Advanced Computer Networking (ACN)

Router Project – Problem 2 Solution

Prof. Dr.-Ing. Georg Carle, Sebastian Gallenmüller

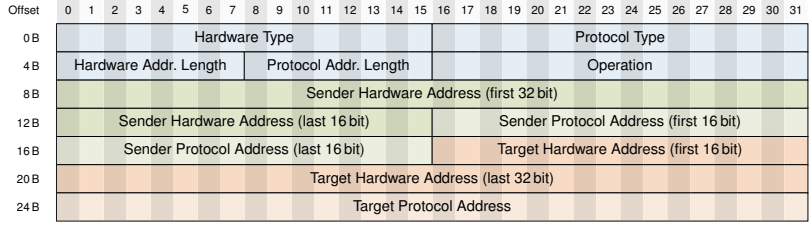
Chair of Network Architectures and Services
School of Computation, Information and Technology
Technical University of Munich

Project — Problem 2: Common Mistakes

Memory Management

- Buffers must be freed to be able to recycle them
- Freeing buffers:
  - `rte_eth_tx_burst()`, automatically frees
  - If a packet is dropped, buffer must be freed manually (`rte_pktmbuf_free()`)
- Common mistakes:
  - Packets were not freed in case of malformed ARP
  - Packets were not freed in case of unknown protocol, e.g., IPv6
  - All packets were freed:
    - Packets were freed twice (after sending and with the additional free)
    - Trying to send already freed packets

Project — Problem 2: Common Mistakes
ARP



ARP header

- All of you recycled the ARP request to create the ARP reply
- Basic operations to perform:
  - Check Ethertype (`0x0806`) of Ethernet frame
  - Check if the ARP request addresses one of the router's own IP addresses
  - Check ARP Operation code (`0x0001`)
  - Other address types/address lengths remain (everyone got that right)
  - Change sender addresses (MAC and IP address of the router)
  - Change target addresses (MAC and IP address of the client)
- ARP request, typically Ethernet broadcast (destination MAC `ff:ff:ff:ff:ff:ff`)
- ARP reply, unicast

Project — Problem 2: Common Mistakes
IPv4

1. Check packet length of link layer (min. 20 bytes)
2. The IP checksum must be correct (software or hardware, but check if it is enabled)
3. The IP version number must be 4
4. The IP header length field must be large enough (min. 20 bytes = 5 words)
5. The IP total length field must be large enough to hold the IP datagram header, whose length is specified in the IP header length field

Project — Problem 2: Common Mistakes
IPv4 TTL

```
ttl -= 1;

if (ttl == 0) free_buffer();
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Problem?

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Problem?

- Packet with `ttl == 0` arrives (should not happen but some routers are designed badly)
- Decrementing 0 → wraparound → packet is sent out
- Packets do not expire and could be routed indefinitely

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IPv4 TTL

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Problem?

- Packet with `ttl == 0` arrives (should not happen but some routers are designed badly)
- Decrementing 0 → wraparound → packet is sent out
- Packets do not expire and could be routed indefinitely

Correct solution: check before decrementing

```
if (ttl <= 1) free_buffer();
ttl -= 1;
```

Project — Problem 2: Common Mistakes
MAC Address Handling

- Router needs to update the destination MAC address with the one returned by the routing table
- Router should also update the source MAC address of the sent frames
- Common mistakes:
  - Only destination MAC address was set, source MAC address was not changed
  - Source MAC address was set to the address of the network port the frame was received (but it should be set to the one of the egress port)
  - You can use the source MAC address of the router's egress port