**P11**. Consider a router that interconnects three subnets: Subnet 1, Subnet 2, and Subnet 3. Suppose all of the interfaces in each of these three subnets are required to have the prefix 223.1.17/24. Also suppose that Subnet 1 is required to support at least 60 interfaces, Subnet 2 is to support at least 90 interfaces, and Subnet 3 is to support at least 12 interfaces. Provide three network addresses (of the form a.b.c.d/x) that satisfy these constraints.

**Answer:**

|  |  |
| --- | --- |
| All | 223.1.17/24 |
| Subnet 2 | 223.1.17.0/25 |
| Subnet 1 | 223.1.17.128/26 |
| Subnet 3 | 223.1.17.192/26 |

**Proccess:**

1. **Determine the requirements for each subnet:**
   * Subnet 1: At least 60 interfaces.
   * Subnet 2: At least 90 interfaces.
   * Subnet 3: At least 12 interfaces.
2. **Calculate the necessary subnet sizes:**
   * Subnet 1 needs at least 60 hosts. The next power of 2 greater than 60 is 64, which requires 6 bits for host addresses (26=6426=64). Thus, we need a subnet mask that leaves 6 bits for host addresses: /26.
   * Subnet 2 needs at least 90 hosts. The next power of 2 greater than 90 is 128, which requires 7 bits for host addresses (27=12827=128). Thus, we need a subnet mask that leaves 7 bits for host addresses: /25.
   * Subnet 3 needs at least 12 hosts. The next power of 2 greater than 12 is 16, which requires 4 bits for host addresses (24=1624=16). Thus, we need a subnet mask that leaves 4 bits for host addresses: /28.
3. **Allocate the subnets within 223.1.17.0/24:**
   * We start from the beginning of the 223.1.17.0/24 range and allocate space for each subnet according to their sizes.

**Subnet Allocations:**

**Subnet 2 (largest, /25):**

* Address: **223.1.17.0/25**
* Host range: 223.1.17.1 to 223.1.17.126
* Broadcast address: 223.1.17.127
* This provides 128 addresses (0-127), sufficient for 90 interfaces.

**Subnet 1 (next largest, /26):**

* Address: **223.1.17.128/26**
* Host range: 223.1.17.129 to 223.1.17.190
* Broadcast address: 223.1.17.191
* This provides 64 addresses (128-191), sufficient for 60 interfaces.

**Subnet 3 (smallest, /28):**

* Address: **223.1.17.192/28**
* Host range: 223.1.17.193 to 223.1.17.206
* Broadcast address: 223.1.17.207
* This provides 16 addresses (192-207), sufficient for 12 interfaces.

**Summary of Subnet Addresses:**

1. **Subnet 2:** 223.1.17.0/25
2. **Subnet 1:** 223.1.17.128/26
3. **Subnet 3:** 223.1.17.192/28

These addresses ensure that each subnet has the required number of interfaces while maintaining the overall prefix of 223.1.17/24.

**P17.** Suppose datagrams are limited to 1,500 bytes (including header) between source Host A and destination Host B. Assuming a 20-byte IP header, how many datagrams would be required to send an MP3 consisting of 5 million bytes? Explain how you computed your answer.

**Answer:**

To determine how many datagrams are required to send an MP3 file consisting of 5 million bytes given the constraints, we need to break down the problem step-by-step:

1. **Understand the size limitations:**
   * Total datagram size (including IP header): 1,500 bytes
   * IP header size: 20 bytes
   * Maximum data payload size per datagram: 1,500 bytes - 20 bytes (header) = 1,480 bytes
2. **Determine the total number of data payloads required:**
   * Total size of the MP3 file: 5,000,000 bytes
   * Data payload per datagram: 1,480 bytes
   * Number of datagrams required = Total file size / Payload size per datagram = 5,000,000/1,480
3. **Calculate the exact number of datagrams:**
   * Perform the division: 5,000,000/1,480≈3378.38

Since you can't send a fraction of a datagram, you need to round up to ensure all data is sent. This means you need to send 3,378 complete datagrams and one additional datagram to carry the remaining fraction of the data.

1. **Calculate the remainder:**
   * Remainder: 5,000,000 mod 1480=560 bytes
   * So, the last datagram will carry the remaining 560 bytes of data.

**Summary:**

* Total number of full datagrams: 3,378
* One additional datagram to carry the remaining data: 1

Thus, the total number of datagrams required is 3,378+1=3,379.

**Explanation:**

* Each datagram (except the last one) carries 1,480 bytes of data.
* The last datagram carries the remaining 560 bytes of data.
* The computation ensures all 5 million bytes of the MP3 file are transmitted.

Therefore, **3,379 datagrams** are required to send a 5-million-byte MP3 file.