You’ve probably heard the news that the Internet is in trouble. The last block of IP addresses has been assigned by the Regional Internet Registries. However, considering that NAT is an efficient mechanism to remedy the shortage of public IP addresses, we won’t really experience problems any time soon.

[](https://4sysops.com/wp-content/uploads/2011/02/IPv6ReadyLogo.png)

**IPv4 address shortage** [**^**](https://4sysops.com/archives/ipv6-part-1-get-started-now/#Content-bal-title)

But this is only true for the developed countries. Developing countries, especially the emerging markets, are only at the beginning of building up their Internet infrastructure. For them, NAT probably is not really a solution because you need at least a certain number of public IP addresses to be able to communicate efficiently with the rest of the world. Hence, these countries probably will start introducing IPv6 quickly now.

This will also increase the pressure on those countries that already have a developed Internet infrastructure. Although there are ways that IPv4 and IPv6 networks can communicate, the fact that IPv6 introduces quite a few new features will cause problems when IPv6 traffic has to be transferred to IPv4-only networks.

**IPv6 complexity** [**^**](https://4sysops.com/archives/ipv6-part-1-get-started-now/#Content-bal-title)

All of these problems are certainly solvable, but there is no doubt that the complexity of the Internet will increase rapidly now, and this won’t make life easier for system administrators. While network engineers will tell you that IPv6 will simplify networking, the truth is that it will only make things easier for computers but not for humans. It is not only that we will have to manage IPv4 AND IPv6 for quite some time, and that during the transition the interoperation of IPv4 and IPv6 will produce countless error messages in our networks, it is also because IPv6 is certainly more complex than IPv4. All of these new features come at a price. Many new organizations will need to hire new network administrators to manage these new complexities.

**IPv6 for Windows admins** [**^**](https://4sysops.com/archives/ipv6-part-1-get-started-now/#Content-bal-title)

As a Windows administrator, you probably don’t have to know all the details of IPv6 as long as you are not responsible for your organization’s routers and firewalls. However, since networking issues are often the cause of Windows administration problems, you need at least a basic understanding of IPv6 and, from what I have seen so far, you will have to invest more time than you invested in learning IPv4.

I think now is a good time to start learning IPv6. This will probably be a long process because you also have to do your regular work. As to my experience, you can’t really learn such a technology by just reading some papers or books. You really have to play with IPv6 for some time until you get a feeling for which things you really need to know for your work. Hence, even if you most certainly won’t switch your productive network to IPv6 within the next months, it can’t be wrong to make the transition now in your test network.

In the next two posts of this IPv6 series, I will give an overview of the [new features of IPv6](https://4sysops.com/archives/ipv6-part-2-new-features-routing/)

# IPv6 tutorial – Part 2: New features: Routing

In the last post of my IPv6 series, I outlined the main reason why you should now [get started with IPv6](https://4sysops.com/archives/ipv6-part-1-get-started-now/): IPv6 will come soon to your network whether you like it or not. Network engineers have a few other reasons to offer, and this is the topic of the next two articles. The new IPv6 features are not really new because the protocol has already existed for more than 10 years. For this reason, I won’t just repeat the feature descriptions, which you can read on countless other sites, but I will outline my view about the significance of these enhancements.

[](https://4sysops.com/wp-content/uploads/2011/02/Cisco.Router.png)

**Large address space** [**^**](https://4sysops.com/archives/ipv6-part-2-new-features-routing/#Content-bal-title)

While the other new IPv6 features are all nice to have, the new large address space is certainly the main (perhaps the only) reason why IPv6 will come. An IPv4 address consists of 32 bits; the IPv4 address space, therefore, allows 232 addresses. An IPv6 address is four times as long and has 128 bits. Thus, in theory, IPv6 allows 2128 = 340,282,366,920,938,463,463,374,607,431,768,211,456 addresses. This corresponds to 655,570,793,348,866,943,898,599 (6.5×1023) addresses for every square meter of the Earth’s surface.

To be honest, I am not really impressed by these numbers. We are now entering the nano technology age, which means that we will have more and more, much smaller, communication devices than the IPv6 inventors have anticipated. Considering that a cubic meter of ideal gas contains around 1025 atoms, the number of 1023 IP addresses per square meter appears to be relatively small. I know this sounds like science fiction, but, for the inventors of IPv4, the Internet as we know it today certainly was science fiction at their time. We needed about 30 years to use up all of the IPv4 addresses. My gut tells me that the IPv6 addresses won’t last that long.

**Hierarchical addressing** [**^**](https://4sysops.com/archives/ipv6-part-2-new-features-routing/#Content-bal-title)

The Internet address classes of IPv4 allow hierarchical addressing to a certain extent. Hierarchical addressing makes routing more efficient because it reduces the size of routing tables. However, considering that the computation power of routers increased at a higher rate than the growth of the Internet, this was not really a problem.

Nevertheless, it is quite likely that the Internet will now grow at a higher rate than ever before, not only because the total population of the emerging markets (especially China and India) far exceeds the population in the developed world but also because the new type of devices (mobile phones, tablets, ebook readers, TV sets, etc.) also require IP addresses. Thus IPv6’s new hierarchical addressing capabilities are certainly important. And here the IPv6 inventors did not really scrimp. Of the 128 bits of an IPv6 address, 64 bits are used for hierarchical addressing, 48 bits for the public topology, and 16 bits for the site topology. The latter means that you can work with hierarchical addresses within your organization.

**Better support for Quality of Service (QoS)** [**^**](https://4sysops.com/archives/ipv6-part-2-new-features-routing/#Content-bal-title)

IPv4 has limited support for Quality of Service (QoS)—that is, real-time delivery of data through the Type of Service (TOS) field. One problem of QoS in IPv4 pertains to TCP and UDP port identification, which is not possible if the IPv4 packet is encrypted. The other problem is that QoS in IPv4 is not really standardized. The IPv6 header has the Flow Label field, which allows QoS handling that is independent of the payload.

While this new feature is technically interesting, in practice QoS is quite problematic for traffic on the public Internet. You might have heard of the stir that the alleged [Google-Verizon deal](http://www.huffingtonpost.com/josh-silver/google-verizon-deal-the-e_b_671617.html) caused. Google intended to pay Verizon to prioritize their traffic.

The main question is how you decide which traffic has priority. Is it justified that you have to wait for the latest 4sysops article to show up on your screen just because some teens clogged the net with their YouTube videos? And if you pay for QoS, how can you measure that your traffic really has a higher priority? One thing is for sure, if QoS really comes, then the complexity level of the Internet will be raised again by one or two bars, which means more work for IT pros.

In the next post I will talk about [IPv6 IPsec and the IPv6 LAN features](https://4sysops.com/archives/ipv6-tutorial-part-3-new-features-ipsec-and-lan-features/).