



IPv6 – Basics, Protocols and Implementation

Course Description

IPv6, first released in 1995, has become an integral part of IoT applications and mobile networks, causing its importance to increase significantly over the last decades. In this course, you will learn the basics, the protocol and addressing, routing, DNS, QoS, IPv6 security, migration from IPv4 and more. The course provides in-depth knowledge in the protocol and common standards with many real-life examples of networks and implementations.

Course Objectives

By the end of the course, the participant will be able to:

- Describe the IPv6 protocol and addressing
- Perform IPv6 address design
- Understand the IPv6 packet structure and headers
- Understand IPv6 mechanisms, including routing, security, QoS, mobility and various features
- Understand IPv4 to IPv6 migration techniques and migration strategies

Target Audience

R&D, engineering and technical Support, IT and communications managers

Prerequisites

High-level understanding of the TCP/IP protocol stack

Duration

2 days

Outline

1. Introduction
 - Limitations of IPv4
 - Consequences of the Limited IPv4 Address Space
 - Features of IPv6
 - New Header Format
 - Large Address Space
 - Stateless and Statefull Address Configuration
 - IPsec Header Support Required

- Better Support for Prioritized Delivery
 - New Protocol for Neighboring Node Interaction
 - Extensibility
- Comparison of IPv4 and IPv6
- IPv6 Terminology
- 2. Addressing
 - Multicast, Unicast and Anycast addresses
 - Address types – Global, Link-local, Site-local and special case addresses
 - IPv6 Multicast addresses
 - IPv6 multicast group management (MLD)
 - IP address design
 - Design exercise
- 3. IPv6 Packet Structure
 - IPv6 datagram header
 - The IPv6 datagram format
 - IPv6 extension headers brief
 - ICMPv6
- 4. IPv6 Headers
 - Base header
 - Extension headers
 - Hop-by-hop options
 - Routing
 - Fragmentation
 - Encapsulating Security Payload (ESP)
 - Authentication Header (AH)
 - Destination Options
- 5. IPv6 Auto-Configuration
 - ICMPv6
 - ICMPv6 Header
 - ICMPv6 Message Types
 - ICMPv6 Error Message Types
 - ICMPv6 Informational Message Types
 - ICMPv6 Ping Operation
 - Neighbour and router discovery in IPv6
 - ICMPv6 Neighbor Discoveries

- Neighbor Solicitation
 - Neighbor Advertisement
 - Router Solicitation
 - Router Advertisement
 - DHCPv6 Overview
 - DHCPv4 and DHCPv6 Comparison
 - DHCPv6 Relay Agent
 - ICMPv6 Redirect
 - ICMPv6 Multicast Messages
 - Fragmentation Service from the Source
 - ICMPv6 MTU Path Discovery
 - ICMPv6 Packet Too Big Error Message
 - Windows Destination Cache Table
 - Fragment Header
 - Fragment Offset Value
 - ICMPv6 Time Exceeded Destination Unreachable, etc.
 - ICMPv6 Multicast Listener Discovery Message
6. IPv6 Routing
- IPv6 Routing and routing Tables
 - MTU discovery
 - Neighbour reachability
 - IPv6 Router renumbering
 - ICMPv6 Redirects
 - RIPng
 - OSPFv3
 - BGPv4 & IPv6
 - IPv6 Multicast Routing - PIM and BGMP
7. Interfacing with other layers
- Interfacing with the DataLink and Physical layer
 - IEEE 802 standards and IPv6
 - Operation of TCP and UDP
 - Ports and sockets
 - Changes to TCP for IPv6
 - Changes to UDP for IPv6
8. IPv6 Security

- Cryptographic techniques
 - IPv6 and IPSec
 - IPv6 AH & ESP Headers
 - Transport and tunnel modes
 - Security associations
 - ISAKMP & IKE
9. IPv6 QoS
- IPv6 Traffic classes
 - The IPv6 Flow label
 - Differential services (DiffServ)
 - Integrated services (IntServ) and RSVP
10. IPv4-IPv6 Transition Mechanisms
- Introduction
 - IPv6/IPv4 Dual Stack
 - Translation Mechanisms
 - Stateless Internet Protocol/Internet Control Messaging Protocol Translation (SIIT)
 - Bump in the Stack (BIS)
 - Bump in the API (BIA)
 - Network Address Translation–Protocol Translation
 - Transport Relay Translator
 - Tunneling Mechanisms
 - Static Tunneling
 - Automatic Tunneling Using IPv4-Compatible Addresses
 - 6over4 Transition Mechanism
 - 6to4 Transition Mechanism
 - Intra-site Automatic Tunnel Addressing Protocol (ISATAP)
 - Teredo
11. DNS and IPv6
- Name Resolution for IPv6
 - DNS Enhancements for IPv6
 - LLMNR
 - Source and Destination Address Selection
 - IPv6 DNS Extensions
 - New Resource Record Type - AAAA (IPv6 Address)
 - New Reverse Resolution Hierarchy

- Changes to query types and resolution Procedure

12. IPSec Security

- IPSec Tunneling
- IPv6 IPSec
 - Security Areas Addressed
- IPSec Framework
 - Authentication Header
 - AH Transport Mode
 - AH Tunnel Mode
 - Encapsulating Security Payload
 - ESP Transport Mode
 - ESP Tunnel Mode
 - Internet Key Exchange
- IPv6 IPSec in a Windows Environment
 - Microsoft Symmetric Key Authentication
 - Setting Up the IPSec6 Tunnel