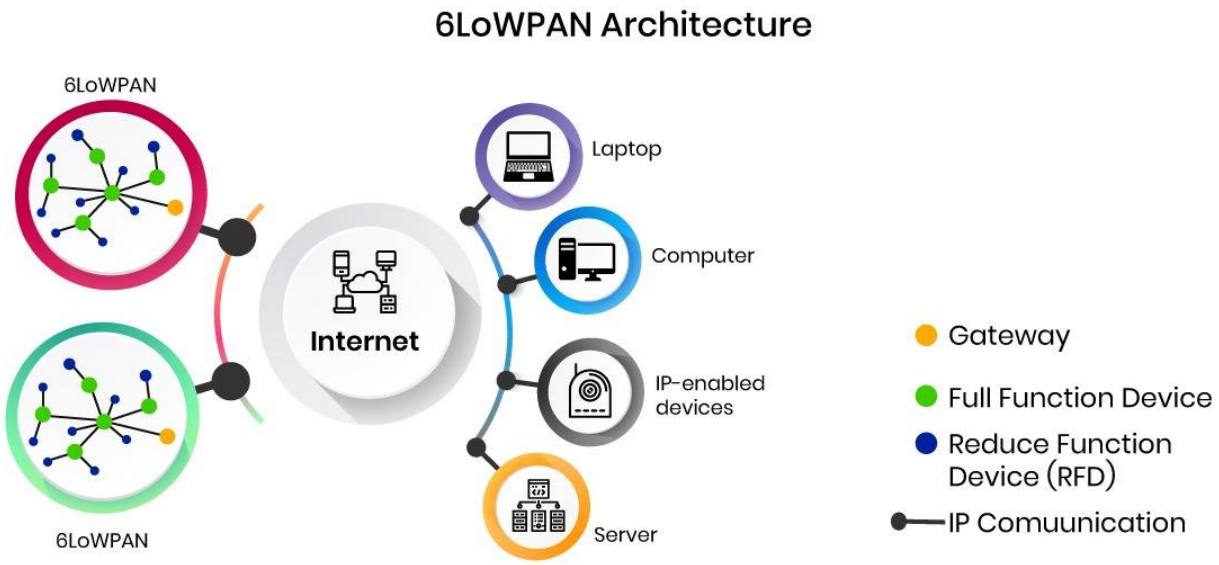
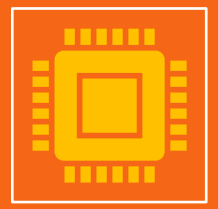


WPAN WITH IP – 6LOWPAN

Bhupendra Pratap Singh

OVERVIEW



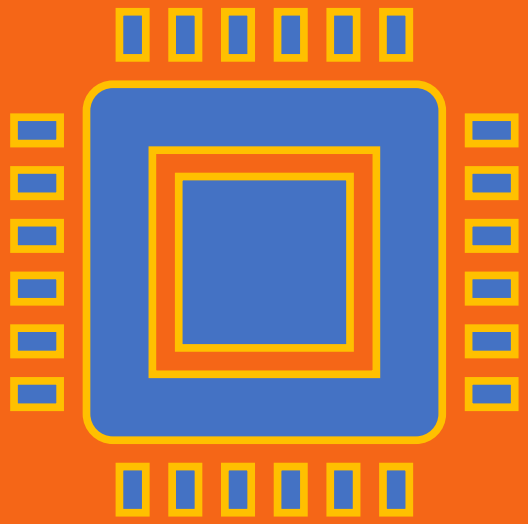
In an effort to bring IP addressability to the smallest and most resource constrained devices, the concept of 6LowPAN was formed in 2005.

A working group formalized the design in the IETF under the specification RFC 4944.

Later updated RFC 6282 – **Address Header Compression**

RFC 6775 for **neighbor discovery**.

OVERVIEW



- 6LowPAN is an acronym that stands for IPV6 over low power WPANs.
- The intent is for IP networking over low power RF communication systems for devices:
- **That are power and space constrained and do not need high bandwidth networking service.**
- Can be used with 802.15.4 as well as Bluetooth and other wireless networks.

