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Internet readies for crowded days

The Internet address space is 'virtual' and we can create more space when things get crowded, says S.Ananthanarayanan.

Internet addresses are expressed as a string of 32 'ones' or 'zeros'. As each digit can have 2 possible values, a 32 digit string can have 2^{32} different forms and this comes to about 4.2 billion. In practice, the 32 'bits' are separated as 4 groups of 8 bits each. 8 bits can count to 2^8=256 and each of the 4 groups is thus a number from 0 to 255. Hence addresses like 216.239.57.99 (google.com) or 64.4.32.7 (hotmail.com). But in fact they are all 32 characters long.

Is it getting crowded?

Although 4.2 billion is a fair number, all the addresses are not actually available for use. This is because the 4.2 billion addresses need to be arranged systematically, so that an address can be traced. The result is that some numbers then do not get used. The four groups in an Internet address can be compared to the country, city, street and door number in a house address. We can see that some streets would have more than 256 houses and many cities would have more than 256 streets. Many streets would also have less than a hundred houses and there would be cities with very few streets. In the crowded places, the answer may be to divide a city into 2 cities or a street into 2 streets and so on. But a good many street and house numbers would still be left unused.

With growing Internet use, there is now real scarcity of Internet host addresses and also growing complexity of the addressing system. The scarcity of addresses is forcing the need to distort the straight, tree-type addressing system to make use of free addresses in other 'branches'. It is like making the house numbers in one street refer actually to houses in some other part of the city (or in another city). One can imagine that postmen would have a difficult time in delivering letters. In Internet-talk, the programming of 'routers', or computers that help messages find their way, is getting devilish!

Enter – IPv6

The 32 bit Internet addressing system is called ***Internet Protocol***, or ***IP***. The current version is version 4, known as ***IPv4***. Apart from the growing numbers of people getting connected to the Internet, we are now seeing devices like cell phones, motor car engines and maybe soon individual cardiac pacemakers being controlled through the Internet. Numbers apart, the routing complexity may become unmanageable.

The problem, in fact, was recognized as early as 1991 and the ***Internet Architecture Board*** took up the need for an alternate system. The new IP version that got developed by the late '90s was ***IPv6***, or a system based on a string of 128 characters, in place of the present 32.

The system developed provides for mnemonics to simplify handling 128 character strings and even provides for IPv6 addresses to exist along with IPv4 addresses. An existing service, for instance, is that intermediate routers poll for the best path to each IPv4 address and to keep tables of the routes discovered. Now, messages from and to IPv6 networks could run into difficulty if they had to pass through an IPv4 network. Methods have been devised to help IPv4 routers cope with this and other transition problems. The great advantage of IPv6, in fact, apart from the greater address space, is simplicity of routing that will become possible with greater organization being feasible.

Is it overkill?

A string of 128 'ones' and 'zeros' can code 2^{128} addresses. This number is nearly $3x10^{38}$. To make it more comprehensible, it is like having $6x10^{23}$ addresses for every square metre of space on the surface of the earth. (and $6x10^{23}$ is about the number of molecules in 22.5 litres of hydrogen gas). Even if his does not make it more 'comprehensible', it hopefully indicates that IPv6 has a huge number of addresses.

A question raised is why jump from 32 bits to 128? Could 64 bit addresses not have served the purpose? The main reason is that larger addresses do not cause inconvenience to users, but they allow abundant elbowroom for simplifying the task of routing. And another thing, there is so much changeover effort involved that it would be a pity to do it again if 64 bit addressing proved inadequate.