Welche Features und Verbesserungen für 5G bringen 3GPP Rel.16,17&18?

Mit Release 15 wurde von der 3GPP der Standard für die 5G-Mobilfunktechnologie definiert. Doch die Entwicklung schreitet voran: Mittlerweile hat die 3GPP mit den Releases 16, 17 und 18 mehrere Erweiterungen verabschiedet, die abwärtskompatibel zu 5G sind und zahlreiche neue Funktionen bereitstellen. Während Release 16 und 17 den Funktionsumfang von 5G kontinuierlich ausgebaut haben, markiert Release 18 den Beginn von 5G-Advanced – einer Weiterentwicklung, die durch deutliche Leistungssteigerungen, neue Architekturen und verbesserte Effizienz nochmals einen großen Technologiesprung darstellt.

Der Kurs bietet einen Überblick über den aktuellen Stand der Entwicklung, führt in die wichtigsten Features ein und zeigt die damit möglichen Anwendungsszenarien auf. Dabei ist er modular aufgebaut. Kundinnen und Kunden können – mit Ausnahme von Einführung und Ausblick – die Module nach ihren Bedürfnissen und der gewünschten Detailtiefe flexibel zusammenstellen.

Zielgruppe / Voraussetzungen

Techniker und Ingenieure im Mobilfunkumfeld, die den neuesten Stand kennen lernen wollen. Die Kursteilnehmer sollten 5G und LTE bereits kennen

Kursinhalt

Einführung*
- 3GPP und ihre Standardisierung
- Zeitplan für neue Releases

Network Architecture
- Enhancements to the Service-Based 5G System Architecture (Rel. 16)
  - Architecture Enhancement: Service Communication Proxy (SCP)
- NF/NF Service Set Mechanism, Binding Mechanism
- Support of LAN-type Services (Rel. 16)
  - 5G LAN
  - Integration with IEEE TSN
- Wireless and Wireline Convergence Enhancement (Rel. 16)
  - Support of wireline access network, Wireline Access Gateway Function (W-AGF)
  - Support of Trusted Access network
- Edge computing (Rel. 17)
  - Enhancement of support for Edge Computing in 5G Core network
  - Enabling Edge Applications
- Enhanced eNB(s) architecture evolution for E-UTRAN and NG-RAN (Rel. 17)
  - eNB Architecture evolution
  - ng-eNB Architecture evolution

Kursdauer:
Je nach Auswahl der Module und nach Vorwissen/Tiefe 7 Tage (1600 Minuten netto)

Kursnummer:
NW1269a

Voraussetzungen:
Gute Kenntnisse von 5G und LTE

Edge Computing

- Edge computing Phase 1 (Rel. 17)
- Edge computing Phase 2 (Rel. 18)
- Edge Application Standards and Alignment with External Organizations

Protocols

- Quality of Service – new 5QI
- NR Uplink Data Compression (UDC) (Rel. 17)
- NR QoE management and optimizations for diverse services
    - Overview
    - Function

Non-Public Networks

- Private and Non-Public Network (NPN) Support for NG-RAN (Rel. 16)
    - Standalone Non-Public Networks (SNPN) and Public Network Interface - Non-Public Network (PNI-NPN)
    - Functionalities
- Enhanced Support of Non-Public and Private Networks (Rel. 17)
    - Support for Onboarding of UEs
    - Support of IMS voice and emergency services for SNPN
- Non-Public Networks Phase 2 (Rel. 18)

Non-Terrestrial Networks

- Integration of satellite components in the 5G architecture – General Background
    - Applications
    - Naming
    - Commercial satellite systems
- **Support of NTN (Rel. 17)**
    - Architectural aspects
    - Frequencies
    - UE aspects
    - Latency Aspects
    - Coverage Aspects
    - Mobility
    - Considerations for protocols
    - Quality of Service
- NB-IoT/eMTC support for Non-Terrestrial Networks
- **NTN Enhancements (Rel. 18)**
    - Radio-only satellite/NTN aspects
    - 5G system with satellite access to Support Control and/or Video Surveillance
    - Management aspects of Satellite
    - IoT (Internet of Things) NTN enhancements

