ALTO Protocol

draft-penno-alto-protocol-03

Presenters: R. Alimi, R. Penno

Current Design Team working on the draft:

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Grateful to the contributions of a large number of collaborators;
Complete list please see draft.

Outline

- Design history
- Basic concepts
- Protocol framework
- Use cases
- Next step

Design history

- IETF-74
  - Merged P4P and InfoExport
- Between IETF-74 and IETF-75
  - Merged ATTP
  - Merged Query-Response
  - Merged DNS based NetLocation Service
  - Merged Proxidor
- IETF-75
  - Today...

Contributing Proposal: P4P

- [draft-p4p-framework-00, draft-wang-alto-p4p-specification-00]
  - R. Alimi, D. Pasko, L. Popkin, Y. Wang, Y. Wang, Y. R. Yang

- Key Features
  - Theoretical foundation based on primal-dual decomposition
  - Network Map and Cost Map
  - PIDs and Grouping
  - Tracker-based selection
  - RESTful URLs and Text encoding
  - Leverage P2P caching (extension)

Contributing Proposal : InfoExport

- [draft-shalunov-alto-infoexport-00]
    - S. Shalunov, R. Penno, R. Woundy
- Key Features
    - Cost Map
    - PIDs and Grouping
    - Client-based selection
    - HTTP Transport and Text encoding
    - Leverage P2P caching (extension)
    - IP/ASN mapping (extension)

Contributing Proposals: Proxidor

- [draft-akonjang-alto-proxidor-00]
  - O. Akonjang. A. Feldmann, S.Previdi, B. Davie, D. Saucez
  - Drawn from merged proposals
    - DT Oracle, Cisco Proximity Engine, UCL-Belgium IDIPS

- Key Features
  - Cost types
  - Path ranking
    - Addresses and groupings
  - Include P2P caches in ranked lists (extension)
  - ALTO Info derived from routing protocols/policies

Contributing Proposal : Query/Response

- [draft-saumitra-alto-queryresponse-00, draft-saumitra-alto-multi-ps-00]
  - S. Das, V. Narayanan, L. Dondeti

- Query/Response
  - XML/Text encoding
  - Cost constraints
  - Service Configuration (now Server Capability)
  - Overlay ID (now type of Endpoint)
  - Multi-homed clients (extension)
  - Client Feedback (extension)

Contributing Proposal : ATTP

- [draft-zhang-alto-attp-02]
    - Y. Zhang, H. Liao, N. Zhou
- Key Features
    - Discovery of tracker (done by Server Capability query)
    - Leverage P2P caching (extension)
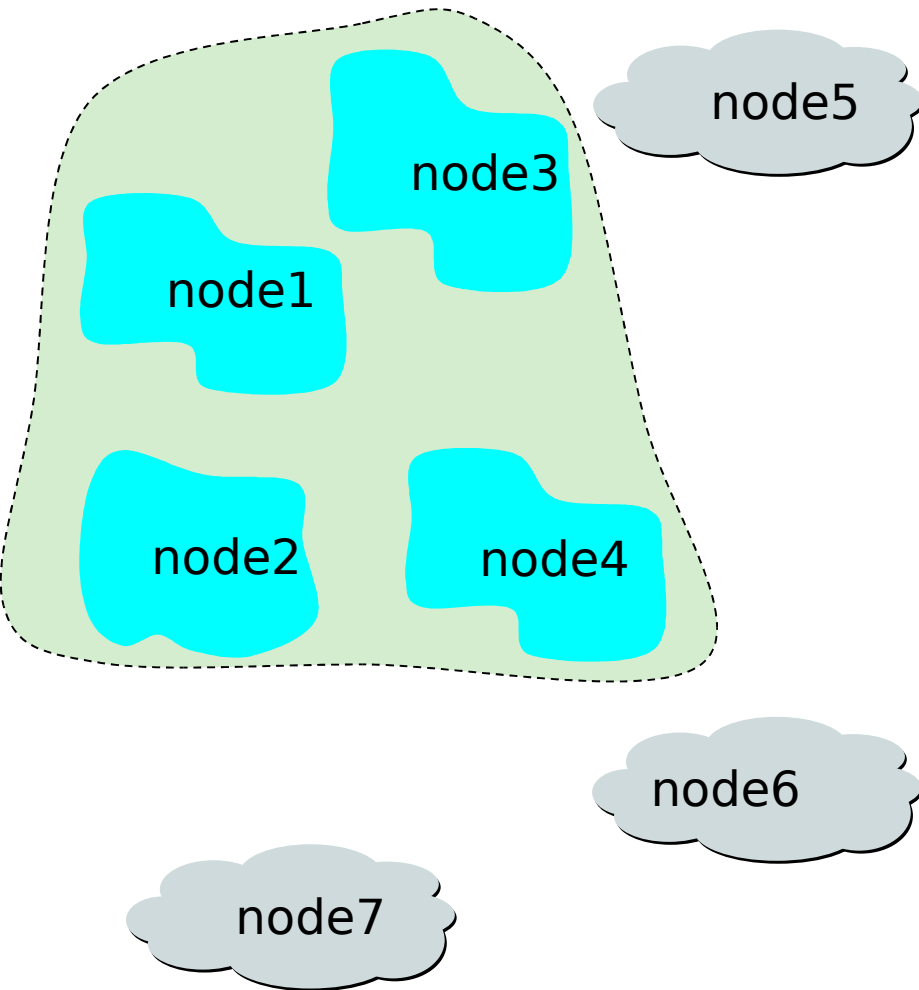   - Client feedback (extension)

