On The Change Rate of Identifier (ID)-to-locator Mappings in Networks with ID/Locator Separation

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Outline

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3. Analytical Approach
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1. Motivation

1.1 Identifier/Locator separation

i) The current Internet faces serious scaling issues caused by factors including multi-homing, traffic engineering.

ii) Identifier /Locator (ID/Loc) separation is attracting increasing attention in recent years, because it helps addressing the routing scaling issues.

iii) In ID/Loc Separation, identifiers are used in the application and transport layers for identifying nodes, and locators are used in the network layer for locating nodes in the network topology.

---Benefits: efficient multi-homing and mobility support
1. Motivation (Cont.)

1.1 Identifier/Locator separation (cont.)

iv) Two classes of approaches implementing ID/Loc separation
   a) Separate at end hosts;
   b) Separate at routers (typically at border routers)
   v) We consider the latter case, due to the possible benefits on network security[1].

1. Motivation (Cont.)

1.2 Network model

(1) and (6)  

(4)  

ID_{CN}  ID_{MN}  data  

Loc_1  Loc_2  ID_{CN}  ID_{MN}  data  

Mapping table at TR1

<table>
<thead>
<tr>
<th>ID</th>
<th>Loc</th>
<th>TTL</th>
</tr>
</thead>
<tbody>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>ID_{MN}</td>
<td>Loc_3</td>
<td>t_1</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

Mapping table at TR3

<table>
<thead>
<tr>
<th>ID</th>
<th>Loc</th>
<th>TTL</th>
</tr>
</thead>
<tbody>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>ID_{CN}</td>
<td>Loc_1</td>
<td>t_1</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
i) When a mobile node changes its attaching TR, its ID-to-locator mapping changes accordingly.

ii) In addition, when the mapping changes, we need to update the mapping for the MN stored at the CN’s ITR and the mapping service.
1. Motivation (Cont.)

1.3 Problem Statement (cont.)

V) usage: if we know these results, we may estimate the average number of mapping updates that a mapping server needs to process. This in turn facilitates our design of a better mapping service.

iii) If not update, it means triangular routing.

iv) The problem: how fast do ID-to-Loc mappings change?
2. Data Collection

traces of 536 taxis at San Francisco (24 days per taxi)

traces of 2,348 buses at Shanghai (5 days per bus)

several tens of pedestrians at five different sites (one day)

Each taxi/bus carries a GPS that records its location every 1 second

Each pedestrian carries a GPS that records its location every 30 seconds
2. Data Collection (Cont.)

The trace of a taxi

‘random’ in the sense that its routes are not fixed;
Large movement area.

The trace of a bus

The route is ‘fixed’, except in some special cases (e.g., gas station);
Relatively smaller movement area.
2. Data Collection (Cont.)

The trace of a pedestrian
3. Analytical Approach

1) We map the traces into a two-dimensional area since the GPS receivers produce three-dimensional positions.
2) We place each trace into a rectangular topology defined by the farthest east, the farthest north, the farthest west, and the farthest south of the trace.

3) We then divide the rectangular topology into a set of squares, each of which has an area of $S \ km^2$.

4) Every square or a small rectangle corresponds to a subnet.
5) When a mobile user moves from one subnet into another one, we think that a handover happens.

6) We compute the interval of two consecutive records as the interval of consecutive handovers.
4. Results

Cumulative distribution function (CDF) of handover intervals of taxis
4. Results (cont.)

Cumulative distribution function (CDF) of handover intervals of buses
4. Results (cont.)

Cumulative distribution function (CDF) of handover intervals of pedestrians
5. Conclusions

1) We have found that, depending on different mobility patterns (by bus, by taxi, or walk), the distributions of the interval of consecutive handovers are different.

2) We have also found that the handover intervals increase with the increase of the area of subnets.

3) We have found that the handover intervals for all mobility patterns span a wide range, which implies that it is unwise to set a common cache timeout for all identifier-to-locator mappings.

4) As an ongoing work, we are trying to approximate the CDF of handover intervals mathematically.
Thanks!