Network Awareness and Failure Resilience in Self-Organising Overlay Networks

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Presented by Chi-Hong Chao
Outline

- Introduction
- Network awareness and load balancing
- Resilience to failure
- Performance evaluation
- Conclusion and Discussion
Introduction

- Connections in the overlay should reflect the underlying network topology.
- Connectivity among active nodes of the overlay should be maintained.
- The cost of using the overlay should be spread evenly among peer nodes.
Each node only maintain a list of addresses of its neighbor

The mean degree of a node is $c \log(N)$
Introduction-Scamp

1. Join request sent at random
2. Join request forwarded
3. Edge created with prob. $P = \frac{1}{\text{sizeof view}}$, forwarded at random otherwise
Introduction - Scamp

But!!

- Scamp is oblivious to the underlying network topology
- The degree of individual nodes are not tightly constrained
Network awareness algorithm

- **Localiser**

\[
E(G) = w \sum_{i \in \mathcal{V}(G)} d_i^2 + \sum_{(i,j) \in \mathcal{E}(G)} c(i, j)
\]
Network awareness algorithm

- **Localiser**
  - Node i performs the following steps periodically
    - 1. measure $c(i,j) \ c(i,k)$
    - 2. request $j,k$ for $d(j),d(k)$, and get $c(j,k)$
    - 3. $\Delta E = 2w(d_k - d_i + 1) + c(j,k) - c(i,j)$
    - 4. determined if we should change the connection
Localiser

(a) → (b) → (c)
Resilience to failure

- If a node leave the system voluntarily, it will send a leave message to the system
- Lease mechanism
Performance evaluation

- Environment
  - 50000 nodes
  - Distance is measured by delays

- three metrics
  - Degree balancing mechanism
  - Network awareness
  - Resilience to failure
**Performance evaluation**

- **Degree balancing mechanism**

<table>
<thead>
<tr>
<th>$$(W, T, NbIt)$$</th>
<th>$$(0,0,0)$$</th>
<th>$$(10,1,100)$$</th>
<th>$$(10,1,1000)$$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max degree</td>
<td>63</td>
<td>23</td>
<td>21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$$(10,1,50000)$$</th>
<th>$$(50,1,100)$$</th>
<th>$$(50,1,10000)$$</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>20</td>
<td>20</td>
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</tbody>
</table>
Performance evaluation

Degree balancing mechanism

![Graph showing the relationship between number of nodes and number of neighbors. The mean value is 19.39. The graph includes data points for different values: (0,0), (10,1,100), (10,1,1000), (50,1,100), and (50,1,1000).]
### Performance evaluation

**Network awareness**

<table>
<thead>
<tr>
<th>(W, T, NbIt)</th>
<th>(0,0,0)</th>
<th>(10,1,100)</th>
<th>(10,1,1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean distance</td>
<td>266</td>
<td>225</td>
<td>141</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>250</td>
<td>208</td>
<td>124</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(10,1,5000)</th>
<th>(50,1,100)</th>
<th>(50,1,1000)</th>
<th>(50, 1, 5000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>66</td>
<td>253</td>
<td>224</td>
<td>215</td>
</tr>
<tr>
<td>51</td>
<td>237</td>
<td>207</td>
<td>199</td>
</tr>
</tbody>
</table>
Performance evaluation

- Resilience to failure
Conclusion and Discussion

- 3 purpose
  - Degree balance
  - Network awareness
  - Resilience to failure
- Potential problem
  - overhead