OVERVIEW

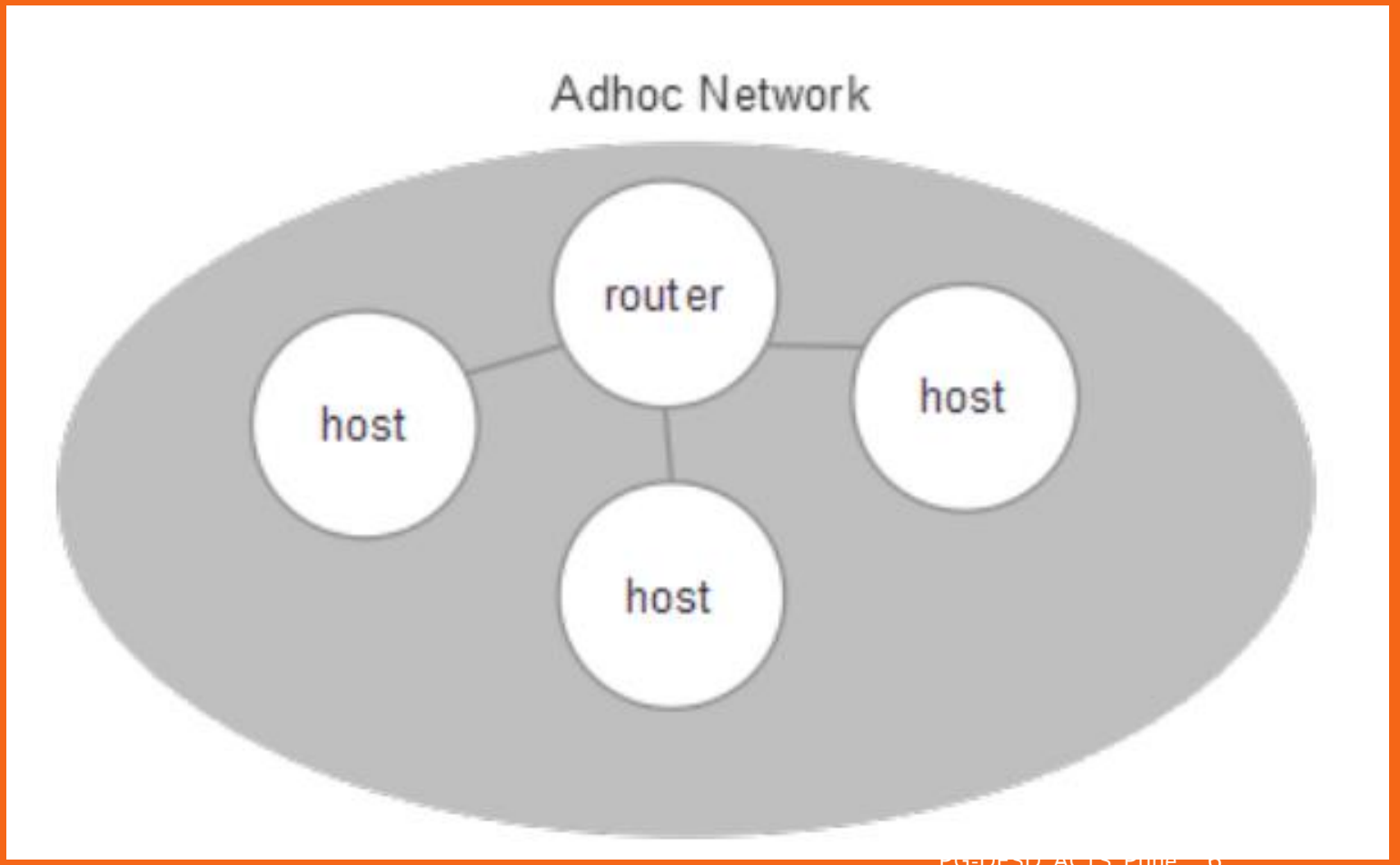
- The principal advantage of 6LowPAN is that the simplest of sensor can have ip addressability and act as a network citizen over 3G/4G/LTE/WI-FI/Ethernet routers.
- A secondary effect is that IPV6 provides significant theoretical addressability of 2^128 or 3.4x10^38 unique addresses.

