**Lab 09**

**4.1**.

A) The use of which NAT type is the most typical of home environment?

[A) The most typical NAT type used in a home environment is **Port Address Translation (PAT)**, also known as **NAT Overload**](https://www.geeksforgeeks.org/types-of-network-address-translation-nat/)1. This method allows multiple devices on a private network to share a single public IP address when connecting to the internet.

B) What is the main advantage of PAT (NAT Overload) over the classical (i.e. static and dynamic) NAT solutions?

[B) The main advantage of PAT over classical NAT solutions (static and dynamic) is that it allows multiple private IP addresses to be mapped to a single public IP address by using different port numbers for each session3](https://ipwithease.com/nat-types-static-dynamic-and-overload/). This is particularly useful for conserving public IP addresses, as it enables numerous internal devices to access the internet through one public address, making it an efficient and cost-effective solution for home networks. [Additionally, PAT can help improve security by making it more difficult for attackers to target specific devices within the private network](https://www.geeksforgeeks.org/types-of-network-address-translation-nat/).

**4.2.**

A) In the case of „Oracle VirtualBox configuration 1” which device performs the address translation function?

A) In the case of “Oracle VirtualBox configuration 1,” the device that performs the address translation function is typically the **VirtualBox NAT service**. [This service works similarly to a home router, grouping the systems using it into a network and preventing systems outside of this network from directly accessing systems inside it, while allowing systems inside to communicate with each other and with systems outside](https://www.virtualbox.org/manual/ch06.html)[1](https://www.virtualbox.org/manual/ch06.html)[2](https://docs.oracle.com/en/virtualization/virtualbox/6.0/user/network_nat_service.html).

B) In the case of the IP packet sent from VM1 how many times will the IP address be translated at the level of LAN, MAN and WAN, if the packet gets to the Internet?

B) For an IP packet sent from VM1 (Virtual Machine 1), the number of times the IP address will be translated depends on the network setup. However, in a typical scenario where VM1 is connected to the Internet through a LAN (Local Area Network) and possibly through a MAN (Metropolitan Area Network) before reaching the WAN (Wide Area Network), the IP address translation could occur as follows:

* **LAN level**: The VirtualBox NAT service will perform the first translation from the VM’s private IP address to the host machine’s IP address.
* **MAN level**: If there is a network setup such as a campus or corporate network that uses another layer of NAT, a second translation could occur here.
* **WAN level**: The router at the edge of the local network, which connects to the ISP, will typically perform another NAT, translating the host machine’s private IP address to a public IP address for use on the Internet.

So, in total, the IP address could be translated up to **three times** before the packet reaches the Internet. However, this can vary based on the specific network architecture and whether additional layers of NAT are used at the MAN level. It’s also worth noting that some networks may use a flat architecture without a distinct MAN layer, in which case there might be fewer translations.

**4.3.**

A) What IP packet ID does the TCP connection establishment begin with?

A) The TCP connection establishment begins with a **random initial sequence number**. [This number is a 32-bit value and is chosen randomly to initiate the sequence number field in the TCP header during the SYN phase of the TCP 3-way handshake](https://www.geeksforgeeks.org/tcp-connection-establishment/).

B) What IP packet ID does the UDP traffic begin with?

B) UDP traffic does not have a connection establishment process like TCP, as it is a connectionless protocol. Therefore, there isn’t a specific starting IP packet ID for UDP traffic. [Each UDP packet is independent, and the identification field in the IP header is used for fragmentation and reassembly purposes, not for establishing a connection or sequence of packets](https://www.geeksforgeeks.org/tcp-connection-establishment/)[2](https://en.wikipedia.org/wiki/List_of_IP_protocol_numbers). The identification field is assigned by the host sending the packet and is used by the receiving host to ensure that fragments of a single IP datagram are properly reassembled.

**4.4.**

A) How is it possible to create a TCP segment whose header length is more than 40 Bytes?

A) To create a TCP segment with a header length of more than 40 bytes, you would need to use the **options field** in the TCP header. [The TCP header has a fixed part of 20 bytes and an optional part that can extend up to 40 bytes, making the maximum possible header size 60 bytes1](https://stackoverflow.com/questions/33863475/what-is-the-min-and-max-sizes-of-udp-tcp-header)[2](https://www.gatevidyalay.com/transmission-control-protocol-tcp-header/). [The options field is variable in length and can contain various options such as Maximum Segment Size (MSS), Window Scale, Selective Acknowledgment (SACK), and others that can increase the header length3](https://www.tutorialspoint.com/what-is-the-tcp-segment-header).

B) Which fields belong to the pseudo header of a TCP segment?

B) The fields that belong to the pseudo header of a TCP segment are:

* **Source Address**: The 32-bit IP address of the sender.
* **Destination Address**: The 32-bit IP address of the receiver.
* **Protocol**: An 8-bit field that indicates the protocol being used (for TCP, this is typically set to 6).
* **TCP Length**: A 16-bit field that represents the length of the TCP segment, including both header and data.
* [**Reserved**: An 8-bit field set to zero](https://stackoverflow.com/questions/33863475/what-is-the-min-and-max-sizes-of-udp-tcp-header)[4](https://www.baeldung.com/cs/pseudo-header-tcp)[5](http://www.tcpipguide.com/free/t_TCPChecksumCalculationandtheTCPPseudoHeader-2.htm).

The pseudo header is not transmitted as part of the TCP segment but is used in the calculation of the TCP checksum to provide additional protection against misrouted segments. [It includes parts of the IP header to ensure that the segment is being sent to the correct endpoint and that it has not been tampered with in transit](https://stackoverflow.com/questions/33863475/what-is-the-min-and-max-sizes-of-udp-tcp-header)[5](http://www.tcpipguide.com/free/t_TCPChecksumCalculationandtheTCPPseudoHeader-2.htm).