - CS usage, num of received interests
- Experiments with running codes
 - (Primary work) Contrace, *IEEE ComMag*, Mar. 2015.
 - ▣ Separate (i.e., individual) daemon implementation (named `contraced`) that interacts with `ccnd` daemon
 - Contrace (proposed in this I-D) implemented into our original CCN-compatible daemon implementation

Next Step

- Under discussion with Spyros (UCLA) who is the first author of the ICN-Traceroute
 - Keep the current Contrace draft the current form as is
 - Merge the ICN-Traceroute and the Contrace draft, and create a new draft for NDN
- RG draft?