Contributing Proposal: DNS based NetLocation Service

- Presentation at IETF74
    - Syon Ding

- Key features
  - Location
  - Potential extension to support info through hierarchy aggregation
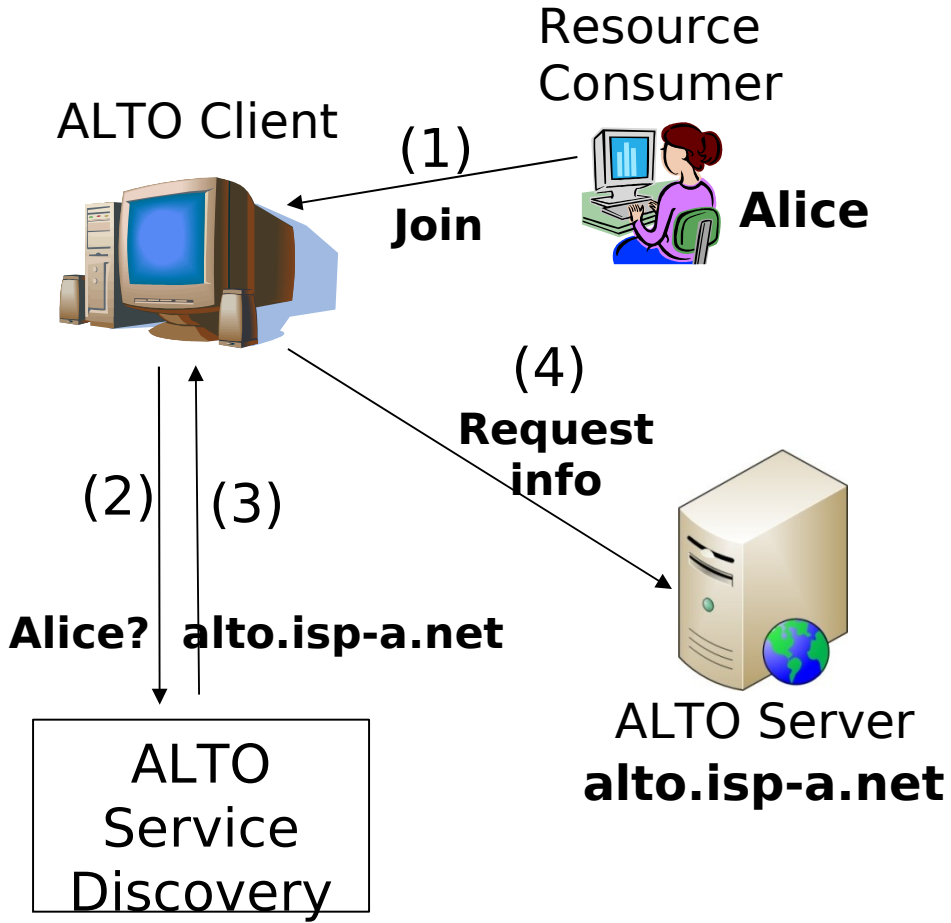
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Concept: my-Internet View

node5

node3

node1

node2 node4

node6

node7

- Defined by ALTO Server
- Defines set of Network Locations
  - Intradomain
  - External
- Defines generic costs amongst network locations

Concept: Hosting ALTO Server

Resource Consumer

ALTO Client

(1) **Join**

Alice

(4) **Request info**

(2) (3)

Alice? **alto.isp-a.net**

ALTO Service Discovery

ALTO Server **alto.isp-a.net**

- Resource Consumer's *Hosting ALTO Server* determined by Service Discovery

- my-Internet View from Hosting ALTO Server applied for guidance of Resource Consumer

