

5G WORLD PRO LIVE TRAINING CATALOGUE



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TRAINING 1: 5G FOUNDATION TRAINING



Comprehensive 3-day 5G foundation covering concepts, radio access, architecture, core network, security, private networks, and MEC. The most complete introductory live training for both technical and non-technical professionals.

Duration	3 Days
Audience	CTOs, Network Managers, Consultants, Graduates
Format	Live Virtual / On-Site

COURSE CONTENT

5G Overview and Concepts

- What is 5G?
- 5G promises
- 5G use case families: eMBB, URLLC, mMTC
- 3GPP position with 5G
- Services and requirements for vertical sectors
- Co-innovation between verticals

5G Radio Access Network

- Spectrum fundamentals
- 5G frequency bands
- 5G New Radio
- New radio technologies
- Massive MIMO
- 5G Beamforming
- 5G NR design and numerology
- 5G slots
- Internet of Things

5G Industry Progress and Offers

- ITU vision
- 5G band deployments
- mmWave
- 5G offers
- Impact of 5G on altimeters in aviation

- Impact of 5G on health

5G End-to-End Architecture

- 5G radio architecture
- Standalone vs Non-Standalone architectures
- 5G deployment options
- 5G Core architecture
- 5G Network Slicing
- NFV, SDN, and orchestration

5G Core Network

- Evolution of 5G Core
- Enablers for 5G Core
- Components of 5G Core SBA
- Interworking between EPC and 5GC
- 5G QoS

5G Technology Enablers and Security

- Massive MIMO details
- Beamforming with examples
- Which Massive MIMO to choose
- 5G security concepts and mechanisms
- 5G security players and threats
- User privacy protection
- Protecting subscriber identity in 5G
- User plane integrity

5G Private Networks and MEC

- What is a private network
- 5G Private Network challenges
- Spectrum requirements
- MEC architecture
- Key drivers of MEC
- MEC market

TRAINING 2: 5G SYSTEM OVERVIEW



One-day overview of the complete 5G system covering concepts, radio, architecture, IoT, core, EMF, and market updates.

Duration	1 Day
Audience	All Professionals (Technical and Non-Technical)
Format	Live Virtual / On-Site

COURSE CONTENT

5G System Overview

- 5G concepts and use cases
- 3GPP position with 5G
- 5G New Radio and spectrum
- 5G frequency bands
- New 5G technologies
- 5G radio architecture
- IoT LPWA networks and evolution to 5G
- Standalone vs Non-Standalone architectures
- 5G deployment options
- 5G Core architecture
- 5G EMF and health impact
- 5G market updates

TRAINING 3: 5G INDUSTRY PROGRESS AND EVOLUTION



Covers 5G standardization progress, terminal evolution, spectrum trends, market updates, operator deployments, tariff plans, and 5G-satellite integration.

Duration	1 Day
Audience	Telecom Professionals, Business Managers
Format	Live Virtual / On-Site

COURSE CONTENT

5G Industry Progress

- Mobile service demand trends and 5G vision
- eMBB ultra-broadband requirements
- mMTC massive connection requirements
- URLLC requirements
- 5G protocol standardization and industry
- 5G NSA and SA standards
- 5G terminal evolution
- 5G spectrum and frequency bands
- 5G NR interface and network architecture
- 5G market updates and operator deployments
- 5G device update
- 5G spectrum auction costs
- 5G tariff plans and offers by country
- 5G-satellite integration and 3GPP NTN progress

TRAINING 4: 5G USE CASES AND BUSINESS MODELS



Covers 5G business models, monetization strategies, co-innovation, industry use cases (Industry 4.0, healthcare, automotive), MEC, and EMF thresholds.

