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Computer Networking and IT Security (INHN0012)

Tutorial 7

Problem 1 Subnetting

TUMexam AG is assigned the address ranges 131.159.32.0/22 and 131.159.36.0/24. The subdivision of those address ranges is left up to TUMexam AG. After a careful analysis the following requirements for the subnets and the minimal number of **usable** IP addresses are determined:

Subnet	NET 1	NET 2	NET 3	NET 4	NET 5
IPs	300	300	15	40	4

The IP address needed in for the router interface is included in those numbers.

a) Write down each first and last IP address of both given address ranges.

b) How many IP addresses does TUMexam AG have available? Can all of them be used to address hosts?

c)* Is it possible to aggregate both blocks of address ranges into one single subnet?

d) Divide both address ranges according to the analysis in order to get subnets with fitting sizes. Use as little IP addresses as possible. A large continuous address range should remain available for future use. For every subnet you should indicate:

- the size of n-th subnet
- the amount of usable addresses
- the subnet in prefix notation
- the subnetmask in dotted-decimal-notation
- the network and broadcast addresses

Subnet	NET 1	NET 2	NET 3
Requirement			
Size			
Usable			
Prefix notation			
Subnetmask			
Network address			
Broadcast			

Subnet	NET 4	NET 5
Requirement		
Size		
Usable		
Prefix notation		
Subnetmask		
Network address		
Broadcast		

Problem 2 Neighbor Discovery Protocol and IP fragmentation with IPv6

Figure 2.1 shows an arrangement of network components with their MAC addresses. PC1 and PC2 are assigned both link-local (LL) and global-unique (GU) addresses by means of SLAAC. For the latter, the prefix `2001:db8:1::/64` (PC1/R1) or `2001:db8:2::/64` (PC2/R2) is used.
PC1 sends an IP packet with 1400 B of data to PC2. The MTU on the WAN link between R1 and R2 is 1280 B[1]. Within the local networks, the MTU is 1500 B, as is typical for Ethernet.

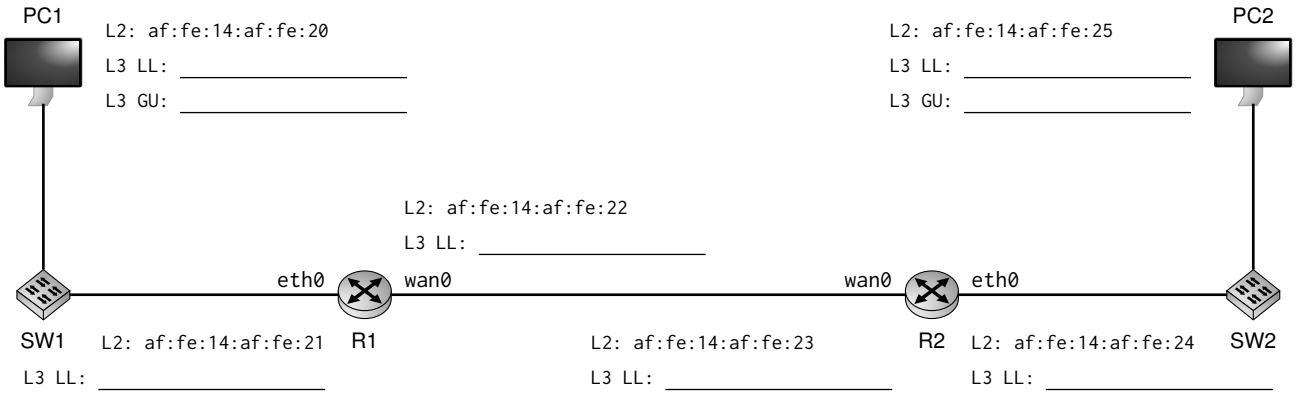


Figure 2.1: Network topology

First, we take a look at the address configuration using SLAAC.

a)* Determine the link-local addresses of all interfaces.

b) Determine the global unique IPv6 addresses of PC1 and PC2. Assume that Router R1 is configured with the prefix `2001:db8:1::/64` and Router R2 is configured with `2001:db8:2::/64`.

c)* At which point in the network does fragmentation happen?