Concept: ALTO Cost Type

node4

Hop-count: 2

Air-miles: 1500

Routing Cost: 684

node3
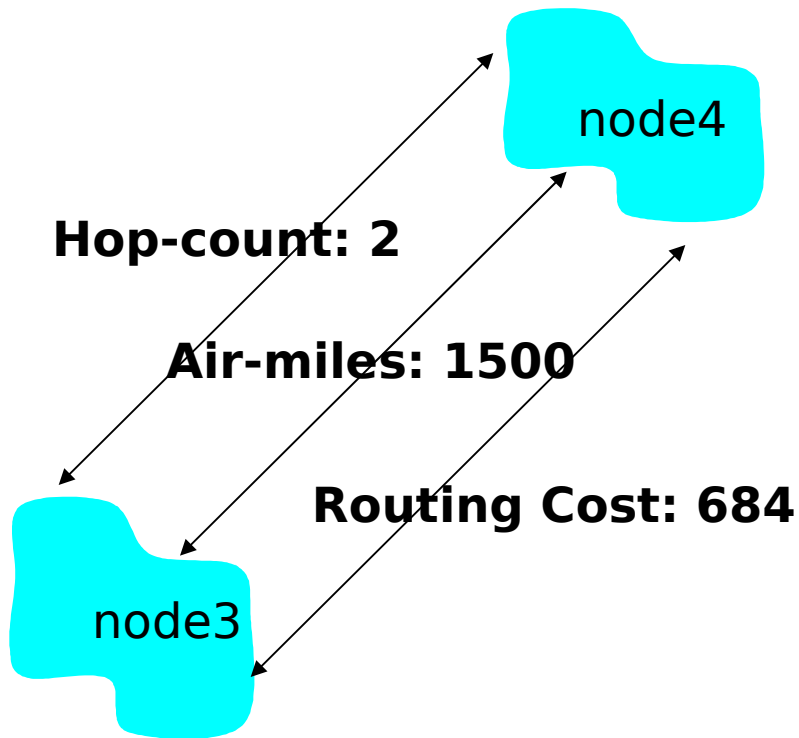
- **ALTO Server may define multiple costs between pair of network locations**
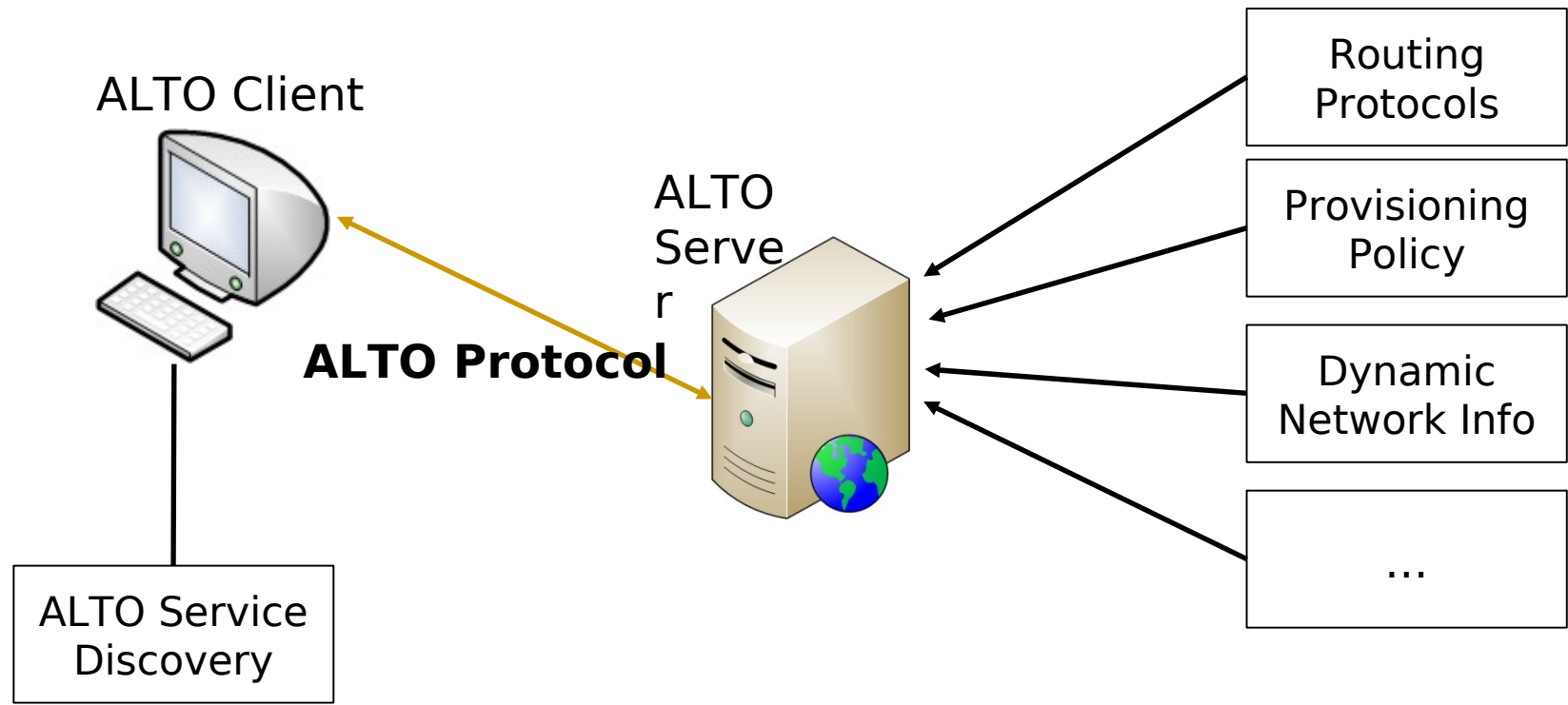- **Each cost distinguished by *Type***

