

DIAMETER and Charging in LTE / IMS

Course Duration:

- 3 days

Course Description:

- This course describes in detail structure and application cases of the Diameter protocol.
- We will start with a review of RADIUS discussing the concepts and protocol usage of AAA architectures and introduce the evolutions introduced with Diameter.
- An important part of the course will cover the policy control architecture and the alternatives with the logical entities PCEF and PCRF in a distributed environment as well as Diameter signaling routing and the use and purpose of Diameter Routing Agents (DRA's)
- Improved security, load sharing and redundancy issues will be discussed through thorough explanation of the Diameter protocol stack and in particular the SCTP transport capabilities.
- A thorough discussion of the Diameter Base protocol with the structure of the specification, Request / Response model, AVP principles and an overview of the Diameter applications defined by IETF such as NAS and CC commands and parameters.
- We will then review the various applications and interfaces developed by 3GPP for Diameter and will particularly focus on Diameter in the IMS and EPC environment for Authorization, Authentication and the usage in the security architecture.
- The Diameter Cx / Dx, S6, SWx and Sta interfaces will be evaluated in detailed with selected scenarios and sample log files to explain interworking with the HSS and AAA servers in 3GPP.
- The details of the commands and parameters of the Sh and Dh interfaces will explain the communications with application servers in the IMS environment with the access and update of profile information and access rights.
- Another important section deals with all aspects of the charging infrastructure accessed through Online and Offline charging interfaces Ro and Rf in IMS systems and Gy and Gz interfaces in the EPC
- Finally, we will review Diameter in the policing environment, evaluating the Gq/Go interfaces and discussing the related procedures and signaling.

*As in all INACON courses we integrated **several interactive exercises** for a perfect learning experience. Mainly 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 architectures in 3GPP. There is no particular knowledge required regarding Radius / Diameter.
- We do recommend our webinar or web based training courses on Diameter as preparation for the course in order to improve efficiency and comprehension.

Course Target:

- The student is enabled to develop, test and debug Diameter based protocols and to operate related networks.

Who should attend this Course:

- Design engineers who need to understand Diameter protocol and interfaces in detail.
- Test engineers who require a deep inside view of the various Diameter enhancements.
- Anyone who needs to understand the Diameter terminology, features, interfaces and the applicability in future 3GPP networks.

Some of your Questions that will be answered:

- What are the main differences between RADIUS protocol and its successor Diameter?
- How is the Diameter protocol structured and which applications and interfaces are supported by IETF and 3GPP?
- Which are the generic functions supported by the Diameter Base Protocol part and which services are being covered?
- What is the Diameter protocol stack in detail and which transport protocols are being used?
- How is Diameter used in the IMS environment, which functions are realized and how?
- Which commands are used on the Cx / Dx, interfaces?
- Where is Diameter used in the EPC and what are the interfaces?
- Which commands are used on the S6, SWx and Sta interfaces?
- What is the structure of a typical charging domain and how and when are the Ro and Rf interfaces being used?
- How is Diameter used for policing in IMS and in the EPC and where are the differences?

Table of Contents:

INTRODUCTION AND NETWORK OVERVIEW

- **The 3GPP Network Architecture in Context**
- **Main Architecture Elements in LTE / SAE**
 - ⇒ MME, SGW, PDN-GW, ePDG
Tasks and functions, interfaces, relations to charging
- **Main Architecture Elements in IMS**
 - ⇒ SIP Proxies, Gateway Function(s), Application Functions
Interfaces, Relations to charging, Interfaces to applications and charging relations
- **Protocol Stack Views**
- **Important Protocols Used in LTE and IMS with Charging Relation**
 - ⇒ SIP / SDP Introduction
Media Definitions and Identification, Service Routing, Flow Identifications
 - ⇒ LTE NAS Level Protocols for Session Control
EMM, ESM protocols, Session and Bearer Setup Scenario

HISTORY AND OVERVIEW OF AAA ARCHITECTURES

- **Overview of Authentication, Authorization and Accounting**
- **RADIUS – the Concept and Protocol Usages**
- **Protocol Evolution with Diameter**
- **Diameter Use Cases and Applicability within 3GPP**
 - ⇒ Authorization, Users, Services
 - ⇒ Authentication, Users, Network
 - ⇒ Security Architecture Overview
 - ⇒ Policing with Diameter, PDF, PCRF
 - ⇒ Session Control with Diameter
 - ⇒ Diameter in the Charging Architecture

