**On Routing Tables and Address Masking**

For the purposes of discussion, there follows a routing table generated by Windows XP (yes, we know its old) for a machine with 2 physical interfaces (0x2 and 0x3), each in a private network. There is also the built in software interface for loopback (0x1). The subnet of which interface 0x2 is a member is an isolated subnet with no router to “elsewhere”. The interface configuration therefore features no gateway setting.  
Note that line numbering has been added.

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Interface List

0x1 ........................... MS TCP Loopback interface

0x2 ...00 22 19 32 e2 71 ...... Broadcom NetXtreme 57xx Gigabit Controller - Packet Scheduler Miniport

0x3 ...ec 08 6b 05 de ef ...... Gigabit PCI Express Network Adapter - Packet Scheduler Miniport

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Active Routes:

Network Destination Netmask Gateway Interface Metric

1 0.0.0.0 0.0.0.0 192.168.x.x 192.168.x.y 20

2 127.0.0.0 255.0.0.0 127.0.0.1 127.0.0.1 1

3 172.xx.xxx.160 255.255.255.224 172.xx.xxx.172 172.xx.xxx.172 20

4 172.xx.xxx.172 255.255.255.255 127.0.0.1 127.0.0.1 20

5 172.xx.255.255 255.255.255.255 172.xx.xxx.172 172.xx.xxx.172 20

6 192.168.x.0 255.255.255.0 192.168.x.y 192.168.x.y 20

7 192.168.x.y 255.255.255.255 127.0.0.1 127.0.0.1 20

8 192.168.x.255 255.255.255.255 192.168.x.y 192.168.x.y 20

9 224.0.0.0 240.0.0.0 172.xx.xxx.172 172.xx.xxx.172 20

10 224.0.0.0 240.0.0.0 192.168.x.y 192.168.x.y 20

11 255.255.255.255 255.255.255.255 172.xx.xxx.172 172.xx.xxx.172 1

12 255.255.255.255 255.255.255.255 192.168.x.y 4 1

13 255.255.255.255 255.255.255.255 192.168.x.y 192.168.x.y 1

Default Gateway: 192.168.x.x

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Persistent Routes:

None

Line 1  
This line is for interface 0x3, which is configured with a standard, class C private address and with a defined default gateway, shown at the bottom of the table. The all zeroes address is used for “anywhere” or, more precisely, “somewhere, wherever that may be”. It is unmasked, so it refers to the entire Internet (even parts that don’t yet exist). What this line says is, in effect, “To get anywhere on the Internet, use this interface and the gateway defined”.

Line 2  
This is for interface 0x1, the internal loopback. For any loopback address (127.0.0.1 to 127.255.255.255), use 127.0.0.1 as interface. The gateway to use via the interface is the interface.

Line 3  
This is derived from the TCP/IP configuration of interface 0x2, which defines a class B private address with a restricted subnet mask (so-called classless addressing and routing). Applying the masking shown to the address 172.xx.xxx.172 yields 172.xx.xxx.160 as a network (subnet) number. The available host numbers in network 172.xx.xxx.160 are 1 to 30. A host number cannot be all zeroes, since this is the “anywhere” address, nor can it be all 1s (31 in this case), since this is the broadcast address for the subnet. To reach addresses in this subnet, use this interface, which is your gateway to this subnet.

Line 4  
To reach this address (interface 0x2), and only this address (masking is all 1s), you can use the loopback interface, since interface 0x2 is installed here.

Line5  
This is intended to define a broadcast address. It might be considered in error. Windows has identified a class B private address and assumed that the full class B range is used. It should have known, from line 3, that the masking for this subnet is 255.255.255.224. This makes host number 31 the broadcast address for the subnet, i.e. 172.xx.xxx.191. Classless addressing and routing became the norm before the introduction of WinXP. The observed behaviour is:  
a) Only devices that understand this point will respond to 172.xx.xxx.191 (in my case, my wireless access point and printer). They do also respond to 172.xx.255.255 but only because, for this route, gateway and interface are identical.  
b) Other WinXP devices will not respond to any broadcast address scheme.  
Regarding broadcast in general, 255.255.255.255 would be, if not otherwise qualified, broadcast for the whole Internet. This would create an intolerable excess of traffic. Restricting broadcast to the local subnet might seem to be unreasonable. The target address for the wider subnet would have to correspond to an all 1s host address on the far side of the local gateway.

Line 6  
As line 3 but for the class C (192.168.) private network.

Line 7  
As line 4 but for interface 0x3.

Line 8  
Broadcast for the subnet interrface 0x3.

Lines 9 and 10  
These are the multicast definitions for the two physical interfaces. Multicast uses a network number in the 224 to 239 range, as defined by the destination and masking.

Lines 11, 12 and 13  
These are the network-wide (all 1s)broadcast definitions for the three non-loopback interfaces.

For any given destination, the procedure is to work down the table to the last entry that matches where you want to go. Thus, for any address external to the private networks, you will stop at line one and use the gateway defined for interface 0x3. For other hosts on the 192.168 LAN, you will stop at line 6 and use interface 0x3, which is also the appropriate gateway.

An ISP could have a customer-side router (BRAS) with a routing table that looks something like:

Active Routes:

Network Destination Netmask Gateway Interface Metric

1 0.0.0.0 0.0.0.0 62.24.54.204 62.24.54.202 20

2 127.0.0.0 255.0.0.0 127.0.0.1 127.0.0.1 1

3 79.77.11.1 255.255.255.255 79.77.255.1 79.77.255.1 20

4 79.77.11.2 255.255.255.255 79.77.255.2 79.77.255.2 20

5 79.77.11.3 255.255.255.255 79.77.255.3 79.77.255.3 20

6 etc.

in order to serve its customers.