Duration	1 Day
Audience	CTOs, CEOs, Directors, Senior Managers
Format	Live Virtual / On-Site

COURSE CONTENT

5G Business and Use Cases

- 5G business models and monetization
- 5G enabling real-time enterprises
- Co-innovation between verticals
- 5G use cases: Industry 4.0, Healthcare, Automotive
- 5G for enterprises
- 5G deployments and ecosystem
- 5G EMF international limits and thresholds
- Mobile Edge Computing fundamentals
- Key MEC drivers and industry use cases
- MEC relationships with AI/5G/IoT

TRAINING 5: 5G E2E NETWORK EVOLUTION AND KEY TECHNOLOGIES



Covers LTE-to-NR air interface evolution, Massive MIMO, beamforming, numerology, DSS, 5G Core SBA, network slicing, and 3GPP Release 16/17 features.

Duration	2 Days
Audience	Telecom Engineers, Technical Managers
Format	Live Virtual / On-Site
Prerequisites	Basic 5G knowledge

COURSE CONTENT

5G Key Technologies and Evolution

- LTE OFDM vs NR-OFDM
- Massive MIMO technologies
- 5G Beamforming procedures
- 5G FDD vs 5G TDD comparison
- 5G New Air Interface and F-OFDM
- Numerology and frame structure
- 5G Bandwidth Part
- 5G slot structure
- 5G Dynamic Spectrum Sharing (DSS)
- DSS challenges and impact on 4G
- 5G Core network architecture and SBA
- Benefits of 5G Core network
- 5G Core transformation principles (CUPS, SBA)
- 5G Network Slicing and technical components
- 3GPP Release 16 and 17 features

TRAINING 6: 5G NETWORK ARCHITECTURE (RADIO, CORE, TRANSPORT)



End-to-end 5G architecture covering radio, core, and transport layers, including IoT, slicing, NFV/SDN, and QoS.

Duration	2 Days
Audience	Network Engineers, Architects
Format	Live Virtual / On-Site

COURSE CONTENT

5G Network Architecture

- 5G New Radio interface
- 5G network architecture (SA and NSA)
- 5G deployment options
- 5G transport architecture
- Core network architecture and NE functions
- RAN network architecture and functions
- IoT LPWA networks (NB-IoT, LTE-M, LoRa)
- IoT platforms and architecture
- IoT use cases and evolution to 5G
- 5G Core transformation (CUPS, SBA)
- Network Slicing technical components
- Slicing types and end-to-end features
- NFV, SDN, and orchestration
- Slicing in RAN, transport, and core
- QoS comparison: 5G NSA vs 5G SA

TRAINING 7: MASSIVE MIMO TECHNICAL WORKSHOP



Hands-on workshop covering Massive MIMO beamforming in C-band, SU/MU-MIMO pairing, capacity assessment, planning, optimization, interference analysis, and EMF control features.

Duration	2 Days
Audience	RF Engineers, Optimization Engineers, Technical Managers
Format	Live Virtual / On-Site
Prerequisites	5G RAN knowledge required

COURSE CONTENT

Day 1: Beamforming and Massive MIMO in C-Band

- 5G 3GPP update and bands
- Massive MIMO and beamforming principles (SSB Beams, CSI-RS)
- Types of beamforming: analog, digital, and hybrid
- 5G practical coverage comparison
- SU-MIMO and MU-MIMO capabilities with 64T64R
- Practical pairing with MU-MIMO and results
- How to enhance pairing results practically
- Practical Massive MIMO capacity assessment
- Practical examples from different trials

Day 2: Massive MIMO Planning, Optimization, and EMF

- 5G Massive MIMO link budget vs 4G
- Massive MIMO beam planning with coverage scenarios
- Practical coverage: 8T8R vs 32T32R vs 64T64R
- Practical 5G optimization issues with Massive MIMO
- 5G interference analysis with Massive MIMO
- Massive MIMO issues impacting throughput
- EMF international limits
- EMF control features from vendors
- EMF simulation

TRAINING 8: 5G RADIO NETWORK PLANNING



Covers 5G RF planning from link budget and propagation models through capacity dimensioning, beam planning, and planning tool features.

