

## ***How to Manage IPv6 Deployments***

### **Course Duration:**

- 2 days

### **Course Description:**

- This course focusses on identification of the most critical IPv6 deployment issues and will provide some guidance for smooth transition from IPv4 to IPv6. We will identify different problem areas, e.g. around dual stack host implementations, OS dependencies with migration strategies, incompatibilities with DNS / DHCP requests and addressing schemes as well as different supported feature sets at network nodes (gateways, routers and servers).
- In order to understand all possibilities and procedures, we will start with a discussion of all IP header field elements, identify all parts that have been inherited from IPv4, clarify the terminology and explain all the new header elements, their purpose and intended usage.
- The IP header structure will be completed with the detailed consideration of the new concept of Extension Headers in IPv6 and the purpose and usage of each of the options.
- We will then thoroughly discuss the address structure of IPv6 with the formats of Unicast, Multicast and Anycast addresses and what the options are to obtain a valid IP address.
- The course will then explain, how ICMPv6 is structured and how it is used to replace and incorporate all other support protocols known from IPv4. This will include detailed discussion of address generation options, including DHCP, Stateless Autoconfiguration, Neighbor Discovery and Duplicate Address Detection, critical issues for the deployment of IPv6.
- Routing in IPv6 will be the next section, which identifies the protocol options within a domain and between domains and discusses the related protocols, such as RIPng and OSPF.
- With the basic IPv6 features and structures in mind, we will evaluate the potential and real obstacles in deploying a mixed IPv4 and IPv6 environment, discuss the missing backward compatibility and several enhancements to overcome address problems and concerns, as well as issues with mixed DNS and DHCP accesses.
- A selected number of documented use cases will indicate fault situations due to improper and incompatible implementations in both hosts and network, e.g. dual stack behaviour, sequence of initialisations and fallback, support for various tunneling methods, multihoming issues etc.
- We will familiarize the student with some commands to check and verify reachability, TCP and DNS connections.
- We will then investigate various operational issues, starting with security in IPv6, usage in VPN networks with IPsec mechanisms for authentication and ciphering.
- This will be followed by a study of Mobile IP with the basic operation and review of ICMP protocol enhancements for this case.

As in all INACON courses we integrated several interactive exercises for a perfect learning experience. Many of these exercises are based on already prepared WIRESHARK logfiles which are provided to the students by the trainer. For those who don't have a PC with them or who do not use WIRESHARK, the logfiles are made available as printouts.

## **Prerequisites:**

- The student must possess a sound understanding of network architecture and packet routing in general and today's TCP/IP version in particular. There is no particular knowledge required regarding IPv6.
- We do recommend our webinar or web based training courses on IPv6 as preparation for the course in order to improve efficiency and comprehension.

## **Course Target:**

- The student is enabled to develop, test and integrate IPv6-equipment and protocols and to operate related networks.

## **Who should attend this Course:**

- Test engineers who need to understand IPv6-features and their implications in detail.
- Designers of IPv6 network domains who require a deep inside view of the various enhancements.
- Anyone who need to understand the IPv6 terminology, features, addressing and routing mechanisms and the applicability in future networks.

## **Some of your Questions that will be answered:**

- How does the IPv6 protocol header differ from IPv4?
- Which elements are still used in IPv6 and what is the reason for changes in terminology?
- What are Extension Headers, which information do they convey and how and when are these extensions being used in IPv6?
- What is the structure of an IPv6 address and which parts are being used for public routing and how?
- What are the changes in the support protocols such as ICMP and what happened to ARP in an IPv6 environment?
- What is a Link-Local Address and how is that address obtained / generated?
- What is the process and the purpose of Stateless Autoconfiguration and how does a terminal / application obtain an IP address in IPv6? How about DHCPv6, when and where must that be used? Is there a dependency with host operating systems?
- How do routing protocols such as RIP and OSPF operate and where are they used?
- How can Interworking with IPv4 and the migration from IPv4 be accomplished? What is the difference in DNS requests and records, where are the incompatibilities?
- What is the difference of the various tunneling mechanisms, such as Teredo, 6to4 and others and where are they used?
- What are the potential problem areas during IPv6 deployment related to implementation and compatibility issues between hosts and network nodes, e.g. in dual stack or tunneling environments.
- Which are the security mechanisms provided with IPv6 and how is IPSec used for authentication and ciphering?
- What is Mobile IPv6, how does it operate and where is it used?