Spectrum and Air interface

- Frequency bands
  - New Frequency Bands (Rel. 16)
  - Channel Bandwidth and Tx-Rx Separation
  - Introduction of 6 GHz NR licensed bands (Rel. 17)
  - Introduction of 900MHz and 1900MHz NR TDD band for Europe for RMR (Rel. 17)
  - Extending FR2 to 71 GHz (Rel. 17)
  - Frequency bands (Rel. 17)
  - Bandwidths
  - New Frequency Bands (Rel. 18)
- NR-based Access to Unlicensed Spectrum (Rel. 16)
  - Introduction
  - Scenarios
  - Physical Layer Signals and Channels
  - Physical Layer Procedures
  - MAC Enhancements
  - Upper Layer Enhancements
  - Enhancements of NR shared spectrum bands (Rel. 18)
- Modulation
  - Support of NR DL 256QAM for FR2 (Rel. 16)
  - Introduction of DL 1024QAM for FR1 (Rel. 17)
- UE Power classes
  - 29 dBm UE Power Class for LTE Band 41 and NR Band n41 (Rel. 16)
  - New UE Power Classes with Rel. 17
- NR Carrier Aggregation
  - Overview (Rel. 16, 17)
  - Efficient SCell activation (Rel. 17)
  - Multi-carrier enhancements for NR (Rel. 18)
  - Support of intra-band non-collocated EN-DC/NR-CA deployment (Rel. 18)
- 2-Step RACH for NR (Rel. 16)
  - Random Access Procedure
  - RA Type Selection
- NR coverage enhancements (Rel. 17)
- Further NR coverage enhancements (Rel. 18)
- NR demodulation performance evolution (Rel. 18)
- MIMO / RF / Requirements (Rel. 18)
  - Enhancement of MIMO OTA requirement for NR UEs
  - NR MIMO evolution for downlink and uplink
  - Enhancement of UE TRP and TRS requirements and test methodologies for FR1 (NR SA and EN-DC)
  - Further RF requirements enhancement for NR and EN-DC in FR1 (FR1 RF requirements)

Remote Interference Management

- Cross Link Interference (CLI) and Remote Interference Management (RIM)
- CLI Handling
- Remote Interference Management (RIM)
- Downlink Symbol Blanking for 4:1 and 8:2 TDD pattern

Procedures

- SRVCC from 5GS to 3G
  - Architecture and Principle
- UE Radio Capability Signaling Optimization
  - UE Radio Capability ID
  - UE Capability Segmentation
  - Secondary DN Authentication and authorization in EPC IWK cases (Rel. 18)
  - Rel-18 enhancements of session management policy control (Rel. 18)
- UE Power Saving in NR and Energy Efficiency
  - UE Power Saving Features of Rel. 16
  - UE power saving enhancements for NR (Rel. 17)
  - Enhancements on EE for 5G networks
  - Energy Efficiency (EE) (Rel. 18)
- NR Mobility Enhancements (Rel. 16)
  - Summary (Rel. 16)
  - Dual Active Protocol Stack (DAPS) Handover (Rel. 16)
  - Conditional Handover (CHO) (Rel. 16)
  - Intra-SN Conditional PSCell Change (CPC) (Rel. 16)
  - T312 based fast failure recovery (Rel. 16)
  - Enhancement of Handover Optimization (Rel. 17)
  - Inter-SN Conditional PSCell Change and Cond. PSCell Addition (Rel. 17)
  - Further NR mobility enhancements (Rel. 18)
- Media
  - 5G Media Streaming Protocols Phase 2 (Rel. 18)

Integrated Access Backhaul

- Integrated Access and Backhaul (IAB) for NR (Rel. 16)
  - Application Scenarios
  - Functionality
  - Integrated Access and Backhaul (IAB) Architecture
  - IAB Protocol Stack
  - Backhaul Transport
  - IAB-Node Integration
  - Topology Adaptation
  - PHY-Layer Specifications
  - RF and RRM Requirements
- Enhancements to IAB (Rel. 17)
  - Inter-donor IAB-MT migration and connectivity
  - Reduction of service interruption
- Enhancements to IAB (Rel. 18)
  - Mobile IAB (Integrated Access and Backhaul) for NR

IoT and RedCap

- Cellular Internet of Things (CIoT) (Rel. 16)
- NB-IoT/eMTC support for Non-Terrestrial Networks (Rel. 17)
  - Overall architecture and general aspects
  - Timing and Synchronization
  - Discontinuous coverage and assistance information
  - Mobility Management
- Support of NR Industrial Internet of Things (Rel. 16)

- Support of Enhanced Industrial IoT (IIoT) (Rel. 17)
- Enhanced Industrial IoT and URLLC support for NR (Rel. 17)
- NR small data transmissions in INACTIVE state (Rel. 17)
- Messaging in 5G (Rel. 17)
- Support of reduced capability NR devices (Rel. 17)
- IoT (Internet of Things) NTN enhancements (Rel. 18)

URLLC

- Enhancement of Ultra-Reliable and Low Latency Communications (URLLC)
  - Release 15 Status of URLLC
  - Conceptual Enhancements (Rel. 16)
  - Physical Layer Enhancements (Rel. 16)
  - 5G Timing Resiliency System (Rel. 18)

