A FIB for DTN?

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Introduction

- A high level walk-through of a DTN FIB design.
- Asking questions of the community:
  - “Have we considered X?”
- Triggering productive discussion around a common set of terms and architectures.
- Is this worthwhile work for the WG?
Disclaimer

- I expect you know all this already.
- I have probably missed something important.
- Keith Scott covered a lot of this in 2008! [1]
Forwarding Information Base

- The minimum information required by a forwarding agent to pass a bundle to the next agent along a route to the bundle endpoint.
Forwarding?

- Passing bundles received externally or from local processes to the next hop along a route.
- Just one-hop, not end-to-end routing.
- Bundles are passed via convergence layers.
- Filtering happens before forwarding.
Information Base?

- The set of information to be stored.
- A conceptual model, not an implementation design.
- Commonly described as a table:

<table>
<thead>
<tr>
<th>Destination EIDs like X</th>
<th>Do Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destination EIDs like R</td>
<td>Do S</td>
</tr>
</tbody>
</table>
Who uses the FIB?

• The forwarding agent consults the FIB to move bundles.
• Convergence layers update the FIB as neighbours are discovered.
• Routing protocol instances update the FIB as routes are discovered.
Conceptual Architecture

Destination: dtn://somewhere_over_the_rainbow
Payload: ...bytes...

Forwarding Agent

FIB

TCP CL

TCP CL Neighbours

Transit Queue

Other CL
So what goes in the FIB?

- **‘Match expression’** for the bundle destination endpoint identifier

<table>
<thead>
<tr>
<th>Destination EIDs like $X$</th>
<th>Do $Y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destination EIDs like $R$</td>
<td>Do $S$</td>
</tr>
</tbody>
</table>
Match expression?

• In IP networks this an Address/Prefix pair:
  • Longest match wins.
  • This keeps the FIB compact.
  
  But:
  • DTN has no concept of address aggregation (subnets)!

• DTN2 uses a regular expression (glob):
  • Flexible, if basic.
  
  But:
  • Requires a pre-agreed endpoint id syntax!
Handling complex endpoint ids

• Perhaps separating name resolution from forwarding is the answer?
  • A ‘name server’ that resolves endpoints into numeric node ids.
    • I don’t mean DNS.
  • Transform endpoint id handling into an ‘address book’ management process/protocol that populates the FIB.
• Such a service need not be on every forwarding agent.
  • Good for constrained devices
Forwarding action parameters

- Definitely need the convergence layer adaptor identifier.
- Do we need to include a ‘via’ endpoint identifier?

<table>
<thead>
<tr>
<th>EIDs like X</th>
<th>Give to CLA: 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>EIDs like R</td>
<td>Give to CLA: 2</td>
</tr>
</tbody>
</table>

Or:

<table>
<thead>
<tr>
<th>EIDs like X</th>
<th>Give to CLA: 1</th>
<th>Send Via Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>EIDs like R</td>
<td>Give to CLA: 2</td>
<td>Send Via S</td>
</tr>
</tbody>
</table>
The answer is ‘Yes’ and ‘No’!

- Convergence layers perform neighbour discovery, and if the bundle destination endpoint is a neighbour, then ‘No’.
- Otherwise some external routing protocol will have learnt a route and populated the FIB with the endpoint id of the next hop along the route, so ‘Yes’.

- Is ‘Via’ a node id, or can it be a generic endpoint id?
  - Recursive lookup?
No match?

- What happens if a matching entry is not found?
  - Added to the transit queue.
  - When the FIB is updated:
    - Contents of transit queue are rechecked against the FIB.

- Is there such a thing as a ‘default route’?
Other issues

• I suggest that ‘blackhole’ or ‘prohibit’ entries have no place in the FIB.
  • The same functionality can be provided by bundle filtering prior to forwarding.
    • That is not to say that routing protocols shouldn’t share them.

• ‘Multicast’ endpoints:
  • I have no idea!

• Breaking ties?

• Source-based forwarding?
  • Builds on a simpler FIB
Why is this useful?

• It may provide a set of minimal requirements for:
  • Higher-level functions such as routing.
  • Convergence-layer adaptors.
• Defining a FIB may highlight gaps in the current architecture.
Questions?