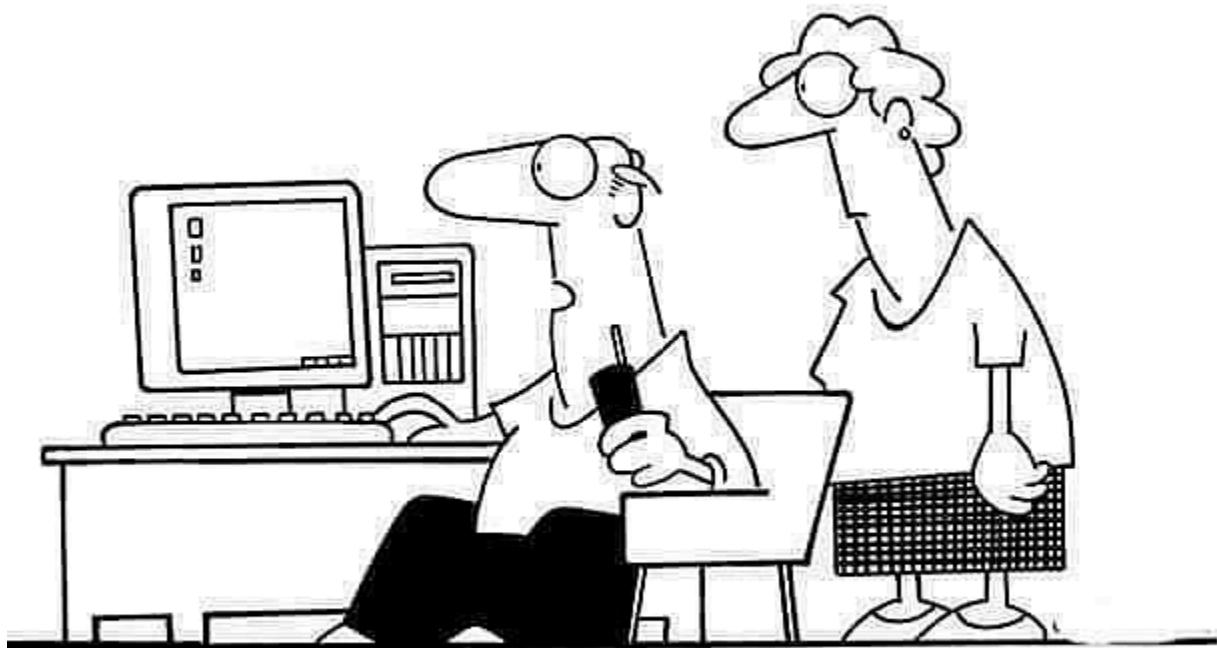# Subnets for Idiots

Or "how to correctly use the address space from the 44net"

"Tech support says the problem is located somewhere between the keyboard and my chair."

Mark Phillips, G7LTT/NI2O	**Initial Release**	**V1.0 01/2026**
Mark Phillips, G7LTT/NI2O	**Links updated**	**V1.01 01/2026**
Mark Phillips, G7LTT/NI2O	**Grammar made even more betterer**	**V1.03 01/2026**

Contents:

This document should not be considered an authoritative work. It is simply for information only.

Abstract:

You have applied for and been allocated a 44net subnet. Now what? How do you deploy it in your shack or radio tower?

This document aims to demystify and explain the use of IP subnets to users of the 44net. It does not aim to instruct you on the subtleties of programming your router or VPN session for use on the 44net. Greater understanding of IP subnetting should allow for an easier user experience when deploying hosts to the 44net.

Background:

The 44net is not unique in its use of IP subnetting. Indeed it is used in every IP based network everywhere. The rules governing IP networks and their deployment are huge and varied. This document does not intend to explain it all but rather equip the reader with just enough knowledge so that they understand what it is when they see it.

Back in the annals of time (Jan 1st 1983 to be exact), TCP/IP was made the official networking protocol for the US military and its various research partners. It is this protocol that gives us IP addresses. In those days networks could use the entire 4.3 billion addresses available to TCP/IP on a single network.

As networks expanded there was a need to talk to other networks. This was possible only if the 2 parties did not use conflicting IP addresses. The more networks that needed to communicate the more likely it was that they would run into the same IP address range somewhere else.

The solution to this problem was 2 fold; 1) reduce the number of IP addresses available to a given network and then create an agency to control this, 2) create a way for a computer to know if the IP address it wanted to talk to was on its network or somewhere else.

The first part was easy. Exactly how many addresses did any network need? 4.3 billion was incredibly unlikely. The second part took a while to work out but turned out to be a mathematical problem that the computer could solve.

For the most part networks can be categorized by their size. The IP address space is divided into groups called "classes" and labeled A, B & C with some space being reserved for the actual host itself and also for something called "multicast". A typical home or small business network can live comfortably within the class C address space while a larger network for a large business would be allocated a class A or B based on their size.

This still did not solve the supply and demand problem so a way to further break up the classes was needed. The resulting solution killed 2 birds with one stone. Not only did it break up the IP addresses into more manageable chunks but it also solved the problem of identifying the different networks you are connected to and how to route to them.

