Al-Mustaqbal Univerity

College of Science

Intelligent Medical Systems Departement

Computer Networks - 3rd Class

جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

Lecture 6 and 7:
TCP/IP Protocol Suite, Addressing

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Hierarchical Addressing

** Each IP address is divided into a prefix and a suffix.

- **Prefix** identifies network to which computer is attached

- **Suffix** identifies computer within that network

** Address format makes routing efficient

Hierarchical Addressing

The IP addressing scheme is hierarchical, and IP routers make hierarchical decisions.

Recall that an IP address comprises a prefix part and a host part (suffix).

A router has to know only how to reach the next hop; it does not have to know the details of how to reach an end node that is not local.

Routers use the prefix to determine the path for a destination address that is not local. The host part is used to reach local hosts.

Route Summarization

With **route summarization**, also referred to as **route aggregation** or **supernetting**, one route in the routing table represents many other routes.

Summarizing routes reduces the routing update traffic and reduces the number of routes in the routing table and overall router overhead in the router receiving the routes.

In a hierarchical network design, effective use of route summarization can limit the impact of topology changes to the routers in one section of the network.

CIDR

Classless Inter-Domain Routing (CIDR) is a mechanism developed to help alleviate the problem of IP address exhaustion and growth of routing tables.

The idea behind CIDR is that blocks of multiple addresses (for example, blocks of Class C address) can be combined, or aggregated, to create a larger (that is, more hosts allowed) classless set of IP addresses. Blocks of Class C network numbers are allocated to each network service provider; organizations using the network service provider for Internet connectivity are allocated subsets of the service provider's address space as required. These multiple Class C addresses can then be summarized in routing tables, resulting in fewer route advertisements.

The CIDR mechanism can be applied to blocks of Class A, B, and C addresses; it is not restricted to Class C.)

Route Summarization

For summarization to work correctly, the following requirements must be met:

- Multiple IP addresses must share the same leftmost bits.
- Routers must base their routing decisions on a 32-bit IP address and a prefix length of up to 32 bits.
- Routing protocols must carry the prefix length with the 32-bit IP address.

Route Summarization - Example

For example, assume that a router has the following networks behind it:

192.168.168.0/24

192.168.169.0/24

192.168.170.0/24

192.168.171.0/24

192.168.172.0/24

192.168.173.0/24

192.168.174.0/24

192.168.175.0/24

Each of these networks could be advertised separately; however, this would mean advertising eight routes. Instead, this router can summarize the eight routes into one route and advertise 192.168.168.0/21.

By advertising this one route, the router is saying, “Route packets to me if the destination has the first 21 bits the same as the first 21 bits of 192.168.168.0.”

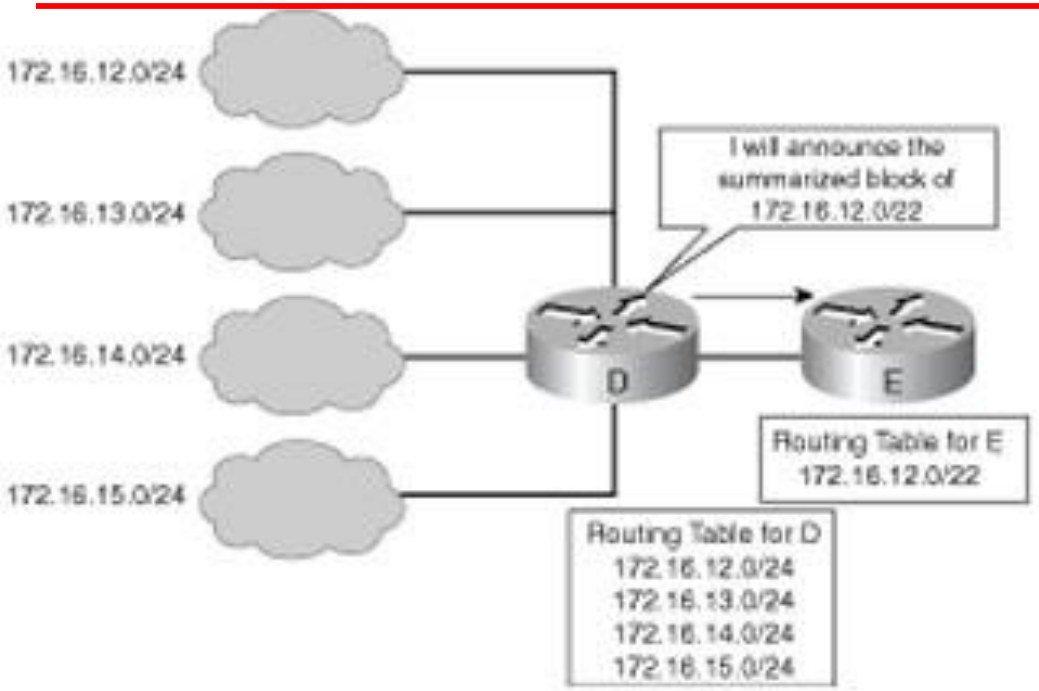
Route Summarization - Example

The following figure illustrates how this summary route is determined. The addresses all have the first 21 bits in common and include all the combinations of the other 3 bits in the network portion of the address; therefore, only the first 21 bits are needed to determine whether the router can route to one of these specific addresses.