Concept: Location Grouping

ALTO Server

ALTO Information

Resource Consumers

Alice

Barbara

cost=10

cost=15   cost=90

Resource Providers
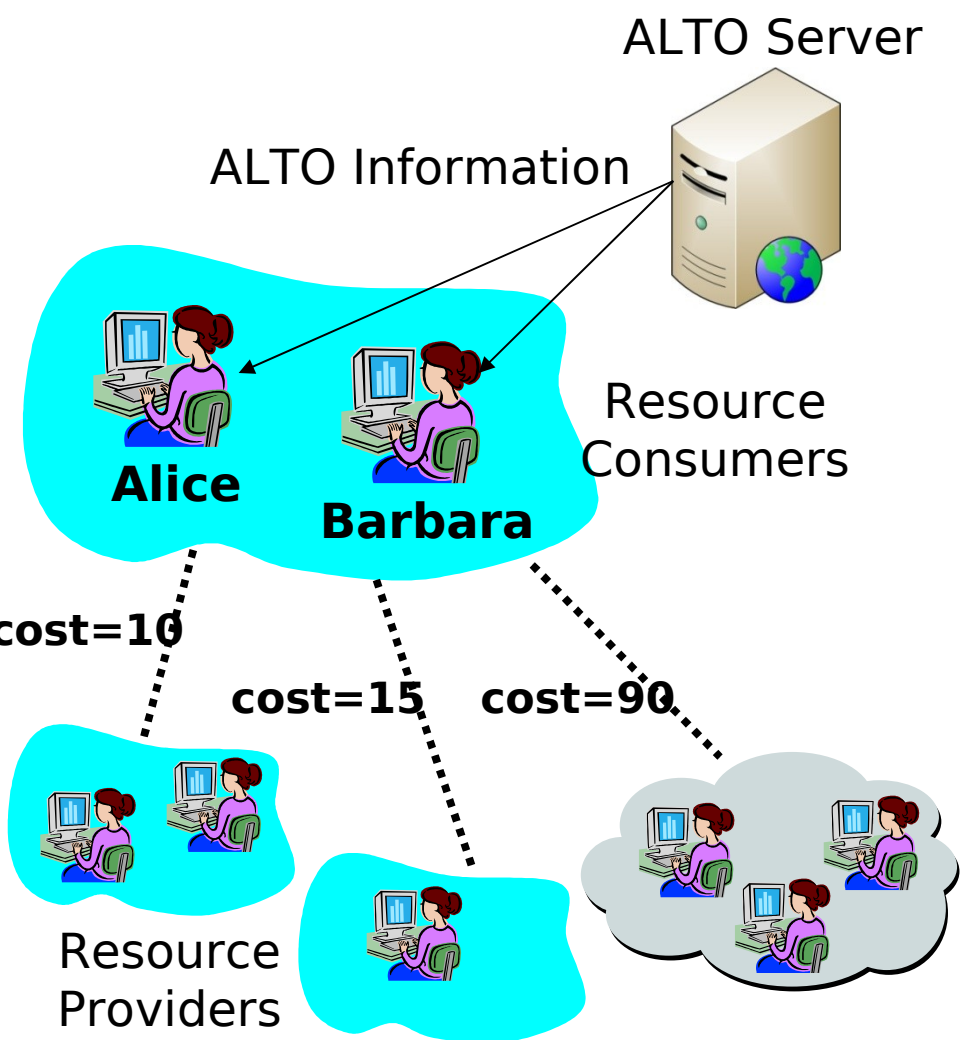
- Network Locations may indicate *set* of locations
  - Coarse-grained proximity
  - Scalability and Privacy

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ALTO Protocol Scope

- ALTO Protocol defines communication between ALTO Client and ALTO Server

ALTO Client

ALTO Server

ALTO Protocol

ALTO Service Discovery

Routing Protocols

Provisioning Policy

Dynamic Network Info

...

