My few researches on network testbed

Katsushi Kobayashi
Advanced Institute for Computational Science (AICS), RIKEN
ikob@riken.jp
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1. i-Path: End-to-end network visibility
   • provide network network internal information to end-systems.

2. DYPOP: Datacenter beside Your telco-POP
   • P2P + Container Datacenter on telco-POP

3. FAIN: Flexible arrays of inexpensive network
   • global parallelism in the internet to satisfy future traffic growth.
i-Path: End-to-end network visibility

- **Objectives:**
  - Collect underlying information along path with hop-by-hop granularity.
  - API for application to access underlying information.
  - Harmonize disclosure policies among end-systems’, and transit ISPs’.

- **Implementation:**
  - FreeBSD / MacOS / Linux (incl. Android) are ready, Windows are planning.
  - Deployment: 5 i-Path routers in JGN2+, 12 in Lab.
  - [http://i-path.goto.info.waseda.ac.jp/trac/i-Path/](http://i-path.goto.info.waseda.ac.jp/trac/i-Path/)
  - Was supported by NICT grant.
How i-path works?

- Expose network information to overwrite IP option header with router data, e.g., bandwidth usage, capacity, geographical location, etc.
- In-band cross-layer designed for transport
- Jack up approach with shim layer middle of IP and Transport
  - ETEN, PTP, SIRENS
- Congestion control with more router support
  - XCP, TCP-QS, RCP, ...

One packet collects one router’s data
DYPOP: Datacenter beside Your telco-POP

- Is HUGE QoE investment for network service a sustainable?
- Big Data Center:
- CDN:
  - Akamai (sells RTT): 90 edges REDUCE/CONCEAL RTT between services and ends.
- P2P is NOT an alternative.
  - Affordable cost in BitTorrent, NanoDataCenters (NaDa).
  - Worse QoE by difficulty to predict behavior
    - Unstable PCs. Too much diverse CPU, OS, Disks, Access BW.
DYPOP: Datacenter beside Your telco-POP

- **Goal:** Managed (predictable) distributed computing infrastructure.
  - Eliminates CPU in home and access network from P2P, to avoid instability and too much diversity.
  - 20M FTTH access potential in Japan, but in under-utilization.
  - [http://dypop.riken.jp](http://dypop.riken.jp)
  - Supported by NICT grant.
DYPOP: Datacenter beside Your telco-POP

Our team

K. Ishida, S. Yamamoto, T. Sogabe (IIJ)
- Split architecture EDGE/Home nodes.
- Dynamic software deployment.

K. Shudo (TITECH)
- Scalable P2P system.

K. Kobayashi (RIKEN)
- EDGE/Resource discovery both from server and users.
- Re-use i-Path implementation - expose Cache content, available VM
FAIN: End-to-end virtual slices

• **Goal**: network architecture for “parallel-in-global”
  - Eliminate Sync. points from networks.

• **FAIN**: whole network is sliced into dedicated virtual slices.
  - Router and Link also sliced into virtual components.

• **All slices have same network topology**.
  - Single control plane manages multiple Virtual Forwarding Engines (VFE)

• **Preventing reorder within a virtual slice for transport.**

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FAIN: router and link with sub-devs.

- Divide full FAIN slices into multiple sub-arrays
  - Different sub-arrays are allocated to different sub-devices
  - Any virtual slice not across between sub-devices.
    - Parallelization level: up to FAIN virtual slices.
    - If sub-device prevents reorder in a box, reorder is also prevented within virtual slice.
- Router: multiple Physical Forwarding Engines
- Link: aggregated links
Thank you!