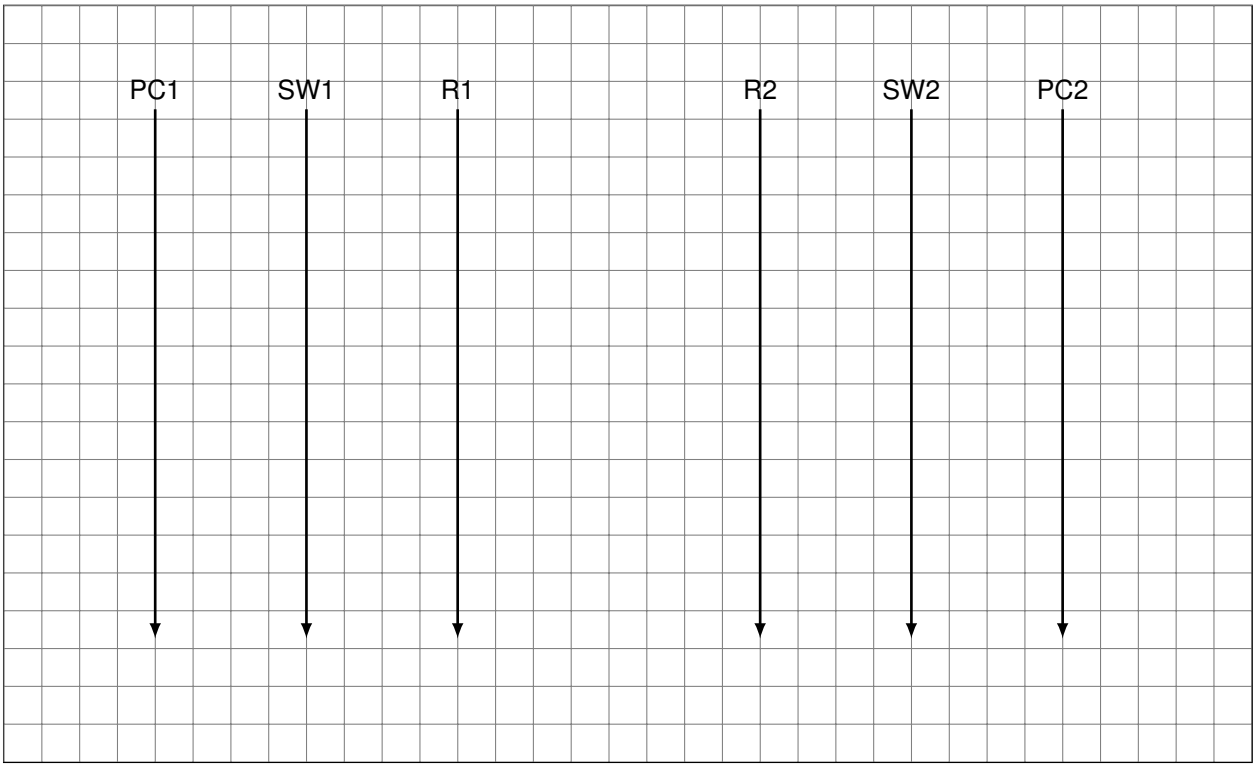
d)* What is the minimum number of fragments the packet must be split into?

e) Determine the size of the L3-SDU for each fragment.

f)* Justify at what point in the network will the fragments be reassembled.

[1] This is the minimum MTU that must be supported by layer 2 according to RFC 2460 for IPv6 support.

g) Sketch a simple path-time diagram that considers **all frames** that need to be transferred on each link. **Name the type of frames replaced and give the frames numbers (1,2,3,...).** (The diagram does not need to be to scale. Serialization times and propagation delays are to be ignored).
Assume that no mappings between IP and MAC addresses are currently cached.
Number each packet by column (column $\triangleq$ range e.g. between R1 and R2).



h) Determine the destination MAC address of the first transmitted frame.

Homework:

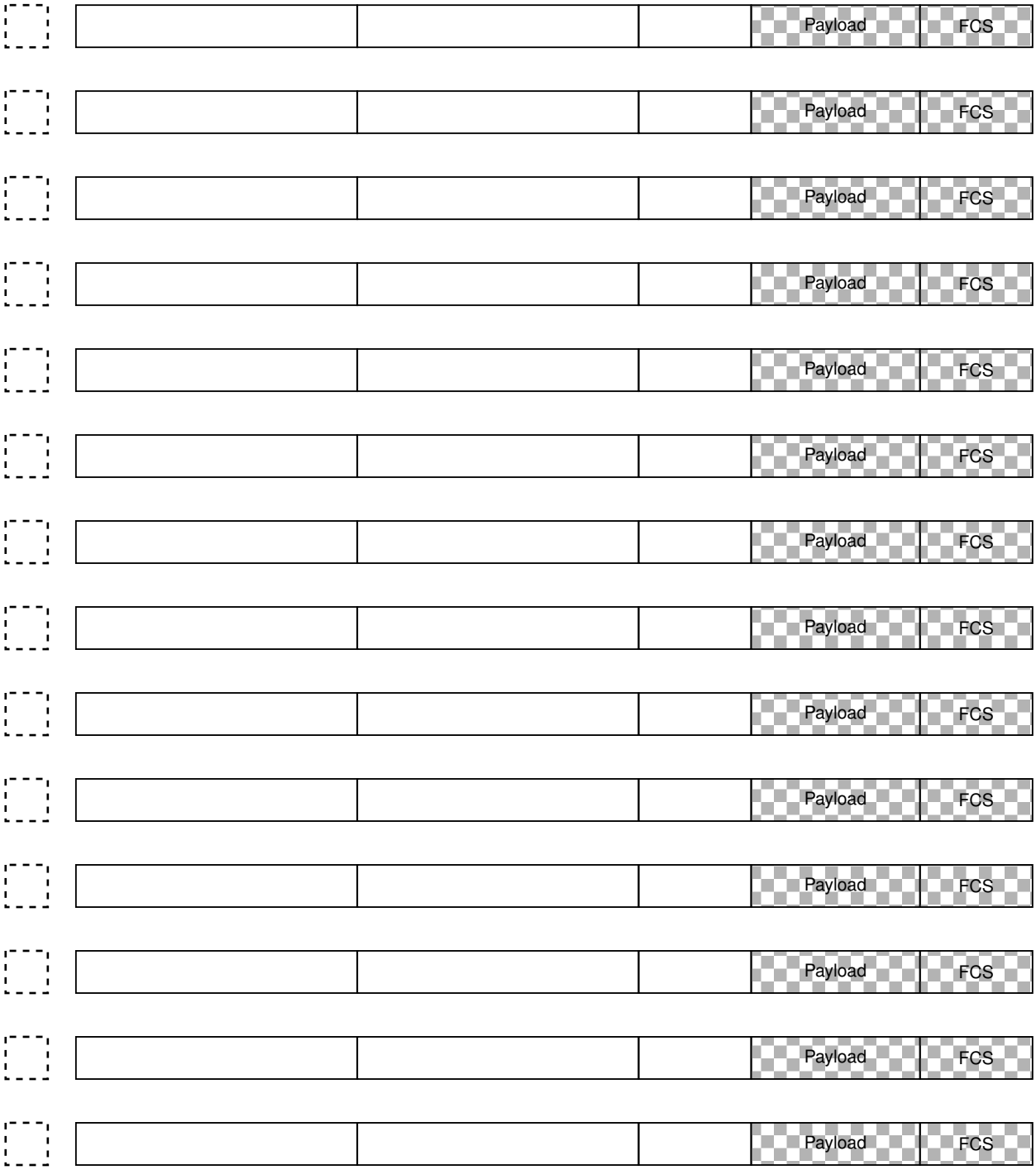
At the end of this exercise sheet you will find preprinted forms for Ethernet header, IPv6 header and ICMPv6/NDP header (more than needed). It is not necessary to fill in the header in binary. Just be sure to clearly mark the number base, e.g. `0x10` for hexadecimal or $63_{(10)}$ for decimal.

i) For each of the first two frames from subtask g), fill in an Ethernet header, an IP header, and the respective payload. Label the dashed box next to each header/packet with the corresponding frame number.
Note: Use the cheatsheet to determine the values (e.g. Next Header). If a value is not clearly determined, make a reasonable choice.

