ECE 697J – Advanced Topics in Computer Networks

Packet Processing Algorithms and Data Structures
9/23/03
### Routing Recap

- **Example routing tree:**

<table>
<thead>
<tr>
<th>string</th>
<th>prefix</th>
<th>node</th>
</tr>
</thead>
<tbody>
<tr>
<td>01011</td>
<td>0</td>
<td>a</td>
</tr>
<tr>
<td>10000</td>
<td>10000</td>
<td>b</td>
</tr>
<tr>
<td>10001</td>
<td>10001</td>
<td>c</td>
</tr>
<tr>
<td>10101</td>
<td>101</td>
<td>d</td>
</tr>
<tr>
<td>11001</td>
<td>1100</td>
<td>e</td>
</tr>
<tr>
<td>11010</td>
<td>11010</td>
<td>f</td>
</tr>
<tr>
<td>11011</td>
<td>11011</td>
<td>g</td>
</tr>
<tr>
<td>11101</td>
<td>111</td>
<td>h</td>
</tr>
</tbody>
</table>

![Routing Tree Diagram](image)
Routing Exercise

- Draw tree for the following prefixes:
  - A: 0010*
  - B: 010*
  - C: 0101*
  - D: 0*
  - E: 10*
  - F: 1011*
  - G: 100*

- Which prefixes match the following lookups?
  - 01
  - 101
  - 0001
  - 1
Overview

• IP lookup paper
• Packet processing algorithms and data structures
  – Bridge algorithm
  – Hashing
  – TCP recognition
  – TCP splicing
• Protocol processing software
  – Interrupts
  – Threads
Bridge Algorithm

• Purpose: forwards frames only on necessary segments
• Algorithm:
  
  Do forever {
   acquire frame
   set I to interface on which frame arrived
   extract source S and destination D
   add (S,I) to list L
   if (D,I) is in L {
     drop frame
   } else {
     forward frame on all interfaces but I
   }
  }

• Is this the best possible bridging algorithm?
Table Lookup and Hashing

• Hash Table:
  – Compute function of “key” to determine table location
  – Check if slot is empty or holds another item
  – Could cause collisions – how can they be resolved?

• Hash function:
  – Many functions possible
  – Comer: double hashing

• Double hashing:
  – Compute \( Q := (P_1 \times K) \mod N \), \( R := (P_2 \times K) \mod N \)
  – Use slot \( Q \)
  – If collision, then search with \( Q := (Q + R) \mod N \) until slot found
Next Class

• Software-based router architectures
  – Read chapter 7
• Router design paper
  – Read paper