Verticals Support

- Service Enabler Architecture Layer (SEAL) for Verticals (Rel. 16)
  - SEAL functional models and functions
- Generic SEAL functionalities for all verticals (Rel. 17)
  - Network and application enablement for verticals
- Common API Framework for 3GPP Northbound APIs (CAPIF)
  - Usage of CAPIF for xMB API (Rel. 16)
  - Enhancement of 3GPP Northbound APIs and Enhancements for Common API Framework for 3GPP Northbound APIs (Rel. 16)
- Messaging in 5G (Rel. 17)
- Enhancements of Public Warning System (Rel. 16)
- Mission Critical Service (MCS) Improvements (Rel. 16)
  - Mission Critical Services Security Enhancements
  - Enhanced Mission Critical Communication Interworking with Land Mobile Radio Systems
  - Enhancements to functional architecture and information flows for MC Data
  - Enhanced Mission Critical Push-to-talk architecture phase 2
- Mission Critical Service (MCS) Improvements (Rel. 17)
  - Mission Critical Services over 5GS
  - Mission Critical security enhancements
  - Mission Critical Services Improvements
  - Mission Critical Data Improvements
  - Enhanced Mission Critical Communication Interworking with Land Mobile Radio Systems
  - Mission Critical system migration and interconnection
  - MC services support on Isolated Operation for Public Safety (IOPS) mode of operation
  - Multimedia Priority Service (MPS) (Rel. 17)
- Mission Critical Service (MCS) Improvements (Rel. 18)
  - Enhanced Mission Critical Push-to-talk architecture phase 4
  - Gateway UE function for Mission Critical Communication
  - Mission Critical Services over 5MBS
  - Mission Critical Services over 5GProSe
  - Mission Critical ad hoc group Communications
  - Other Mission Critical aspects
- Railway Communication, FRMCS

- Enhancements to Application Architecture for FRMCS (Rel. 16 & 17)
- Enhanced NR support for high speed train scenario (Rel. 17)
- NR Frequency bands for Railways (Rel. 17)
- Interconnection and Migration Aspects for Railways (Rel. 18)
- Drone/UAS/UAV/EAV (Rel. 17)
  - C2 Communication
  - Uncrewed Aerial Vehicles (UAV), UAS, UAM (Rel. 18)
  - Application layer support and procedures for UAS
- Multicast-Broadcast (MBS)
  - 5G Multicast-Broadcast User Service Architecture
  - Multicast-Broadcast Services (Rel. 17)
  - Enhancements (Rel. 18)
- V2X Enhancements (Rel. 18)
  - MBS support for V2X services
  - Application layer support for V2X services; Phase 3

Sidelink and V2X

- Introduction
  - Transmission and Deployment Scenarios
  - NR ProSe Functions
  - Physical Layer Structure
  - Resource Allocation
  - SL HARQ Feedback, SL CSI and PC5-RRC for Unicast and Groupcast
  - NR Sidelink enhancement (Rel. 17)
  - NR Sidelink Relay (Rel. 17)
- Architectural reference model
  - Non-roaming reference architecture
  - Reference points
  - Service-based interfaces
  - 5G ProSe UE-to-Network Relay reference architecture
- Functional Entities
- 5G ProSe Function
  - Communication path selection between PC5 and Uu reference points
  - 5G ProSe Direct Discovery
  - 5G ProSe Direct Communication
  - 5G ProSe UE-to-Network Relay
  - QoS handling on sidelink - PQI
- Control and user plane stacks
  - Control Plane without relays
  - Control Plane with relays
  - User Plane without relays
  - User Plane with relays
- Procedures
  - Procedures for Discovery
  - Procedure for Direct Communication via PC5
  - Procedure for Direct Communication via network relay
- V2X (Rel. 16)
  - Architecture
  - Functional Entities
  - QoS for V2X sidelink - PQI
  - Protocol stacks
  - Procedures
- V2X Enhancements (Rel. 17)
  - DRX

- Enhanced application layer support for V2X services
- Sidelink, Proximity, Location and Positioning (Rel. 18)
  - 5GC LoCation Services - Phase 3
  - Expanded and improved NR positioning
  - NR sidelink evolution
  - NR sidelink relay enhancements
  - Proximity-based Services in 5GS Phase 2
  - Ranging-based Service and sidelink positioning
  - Mobile Terminated-Small Data Transmission (MT-SDT) for NR
  - 5G-enabled fused location service capability exposure