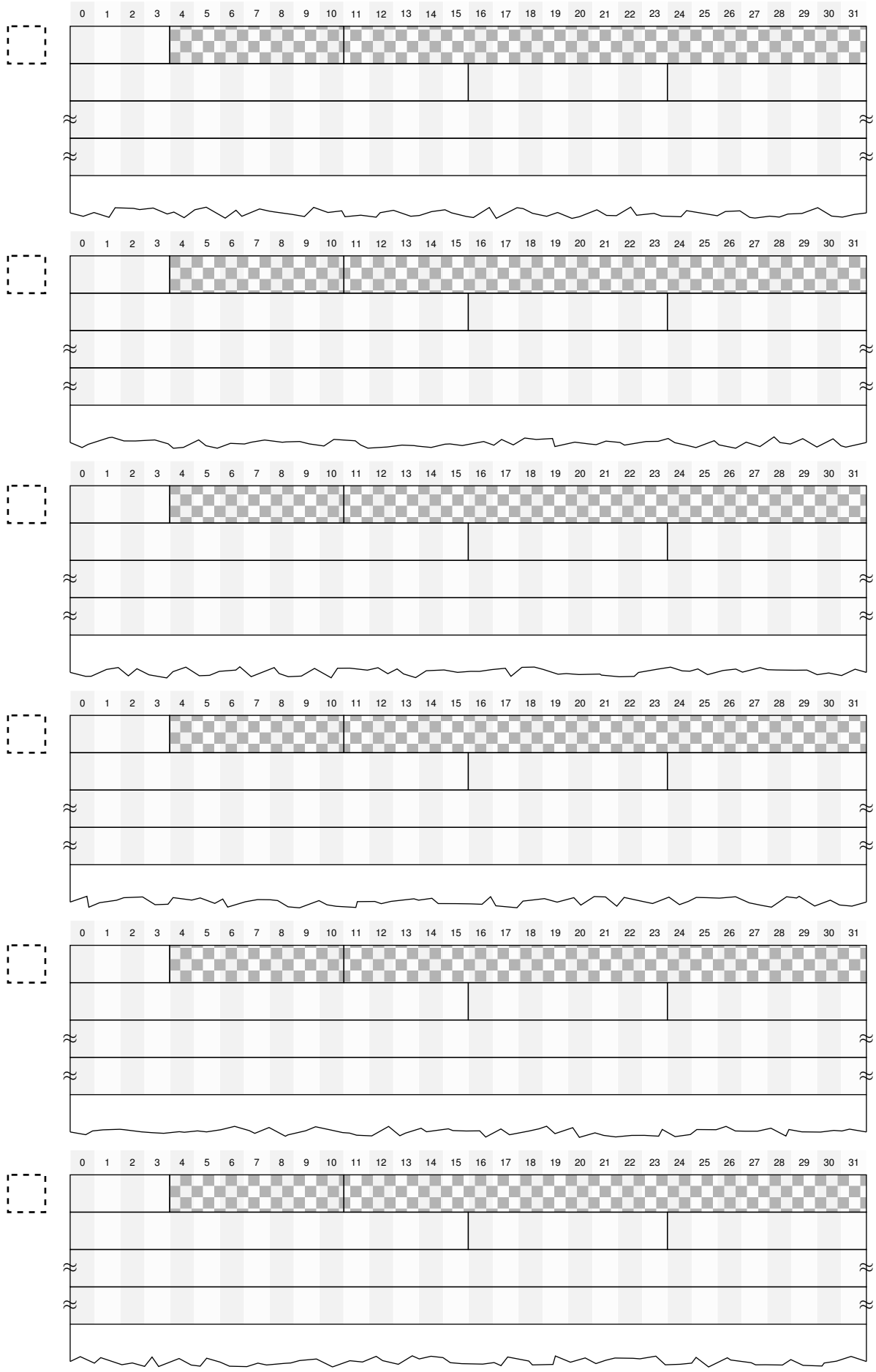
j) For each path segment (e.g. B. between R1 and R2), fill in the respective first fragmented packet, one Ethernet header and one IP header. off. Label the dashed box next to each header/packet with the respective frame number.
Note: Use the cheatsheet to determine the values (e.g. Next header). If a value is not clearly determined, make a sensible choice.

Preprints for protocol headers:

