V 1.5

5G SA Core – Signaling & Protocol Analysis

Duration: 2,5 days or 5 x ½ day

Table of Content:

Chapter 1: Warming Up / Getting up to Speed (0.5. - 1.5 h)

- **The Shape of 5G:** new services, e.g. URLLC and V2X, mobile edge computing and network slicing, ...)
- **Option 1 - 7:** What ist 5G NSA? What is 5G SA? Wrong adaption of these terms.
- **CUPS with Rel 14:** Control and User Plane Separation, PFCP, SGW-C, PDN-GW-C and PGW-U, Sxa and Sxb
- **Network Slicing**: Meaning, operation, NSSAI and S-NSSAI / SST, slicing management functions in the 5GC: NSMF and NSSMF
- **Service-Based Handover**: key features, criteria for service-based handover (e.g. service performance), multi-access support, selection criteria for target cells
- **QoS in 5G**: QoS-Profile, 5QI, other QoS-parameters, introducing delay critical GBR
- **Important Updates with Rel 17 – 19**

Chapter 2: Reviewing the 5G Core

- **Introducing Service Based Architectures (SBA):** Definition of client / server architecture, SBI, RESTful API's, protocol suite, definition of RESTful Communication
- **Hands in the Mud:** HTTP Methods used on RESTful Interfaces
- **5GC in SBA plus NW Functions:** AMF, SMF, UDM, UDR, AUSF, PCF, SCP, SEPP...

Chapter 3: HTTP/2 => Theory

- **Essentials of HTTP/2:** Differences bw/ HTTP1.1 and HTTP/2, streams, relationship to SPDY, binary formatting, specifics of the header block, comparison with HTTP/3
- **HTTP/2-Frame Types:** General Frame Header, HEADERS, DATA, GOAWAY, PING, PRIORITY, SETTINGS, ...
- **Concatenation of HTTP/2-Frames:** Operation, what needs to be considered during tracing
- **Pseudo Headers:** meaning, operation, types:method, :path, :scheme, :authority, :status

Chapter 4: HTTP/2 => Practice

- **HTTP/2-Session Setup:** TCP 3-way handshake, HTTP/2: MAGIC-frames, HTTP/2: SETTINGS-frames ...
- **HTTP/2 at Work: CRUD:** POST-Method: Create a Resource, PUT-Method: Create or Update a Resource, GET-Method: Read a Resource, PATCH-Method: Update a Resource partially, DELETE-Method: Delete a Resource
- **Hands in the Mud:** Operating with YAML-files, Use of SWAGGER and other YAML-viewers for logfile interpretation, relationship with the 3GPP-specifications
- **Hands in the Mud =>**
    - **Analysis of an HTTP/2 based scenario within the 5GC**
    - **Detailed Message Analysis: AMF => UDM**
    - **Other Message Examples**

Chapter 5: Towards RAN & UE: NGAP, PFCP, 5GMM & 5GSM

- **NGAP:** Principles, Operation, Mgmt of UE-contexts, transparent transfer, registration of gNB towards AMF
- **PFCP:** Protocol Stack, operation, messages, important parameters (e.g. F-SEID)
- **5GMM:** Meaning, important procedures, message formatting, Inter-RAT mobility w/ and w/o N26-interface, single vs dual registration mode
- **5GSM:** Meaning of a “session”, important procedures, message formatting, important parameters

Chapter 6: Scenarios (Reference / Theory)

- **Registration/TA-Update (Single Registration / Dual Registration Mode)**
- **Authentication with 5G-AKA**
- **UE-requested PDU Session Establishment**
- **HO 5GS <=> 4G (w/ N26 IF)**
- **De-Registration**

Chapter 7: Scenarios (Wireshark / Practice)

- **Initial Attachment in 5G NR / 5GC**
- **UE-requested PDU Session Establlishment**