Positioning

- 5G Location and Positioning Services
  - Introduction
  - Positioning Network Architecture
  - Accuracy Requirements
  - RAT Independent Positioning Techniques
  - NR Positioning Support
  - Details on Positioning Methods
  - UE Positioning Operations
- Location and positioning Improvements (Rel. 17)
  - Improvement of positioning accuracy and latency
  - On-Demand PRS transmission
  - Positioning in RRC_INACTIVE state
  - GNSS Integrity

Network Slicing

- Enhancement of Network Slicing
- User Identities and Authentication
- Business Role Models for Network Slicing
- Slicing
  - Network Slicing Phase 2 (CN and AN aspects)
  - Network Slice charging based on 5G Data Connectivity
- Access Traffic Steering, Switch and Splitting support in the 5G system architecture; Phase 2
- Network Slicing Enhancements (Rel. 18)
  - Network Slicing Phase 3
  - Enhancement of NSAC for maximum number of UEs with at least one PDU session/PDN connection
  - Enhancement of Network Slicing UICC application for network slice-specific authentication and authorization
  - Charging Aspects of Network Slicing Phase 2
  - Charging Aspects for NSSAA
  - Charging enhancement for Network Slice based wholesale in roaming
  - Network Slice Capability Exposure for Application Layer Enablement
  - Other slice aspects

Security

- Introduction

- Authentication and key management for applications based on 3GPP credential in 5G (AKMA)
- AKMA TLS protocol profiles
- User Plane Integrity Protection for LTE
- Non-Seamless WLAN offload authentication in 5GS
- Generic Bootstrapping Architecture (GBA) into 5GC
- Security Assurance Specification for 5G
- Adapting BEST for use in 5G networks
- Other security aspects
- Security-centric aspects (rel. 18)
    - IETF DTLS protocol profile for AKMA and GBA
    - IETF OSCORE protocol profiles for GBA and AKMA
    - Home network triggered primary authentication
    - AKMA phase 2
    - 5G Security Assurance Specification (SCAS) for the Policy Control Function (PCF)
    - Security aspects on User Consent for 3GPP services Phase 2
    - SCAS for split-gNB product classes
    - Security Assurance Specification for AKMA Anchor Function Function (AAnF)
    - Other security-centric items

SON and Network Automation

- SON Support for NR (Rel. 16)
- Additional SON Support for NR (Rel. 17)
    - Enhancements of NWDAF
    - Enhancement of data collection for SON/MDT in NR and EN-DC
- Autonomous network levels (Rel. 17)
- Network automation (Rel. 18)
    - Enablers for Network Automation for 5G phase 3
    - Enhancement of Network Automation Enablers
- Enhancement on NR QoE management and optimizations for diverse services (Rel. 18)
- Further enhancement of data collection for SON (Self-Organising Networks)/MDT (Minimization of Drive Tests) in NR and EN-DC (Rel. 18)
- Self-Configuration of RAN Network Entities (Rel. 18)
- Administration, Operation, Maintenance and Charging-centric Features (Rel. 18)

XR, AR, VR

- eXtended, Augmented and Virtual Reality (XR, AR, VR), immersive (Rel. 18)
    - XR (eXtended Reality) enhancements for NR
    - Media Capabilities for Augmented Reality
    - Real-time Transport Protocol Configurations
    - Immersive Audio for Split Rendering Scenarios (ISAR)
    - Immersive Real-time Communication for WebRTC
    - IMS-based AR Conversational Services
    - Split Rendering Media Service Enabler
    - Extended Reality and Media service (XRM)
    - Other XR/AR/VR items

AI

- Artificial Intelligence (AI)/Machine Learning (ML) (Rel. 18)
  - AI/ML model transfer in 5GS
  - AI/ML for NG-RAN
  - AI/ML management & charging
  - NEF Charging enhancement to support AI/ML in 5GS

Ausblick*

- Ausblick auf Rel. 19
- Zeitplan für Rel. 20 und 21

Zertifizierung

Jeder Teilnehmer erhält ein Zertifikat über die erfolgreiche Kursteilnahme.

Kursanmeldung:

Bitte kontaktieren Sie uns
- per Telefon: +49 89 1894354-405
- per eMail: anmeldung@tfk-technologies.de oder
- über unsere Internet-Seite www.skilleap.com

Sie erhalten von uns umgehend eine Bestätigung Ihrer Anmeldung oder können sich bei der Zusammenstellung der Kursinhalte beraten lassen.

Gern erstellen wir gemeinsam mit Ihnen ein Kurskonzept, das sich speziell an Ihren Anforderungen orientiert. Sie können verschiedene Themengebiete aus unseren Standard-Kursinhalten kombinieren und an Ihre firmenspezifischen Gegebenheiten anpassen lassen.