192.168.168.0 =	11000000 10101000 10101	000	00000000
192.168.169.0 =	11000000 10101000 10101	001	00000000
192.168.170.0 =	11000000 10101000 10101	010	00000000
192.168.171.0 =	11000000 10101000 10101	011	00000000
192.168.172.0 =	11000000 10101000 10101	100	00000000
192.168.173.0 =	11000000 10101000 10101	101	00000000
192.168.174.0 =	11000000 10101000 10101	110	00000000
192.168.175.0 =	11000000 10101000 10101	111	00000000

Number of Common Bits = 21
Number of Non-Common Network Bits = **3**
Number of Host Bits = **8**

Route Summarization - Example



Router D can either send four routing update entries or summarize the four addresses into a single network number. If router D summarizes the information into a single network number entry, the following things happen:

** Bandwidth is saved on the link between routers D and E.

** Router E needs to maintain only one route and therefore saves memory.

** Router E also saves CPU resources, because it evaluates packets against fewer entries in its routing table.

Benefits of Hierarchical Addressing

A network designer decides how to implement the IP addressing hierarchy based on the network's size, geography, and topology. In large networks, hierarchy within the IP addressing plan is mandatory for a stable network (including stable routing tables). For the following reasons, a planned, hierarchical IP addressing structure, with room for growth, is recommended for networks of all sizes:

1- Influence of IP addressing on routing: An IP addressing plan influences the network's overall routing. Before allocating blocks of IP addresses to various parts of the network and assigning IP addresses to devices, consider the criteria for an appropriate and effective IP addressing scheme. Routing stability, service availability , and network scalability are some crucial and preferred network characteristics and are directly affected by IP address allocation and deployment.

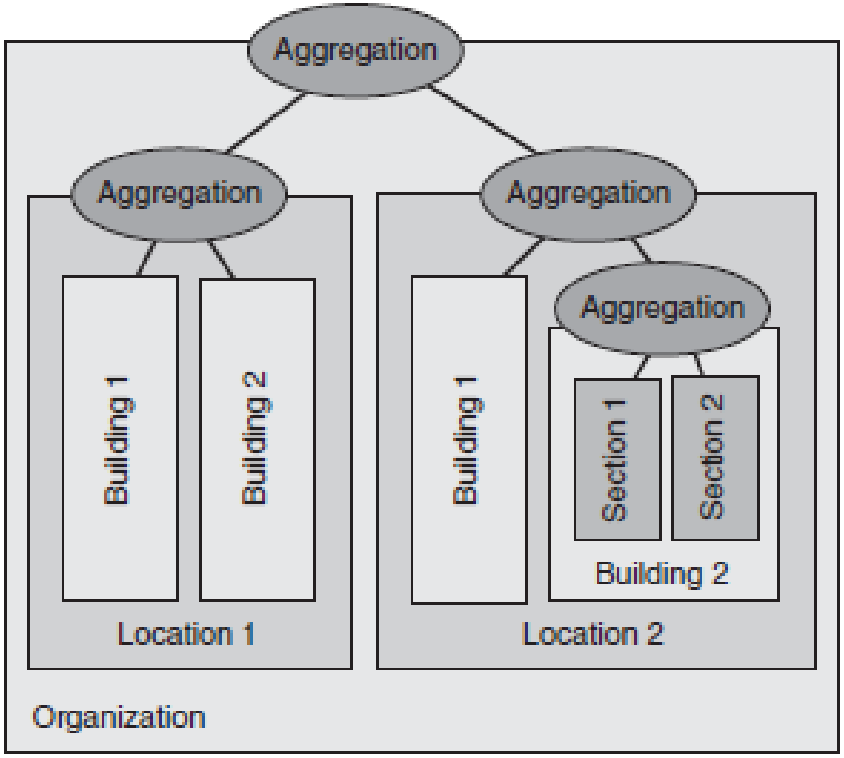
Benefits of Hierarchical Addressing

2- Modular design and scalable solutions: Whether building a new network or adding a new service on top of an existing infrastructure, a modular design helps to deliver a long-term, scalable solution. IP addressing modularity allows the aggregation of routing information on a hierarchical basis.

3- Route aggregation: Route aggregation is used to reduce routing overhead and improve routing stability and scalability. However, to implement route aggregation, a designer must be able to divide a network into contiguous IP address areas and must have a solid understanding of IP address assignment, route aggregation, and hierarchical routing.

Summarization Groups

To reduce the routing overhead in a large network, a multilevel hierarchy might be required. The depth of hierarchy depends on the network size and the size of the highest-level summarization group. The following figure shows an example of a network hierarchy.



Summarization Groups

A typical organization has up to three levels of hierarchy:

- **First level: Network locations** typically represent the first level of hierarchy in enterprise networks. Each location typically represents a group of summarized subnets, known as a summarization group.

- **Second level:** A second level of hierarchy can be done within first-level summarization groups. For example, a large location can be divided into smaller summarization groups that represent the **buildings within that location.** Not all first-level summarization groups require a second level of hierarchy.

- **Third level:** To further minimize the potential routing overhead and instability, a third level of hierarchy can exist within the second-level summarization group. For example, **sections or floors within individual buildings** can represent the third-level summarization group.

Thank you