DIAMETER PROTOCOL STACK DETAILS

- **Diameter Protocol Stack Review**

- ⇒ IPv4 / IPv6 Key Parameters, Comparison and Terminology
- ⇒ The Transport Alternatives – TCP vs. SCTP

- **SCTP as Diameter Transport**

- ⇒ Feature Overview and Terminology
Association, Path, (primary, idle, inactive) Stream, Multi-Streaming, Chunk, Chunk Bundling, Multi-Homing, SCTP Packet, Heartbeating, ASP's and AS
- ⇒ SCTP Details
Association Establishment, Management and Operation, Selected SCTP packet and chunk formats.
- ⇒ SCTP Security Considerations
- ⇒ Redundancy Modes and Options with SCTP
Loadsharing principle with ASP's

ARCHITECTURE DETAILS AND OPTIONS

- **Logical Policy and Charging (PCC) Architecture – Non Roaming Case**

Reference Points and Interfaces

- **PCC Roaming Architecture – Home Routed Access**

Reference Points and Interfaces

- **PCC Roaming Architecture – Local Breakout Case**

Reference Points and Interfaces

- **Operational Issues**

- ⇒ Session Establishment, Modification and Termination Involving PCEF and PCRF Functions
- ⇒ PCRF in V-PLMN vs H-PLMN
The need for centralized Diameter routing
- ⇒ PCRF Discovery and Selection – the Case of the Optional Diameter Routing Agent(s) (DRA)
DRA roles, load balancing, topology hiding, policy session binding

DETAILS OF THE CHARGING ARCHITECTURE WITH LTE/SAE AND IMS

- **Charging in the Specification**

- ⇒ CS Domain, PS Domain, WLAN, IM Subsystem
- ⇒ Service Charging, Advice of Charge (AoC), Online Charging System (OCS)

- **The Billing Domain**
 - ⇒ Online-, Offline-, Flow based Charging
- **Charging Architecture without IMS**
- **Charging Architecture with IMS**

DIAMETER PROTOCOL DETAILS

- **Protocol Architecture**
 - ⇒ Real Life Message Example
 - ⇒ ... and the Related Message Layout
 - Operation Principles of DIAMETER, Capabilities Exchange, Command Code, Application Id, Attribute Value Pairs, Vendor Id
 - ⇒ Application IDs
 - ⇒ Command Codes
 - ⇒ Vendor ID
- **Selected Protocol Formats**
 - ⇒ Header Format
 - Version-field
 - ⇒ Command Flags
 - R-Flag, P-Flag, E-Flag, T-Flag, r-Fields
 - ⇒ Command Codes
 - ⇒ Hop-by-Hop and End-to-End Identifier
 - End-to-End Identifier, Hop-by-Hop Identifier
 - ⇒ Attribute Value Pairs (AVP)
 - AVP Code
 - ⇒ AVP Flags and their Meaning
 - V-flag, M-flag, P-flag, R-field
- **Differences between DIAMETER and RADIUS**
 - ⇒ AVP Address Space
 - ⇒ Length Field of AVPs
 - ⇒ e2e-Ack of Messages
 - ⇒ Transport Protocol
 - ⇒ Peer Discovery
 - ⇒ Security

SELECTED SCENARIOS AND USE CASES

- **Connections vs. Sessions**

- ⇒ Definition
- ⇒ Connections
- ⇒ Sessions
- ⇒ Real-Life Example of a Session-ID

- **Capabilities Exchange Procedure (CER / CEA)**

- ⇒ Procedural View
- ⇒ CER -Message Example
- ⇒ CEA -Message Example

- **Selected Scenarios**

- ⇒ **DIAMETER: Registration towards the IMS**
Initial Conditions, Applicability of this Procedure, Description
- ⇒ **Session Establishment, Termination and Modification with PCEF and PCRF Involvement**
IP-CAN session establishment, UE initiated session termination, PCEF initiated session termination, PCEF initiated session modification, PCRF initiated session modification.
- ⇒ **DIAMETER Use within the Evolved Packet Core**
Part 1: Access from 3GPP-Networks, Part 2: Roaming Issues, Part 3: Access from Non-3GPP Access Networks, Example Scenario: Attachment from E-UTRAN (Extract)
- ⇒ **DIAMETER: Charging at the IMS**
Part 1: Connection Setup with Credit, Part 2: Connection Setup – no Credit