ALTO Service Model

- ALTO Server provides ALTO Information to ALTO Clients
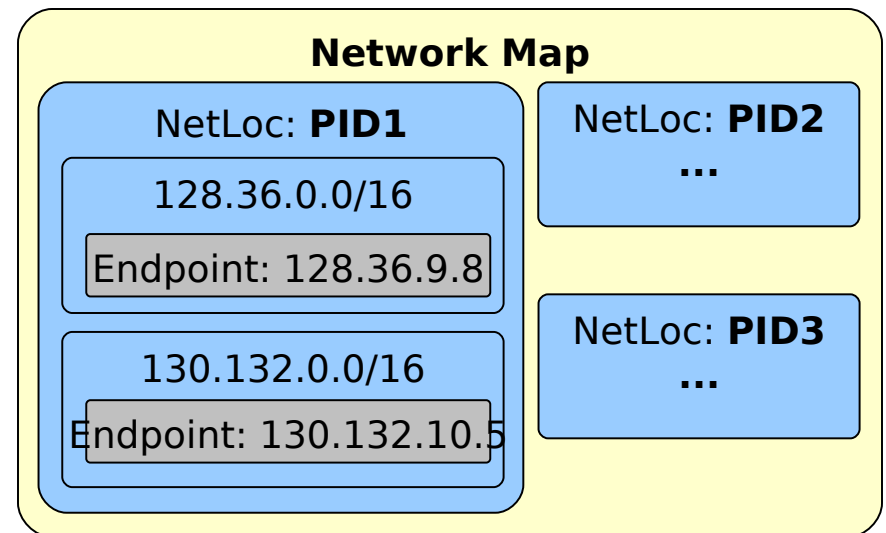 - Indicates preferences amongst Resource Consumers and Resource Providers

ALTO Client
(P2P Client)

ALTO Server

ALTO Client
(P2P Tracker)

Resource Consumers and Providers
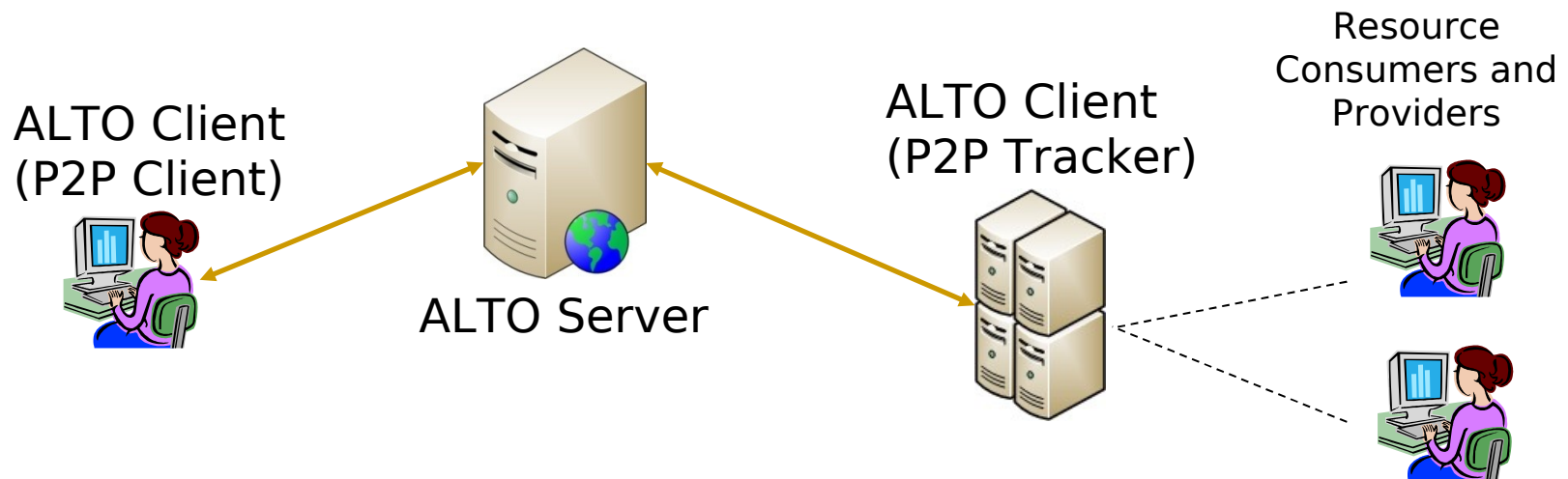
ALTO Query Types

- Generic and extensible query framework
- Four types of queries
  - ALTO capability query
  - Endpoint property lookup service
    - [IP, property] -> value
    - Property can be, e.g., Location definition, Connectivity type (e.g., ADSL, 512Kup/2Mdown), Usage (e.g., client usage cap; current usage), Devices (e.g., caches/Gateway)
  - Network property reverse mapping service
    - E.g., Location -> list of IP prefixes in a location
  - Path property service
    - E.g., inter-location path cost/distance

ALTO Protocol Design

- Focus on
  - Network Map: an endpoint property

  - Path Rating: a path property to indicate preference of communication patterns

Network Map

- Grouping indicated by an endpoint property
  - Set of groupings is called *Network Map*
- PID: identifier for a group
  - Network-agnostic
    - Subnet, set of subnets, metro area, PoP, AS, etc
  - Indicates coarse-grained proximity
  - Scalability and privacy

Network Map

NetLoc: **PID1**

128.36.0.0/16

Endpoint: 128.36.9.8

130.132.0.0/16

Endpoint: 130.132.10.5

NetLoc: **PID2**
...

