What is IPv6 and why is it needed?

- The world is changing, and Everything is connecting to an IP network.
- The current Internet Protocol IPv4 is running out of room to accommodate all of the unique IP addresses required for the world's growing number of connected devices.
- IPv6 is a new Protocol that increases the number of possible unique IP addresses from 4.3 billion to 340 trillion-trillion-trillion.

On the internet, IP traffic is transmitted via network packets, which are like envelopes that contain the voice, data, or video traffic travelling over the IP network. When a network packet is sent from one IP device to another, the device is assigned a unique IP address to define its exact identity and location. This is where the address protocols, IPv4 and IPv6 (Internet Protocol version 4 and version 6) come in.

IPv4 was deployed in 1981 by the Internet Engineering Task Force (IETF). IPv4 addresses are based on 32-bit identifiers, which can be used in 232 unique combinations, to create 4,294,967,296 unique IP addresses that can be supported by IPv4. 4.3 billion is a very limiting number, considering the fact that Apple alone had sold about 1 billion iPhones and iPads by the end of 2015. And according to Cisco's VNI (2015), there will be more than 24 billion IP devices connected by 2019.

IPv4 Address (example only)

190	:	18	:	345	:	1
10101110		00011001		11101001		00011011

1 byte = 8 bits → 4 bytes = 32 bits

It is easy to see why a new address protocol was needed. IPv6. (IPv5 was mostly experimental, which is why the protocol skips from v4 to v6.) In terms of the number of possible addresses, IPv6 is a game changer. It employs a 128-bit 2128 address system, which means that the number of unique IP addresses that can be created is now 340 trillion-trillion-trillion, also known as 340 undecillion.

IPv6 Address (example only)

2002:0DG6:DC08:EF03:0000:0000:0000:0000:0000:0000:0000:0000:0000:0000:0000:0000

10101110 00011001 11101001 00011011 00110011 00101010 00110011 00110010 00110010 00110010 00101010 00101010 00101010 00101010 00011001 00011001

1 byte = 8 bits → 16 bytes = 128 bits

To put into perspective how many addresses the new IPv6 protocol can offer, consider this comparison:

Number of gallons in the world's oceans	: 352,670,000,000,000,000,000
Number of unique IP addresses in IPv6	: 340,000,000,000,000,000,000,000,000,000,000,000,000

IPv6 was officially launched globally in 2012, but the transition from IPv4 to IPv6 will take years. In addition to the ability to offer many more unique IP addresses, IPv6 also has other advantages to IPv4 including mandatory IP encryption security, more payload per IP packets, and simplified router processing.

Application:

It is anticipated that by 2019, there will be more than three IP devices for every person on earth. That means about 24 billion IP devices. Many of them will require a unique IP address so that they can be located and identified on an IP network.

Challenge:

The internet is running out of room because Everything is connecting to an IP network. Specifically, we are running out of unique IP addresses with IPv4 which provided only about 4.3 billion unique IP addresses. IPv4 protocol employs a 32 bit (four byte) 232-address system. This was once thought to be a huge number, but it quickly became a limiting factor.

Solution:

IPv6 employs a 128-bit (16 byte) 2128 address system which will allow for 340 undecillion unique IP addresses or... as we like to say today (in 2017), an almost limitless number.

If the number of IPv4 addresses could be contained inside **a golf ball** then the number of IPv6 addresses would fit inside **the sun**.