CIDR: Classless Inter-Domain Routing:

IP addresses are collected into sub-networks or "subnets" and given a "mask". These subnets are a group of IP addresses consisting of at least a network address, broadcast address and some usable addresses. Subnets are usually divisible by 8 but can be as small as just 4 addresses. A mask might be expressed as "/29" or "255.255.255.248".

With the advent of CIDR it was now possible to know what IP address space exists in your network and also how to reach other address spaces. Routers were not a new thing but until this point they required explicit programming for each network they connected to. This version of TCP/IP became known as Version 4 or IPv4.

IPv4 Subnet Calculator

Result

IP Address:	44.27.32.193
Network Address:	44.27.32.192
Usable Host IP Range:	44.27.32.193 - 44.27.32.198
Broadcast Address:	44.27.32.199
Total Number of Hosts:	8
Number of Usable Hosts:	6
Subnet Mask:	255.255.255.248
Wildcard Mask:	0.0.0.7
Binary Subnet Mask:	11111111.11111111.11111111.11111000
IP Class:	C
CIDR Notation:	/29
IP Type:	Public
Short:	44.27.32.193 /29
Binary ID:	00101100000011011001000001 1000001
Integer ID:	739975361
Hex ID:	0x2c1b20c1
in-addr.arpa:	193.32.27.44.in-addr.arpa
IPv4 Mapped Address:	::ffff:2c1b.20c1
6to4 Prefix:	2002:2c1b.20c1::/48

The above image demonstrates a /29 IP subnet and how it is broken out into its various parts. What this image is telling us is that there are 8 possible addresses in our "/29" allocation, that there are a possible 6 usable addresses for our devices (hosts) along with what the network and broadcast addresses are. It also outlines the various ways in which computers may see the addresses being used. Finally it tells us what class of IP range we have. CIDR changed the definition of "class" from a particular range of numbers to a particular quantity of numbers.

CIDR also defined "private" IP address space intended for organisational use for example around an office or factory. This space is based on size. Network managers can choose a network size appropriate to their needs.

The /xx number describes how many numbers there are based on computer bits and is called the "prefix" (despite it actually being a suffix!). It's all "divide by 8" arithmetic that frankly is a bind to do so refer to the appendix for a precalculated chart.

Calculating subnet mask information by hand:

It's actually quite easy to calculate subnet information based on the mask expression. The first question is "how many numbers are there in this mask?". Some simple primary skoool sums gives us the answer.

We are interested in the last part of the subnet mask 255.255.255.248. In this case we have the number 248. Deduct this number from 256 (0-255 = 256 numbers - we start at zero in computers but 1 in mathematics) and the remaining number is how many addresses we have. Add that to the base IP address and we have our complete range. So for example

    44.27.17.64/29 breaks out to 255.255.255.248 (see appendix for how this works)
    256 - 248 = 8
    44.27.17.64 + 8 = 44.27.17.73

Now we know how many addresses we have as well as our "network" and "broadcast" addresses. If you cannot count there are some online tools available to help. See the Useful Tools section.

Deployment:

So now we know what a subnet is and what it describes, how do we use it? For the most part you will need only 3 bits of information for your devices: IP address, subnet and gateway. These 3 items tell your computer (repeater/AllStarLink/etc) everything it needs to know. If it has an IP address of 44.100.200.7 with a subnet of /29 (255.255.255.248) and it wants to talk to 44.100.200.5 it does the arithmetic to work out if the destination address is on its own network. Assuming the answer is "yes" your computer will deposit its data directly onto the network addressed directly to the other IP address. Note that your computer did not need to know the subnet of the target address.

If the answer was "no" then the IP address was calculated to be on another network entirely. The computer then uses the gateway information and sends its data to the gateway IP address. It makes an assumption that the gateway can manage the connection from that point onwards.

Typically networks would have a single address space and subnet but for larger or more complicated networks you might have more than one IP range and subnet. For example a network might be broken down by function. All the computers in the office have one IP range, the VoIP phones have another and the CCTV cameras have yet another. All this traffic would be handled by the gateway. It would send data back and forth between the IP ranges without the computers/phones/CCTV needing to know how to talk to each other.

Subnets are lossy:

Every subnet has 2 immoveable and "lost" addresses; the first and the last. The Network Address and the Broadcast address. These 2 addresses tell the network attached devices how big the network is and what address to send data to that is meant for all of the devices rather than a single device.

So a /24 network of 256 addresses would sacrifice these 2 addresses but still have 254 remaining. Probably more than plenty for a small operation such as your house or office. But when we go smaller with our subnets we still have to sacrifice those 2 addresses. When we get down to /29 (8 addresses) and /30 (4 addresses) we still need to give up the first and last. So 4 addresses becomes just 2 usable ones (perfect for a back-to-back router scenario).

Worse still, we are obliged to give up one of our usable addresses to our gateway device (usually the lowest usable number) as we must have a way to get off the network. Again, not a problem if we have 253 remaining addresses but now we are down to just 5 addresses in a /29.