NetLoc: **PID3**
...

Network Map Queries

Endpoint PID Query: Lookup PIDs for set of endpoints

Input
Set of endpoints

Output
PID for each endpoint

Reverse Network Map Query: Find set of Endpoints

Input
Set of PIDs

Output
Set of Endpoints within each PID

Path Rating

- Property indicating rating of path between network locations (endpoints or PIDs)

- Rating is conveyed by Path Costs
  - Type: What the cost represents
    - Air miles, hop count, routing cost, etc
  - Mode: Interpretation of the cost
    - Numerical or ordinal (ranking)

Path Rating Query

Path Rating Query: Lookup costs among network

Input
Cost type and mode
List of source network locations
List of destination network locations
Constraints (optional)

Output
Cost Map containing costs among
      each source/destination pair

Protocol Message Encoding

- ## Employ HTTP

  - Wide infrastructure support, implementations

  - Authentication/encryption in HTTP and SSL

- ## REST-ful API

  - Simple; HTTP caching

- ## Currently use XML encoding

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Use Case 1: ALTO Client Embedded in App. Tracker

ALTO Server
(alto.isp.net:80)
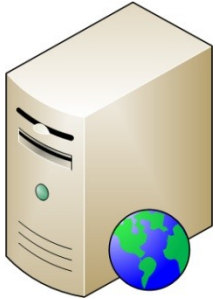
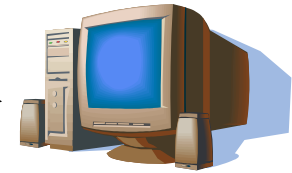**_Retrieve Server Capability_**
GET /capability

ALTO Client
@appTracker

```xml
<?xml version="1.0" encoding="UTF-8"?>
<alto xmlns="urn:ietf:params:xml:ns:p2p:alto">
  <configuration instance-name="alto.isp.net">
    <alto-server uri="http://alto.isp.net:80"/>
    <cost type="latency" units="ms"/>
    <cost type="pDistance" units="scalar"/>
    <constraint-support value="false"/>
  </configuration>
</alto>
```
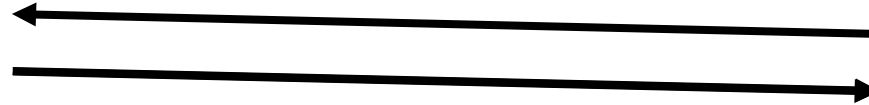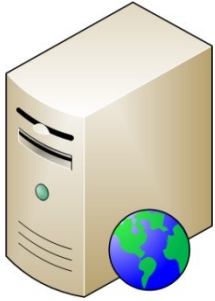
ALTO Server
(alto.isp.net:80)

**ALTO Client
@appTracker**

Retrieve Network Map
```
GET /prop/pid
```

```xml
<?xml version="1.0" encoding="UTF-8"?>
<alto xmlns="urn:ietf:params:xml:ns:p2p:alto">
  <pids size="3">
    <pid name="PID1" size="3">
      <cidr4 name="128.36.1.0/24"/>
      <cidr4 name="132.130.1.0/24"/>
      <cidr4 name="132.130.2.0/24"/>
    </pid>
    <pid name="PID2" size="1">
      <cidr4 name="130.132.3.0/24"/>
    </pid>
    <pid name="PID3" size="1">
      <cidr4 name="0.0.0.0/0"/>
    </pid>
  </pids>
</alto>
```
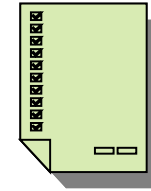
ALTO Server
(alto.isp.net:80)

