

# 6LowPAN and the Internet of Things (4 days)

How to plan and implement sensor networks and applications using 6LowPAN

## You will learn how to

- Configure networks to support IPv6
- Differentiate between 6LowPAN and other IoT technologies
- Choose 6LowPAN hardware
- Select 6LowPAN implementations
- Configure IEEE 802.15.4 LowPANs
- Implement 6LowPAN on hosts and routers
- Configure 6LowPAN
- Create 6LowPAN applications
- Capture and decode 6LowPAN traffic
- Secure 6LowPAN networks
- Deploy and manage 6LowPAN networks
- Integrate 6LowPAN networks with the wider Internet

## Course Benefits

The Internet of Things (IoT) is growing at an astounding pace. There is a proliferation of Internet enabled devices, with new ones appearing almost daily. Cars, houses, farms, businesses and public places are all becoming a part of the Internet enabled world. The Internet of Things is changing the way that we live.

IPv6 is playing a crucial role in the growth of the Internet of Things. It provides the required address space for the expected hundreds of billions of Internet enabled devices of the future. Furthermore, IPv6 provides a way to leverage standard Internet protocols all the way from the user to the end device. A form of IPv6 (6LowPAN) makes it possible for sensors and actuators that are small, low-power and cheap, to be connected to the Internet of Things.

Erion's comprehensive 6LowPAN training covers all aspects of 6LowPAN.

In this course, you will learn how to obtain and implement 6LowPAN in a variety of environments and on a number of different platforms.

This course provides extensive hands-on sessions and in-depth technical analysis.

## Who Should Attend

This course is ideal for software and hardware engineers developing sensor networks using 6LowPAN. It is also appropriate for those looking to deploy and manage 6LowPAN based sensor networks.

A good knowledge of general networking concepts is assumed.

## Relevant Platforms:

Various platforms are covered by this course. The material is generic and is applicable to a range of hardware and software platforms.

## Course Contents

### Introduction to the Internet of Things (IoT)

- What is the Internet of Things (IoT)?
- Overview of IoT
- IoT benefits
- Where is IoT used?
- Characteristics of IoT networks and devices
- Low power Personal Area Networks (LowPANs)
- Why IPv6 is important to IoT
- Why 6LowPAN?
- Alternatives to 6LowPAN

### IPv6 Basics for IoT

- IPv6 datagram format and headers
- IPv6 extension headers
- IPv6 addresses
- IPv6 address representation
- Unicast, multicast & anycast in IPv6
- Link local, site local and unique local addresses
- IPv6 autoconfiguration methods

- Options for the IPv6 interface identifier
- Neighbor discovery (ND) and IPv6
- IPv6 router discovery (RS and RA)
- IPv6 and QoS
- IPv6 Traffic class and Flow label
- IPv6 and DNS
- IPv6 AAAA resource records
- Reverse DNS lookups in IPv6

### Embedded Hardware Overview

- Sensors and actuators
- Wireless
- Microprocessors
- Examples of existing solutions

### 6LowPAN Datalink Protocols

- How the datalink influences 6LowPAN
- IEEE 802.15.4
- Bluetooth
- DECT Ultra Low Energy
- G.9959 Short range narrow-band digital
- NFC (Near Field Communication)

### Introduction to 6LowPAN

- The purpose of 6LowPAN
- Overview of 6LowPAN
- 6LowPAN addressing
- IPv6 and 6LowPAN MTUs
- The 6LowPAN adaption layer
- 6LowPAN header formats
- Address autoconfiguration in 6LowPAN
- Header compression
- 6LowPAN basic header compression (HC)
- 6LowPAN IPHC compression
- 6LowPAN NHC compression
- 6Low PAN generic header compression (GHC)

### 6LowPAN and IEEE 802.15.4

- IEEE 802.15.4
- IEEE 802.15.4 physical layer
- IEEE 802.15.4 packet structure
- The MAC layer in IEEE 802.15.4
- Full and reduced function devices
- Topologies
- 6LowPAN and IEEE 802.15.4
- Capturing and decoding IEEE 802.15.4 traffic

### Routing in 6LowPAN Networks

- IPv6 default routes
- Overview of dynamic routing
- Routing considerations for IoT
- L2 forwarding or "Mesh-Under"
- L3 routing or "Route-Over"
- RPL ROLL
- RPL and compression
- Routing header dispatch

### 6LowPAN Neighbor Discovery

- The problems with neighbor discovery
- ND changes for 6LowPAN
- 6LowPAN ND options
- Address registration option
- 6LowPAN context option
- Authoritative border router option
- Duplicate address messages (DAR & DAC)
- Overview of 6LowPAN ND operation
- The context table
- Registration and unreachability detection
- Address resolution
- Sleeping
- Bootstrapping

### 6LowPAN Application Protocols

- Application protocols
- Designing 6LowPAN applications
- RESTful applications
- Constrained Application Protocol (CoAP)

### Developing 6LowPAN Applications

- Hardware options
- Protocol stacks
- Contiki & Cooja
- TinyOS and BLIP

- Sensinode Nanostack
- Jennic 6LowPAN
- Nivis IAS 100

### Monitoring and Testing 6LowPAN

- Packet Capture
- SNMP & IPv6
- The extended MIB for IPv6
- The 6LowPAN MIB

### 6LowPAN Security

- Link-layer security
- IEEE802.15.4 security
- Securing neighbor discovery
- Lightweight secure ND

### 6LowPAN and IPsec

- Cryptographic techniques
- Link-layer security
- IEEE802.15.4 security
- IPv6 and IPsec
- IPv6 AH & ESP headers
- Transport and tunnel modes
- Security associations
- ISAKMP & IKEv2
- Implicit-IV (Initialization Vector)
- Diet-ESP
- IKEv2 and Diet-ESP
- Diet-ESP payload compression

### Mobile IPv6 for IoT

- Mobile IPv6 Home Agents (HAs)
- Binding updates & binding cache
- Mobile IPv6 in operation
- Mobile IPv6 security
- NEMO

### Alternatives to 6LowPAN

- Zigbee
- Z-Wave
- RF for Consumer Electronics RF4CE
- IEEE 802.15.6 WBANs
- IEEE 802.15 WPAN TG4j MBANs
- ETSI TR 101 557

### Deploying IPv6 for IoT

- IPv6 deployment scenarios
- IPv6 network configuration considerations
- Obtaining an IPv6 prefix
- Creating an IPv6 address schema
- Providing IPv4 support
- NAT64 and DNS64
- Utilising transition mechanisms
- 6over4, 6to4, 6rd, ISATAP and Teredo
- What when and how to migrate to IPv6
- IPv6 strategic factors

### Hands-on IPv6 Practical Labs

Most modules include detailed exercises or demonstrations.

Hands-on IPv6 practical exercises include:

- Installing and configuring IPv6
- Capturing and decoding IEEE 802.15.4 traffic
- Capturing and decoding 6LowPAN datagrams
- Deploying a 6LowPAN network
- Designing a 6LowPAN network
- Designing a 6LowPAN application
- Simulating a 6LowPAN network
- Developing a 6LowPAN application
- Integrating a 6LowPAN with an IPv6 network

### The IPv6 Trainers

Trainers are practising IPv6 consultants with extensive experience of IPv6 and 6LowPAN. Further information can be found at [www.erion.co.uk](http://www.erion.co.uk).

Erion is the world's leading IPv6 training company.

