Creating an IP Router for Space to Ground Communications

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Ground System Complexity

- Racks of equipment
- Proprietary and custom data formats
- Integration of many systems just for communications
- Long development/test time
The Space Router
<table>
<thead>
<tr>
<th>CCSDS Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>702.1-B-1</td>
<td>IP Over CCSDS Space Links</td>
</tr>
<tr>
<td>131.0-B-2</td>
<td>TM Synchronization and Channel Coding</td>
</tr>
<tr>
<td>732.0-B-2</td>
<td>AOS Space Data Link Protocol</td>
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<tr>
<td>231.0-B-2</td>
<td>TC Synchronization and Channel Coding</td>
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</tbody>
</table>
Packets from Ground

Incoming packets from Ground

Regular NIC

Linux router NAT
This packet is going to the space segment!

driver and user space app
Format into CCSDS packets
Send to Modem for transmit to satellite

Space NIC
Some Considerations...

• Encryption
• Packet Loss
  – Forward Error Correction
  – TCP/IP vs UDP vs Other
• TCP/IP Congestion Avoidance
• Nagle Algorithm
• Delayed Acks
Benefits

- Ease of integration
- Fast development time
- Ease of test
- Ease of update
- Availability of resources