6LOWPAN TOPOLOGY

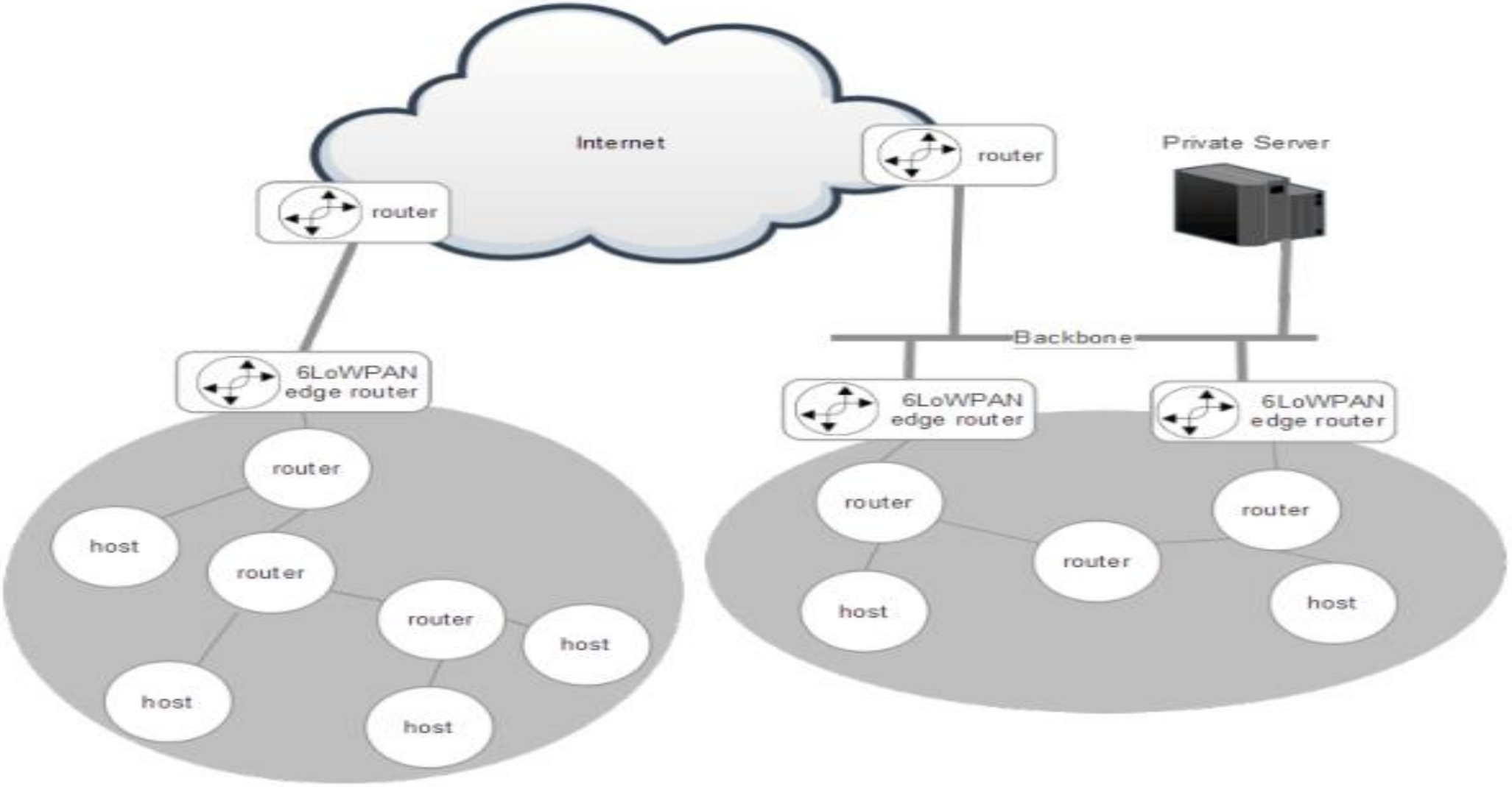
- 6LowPAN networks are mesh networks residing on the periphery of larger networks.
- Allowing for ad-hoc and disjointed networks without any binding to the internet or other systems, or they can be connected to the backbone or the internet using edge routers.
- Multi-Homing – 6 LowPAN networks can be conjoined with multiple edge routers; this is called multi homing.

