

NG YOU FORWARD

Excuse me, Sir, but can we deliver packets without addresses?

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Outline

LIPSIN: Line Speed Publish/Subscribe Inter-Networking

- Context: background and targets for the project
- How to forward without IP addresses?
 - Our solution for forwarding without globally routable addresses
- Optimizations for better performance
- Implementation
- Summary

Context - Clean Slate Approach

- DATA as the first class citizen
 - Users interested in data, not in the hosts
 - Topic based publish/subscribe
- DDoS problems
 - Unwanted traffic can be sent against the receiver's will
 - Target: Data delivery ONLY when explicitly requested
- Data published once, received multiple times BUT from different locations and at different times
 - Multicast also for *timely* separated events
 - Data caching in the network

Context - RTFM architecture

- Rendezvous matching publish and subscribe events
- Topology network topology knowledge, path creation
- Forwarding fast delivery



Topic based pub/sub: How to deliver data?

- Routing based on Topic ID
 - 10^11 topics => enormous amount of state in forwarders
 - State need to be changed based on subscriptions
 - => Not scalable
- How about storing the state in the packet?
 - Define the path from the source to the destination
 - IP: include all visited IP addresses in a list
 - A long list of IP addresses, and we do not solve the DDoS
 - Without IP: Include all visited nodes in the packet
 - Long list of Node IDs!
 - Compress the list into a Bloom filter!
 - Path not visible

Link IDs and forwarding Bloom filters (zFilters)

- No names for nodes
 - Each *link* is identified with a unidirectional Link ID
- Link IDs
 - Statistically unique
 - Periodically changing
 - Size e.g. 256 bits
 - Local or centrally controlled
- Source routing
 - Include all Link IDs into a Bloom filter
 - Multicasting supported
- "Stateless"



Forwarding Decision

- Forwarding decision based on binary AND and CMP
 - zFilter in the packet matched with all outgoing Link IDs
 - Multicasting: zFilter contains more than one outgoing links



Using Link Identity Tags (LIT)

- Make results better with a simple trick
 - Define d different LITs instead of a single LID
 - LIT has the same size as LID, and also k bits set to 1
 - [Power of choices]
- Route creation and packet forwarding
 - Calculate d different candidate zFilters
 - Select the best performing zFilter, based on some policy





Forwarding efficiency

- Simulations with
 - Rocketfuel
 - SNDlib
- Forwarding efficiency with 20 subscribers

- ~80%



Forwarding efficiency evaluation in AS6461 (k=5)

Forwarding efficiency

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 - LIT Optimized:
 88 %



Forwarding efficiency evaluation in AS6461 (k=5)

Forwarding efficiency (%)

Virtual Trees

Popular paths can be merged into virtual trees

- A single Link ID for the tree
- Additional state in the forwarding nodes
- Increase scalability



Virtual B->C->D->E 0 0 1 0 1 0 0 0 1

Implementation

- NS3 simulator
- FreeBSD 7.x : end-host + forwarding
- NetFPGA : Forwarding
- BSD & NetFPGA Implementations available at <u>http://www.psirp.org</u>



Summary

- Link-identity-based source routing
- Stateless small-group multicast and unicast
- Small forwarding table
- Very simple forwarding decision
- Preventing unwanted traffic
 - No possibility to send data by guessing the destination
- Forwarding implemented: both software and hardware

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