Caching and Mobility Support in a Publish-Subscribe Internet Architecture

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Motivation

● Need for Mobility
● Change in usage model
  ○ From sharing Resources -> Info
    (regardless of end-point hosting it)

PSI claims:
● Scaling not affected by addressing or routing assumptions
● Supports native multicasting
● Asynchronous nature and caching help with MN handoff
Architecture Overview

Naming:
● Scope Identifier (SID)
● Rendezvous Identifier (RID)

Network Primitives:
● Publish
● Subscribe
Architecture Overview (cont)

Functions (3):
● Rendezvous
● Topology Management
● Forwarding
Example Retrieval

Steps:

1. Producer publishes item
2. Consumer subscribes
3. Subscription is propagated to the Rendezvous Function
4. Topology Manager constructs forwarding path -> Forwarding Identifier (FID) and returns it to Publisher (notification)
5. Publisher starts transmission
Network Design

4 Types of Elements:

1. Hosts
2. Forwarding Nodes (FNs)
3. Rendezvous Nodes (RNs)
4. Topology Managers (TNs)

Key Benefits (Hosts behind gateway RN):
- Increased security and privacy
- Reduced control overhead and rendezvous traffic
Forwarding

- **Using LIPSIN**
  - On-path links encoded in fixed size bit string (Bloom Filter) -> FID
  - Included in packet

- **Packets can be delivered over multicast trees by adding tree links to the FID**
  - No extra state in the network is required

- **Topology Managers can enforce routing policies**
RENE and Topology Management

● Made out of multiple RNs
  ○ Built from FNs and RNs talking to TMs
  ○ Link State Announcements (LSA)
● Topologies built used for intra-domain routing
● TMs send FIDs with paths
Transport

- RNs maintain list of subscribers (state)
- New subscribers are added to FID
- Documents (reliable delivery)
  - TMs compute bidirectional FIDs
- Push-based

- Pull-based
Caching and Replication

- On-path Caching
- Off-path Caching
- Content Replication
On-path Caching

- Requests can be served by FNs on the path
- Prevent feedback implosion of multicast errors
- Possible to use on the Internet at the Application layer
  - Requires proxy server for Browser
Off-path Caching

- Take advantage that any node can serve request
- RENE can decides to cache or not to cache info
- Additional overhead -> announce to local RENE
- Hard to achieve on the Internet as it needs coordination between various application-level caches
Content Replication

- Used to minimise inter-domain traffic and improve user experience
- Does not rely on DNS tricks like on the Internet
- Can also exploit off-path caching
Mobility and Caching

- Decoupling from Time and Space
- Re-issue subscriptions for missed data
  - RENE takes care of redirection to caches

- Micro-mobility:
  - Use off-path caches to support MNs ->
    requests forwarded after handoff to cache
  - Assigned based on topology or forecasting

- Macro-mobility:
  - Set caches in neighbouring networks
    (expensive)
Conclusions

- Information-centric architecture
- Individually identified items can be cached at Network Layer
- Asynchronous nature of PSI make it mobile-ready
- Constantly evolving architecture
Critique

● No performance analysis about the impact on the network on various conditions
  ○ Possibly not very applicable in many cases

● Privacy concerns about data being replicated without any control
Questions?