6LOWPAN TOPOLOGY

Allowing for ad-hoc and disjointed networks without any binding to the internet



6LOWPAN TOPOLOGY



6LOWPAN TOPOLOGY - EDGE ROUTER

- An Edge router is also known as border router.
- It has four functions

1. Handles the communication of the 6LoWPAN devices and relays data to the internet.
2. Performs compression of IPV6 headers by reducing 40 byte IPv6 header and 8 byte UDP headers for efficiency in a sensor networks. A typical 40 byte IPv6 header can compress to 2-20 bytes depending on usage.
3. Initiates the 6LowPAN networks.
4. Exchanges data between devices on the 6LoWPAN network.

6LOWPAN TOPOLOGY

- All nodes within a 6LoWPAN network share the same IPv6 prefix that the edge router establishes.
- Nodes will register with the edge routers as a part of the **NETWORK DISCOVERY (ND) or neighbor discovery phase.**
- IPv6 Neighbor Discovery provides several important mechanisms used for router discovery, address resolution, Duplicate Address Detection, and Redirect messages, along with prefix and parameter discovery.
- **More can be explored related to ND with RFC4861, 6775.**

6LOWPAN MESH

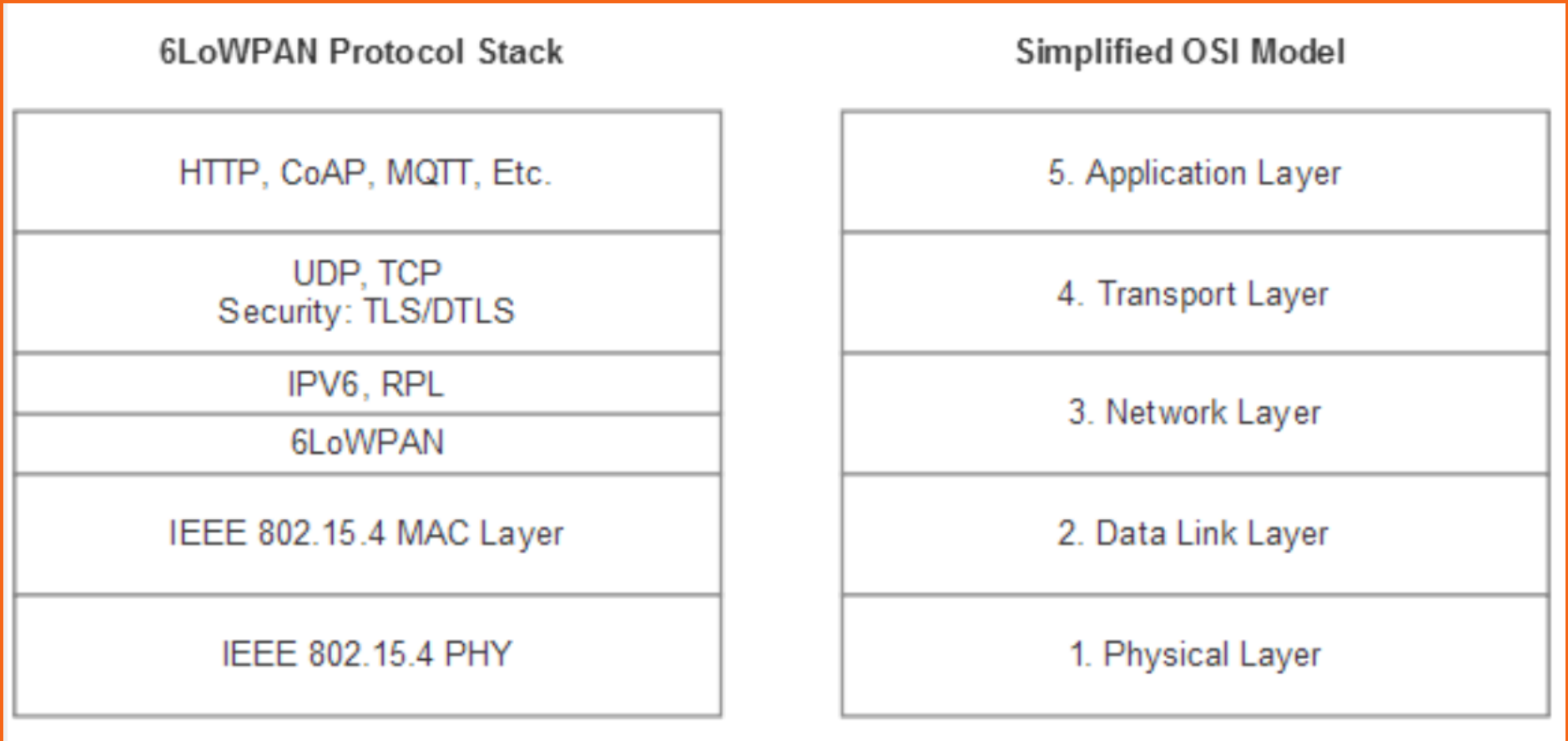
- There are three types of nodes within the 6LoWPAN Mesh
- **Router Nodes:**
  - These nodes marshal data from one 6LoWPAN mesh to another. Routers can also communicate outward to the WAN and internet.
- **Host Nodes:**
  - Hosts in the mesh network cannot route data in the mesh and are simply endpoints consuming or producing data.
  - Allowed to be in sleeping states, occasionally waking to produce data or receive data cached by their parent routers.

