ALTO and Content Delivery Networks

draft-penno-alto-cdn

Stefano Previdi, sprevidi@cisco.com
Richard Alimi, ralimi@google.com
Jan Medved, jmedved@juniper.net
Reinaldo Penno, rpenno@juniper.net
Richard Yang, yry@cs.yale.edu
Alto Server and the CDN

• Goals
  – Optimize traffic delivered from CDN
  – Improve global and local server load balancing
  – Facilitate topology & status information sharing between domains (e.g. CDN – ISP)

• Non Goals
  – Standardization of particular server selection criteria
Alto Server and the CDN

• Scope:
  – Integration of the ALTO Service with the main CDN request routing / content location selection techniques
    • HTTP Redirect
    • DNS Integration
  – Multi-Domain Use Cases
HTTP Request Routing

1. HTTP Request
2. HTTP Redirect (302)
3. HTTP Request

HTTP Request Routing
- HTTP Server
- Alto Client

Alto Server

Alto interface (Map or Endpoint Cost)

Cache
HTTP Request Routing
(Status Updates into Request Routing)

1. HTTP Request
2. HTTP Redirect (302)
3. HTTP Request

Administrative Domain

Status Updates

Alto interface
(Map or Endpoint Cost)
HTTP Request Routing
(Status Updates into ALTO Server)

1. HTTP Request
2. HTTP Redirect (302)
3. HTTP Request

HTTP Redirector

HTTP Server

Alto Client

Alto Server

Cache

Administrative Domain

Status Updates
DNS Resolution
Single Administrative Domain

1. User requests content from a URL.
2. Request is routed to the proxy server.
3. Proxy server queries the root name server.
4. Root name server directs the query to the .com name server.
5. .com name server directs the query to the cdn.com name server.
6. cdn.com name server directs the query to the Alto Client.
7. Alto Client returns the content to the Alto Server.
8. Alto Server caches the content.
9. Cache returns the content to the user.

Content Provider

Administrative Domain

Alto Map interface
Request Routing: Map Service

- Host PIDs: host subnets
- CDN Node PIDs: IP addresses of available CDN Nodes
- If Request Router knows the subset of host and CDN PIDs that it will serve, it can download relevant Network and Cost Maps in advance:
  - Use the Filtered Map Service to only get data about relevant PIDs
  - Or ALTO Server should support multiple views
- HTTP Cache Control headers to determine how long the client keeps the Network and Cost Maps
Suggested Protocol Additions/Extensions

• PID Attributes (and Query):
  – Needed to disambiguate between PIDs containing endpoints of a specific class
  – PIDs classified as containing "CDN nodes", "Mobile Hosts", "Wireline Hosts", etc.
  – Allows ALTO Network Map to provide simple resource discovery/location.

• Incremental Map Updates:
  – Beneficial is maps are large and/or change often
  – The map contained in the reply is the delta from the previous version
  – Note: pertinent for ongoing discussions regarding mobility.
Request Routing: Endpoint Cost Service

- ECS is a ranking service delivered on demand by ALTO server
  - ALTO client resides in CDN and request ECS based on endpoint addresses
  - ALTO server collects topology information, computes rankings

- Network Information sources
  - By default, ranking is based on routing distance
  - ALTO server may integrate different information sources: geo-location, network performance, resources utilization, policies, …

- Caching
  - ALTO server may pre-compute topology information and store different abstractions of network infrastructure/topology
  - ALTO client may cache ECS results for further use
Request Routing: Endpoint Cost Service

1. Content/Service Request
   - CDN Client
   - Redirector
   - DNS
2. REQUEST
   - User IP Add: 10.1.1.1
   - Target-1: 10.20.1.1
   - Target-2: 10.30.1.1
   - Target-3: 10.40.1.1
3. REPLY
   - User IP Add: 10.1.1.1
   - Target-2: 10.30.1.1 10
   - Target-3: 10.40.1.1 20
   - Target-1: 10.20.1.1 30

Network Layer/Infrastructure

Alto Server

Topology info

Other Information Sources

CDN

Client

Content/Service Request

10.30.1.1

10.40.1.1

10.20.1.1
Request Routing: ECS and Maps

- Security & confidentiality ALTO requirements are addressed by both Maps and ECS
- Mechanisms through which an ALTO server collects network infrastructure topology information are common to Maps and ECS
- ECS and Maps only differ in the way service is delivered
- When ECS is used, the ALTO client (CDN) doesn’t hold any topology information
- Intelligence of topology computation, abstraction, ranking is placed inside the ALTO server
Multiple Admin Domains
Cost Advertisement

DNS Resolve

Network Map {PID1, ..., PID5}
Cost Map {C1-4, C2-4, C3-4}

Alto Server

Host PID1

Host PID2

Host PID3

Border Router PID4

Border Router PID5

Border Router PID6

Border Router PID7

Cache PID8

Cache PID9

Cache PID10

cdn.com
Name Server

Alto Client

Network Map {PID1, ..., PID3, PID7, 8, 9}
Cost Map {C1-8, C1-9, C1-10, ..., C3-10}

Alto Server

Alto Client

Network Map {PID1, ..., PID5, PID6, PID7, 8, 9}
Cost Map {C1-8, C1-9, C1-10, ..., C3-10}
Additional Suggestions

• Federated deployment of ALTO Servers
  – Is anything beyond standard ALTO Protocol needed for distributing information amongst servers?

• Extensible Cost Maps
  – Does it make sense to store “opaque” information for paths within ALTO Maps, instead of just numeric/ordinal costs?

• Discovery
  – Discover CDN's ALTO Server instead of ISP's ALTO Server. Input to discovery discussion
Open Questions

• Maps with incremental updates
• Conceptually, maps are no different from topology DBs
  – Analogy between an OSPF/ISIS LSDB and Maps
• Does it make sense to apply same mechanisms ?
  – Incremental updates based on Maps objects
  – Routing protocols: node-ID, adjacency, cost
  – Maps: PID, neighboring PID, cost
• ALTO server may establish sessions/adjacencies between them and exchange information in a reliable incremental fashion
  – Minimal state is required
  – Scalable and efficient