ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

Information-Centric Networks

Section # 6.2: Evolved Naming & Resolution

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Department: Informatics

European Union
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OPERATIONAL PROGRAMME
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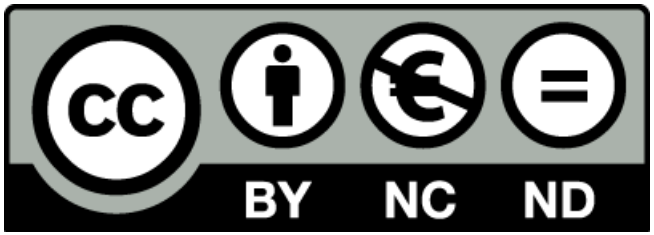

Week 6 / Paper 2

- A layered naming architecture for the Internet
  - Hari Balakrishnan, Karthik Lakshminarayanan, Sylvia Ratnasamy, Scott Shenker, Ion Stoica and Michael Walfish
  - ACM SIGCOMM 2004
- Main point
  - There is one step of name resolution today: DNS to IP
  - There should instead be three
    - User name to service identifier
    - Service identifier to endpoint identifier
    - Endpoint identifier to IP address
  - This would make data and services equal to hosts
    - It would also accommodate mobility and multihoming
    - And properly integrate middleboxes into the Internet

Introduction

- There are two namespaces on the Internet: DNS and IP
  - DNS is tied to administrative structure, IP to network topology
  - Data and services are only named indirectly
    - We name the host where data and services reside
    - They are thus tied to administrative structure and network topology
  - Middleboxes violate even this simple model
    - NATs/NAPTs modify the IP addresses
    - Ideally they should be explicitly delegated to do their job
- What should naming be like?
  - We really need four layers of naming
    - Human names, service IDs, endpoint IDs and IP addresses
  - Naming is relatively easier to modify than IP itself
    - But it cannot solve problems that are due to IP limitations

Design principles

- Names should bind protocols as little as possible
  - If you need a service (or some data) why involve a host name?
  - Service identifier (SID): persistently identifies a service
    - Produced from human friendly names by a mapping service
  - Transport protocols should not be aware of network addresses
  - Endpoint identifier (EID): topologically independent (unlike IP)
  - Human friendly->SID->EID->IP
  - First locate the SID and start a session (application)
  - Resolve the SID to one or more EIDs (transport)
  - Resolve one or more EIDs to IP addresses (network)
  - Host mobility: update EID to IP mapping
  - Service mobility: update SID to EID mapping

Design principles

- Persistent names should not restrict referred to elements
  - DNS names for data and services are ephemeral
    - Data/services not necessarily bound to a specific organization
    - DNS prohibits data/service mobility
  - One solution is to partition the namespace to genres
  - Another one is to use flat names
- Names should be possible to resolve to delegates
  - An endpoint may want to only receive data via a delegate
    - NAT/NAPT, firewall, whatever
  - The architecture should handle middleboxes
- Destinations should be generalized to sequences
  - Allow both sender and receiver to use middleboxes
  - The sender indicates them, the receiver relies on resolution

EIDs and SIDs

- ULD resolution: maps human friendly names to SIDs
  - Beyond the scope of the paper
- SID resolution: maps SIDs to EIDs
  - Application sends a SID to the resolution service
  - The service returns one or more (EID, transport, port) triples
    - For data additional data may be returned (e.g. pathnames)
  - The transport layer uses the triple to initiate a connection
  - SIDs are included in application data units
    - Example: HTTP headers, SMTP headers
- EID resolution: maps EIDs to IP addresses
  - The transport layer sends packets to the EID resolver
  - The EID resolver may pick one of the returned IP addresses
  - EIDs are included in network packets

Delegated bindings

- Delegation at the EID or SID layer (stateful)
  - EID: The endpoint advertises the IP address of a delegate
  - The delegate needs to know where to forward packets
  - SID: Same as above, but at a the application level
- Delegation via identifier stacking (stateless)
  - Sequences of SIDs or EIDs can be returned by the resolver
  - Similar sequences can be indicated by the sender
  - The path consists then of the concatenation of the sequences
- Examples of explicit delegation
  - EID level: NAT/NAPT, firewalls, VPNs
  - SID level: virus scanners, spam detectors
  - Works even for individual e-mail addresses

Coping with flat names

- Flat name resolution
  - DNS achieves scalability through hierarchy
  - DHTs can handle flat names in a scalable manner
    - Assume managed DHT substrates with low churn
  - Ensuring flat names are unique is tricky
  - DHT resolution time needs to be reduced
    - Caching and replication can help
  - An economic and trust model is needed
    - Why would I buy a server to store other people's names?
    - Why I should trust you to resolve somebody else's names?
- Mapping from human friendly names
  - Users need to trust services that map names to SIDs
  - Cryptographic techniques can help users trust SIDs

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End of Section # 6.2

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