Route caching: a technique to improve the scalability of ICN

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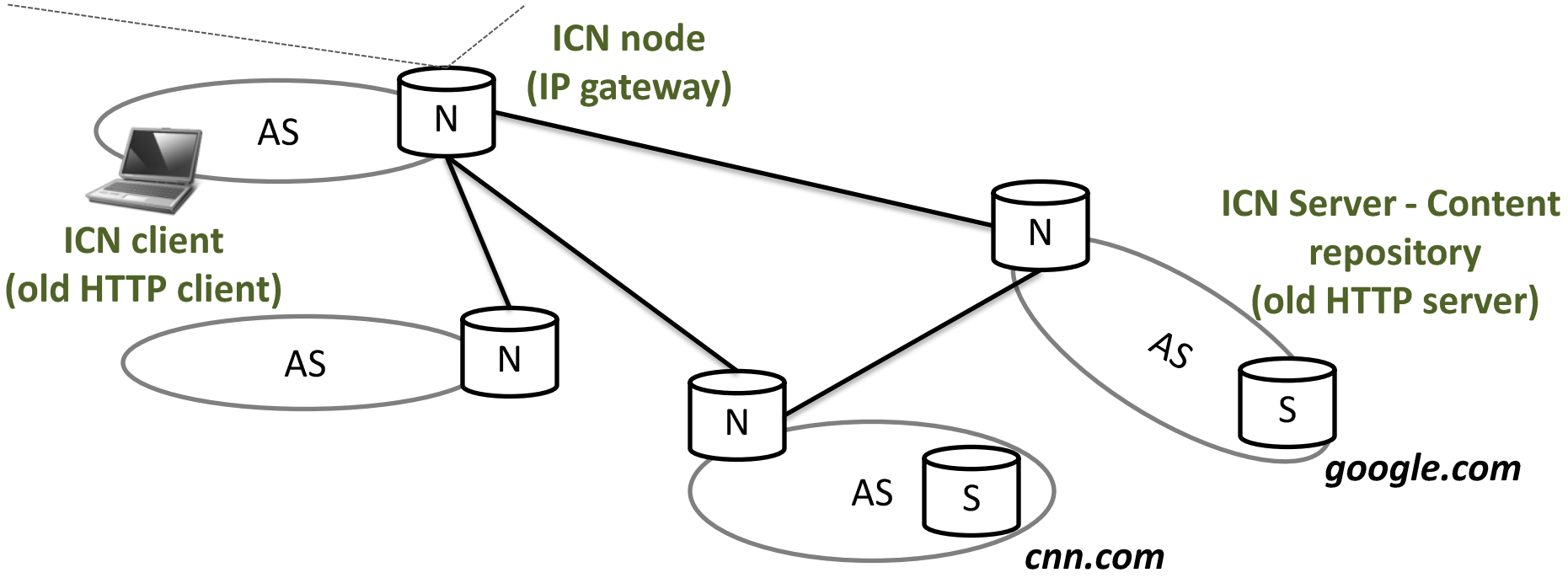
- We consider an ICN that routes-by-name content-requests towards serving nodes at line speed, such as the V. Jacobson CCN architecture
- As an "example", we evaluate the possibility of using such an ICN to fetch current Web contents, maintaining their actual names: domain-name/path; e.g. "cnn.com/index.html"
- We focus on the scalability of name-based routing