ARDC, the group managing the 44net, somewhat recently sold about a third of its address space which was originally some 16.7 million possible addresses. Because of the "divide by 8" rule the complete address space was broken down into 3 smaller subnets. A /9 and 2 /10's. This equated to a half and 2 quarters of the original subnet. It was one of these /10 subnets that was sold to fund the future of the 44net. This left some 12.5 million addresses remaining. But still because of the subnet losses this number has at least 4 less usable numbers in it.

Network Address Translation (NAT):

As time went by it was realized that the demand for IP addresses far exceeded the supply. CIDR tries to address this problem by creating private groups of IP address space that can be used by standalone networks. Anywhere you see networks looking like 10.x.x.x, 172.16.x.x and 192.168.x.x these are private networks. These are the most common networks you'll come across and unless they need to talk to other networks they can be self contained and operate without issue despite the IP address space being replicated many times over across many

multiple networks. Your home network likely uses the address space 192.168.0.x/24. This is not unique to you but unless you need to connect to another network it is perfectly fine on its own.

But what if you need to connect your private network to a public network? There's no getting away from the fact that to communicate with another network your network has to appear to be unique. Thanks to Network Address Translation (NAT) our non-unique network can be hidden behind a single unique public address thus allowing us to appear unique to the network we are connected to.

By assigning just a single public IP address to a network and then hiding the network behind it the demand for IP addresses is greatly reduced. Remember, there are only 4.3 billion addresses available to us. However, there are significantly more than 4.3 billion IP users out there in the network world. This number is further decreased by the losses involved in subnets.

This works because our outgoing "from" address (the IP address that is tagged to a given device's outgoing data) gets changed to the IP address of the public facing interface on the gateway. This data is then forwarded in the normal fashion to the intended recipient who now knows where to send replies to.

IP address hoarding/land grab:

The shortage of IP addresses and the losses involved in subneting has become a significant issue. Because of these losses it was realised that possession of larger subnets was preferable. To this end anyone that thought they could justify possession of a large range of IP addresses tried to acquire some.

Back in the early 1980's 44net was able to acquire the ownership of 44.0.0.0/8. Note the word "ownership". IP addresses are a monetized commodity. Each address currently (at time of writing) has a monetary value of around US$15. This means that the more addresses an entity owns the more money its network is worth.

Hoarding of IP addresses has become a significant problem. New networks are unable to acquire IPv4 addresses for their legitimate purposes and so have to come up with creative ways in which to offer their network services to the world.

One of these creative ways has been the renting of IP address space. There exist agencies who will rent IP addresses to you for a fee. Network managers may use these addresses exclusively for as long as they pay the rental on those addresses.

This is where ARDC shines in that it does not rent its addresses to you but rather lends them to you. But they too must husband their supply properly. They too must prevent the land grab and hoarding of IP addresses. They manage this through their IP address allocation system on their portal.

Identifying network types:

IP networks are actually quite easy to identify. As mentioned earlier, CIDR created ranges of "private" IP addresses. They are intended for use on private networks that will not likely see incoming public connections. These addresses are

10.x.x.x/8	(255.0.0.0)	16.7 million addresses
172.16.x.x/12	(255.240.0.0)	1.048 million addresses
192.168.x.x/16	(255.255.0.0)	65.5 thousand addresses

Additionally CIDR created IP address space for the device itself to use. Communicating from one application to another within the same computer is possible using TCP/IP thus negating the requirement to teach applications how to talk to contact each other. This is often called the "loopback block" and looks like

127.0.0.0/8	(255.0.0.0)	16.7 million addresses

Useful tools:

Follow the below links for some useful subnetting tools

https://connect.44net.cloud/tools/subnet-calculator
https://www.calculator.net/ip-subnet-calculator.html

Appendix:

IP subnet prefix chart

Prefix size	Network mask	Usable hosts per subnet
/1	128.0.0.0	2,147,483,646
/2	192.0.0.0	1,073,741,822
/3	224.0.0.0	536,870,910
/4	240.0.0.0	268,435,454
/5	248.0.0.0	134,217,726
/6	252.0.0.0	67,108,862
/7	254.0.0.0	33,554,430
Class A		
/8	255.0.0.0	16,777,214
/9	255.128.0.0	8,388,606

/10	255.192.0.0	4,194,302
/11	255.224.0.0	2,097,150
/12	255.240.0.0	1,048,574
/13	255.248.0.0	524,286
/14	255.252.0.0	262,142
/15	255.254.0.0	131,070
Class B		
/16	255.255.0.0	65,534
/17	255.255.128.0	32,766
/18	255.255.192.0	16,382
/19	255.255.224.0	8,190
/20	255.255.240.0	4,094
/21	255.255.248.0	2,046
/22	255.255.252.0	1,022
/23	255.255.254.0	510
Class C		
/24	255.255.255.0	254
/25	255.255.255.128	126
/26	255.255.255.192	62
/27	255.255.255.224	30
/28	255.255.255.240	14
/29	255.255.255.248	6
/30	255.255.255.252	2
/31	255.255.255.254	0
/32	255.255.255.255	0