
- Are users predictable in terms of mobility? If so, how predictable are they (we)?
- Mobile device users can be tracked with respect to their mobility patterns, and these patterns tend to be repetitive.
- Can we actually predict the location where the user will go next, based on the mobility pattern history?

- Visualization of such data sets helps to
  - Display the dynamics of users in its geographical context
  - Visually verify the discovered trends in the user behavior
  - Show-case various concepts

Reconstruction rank (k)

<table>
<thead>
<tr>
<th>Power captured in Target percentage of power captured</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.70</td>
</tr>
</tbody>
</table>

Summary vectors

\[
\text{Sim}(U, V) = \sum_{w,w} w_u w_v |u - v|
\]

- Reduce the computation overhead to calculate the similarity of users based on their “eigen-behavior vectors”

• (STEP3) Hierarchical clustering is used to classify users into hundreds of groups with distinct mobility trends

Significance score of top eigen-behavior for

<table>
<thead>
<tr>
<th></th>
<th>USC</th>
<th>Dartmouth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Its own group</td>
<td>0.779</td>
<td>0.727</td>
</tr>
<tr>
<td>Other groups</td>
<td>0.005</td>
<td>0.004</td>
</tr>
</tbody>
</table>


- A new communication paradigm in which the receivers are identified by their behavioral patterns, not the network IDs.

- (STEP1) Each user represents its mobility preference and summarizes.
- (STEP2) The sender specifies the “target profile (TP)”. Message follows nodes with increasing similarity to the TP.
- (STEP3) A group-spread phase follows after the message reaches a node that is highly similar to TP.

5. Application: Gender-Based grouping of WLAN users [6]

- A method to classify users into gender based groups for mobile student communities.

- People associating to AP in fraternity and sorority are classified into male and female after removing visitors using statistical methods [6]

- The visualization framework enables us to display these users to show-case their mobility characteristics and also to look at other statistical data like manufacturer preference combined with gender information and mobility in a meaningful way.

- In the TRACE framework we seek solid understanding of user behaviors based on empirical traces first, and then propose applications – bottom-up approach.

- The returned entries from the database are parsed into KML format for Google Earth display.


- How can we distinguish users with different behaviors from their activities logged in the WLAN trace?
- We use “summarized mobility history” as an example

- (STEP1) Each user represents its mobility preference in a matrix form

• Visualization of such data sets helps to
  - Display the dynamics of users in its geographical context
  - Visually verify the discovered trends in the user behavior
  - Show-case various concepts

2. Framework

{\text{STEP1}} 

Query

Trace

Styrofoam

KML

map

PHP

Database

{\text{STEP2}}

forwarding decision

1. profiling

2. Forwarding decision

Probability

Probability

Probability

who visits the library between 2PM-3PM?

Who visits the library between 2PM-5PM?

• Our previous findings indicate that WLAN users are more predictable than on-the-go VoIP users. How true is this?
- By visualization we could estimate how close or far off our prediction really is.

7. Future Application: Regular and irregular appearances

- Regular appearance can help in deciding the messenger nodes in terms of probability to deliver data bundles.

- Analyze the regular/irregular encounter patterns of the potential messenger nodes with the destination nodes.

- Only the nodes with regular encounters are candidates with calculated probability.


- Ability to trace users, gives us an opportunity to understand human behavior, however it also leads to the challenging question about user’s privacy.

- We want to apply/modify traditional techniques of data anonymization and see how they hold up in the mobile world.


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