IPv6 and short-range protocols

IPv6's huge increase in address space is an important factor in the development of Internet of Things. **Internet Protocol version 6** (**IPv6**) is the latest version of the Internet Protocol (IP), the communications protocol that provides an identification and location system for computers on networks and routes traffic across the Internet. IPv6 was developed by the Internet Engineering Task Force (IETF) to deal with the long-anticipated problem of IPv4 address exhaustion.

IPv6 is intended to replace IPv4, which still carries the vast majority of Internet traffic as of 2013. As of February 2014, the percentage of users reaching Google services over IPv6 surpassed 3% for the first time.

Every device on the Internet is assigned an IP address for identification and location definition. With the ever-increasing number of new devices being connected to the Internet, the need arose for more addresses than the IPv4 address space has available. IPv6 uses a 128-bit address, allowing 2128, or approximately 3.4×1038 addresses, or more than 7.9×1028 times as many as IPv4, which uses 32-bit addresses. IPv4 provides approximately 4.3 billion addresses. The two protocols are not designed to be interoperable, complicating the transition to IPv6.

IPv4 vs IPv6

The main advantage of IPv6 over IPv4 is its larger address space. The length of an IPv6 address is 128 bits, compared with 32 bits in IPv4. The address space therefore has 2128 or approximately 3.4×1038 addresses. By comparison, this amounts to approximately 4.8×1028 addresses for each of the seven billion people alive in 2011.In addition, the IPv4 address space is poorly allocated, with approximately 14% of all available addresses utilized. While these numbers are large, it wasn't the intent of the designers of the IPv6 address space to assure geographical saturation with usable addresses. Rather, the longer addresses simplify allocation of addresses, enable efficient route aggregation, and allow implementation of special addressing features. In IPv4, complex Classless Inter-Domain Routing (CIDR) methods were developed to make the best use of the small address space. The standard size of a subnet in IPv6 is 264 addresses, the square of the size of the entire IPv4 address space. Thus, actual address space utilization rates will be small in IPv6, but network management and routing efficiency is improved by the large subnet space and hierarchical route aggregation.

Renumbering an existing network for a new connectivity provider with different routing prefixes is a major effort with IPv4. With IPv6, however, changing the prefix announced by a few routers can in principle renumber an entire network, since the host identifiers (the least-significant 64 bits of an address) can be independently self-configured by a host.

According to Steve Leibson, who identifies himself as “occasional docent at the Computer History Museum,” the address space expansion means that we could “assign an IPV6 address to every atom on the surface of the earth, and still have enough addresses left to do another 100+ earths.” In other words, humans could easily assign an IP address to every "thing" on the planet.

Short-range protocols

Sensor networking and M2M communication have become subject to special interest during the past few years. We present here both proprietary and standardized solutions, which have commercial deployments and concentrating on protocols that are being used for user/device monitoring, home and building automation and automotive applications.

	User/device monitoring	Home automation	Large building automation	Automotive
ZigBee	x	x	x	
Z-Wave		x		
Insteon		x		
EnOcean		x	x	
ONE-NET		x		
KNX		x	x	
LonWorks		x	x	
BACnet			x	
Modbus			x	
IEEE 802.11x (e.g. WiFi)	x	x	x	x
DASH7				x
IEEE 1902.1 (RuBee)	x			
Bluetooth (LE)	x			x
ANT/ANT+	x			
Infrared	x	x		

Short-range protocols for IoT (source: Oleksiy M, et al. 2013)

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