

5G Core Network Signalling – 2 days

CONTENTS

This course presents the signaling communication within 5G Core Network as specified in the current Rel-16 3GPP standards.

In order to provide the general context, the course briefly introduces the network organization, the roles of all the major 5G Network Functions (NFs), the basic 5G use cases (eMBB, mMTC and URLLC), the UE identities, and so on.

The course focuses on protocols and signaling procedures inside the 5G Core Network, between the UE and the Core Network and also between the 5G Radio Access Network and the 5G Core Network. The course describes the procedures used in the Standalone 5G Network deployments. The selected signaling procedures are presented on a message parameters level of details with some examples using traces from the 5G network.

PREREQUISITES

The overall knowledge of the 5G System is required to fully benefit from this course. We strongly recommend APIS' 5G System Overview and/or 5G Core Network Architecture courses to provide an overall introduction.

Architecture and Protocols

- An overview of the 5G standalone network architecture.
- Introduction to functionalities of various Network Functions.
- 5G Core Network UE identities.
- Registration types and introduction to Registration Areas.
- UE connectivity states to Radio Access Network and Core Network
- PDU Session attributes and possible connection options.
- General principles of communication in the Service Based Architecture.
- Basic concepts of Network Slicing.
- Overview of the functions of various protocols used inside 5G Core Network, between UE and 5GC, and between 5G RAN and 5GC: HTTP with JSON, PFCP, PRINS, GTP-U, NAS (5GMM and 5GSM), RRC, NGAP.

NAS and NGAP

- Functions of 5G Mobility Management protocol between UE and AMF.
- Functions of 5G Session Management protocol between UE and SMF.
- Functions of NG Application Protocol: Non-UE-associated services and UE-associated services.
- Security improvements over the 4G Evolved Packet System: VPLMN authorization, handling of Subscription Concealed Identifier (SUCI), horizontal and vertical key derivation in NG-RAN, slice-specific authorization and authentication, secondary authentication.
- UE states in RAN and Core Network: idle, connected, inactive.
- Overview of RAN-based paging and mobility procedures.
- Signaling flows for UE Registration, PDU Session Establishment, UE configuration update, and others between UE and 5GC.

Service Based Architecture

- SBA communication principles: NF Consumers and NF Producers, services, service operations, and procedures.
- SBA communication models: with/without NRF and/or SCP.

- Principles of REpresentational State Transfer (REST) architecture model.
- HTTP/2 improvements over HTTP/1.1.
- HTTP/2 message format, methods, headers and responses used in 5G Core Network.
- Handling of policy related information between AF, PCF, SMF, AMF, gNB and UE.
- Examples of Network Function service definitions using OpenAPI.
- Selected details of Common API Framework (CAPIF): CAPIF Core Function, API Exposing Function, API Invokers.
- Basic principles and service APIs for Service Enabler Architecture Layer (SEAL).
- Signaling flows for UE Registration, PDU Session Establishment, NF Registration, NF Discovery and service authorization using OAuth 2.0.

PFCP and GTP-U

- Functions of PFCP protocol between SMF and UPF on N4 interface.
- Functions and extensions of GTPv1-U protocol between UPFs, and NG-RAN and UPF.
- Functions of PDU Session User Plane protocol.
- Handling of PDU Sessions in SSC modes 1, 2, and 3.
- PDU Sessions with Multiple PDU Session Anchors.

Procedures

- Overview of various signaling procedures defined for the 5G System: various registration scenarios, PDU session options, overview of mobility procedures, etc.
- Signaling flows for UE Registration in new AMF, AMF relocation, Multi-access PDU Session handling, SSC modes, addition/removal of PDU session anchors, inter-gNB handover, handovers between Access Types, etc.
- SMS over 5G NAS: registration and message transfer.
- Data without User Plane resources usage: CIoT optimisation and NIDD.

Throughout the course

- Details of selected messages from captured trace files for various procedures.