## Table of Contents:

### Review of IPv4 and Differences to IPv6

- **IPv4 History and Weaknesses**
  - ⇒ Address Space and its Limits
  - ⇒ Functionality
  - ⇒ IP Control Protocols and Complexity
  - ⇒ IPv4 Routing Overview
- **Overview of the IP Protocol Headers**
  - ⇒ Terminology
  - ⇒ Protocol Elements inherited from IPv4
  - ⇒ New IPv6 Protocol Elements, Flow Label and others
  - ⇒ Detailed IPv6 Header Element Discussion
- **Extension Header Concept in IPv6**
  - ⇒ Type and Order of Extension Headers
  - ⇒ Routing Headers
  - ⇒ Fragmentation
  - ⇒ Option Header, Jumbograms
  - ⇒ Security Headers
- **Practical Exercise**
  - ⇒ *Laptop Configuration for IPv6 under Windows XP and LINUX*
  - ⇒ *Determine the structure of an IPv6 Header*

### Details of IPv6 Addressing

- **Address types**
  - ⇒ Unicast, Multicast and Anycast Addresses
  - ⇒ Address Structures
  - ⇒ Interfaces and Addresses

- **Details of ICMPv6**
  - ⇒ Diagnostic Messages
  - ⇒ Echo Messages
  - ⇒ Multicast Messages
  - ⇒ Router and Neighbor Messages
  - ⇒ Redirect Messages
- **Practical exercise**
  - ⇒ *IPv6 Log File Analysis*
- **Address Configuration Options**
  - ⇒ DHCPv6 Details
  - ⇒ Link-Local Address Generation
  - ⇒ Stateless Address Autoconfiguration
  - ⇒ Neighbor Discovery with ICMPv6
  - ⇒ Duplicate Address Detection Mechanism
- **Practical exercise**
  - ⇒ *Generation of an IPv6 Host Address based on MAC Address and Link-Local Address using Modified Extended Unique Identifier Mechanism*
- **Name Resolution in IPv6**
  - ⇒ DNS Overview
  - ⇒ DNS Enhancements for IPv6
    - A6 Records, Reverse Lookup
  - ⇒ Compatibility Issues with IPv4
    - DNS requests in dual stack environments

## IPv6 Routing Concepts

- **Address Architecture and Hierarchy**
- **Routing Protocol Overview**
  - ⇒ Intra Domain Routing Protocols
    - RIPnG, OSPFv6 and IS-IS
  - ⇒ Inter Domain Routing Protocols
    - BGP4+ for IPv6, IDRPv2
- **Practical exercise**
  - ⇒ *Completion of a RIP Routing table example based on a given scenario*

## IPv6 Deployment – Obstacles and Solutions

- **IP Network Overview and Problem Description**
  - ⇒ Impact on other Protocol Layers
    - Host OS related (Windows, Linux, MAC),
    - Transport related (TCP / SCTP issues, Multi-Homing),
    - Service related (DNS and DHCP issues)
    - OS related: Which OS supports which feature set?
  - ⇒ IPv6 Addressing Issues
    - Extensions to Stateless Autoconfiguration (Privacy Extensions)
    - Router Advertisements with DNS specifications (RDNSS, DNSSL vs DHCPv6)
    - Are these RA reliable and what should be the fallback solution?
    - Extensions to Link-local Addresses (use of Zone Index)
- **Migration Strategies**
  - ⇒ IPv4 / IPv6 Coexistence
    - Dual Stack (DSTM),
    - Tunneling (6to4, 6over4, Teredo, Tunnel Broker, ISATAP),
    - Translation (SIIT, NA(P)T-PT, SOCKS, BIS)
- **Selected Deployment Use Cases**
  - ⇒ Dual Stack host problems
  - ⇒ DNS / DHCP Issues
  - ⇒ Migration Issues with supported features at gateways, routers and servers.
- **Practical exercise**
  - Introduction of commands to verify IPv6 and DNS configuration, check TCP connections and reachability under IPv6.*

## Operation of IPv6

- **Security, VPN Configuration and Operation**
  - ⇒ Threats and Security Attacks regarding IP
  - ⇒ IPSec configuration with Authentication
    - AH header details and usage
  - ⇒ IPSec configuration with Ciphering
    - ESP header details and usage
  - ⇒ Key exchange method overviews

- **Mobile IP in IPv6**
  - ⇒ Mobile IP – Basic Operation Principles
  - ⇒ Use of Destination Options for Mobile IPv6  
Home Address, Binding Options
  - ⇒ ICMP Protocol Enhancements
  - ⇒ Home Agent Solicitation