Multicast in Information-Centric Networking

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Mobile Data Traffic Prediction

From 2010 to 2015: factor 26 increase expected
Video Data Traffic Prediction

From 2010 to 2015: factor 5 increase expected

*Cisco VNI June 2011
Popular Conception: Content Distribution Over the Internet Does Not Scale

Tier 1 Networks

ISPs

ICN side meeting @ IETF-81
Attempts to Mitigate

- **IP-Multicast**
  - Packet-level one-to-many and many-to-many communication
  - Mostly used in controlled environments (e.g., IPTV distribution)

- **P2P**
  - Enhancing scalability by distributing serving load
  - But: traffic management and peer selection control deemed necessary
  - Also: combining P2P w dedicated in-network storage (DECADE)

- **CDN**
  - Enhancing scalability and performance by operating dedicated caches close to access networks
  - But: proprietary, standalone networks – increasing demand for interconnect: CDNI

- **Evolving specific system architectures**
  - 3GPP EPS: mobile data offload
Summary

• Massive deployment of P2P, CDN

• Represents a need for
  – Accessing named resources – not hosts
  – Scalable distribution through replication and caching
  – Good control of resolution/routing and access

• But
  – We are engineering a lot of overlay infrastructure to make it happen
  – Using DNS, HTTP in creative ways
  – Still unresolved problems
Problems

• Security
  – Can’t trust a copy received from an untrusted server
  – Trust on object authenticity today based on transport layer security (based on host name certificates)
  – CDN: ‘proxy TLS’ for enabling HTTPS with DNS rewriting
Problems

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• Application and content provider independence
  – CDNs focus on web content distributions for major players
  – What about other applications and other players?

• Inefficient information dissemination
  – Can’t benefit from existing copies (e.g. local copy on client)
  – No “anycast”: e.g., get “nearest” copy
  – Flash-crowd effects, disruptions not well tolerated
  – Names can depend on location => 404 Not Found
Information-Centric Networking

- Since we are mostly accessing named resources anyway
  - Design the network so that this is optimally supported

- Considering important requirements
  - Accessing named data objects
    - not hosts
  - Scalable distribution through replication and caching
  - Good control of resolution/routing and access

- With ubiquitous caching
  - But for all applications
  - And for all users and content/service providers

ICN side meeting @ IETF-81
Information-Centric Networking (ICN)

Web browser

XY1

Original Content “XY1”

Owner “Joe”

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ICN Technical Topics

- **Naming of information objects**
  - Unique object identification
  - Names as keys for request/content routing

- **Routing and Name Resolution**
  - Want to locate “best” copy of named objects
  - Need a mapping/link between named objects and underlying network topology

- **Transport**
  - Reliable, congestion- and flow-controlled transport of objects from a given location to interested receiver
  - Receiver-oriented transport – End-to-end vs. hop-by-hop

- **Security / Trust**
  - Host-based e2e security no longer applies
  - Receiver is agnostic to object location
1) ICN Multicast Service

- Multipoint communication as an implicit feature
1) ICN Multicast Service

- Multipoint communication as an implicit feature
2) (IP) Multicast for ICN

Multicast Domain A

Multicast Domain B
2) (IP) Multicast for ICN

Multicast Domain A

GET XY1

Multicast Domain B
2) (IP) Multicast for ICN

GET XY1

Multicast Domain B

GET XY1

Multicast Domain A
2) (IP) Multicast for ICN
Other Possible Multicast Employments

• Carrousel-like data object distribution
  – FLUTE (RFC 3926)

• Name resolution (think Multicast DNS)
  – Resolve data object name to lower layer locator
  – Locator can be IP address, group communication session specification etc.
Current IETF/IRTF Work on ICN

• DECADE
  – URI format for Named Information
    – draft-farrell-decade-ni
    – draft-hallambaker-decade-ni-params

• DTNRG
  – Bundle Protocol Query Extension Block
    – draft-farrell-dtnrg-bpq

• ICN in IRTF
  – http://trac.tools.ietf.org/group/irtf/trac/wiki/icnrg
URI Format for Named Information

• Motivation: enabling naming of data objects with name-data integrity validation

• Internet Draft draft-farrell-decade-ni

• Flexible approach: common name format enabling different forms of name resolution and name-based routing

• Basic idea: generic URIs for hash function outputs
  – Naming the hash function and an optional authority
  – Extensibility mechanism to include locators, decryption keys etc.

• Currently text-based URI format – working on additional binary representation

```text
ni://example.com/sha-256-32;B_K97zTtFuOhug27fke4_Q
```

```text
ni://example.com/sha-256-32;B_K97zTtFuOhug27fke4_Q?alt=ni.example.net
```
Running Code

• https://sourceforge.net/projects/netinf/