Introduction
- Service composition: Process of combining two or more services or functionalities
- Opportunistic networks: Communication through opportunistic contacts

Can we efficiently perform service composition in opportunistic networks?

Objective
Develop a framework to facilitate service composition in opportunistic networks.

Background
Service composition is achieved through service graphs (SG).
- Edges: Services | Vertices: I/OParams
- SG has two levels
  - Semantic SG = <Sem I/O, ServiceInfo>
  - Syntactic SG = <Syn I/O, ServiceInfo>
  - Sem I/O → high level I/O description
  - Syn I/O → low level I/O description

Components:
- Service composition handler: Singleton object to maintain state of application
- Concurrent task performers: Threads to perform request invocation, response dispatch, service graph collection, Ack dispatch and message forwarding
- Helpers: Modules providing the infrastructure for network I/O and file I/O. As of now, only Bluetooth is supported

Protocol:
All communication happens in two parts;
- Control Message: Responsible for priming the recipient for upcoming interaction between mobile devices and its format is as follows.
  - Control message code
  - Request ID
  - Bluetooth Source Address
  - Bluetooth Destination Address
  - Size of incoming file
  - List of service objects
  - Request TimedOut
  - Max Number of hops
- Payload: File containing the data, if required by the recipient for completing the interaction between mobile devices

Implementation

Test Setup

<table>
<thead>
<tr>
<th>Mobile Device #</th>
<th>Translation Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile Device 1</td>
<td>Spanish to German</td>
</tr>
<tr>
<td>Mobile Device 2</td>
<td>German to Italian, Finnish to French</td>
</tr>
<tr>
<td>Mobile Device 3</td>
<td>Italian to Finnish, French to English</td>
</tr>
</tbody>
</table>

Results

<table>
<thead>
<tr>
<th>Time limit = 120 s</th>
<th># of words = 110</th>
</tr>
</thead>
<tbody>
<tr>
<td>Services</td>
<td>Levels</td>
</tr>
<tr>
<td>Spanish to German</td>
<td>1</td>
</tr>
<tr>
<td>Spanish to Italian</td>
<td>2</td>
</tr>
<tr>
<td>Italian to English</td>
<td>3</td>
</tr>
<tr>
<td>German to English</td>
<td>4</td>
</tr>
<tr>
<td>Spanish to English</td>
<td>5</td>
</tr>
</tbody>
</table>

Future Work
- Network I/O module helper can be extended to include Bluetooth Low Energy protocol and Wi-Fi P2P protocol
- An additional helper module may be implemented to determine routing based on mobility patterns of the devices
- Service compositions can be filtered based on parameters like; cost, delay, etc
- Module to support service incentives may also be implemented

Conclusion
Resolution time for composed service requests are subject to the interaction of mobile devices and size of the payload.

The framework is generic and can be adopted for any kind of service composition in opportunistic networks.

References