ALTO Client
@appTracker
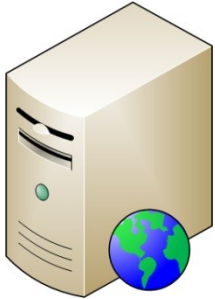
Retrieve Cost Map
`GET /cost/map`

```xml
<?xml version="1.0" encoding="UTF-8"?>
<alto xmlns="urn:ietf:params:xml:ns:p2p:alto">
  <costmap type="routingcost" mode="numerical">
    <row srcpid="PID1" size="2">
        <pid name="PID2" cost="5"/>
        <pid name="PID3" cost="10"/>
    </row>
    <row srcpid="PID2" size="2">
        <pid name="PID1" cost="5"/>
        <pid name="PID3" cost="15/>
    </row>
    <row srcpid="PID3" size="2">
        <pid name="PID1" cost="20"/>
        <pid name="PID2" cost="15"/>
    </row>
  </costmap>
</alto>
```
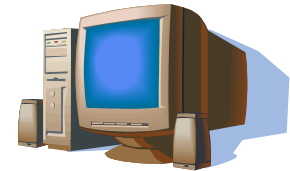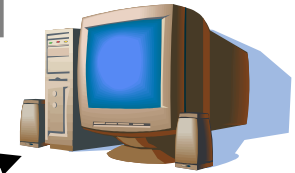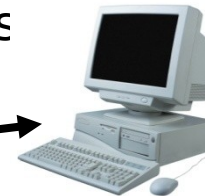
ALTO Server
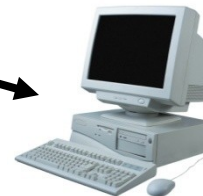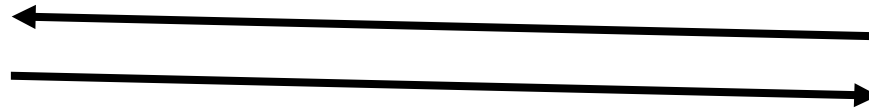(alto.isp.net:80)

**ALTO
Info**

ALTO Client
@appTracker

get peers

selected peer list

Peer 1

Peer 2 ▪ ▪ ▪

Peer 40

Use Case 2: ALTO Client Embedded in a P2P Client

ALTO Server
(alto.isp.net:80)

P2P Client
(in PID1)

Retrieve Server Capability
`GET /capability`

```xml
<?xml version="1.0" encoding="UTF-8"?>
<alto xmlns="urn:ietf:params:xml:ns:p2p:alto">
  <configuration instance-name="alto.isp.net">
    <alto-server uri="http://alto.isp.net:80"/>
    <cost type="latency" units="ms"/>
    <cost type="pDistance" units="scalar"/>
    <constraint-support value="false"/>
  </configuration>
</alto>
```
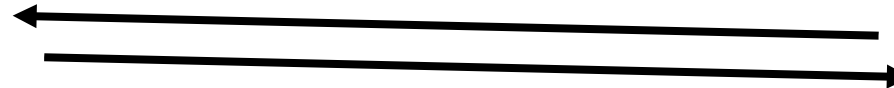
ALTO Server
(alto.isp.net:80)

P2P Client
(in PID1)

Retrieve Network Map
GET /prop/pid

```xml
<?xml version="1.0" encoding="UTF-8"?>
<alto xmlns="urn:ietf:params:xml:ns:p2p:alto">
  <pids size="3">
    <pid name="PID1" size="3">
      <cidr4 name="128.36.1.0/24"/>
      <cidr4 name="132.130.1.0/24"/>
      <cidr4 name="132.130.2.0/24"/>
    </pid>
    <pid name="PID2" size="1">
      <cidr4 name="130.132.3.0/24"/>
    </pid>
    <pid name="PID3" size="1">
      <cidr4 name="0.0.0.0/0"/>
    </pid>
  </pids>
</alto>
```

ALTO Server
(alto.isp.net:80)

P2P Client
(in PID1)

