Internetwork Protocol Approaches

Jonathan B. Postel

Presented by–

Virajith Jalaparti
Interconnection of Networks

- Inter-Process
- Gateway
- Open Systems Architecture
- Virtual Circuit – X.25 networks
- Datagram – APRA networks
Datagrams vs Virtual Circuits

Datagrams
- Unreliable
- Simpler
- Complete addressing
- Just send data
- Transaction type of service

Virtual Circuits
- Reliable
- Complicated
- Addressing depends on type of packet
- Setup–send data–connection tear down
- Interactive computer systems
Gateways

Fig. 2. Interconnected networks.

H HOST
G GATEWAY
Fig. 3. Gateway halves.
Types of Gateways

- Based on type of connectivity provided

  - Media Conversion Gateway
    - Connects different link and physical protocols
    - Provides Encapsulation and De-encapsulation
    - Simpler

  - Protocol translation Gateway
    - Network and Transport layers bridged
    - Might require address translation
    - Packet semantics can be entirely changed
### OSI Model

<table>
<thead>
<tr>
<th>Level</th>
<th>Function</th>
</tr>
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<tbody>
<tr>
<td>7</td>
<td>Application</td>
</tr>
<tr>
<td>6</td>
<td>Presentation</td>
</tr>
<tr>
<td>5</td>
<td>Session</td>
</tr>
<tr>
<td>4</td>
<td>Transport</td>
</tr>
<tr>
<td>3</td>
<td>Network</td>
</tr>
<tr>
<td>2</td>
<td>Link</td>
</tr>
<tr>
<td>1</td>
<td>Physical</td>
</tr>
</tbody>
</table>

- Lower layers (1–2) – hop by hop
- Higher layers (5–7) – interconnection of different protocols unlikely
- Layers 3/4
X.25 PDNs

- Data terminal equipment
- Data circuit-terminating eq.
- Signaling terminal eq. (X.75)
X.25 PDNs

Call has 3 phases:
- Setup
  - Large header (20–166 bytes) containing complete src–dst addresses
  - State information stored in various hosts
- Data transfer
  - Simple 3 byte header
- Termination
X.25 PDNs Characteristics

- Addressing: varies–60 bits (max)
- Routing?
- Flow control
  - Different for each virtual circuit
  - STE–STE links
  - Effects?
- Error Control
  - Each portion has its own ack.
  - Unrecoverable failures– RESET or call cleared
- Security
ARPA Inter-Network

- Developed based on TCP/IP
- Datagram based
**ARPA–InterNets Communication**

- IP in all gateways and hosts
- Source→Gateway→….→Gateway→Dest
- TCP used for providing functionality equivalent to virtual circuits
ARPANets Characteristics

- **Addressing**
  - Network–1 Byte, Host–3 Bytes (Fixed?)
  - Protocol identifier and port info also used

- **Routing?**

- **Flow Control**– by TCP

- **Error recovery**– by TCP

- **Security**
  - AUTODIN II
  - TCP checksum: test positive indicates fields have not been corrupted
Congestion Control not identified as a problem/issue.

- In ARPA Internetworks, "Gateways may protect themselves against congestion by dropping messages"