6LOWPAN MESH

- **Edge Routers**
  - These are the gateways and mesh controllers usually at a WAN edge. A 6LoWPAN mesh would be administered under the edge router.

Nodes are free to move reorganize/reassemble in a mesh.

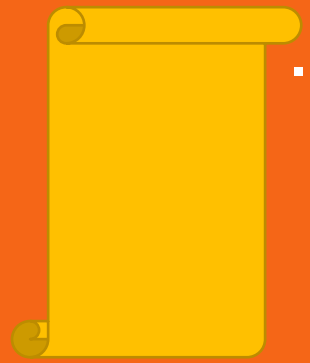
6LOWPAN PROTOCOL STACK



Source : Internet of Things for Architects, page 186

6LOWPAN PROTOCOL STACK

- Physical Layer is responsible for receiving and converting data bits over the air.
- MAC Layer – responsible for detecting and correcting errors at this layer.



- By enabling IP traffic at sensor level, the relationship between the device and gateway would use some form of application layer to convert data from Non IP protocols to IP protocol. (Ex. Bluetooth, ZigBee, Z-wave)

HEADER COMPRESSION AND FRAGMENTATION

- While the advantage of having virtually unlimited ip addresses for things is a significant milestone, placing IPV6 on an 802.15.4 link poses some challenges that must be overcome to make 6LoWPAN usable.
- IPV6 has a Maximum Transmission Unit (MTU) size of 1280 bytes or greater, while 802.15.4 has a limit of 127 bytes.
- The second issue is that IP6 in general adds significant girth to an already bloated protocol, for example, in IPv6 headers are 40 bytes long.

HEADER COMPRESSION AND FRAGMENTATION

- Header compression is a means to compress and remove redundancy in the IPV6 standard header for efficiency reason.
- 6LoWPAN adopted stateless and shared-context compression.

IPV6 VS IPV4

- A significant difference between IPv6 and IPv4 is the address notation. IPv4 uses a period (.) between each octet, compared to IPv6 which uses a colon (:). With IPv6, if you have a series of zeroes in a row, the address need not be written out completely.

- a double colon (::) is used to represent that series of zeroes, however you can only use that once. For example, Address like "2001:0DB8:0000:0003:0000:01FF:0000:002E", it can be written like "2001:DB8::3:0:1FF:0:2E" or "2001:DB8:0:3:0:1FF::2E", but would never be written like "2001:DB8::3::1ff::2E".

KEY POINTS TO REMEMBER

- IPV6 header is fixed 40 bytes long.
- IPV4 header is 20bytes fixed, max. 60 bytes long.
- IPV4 support three addressing modes –
  - Unicast
  - Multicast
  - Broadcast
- **IPV6 doesn't support broadcast, instead of Anycast method.**

Thank you !!

Q&A??