مبואו לרשויות מחשבים
(236334)

Class 12

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Packet fragmentation

Layer 2 of the IP network allows transporting data over various networks, with a wide range of technologies. Ethernet is the most popular, but it is not the only one. Almost every layer 2 protocol has a maximum transfer unit (MTU) constraint on the length of the data field in a frame. The size of this is called MTU, commonly referred to as the maximum transfer unit. For example, the MTU of Ethernet is 1500 bytes.

If a packet arrives at a router and needs to be transmitted on a network with a smaller MTU, the router must fragment the packet into smaller pieces. This process is called fragmentation. The reverse process, called re-assembly, is performed only on the destination computer to save router and switch processing time and memory.

raabah Cohen, The Ark protocol for IPv6, courtesy of the authors.

מרטין שמש

מבוא ל.lesson mutate 34 (236334)
Packet fragmentation

Packet fragmentation is the process of splitting a large packet into smaller, manageable pieces when the maximum transmission unit (MTU) of the network is smaller than the packet size.

For example, consider a packet that is 1420 bytes long, including the header. If the MTU of the network is 620 bytes, the packet needs to be fragmented into three smaller packets.

- The router will create 3 fragments from the original packet:
  - The first fragment will contain 620 bytes (20 + 600 bytes) and will have a fragment offset of 0.
  - The second fragment will contain 620 bytes (20 + 600 bytes) and will have a fragment offset of 600.
  - The third fragment will contain 220 bytes (20 + 200 bytes) and will have a fragment offset of 1200.

It's important to note that packet fragmentation is dynamic, and the router will determine how many fragments are needed based on the MTU of the network.

DF – do not fragment

MF – more fragments

DF and MF are bits in the header of the packet that indicate whether fragmentation should be allowed or not. DF is set to 1 if the fragment is the last fragment of the packet, and MF is set to 1 if there are more fragments to follow.
SubNet Mask

126.56.78.222
### Example

<table>
<thead>
<tr>
<th>Destination IP</th>
<th>Destination Mask</th>
<th>Next hop</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.10.0.0</td>
<td>255.255.0.0</td>
<td>10.10.10.2</td>
</tr>
<tr>
<td>10.10.11.0</td>
<td>255.255.255.0</td>
<td>10.10.11.2</td>
</tr>
<tr>
<td>10.10.12.0</td>
<td>255.255.255.0</td>
<td>10.10.12.2</td>
</tr>
<tr>
<td>10.10.30.0</td>
<td>255.255.255.0</td>
<td>10.10.11.2</td>
</tr>
<tr>
<td>0.0.0.0</td>
<td>0.0.0.0</td>
<td>132.68.24.3</td>
</tr>
</tbody>
</table>

### Diagram

- **Internet**
- **A**
- **B**
- **C**
- **D**
- **E**
- **F**

- 10.10.10.1
- 10.10.10.2
- 10.10.11.0
- 10.10.11.1
- 10.10.11.2
- 10.10.12.0
- 10.10.12.1
- 10.10.12.2
- 10.10.20.0
- 10.10.20.1
- 10.10.20.2
- 10.10.30.0
- 10.10.30.1
- 10.10.30.2
- 10.10.35.0
- 10.10.35.1
- 10.10.40.0
- 10.10.40.1
- 10.10.50.0
- 10.10.50.1
- 10.10.50.2
- 132.68.24.3
- 132.68.24.55

**Note:** The diagram illustrates network topology and addresses.
LONGEST PREFIX

1. Extract destination IP address - DA - from datagram
2. Find in forwarding table the entry with the longest prefix matching DA and forward the packet accordingly
3. The default entry has address 0.0.0.0
4. If no entry was found declare a routing error
Routing Protocol Design Choices

- Centralized ↔ Distributed
- Source-based ↔ hop-by-hop
- Stochastic ↔ deterministic
- Single path ↔ multiple path
- State-dependent ↔ state-independent
- Static ↔ dynamic (dynamic metrics)

What is a good routing scheme?

- Optimal resource utilization
  - minimize routing table space
  - minimize control messages (number, size)
- Robustness
  - Link failure
  - Cost change
- Optimal Paths
  - lowest “cost”
פרוטוקולים ייחודיים באנטונט

RIP – Routing Information Protocol

**distance vector routing**
- עובד בשיטת distance vector בתוכי AS
- טוב לניתוב בתוךitat כל חלקי {-AS
- זמן תכונת אחרי שינוי עלול להיות ארוך جدا, ולהמשיח {-AS
- מוצאת את הניטוב ה"зол ביוור" מ鹧鸪 המקור לשרת יעד

OSPF – Open Shortest Path First

**link state**
- עובד בשיטת link state בתוכי AS
- טוב לניתוב {-AS
- התכונת המהירה לאחרים שינויי תופולוגים
- מוצאת את הניטוב ה"зол ביוור" מ鹧鸪 המקור לשרת יעד

BGP – Boarder Gateway Protocol

**פרוטוקולים לניתוב בין {-AS
- מוצאת את הניטוב ה"מתאים ביוור" מ鹧鸪 המקור לשרת יעד.

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Mob: 052-3343633
Summary: Internet Architecture

- Packet-switched datagram network
- IP is the glue
- Hourglass architecture
  - all hosts and routers run IP
- Stateless architecture
  - no per flow state inside network