Content-oriented Networking Platform in Future Internet

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Introduction

• Move to Content-oriented Network
  – Internet traffic is already content-oriented
    • CDN, multimedia, P2P...

  – Users/applications care “what to receive”
    • They don’t care “from whom”
    • Host based communication model is outdated
Challenges

• IP networking
  – Lookup-by-name
    • Indirection (from name to locator)
      – DNS
    • Host/link availability concern
    • Locators can be aggregated
      – Concerning routing scalability

• Content networking
  – Route-by-name
    • No indirection, better availability
    • Content name (CID) is a routing entry
    • Huge scalability issue
      – CID is flat
Content networking under IP network

• Motivation
  – Current IP networking leverages network prefixes in routing
    • Routing scalability is not bad
  – Content ID is not good for routing
    • Huge scaling burden

• Content routing and IP routing should be combined

• We propose a grassroots approach
  – Some popular contents will be cached
  – Routing info. for those contents can be propagated in local and best-effort manner
Content-oriented networking platform

• Objectives
  – Exploit content networking to adopt current Internet

• Environments
  – Content-aware Agent
    • Interact content based network and IP network
  – Content-aware Router
    • Efficient content delivery mechanism
  – Content directory service
    • Mapping/Resolution content to location

• Achievements
  – Security, accountability, deployment
General Architecture

- **Content based Communication**
- **IP based Communication**
- **Content Distribution**

- **Agent**
- **Gateway A**
- **Gateway B**
- **Publisher**

- Req. particular contents
- Rep. Here you are

- Agent’s IP address

- DNS
- CDS

- Content based System (CDS)
- Content-Aware Agent (CAA)
- Content-Aware Router (CAR)

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Communication Procedure

Content req. with URI → FQDN → Relay the req. to publisher’s CAA → Relay the requested contents → Cache contents → Rep. contents

Content-Aware Agent (CAA) → Content-Aware Router (CAR) → CAA

Find contents → Rep. the contents → Cache contents
Content-Aware Agent (CAA)

- Proxy for interaction CON to IP network
  - Handle content requests / response
    - FQDN to obtain IP address for publisher’s CAA
    - Authority content server’s CAA
  - Caching the requested contents

- Gateway for heterogeneous networks
  - Protocol translate or Tunneling
  - Relay contents in inter-domain environment
Content network domain

- IP-less communication
- Assumption
  - Lookup "Content ID (CID)" by web search
  - CID
    - URI form
    - http://youtube.com/south-afreeca-worldcup-2010
- Communication inside domain
  - Request packets are relayed CAA by MAC protocol
  - CAA contacts DNS
  - Solicitors cannot contact server directly

1: I want a particular content (e.g. HTTP URI)
2: Here you are
Content-Aware Router (CAR)

- Legacy routers look at IP address in transit header
- CARs also look at CID in global header
- CARs can participate in content relaying
  - CARs can cache contents
**CANA operations: Content Request Message**

1. H1 sends a content request message to A1, its src:dst is H1:A1 (the content \( C_{H2} \) belongs to H2)
2. A1 makes a CIB entry \((C_{H2}, H1)\) to deliver content data
3. The content request message now has A1:A2 as src:dst IP addresses
4. C1 makes a CIB entry \((C_{H2}, A1)\) to deliver content data

• As content request message traverses, a content info base (CIB) entry is set up backwards to relay content data
Publisher’s domain

- Registers its domain name with the DNS
  - Agent’s IP address (of the egress link)

- Content distribution with other publisher’s domain
  - Maintain contents distributed information
    - By Content Directory System
Contents dissemination

• Content dissemination
  – Contents are distributed at whole network to achieve efficient content delivery
  – Distributed information need to maintained

• Content Resolution Service
  – It is hard to implementation
    • Contents are not identified by hierarchical manner
      – Content ID is flat
    • DNS is not adequate for contents resolution
Content Directory System (CDS)

• Assumptions
  – Contents Directory System is provided only for authority domain
    • CDS is located at the publisher’s domain
  – Contents distribution is performed by authority publisher’s domain administrator
    • Do not concerned others contents, such as P2P distributed or routing cached contents

• CDS
  – Mapping authorized contents to publisher’s address
  – Make CID extension attached attributes
    • CID can be maintained by hierarchical manner
Communication procedure with CDS

- **FQCN** – obtain Authority domain or location
- **Req. particular contents**
- **Relay request**
- **Make connections**
- **/twyou.co.kr/xxx** – xxx’s authority domain location
- xxx’s attributes
- xxx | type | codec | …
Conclusion

• We propose a grassroots approach
• Content-oriented Networking Platform
  – Content-Aware Agent (CAA)
  – Content-Aware Router (CAR)
  – Content Directory System (CDS)
• Future works
  – Content-Aware Routing
  – Content Directory System