Deployment scenario

FIB used to forward content-requests,
i.e. Interest messages

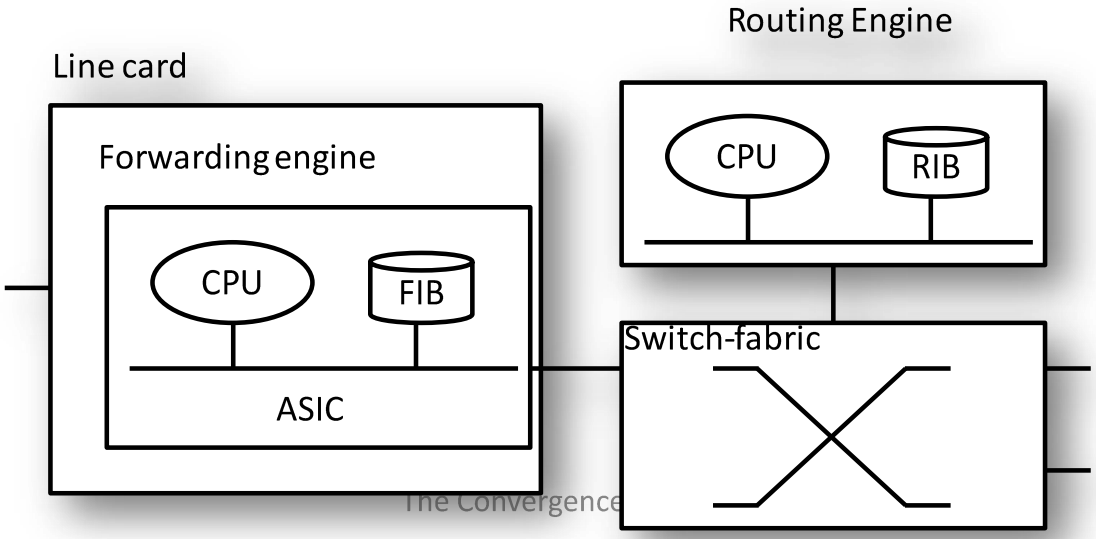
Name prefix	Next Hop	Iface
cnn.com/		
google.com/		
youtube.com/		

"ICN routes" are current Web domain-names (approx 10^9)