Retrieve Cost Map
```
GET /cost/row?srcpid=PID1
```

```xml
<?xml version="1.0" encoding="UTF-8"?>
<alto xmlns="urn:ietf:params:xml:ns:p2p:alto">
  <costmap type="routingcost" mode="numerical">
    <row srcpid="PID1" size="2">
        <pid name="PID2" cost="5"/>
        <pid name="PID3" cost="10"/>
    </row>
  </costmap>
</alto>
```
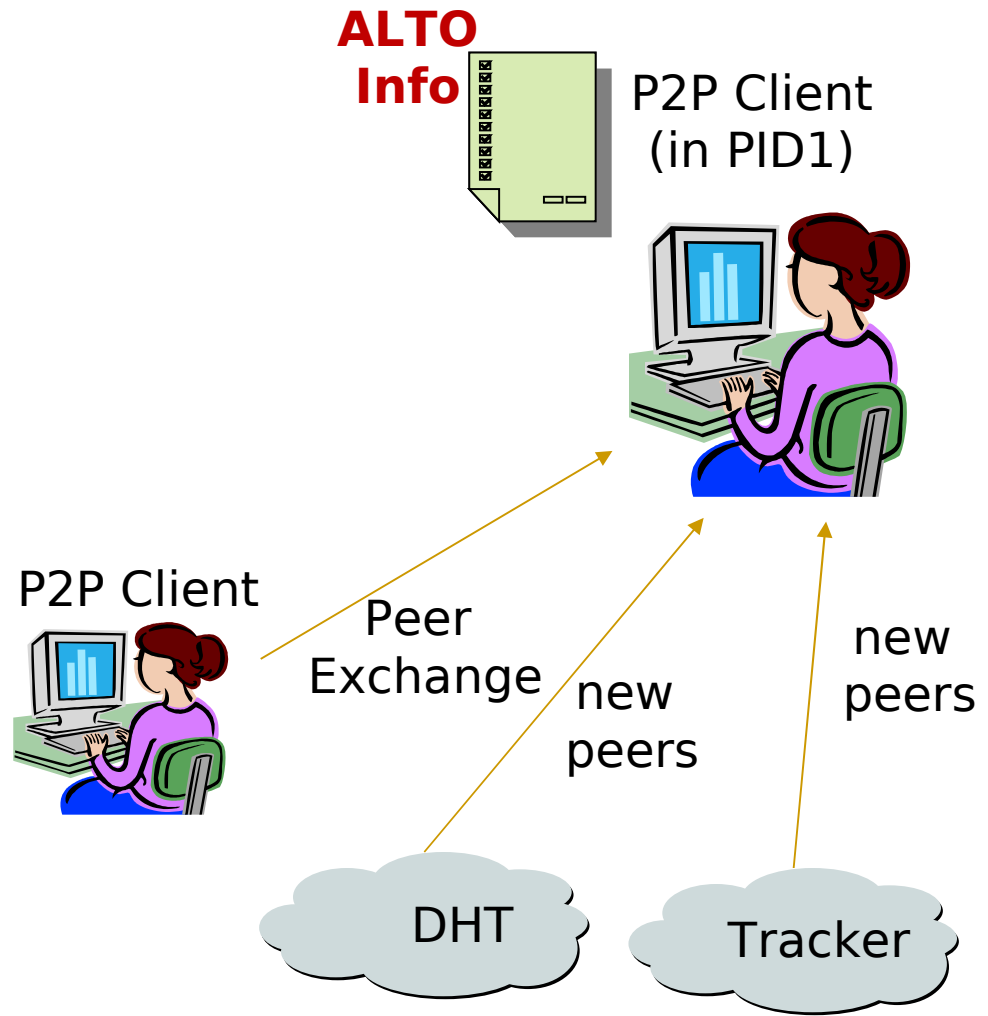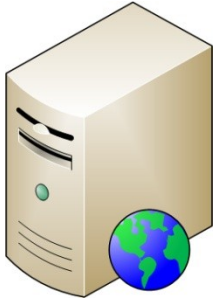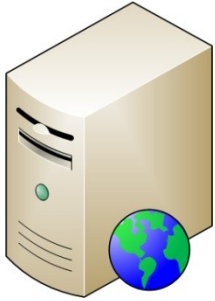
ALTO Server
(alto.isp.net:80)

ALTO Info

P2P Client
(in PID1)

P2P Client

Peer Exchange

new peers

new peers

DHT

Tracker

Use Case 3: ALTO Client Embedded at a P2P Client using Ranking

ALTO Server
(alto.isp.net:80)

P2P Client
(in PID1)

Retrieve Server Capability

`GET /capability`

```xml
<?xml version="1.0" encoding="UTF-8"?>
<alto xmlns="urn:ietf:params:xml:ns:p2p:alto">
  <configuration instance-name="alto.isp.net">
    <alto-server uri="http://alto.isp.net:80"/>
    <cost type="latency" units="ms"/>
    <cost type="pDistance" units="scalar"/>
    <constraint-support value="false"/>
  </configuration>
</alto>
```
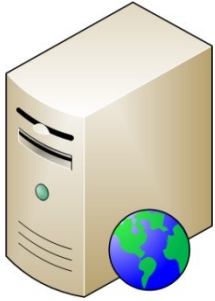
ALTO Server
(alto.isp.net:80)

Request Ranking
```
POST /cost/m?mode=ordinal HTTP/1.1
...(contains src & dest addresses)
```

P2P Client
(in PID1)

```xml
<?xml version="1.0" encoding="UTF-8"?>
<alto xmlns="urn:ietf:params:xml:ns:p2p:alto">
  <costmap type="routingcost" mode="ordinal">
    <row srcendp="ipv4:128.36.22.1" size="3">
      <endpoint name="ipv4:130.132.33.4" cost="1"/>
      <endpoint name="ipv4:128.30.24.89" cost="2"/>
      <endpoint name="ipv4:12.32.67.3" cost="3"/>
    </row>
  </costmap>
</alto>
```

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Next Steps

- Adoption as WG document
- Discussions on possible extensions

Extensions

- ALTO Info Caching / Redistribution
  - Mechanisms
    - ALTO Info served by existing HTTP caches
    - ALTO Clients redistribute amongst themselves
  - Improves scalability
    - Example: millions of viewers beginning to watch the same live streaming event
- Hierarchical Groupings (PIDs)
  - Allow hierarchy of PIDs (Group IDs) for finer accuracy when desired

Extensions

LTO Client feedback
- Allow clients to feed back information to ALTO Service
  - Improve ALTO info
  - Examples: ATTP, Query/Response

Thank you!