Rules of IP addressing for Routed Ports

General routing rules

These rules apply to TCP/IP in general and to TCP/IP on the IBM® i operating system.

To manage packets on your system, you should consider these rules as you implement routing functions on your system. These rules can help you determine what is happening to the packets on your system and where they might be going. As with most rules, there are exceptions.

- Your system does not have an IP address; only interfaces have IP addresses.
  Note: Virtual IP (connectionless) addresses are assigned to the system.
- In general, if the destination IP address is defined on your system, your system will process it regardless of what interface a packet comes in on.

  The exception in this case is that if the address is associated with an unnumbered interface, or if IP NAT or filtering is active, the packet might be forwarded or discarded.

- The IP address and mask define the address of the attached network.
- The route out of a system is selected based on the network address attached to an interface. The route selected is based on the following items:
  - Route group search order: direct routes, subnetwork routes, and then default routes.
  - Within a group, the route with the most specific subnet mask is chosen.
  - Equally specific routes are subject to list order or load-balancing techniques.
  - Routes can be added manually or dynamically by the system.

IP Addressing Rules

In order to be certain that IP addresses are valid, there are a number of rules that must be followed. Be sure to pay particular attention to these rules, as they form the basis of determining valid IP addresses.

The first rule of IP addressing is critical. The host portion of an address cannot be set to all binary 0s or all binary 1s. When the host portion of an address is set to all binary 0s, it is used as a way of referring to that particular network.

The second rule that you need to remember is the use of all binary 0s or 1s in the network portion of an address. When the network portion is set to all 0s, it is interpreted to mean "this network". For example, the address 0.0.12.145 would be interpreted as "host 12.145 on this network". When the network portion is set to all ones, for example 255.255.1.2, this is the same as saying "host 1.2 on all networks". For the most part, you will not be manipulating the network portion of addresses in this manner – these designations will be used by the protocols, as per their programming.

The remaining rules are fairly simple. They include:

- The network ID of 127.0.0.0 is reserved for diagnostics and testing. The address 127.0.0.1 is referred to as the loopback address
- An IP address of all 0s (0.0.0.0) is used to represent the default route, or where all packets destined for unknown networks should be sent.
- An IP address of all 1s (255.255.255.255) is used to represent a broadcast to all hosts on a network.
- Network IDs of 224 and above in the first octet are not valid to assign to hosts, since Class D and E addresses are not valid for hosts.

The table below summarizes the IP addressing rules that we've looked at in this section.

Rule	Purpose	Example
Host ID cannot be all binary 1s	This address represents a network broadcast	131.107.255.255
Host ID cannot be all binary 0s	This address identifies a network	131.107.0.0
Network ID cannot be all binary 0s	This address represents "on this network"	0.0.145.23
Network ID cannot be all binary 1s	The address represents " on all networks"	255.255.1.142

Network ID cannot be decimal 127	This address range is reserved for the loopback address	127.0.0.1
IP address cannot be all binary 0s	This address is used to represent the default route	0.0.0.0
IP address cannot be all binary 1s	This address is used to represent a broadcast	255.255.255.255
Network IDs of 224 and above in the first octet cannot be assigned to hosts	Class D addresses are reserved for multicasting, while Class E addresses represent an experimental range	224.0.0.1

As a quick test, see if you can answer the following question. Is the address 47.203.191.0 valid to assign to a host? You may not have thought so, but answer is yes. Why? The fact that the address ends in a decimal value of 0 doesn't make a difference. Since this is a Class A address, if you convert it to binary, you'll notice that the host portion (the last three octets) is neither all binary 0s nor all binary 1s. This is just another example of why it's so important to always consider addresses in binary. Try not to let assumptions based on what you see in decimal throw you off.

IP Addressing on a Router IP Addressing on a Router IP Addressing on a Router

The role of a router is to receive IP packets and **route them from one subnet to another** based on routing rules that exist within the router (statically assigned routes or routes learned from routing protocols such as OSPF or EIGRP).

As such, a router will have multiple layer 3 interfaces, each one assigned an **IP address on a different subnet**. It will receive a packet on one interface and route it out another.

Router interfaces **cannot be assigned IP addresses in the same subnet**. If you attempt to configure two interfaces on the same subnet, it will give you an error. Such a configuration defeats the purpose of the router, which is to **route packets from one subnet to another**.