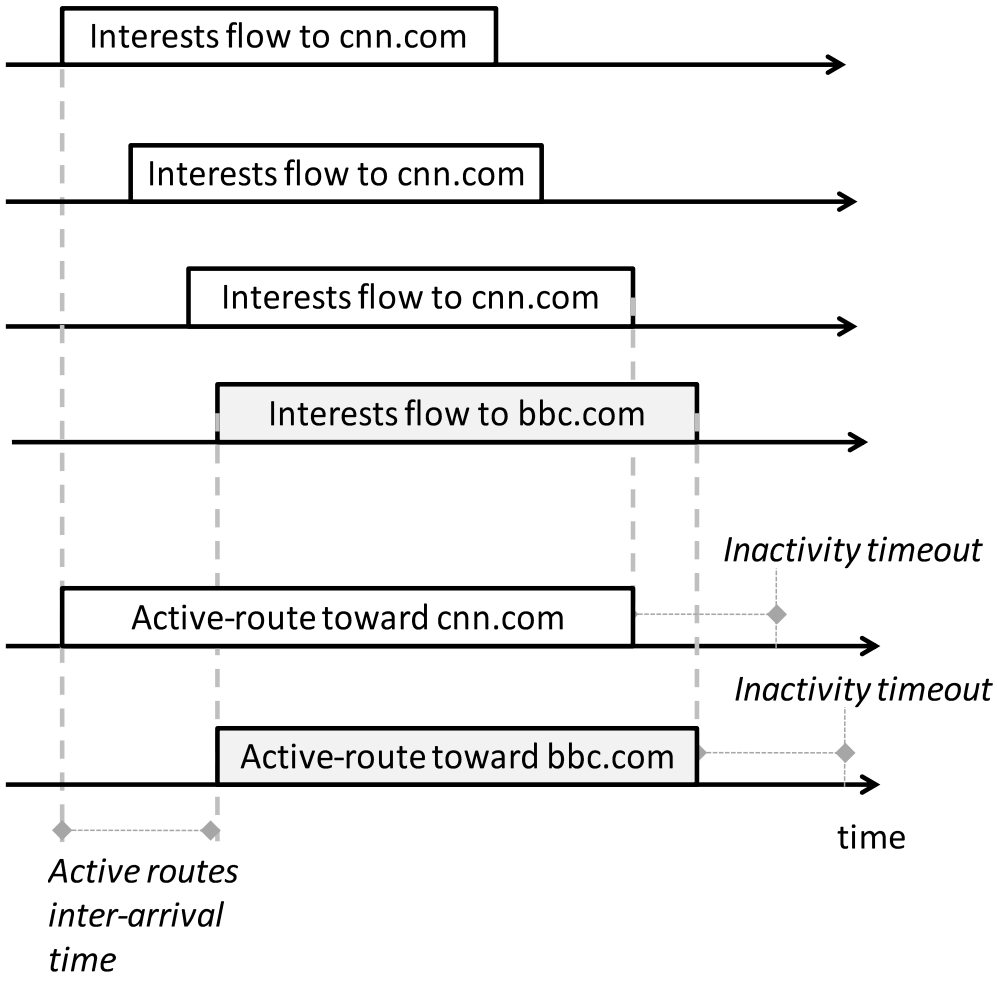
Practical Issues

- The forwarding plane of a tier-1 node should handle **10^9** ICN routes
- The routing plane of a tier-1 node should handle **10^{10}** ICN routes
- Re-using the architecture of an IP router is not practical:
  - **FIB memories can not store 10^9 ICN routes;**
    - SRAM chip 32 Mbit → max 10^6 ICN routes
  - **Storing 10^{10} ICN routes in a RIB requires motherboards with 100 DRAM slots – very expensive deployment**:
    - DRAM chip (4 GB) → 10^8 ICN routes per chip



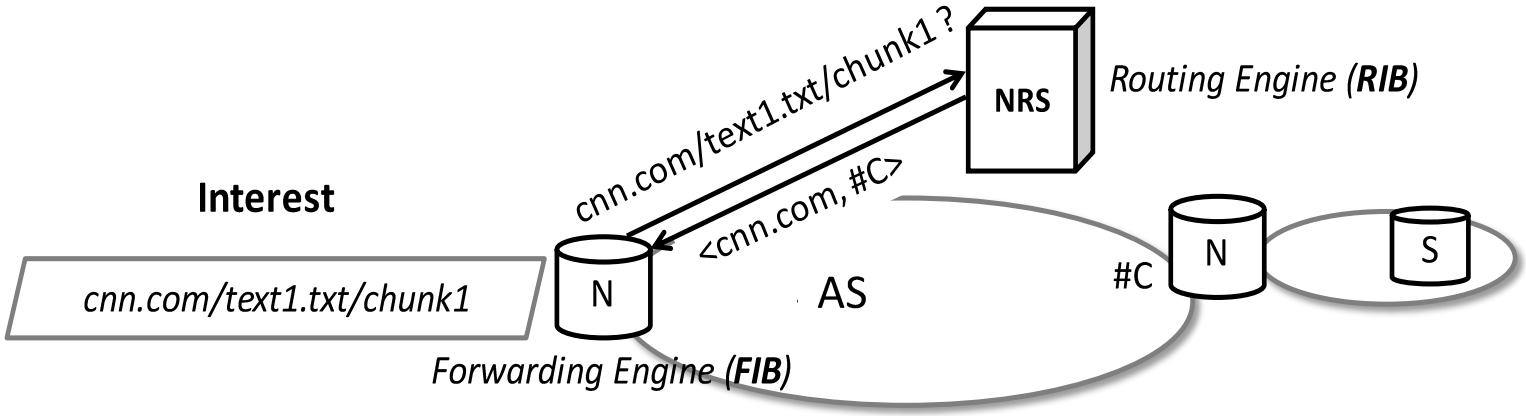
Coping with the limited space of FIB

- **Use the FIB as a cache of ICN routes:**
  - Zipf nature of the Web implies that, in a small time period, only a very limited set of ICN routes are concurrently used by a FIB to forward flows of Interest messages
  - We could use the FIB storage space as a cache of these ICN *active-routes*
  - An ICN active-route is a FIB entry used by at least one flow of Interest messages
    - Route activity estimation based on timeout



Coping with the deployment cost of RIB

- **Deploy one centralized RIB serving all the ICN nodes of an Autonomous System, looked up in case of FIB route miss**
  - Separating routing from routers (J. Rexford et al, SIGCOMM'04), Software Defined Network - OpenFlow switch