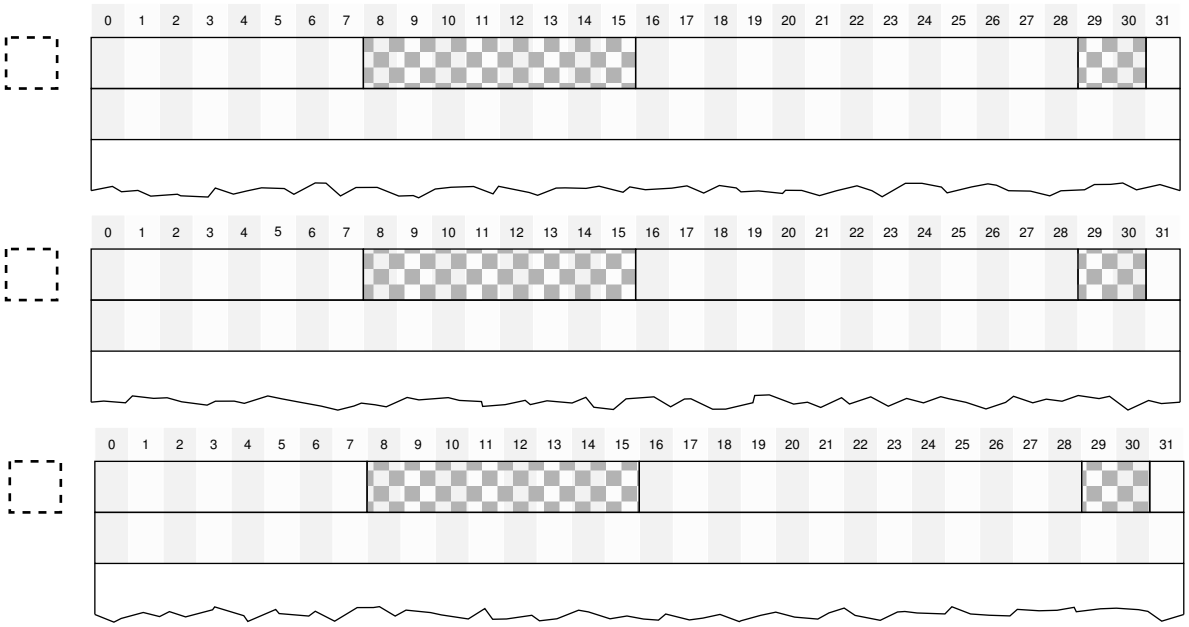
Ethernet frames



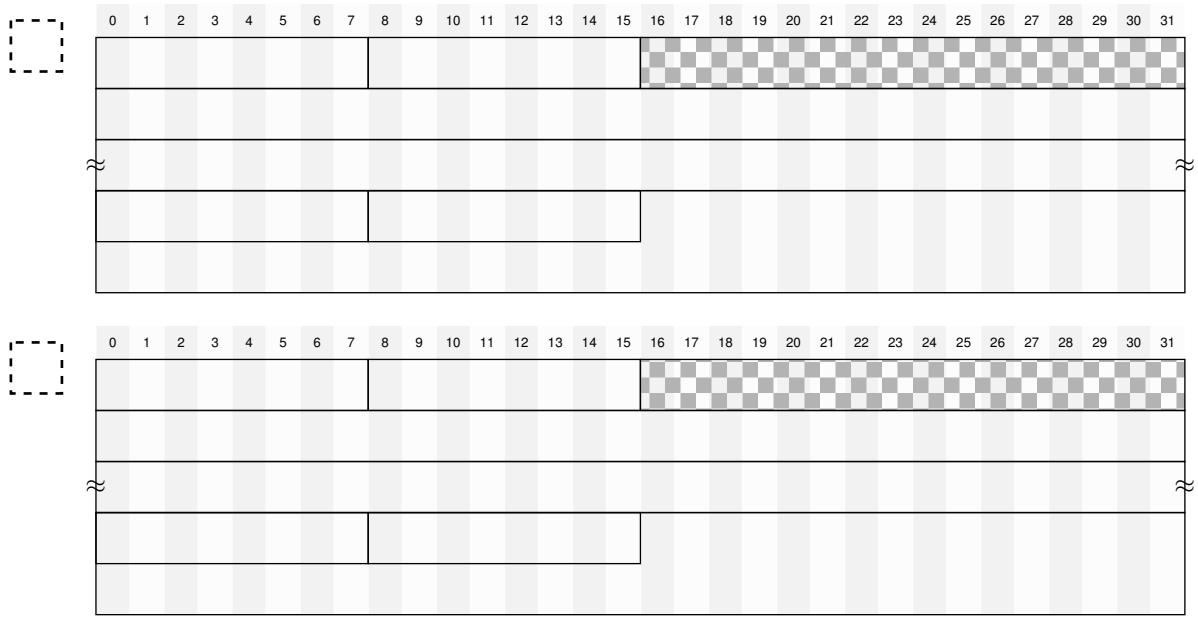
IPv6 Header


0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

IPv6 Fragment Header



ICMPv6 Neighbor Solicitation



ICMPv6 Neighbor Advertisement