Name prefix	Next Hop
…	…
…	…

FIB at Interest arrival

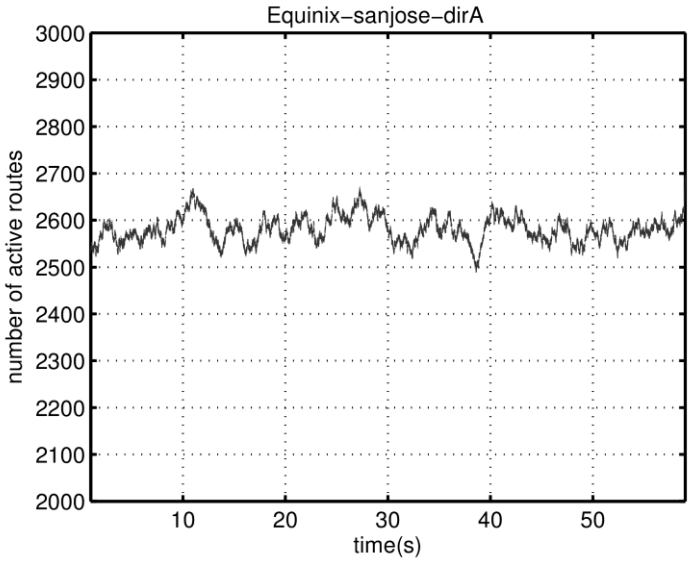
Name prefix	Next Hop
cnn.com	#C
…	…

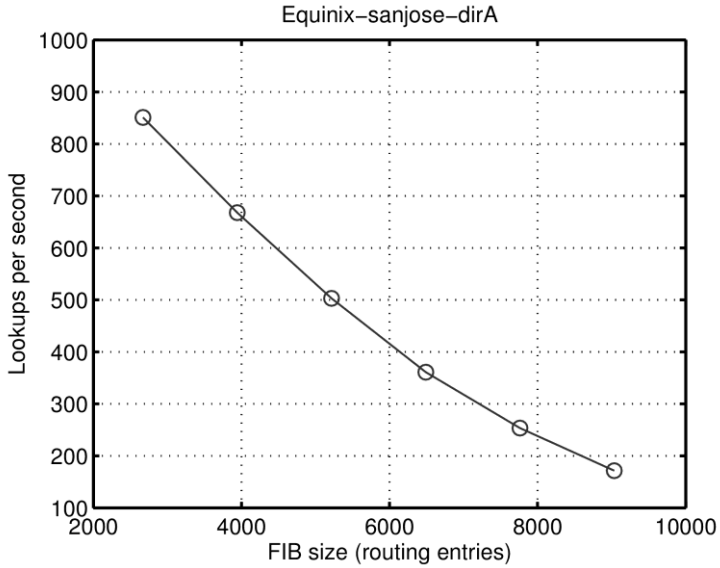
FIB after lookup-and-cache

Feasibility check

- The proposed routing architecture seems feasible: we analyzed real Internet traces of tier-1 nodes, and we verified that:
  - The number of active-routes is in the order of 10^3 -10^4 , much lower than then current FIB capacity (10^6)
  - The lookup rate is in the order 10^2 -10^3 lookups per second, easily sustainable by a DB technology
    - Note: we “mapped” the IP trace to an “ICN trace”, by pretending that flows of TCP ACKs toward HTTP servers are flows of Interest messages toward ICN servers

Tier 1 router





Credits

- This work has been carried out in the **CONVERGENCE** and **OFELIA** projects
  - http://www.ict-convergence.eu
  - http://www.fp7-ofelia.eu

- Details and CCNx-based software can be found in:
  - A. Detti, M. Pomposini, N. Blefari-Melazzi, S. Salsano. *Supporting the web with Information-Centric Network that Routes by Name. Technical report.* Available at http://netgroup.uniroma2.it/Andrea_Detti/Lookup-and-Cache/tech-rep-ICN.pdf (submitted to Elsevier Computer Networks)
  - L. Veltri, G. Morabito, S. Salsano, N. Blefari-Melazzi, A. Detti. *Supporting Information-Centric Functionality in Software Defined Networks. IEEE ICC – SDN Workshop 2012*