Duration	2 Days
Audience	RF Engineers, Planning Engineers, Technical Consultants
Format	Live Virtual / On-Site
Prerequisites	5G RAN knowledge required

COURSE CONTENT

5G NR Planning

- 5G planning-related features
- NSA networking features
- Massive MIMO
- 5G bands and edge throughput benchmarks
- 5G practical coverage and link budget vs 4G
- 5G propagation models and parameters
- 5G network planning process
- 5G ray tracing and 3D digital maps
- 4G/5G planning differences (8T8R vs 64T64R)
- Massive MIMO beam planning
- 5G downtilt, PRACH, neighbor cell, PCI planning
- 5G capacity and Shannon Law
- 5G NR throughput calculation and dimensioning
- 3D Monte Carlo simulation
- Planning tool features: EN-DC, 3D beamforming, DSS

TRAINING 9: 5G KPI AND 5G OPTIMIZATION



In-depth 5G optimization training covering KPIs, accessibility, retainability, throughput, mobility, latency optimization, DSS, DRX, and ANR.

Duration	3 Days
Audience	RF Engineers, Optimization Engineers, Technical Managers
Format	Live Virtual / On-Site
Prerequisites	5G NR Advanced knowledge recommended

COURSE CONTENT

5G KPI and Optimization

- 3GPP update
- Massive MIMO with SU/MU-MIMO
- 5G Beamforming procedures
- 4G/5G interoperability principles
- 5G accessibility, retainability, throughput, mobility optimization
- 5G control and user plane latency optimization
- 5G counters in NSA with call flow procedures
- 5G NSA mobility management and KPI acceptance
- 5G Attach call flow with traces
- 4G/5G Attach failure use cases
- Split Bearer in NSA mode
- DSS for practical deployments (SA and NSA)
- Feature optimization for high-speed mobility
- DMRS optimization and Hyper Cell
- 5G DRX principles, parameters, and configuration
- 5G RAN ANR principles and procedures

TRAINING 10: 5G TROUBLESHOOTING AND MASSIVE MIMO ASSESSMENT



Practical troubleshooting covering throughput analysis, MCS/IBLER/rank issues, Massive MIMO comparison (8T/32T/64T), pairing optimization, interference analysis, and EMF.

Duration	2 Days
Audience	RF Engineers, Optimization Engineers, Technicians
Format	Live Virtual / On-Site
Prerequisites	5G optimization knowledge required

COURSE CONTENT

5G Troubleshooting and Massive MIMO

- 5G NR throughput calculation
- Factors and prerequisites for max throughput
- Grant and RB troubleshooting
- Low MCS, high IBLER, and low rank troubleshooting
- 5G MIMO feature practice
- 5G data service throughput problem analysis
- 5G scheduling feature practice
- Practical optimization with Massive MIMO
- Coverage comparison: 8T8R vs 32T32R vs 64T64R
- SU-MIMO and MU-MIMO with 64T64R
- Practical pairing and capacity assessment
- Drive test results after site swap (8T to 32T to 64T)
- EMF limits, control features, and simulation

TRAINING 11: 5G OPEN RAN



Covers Open RAN evolution, O-RAN Alliance architecture, functional splits, RIC, SMO, use cases, and operator deployment case studies.

Duration	2 Days
Audience	Technical and Non-Technical Engineers with basic 5G knowledge
Format	Live Virtual / On-Site
Prerequisites	Basic 5G knowledge

COURSE CONTENT

Open RAN

- What is Open RAN
- Understanding D-RAN, C-RAN, V-RAN
- Evolution towards Open RAN
- Open RAN vendors and global ecosystem
- O-RAN Alliance vs TIP vs workgroups
- Deep dive into O-RAN architecture
- RU/CU/DU split
- SMO, RIC, O-Cloud, O-CU, O-DU, O-RU
- O-RAN interfaces and functional splits
- Network Slicing in O-RAN
- Open RAN drivers, challenges, and 7 benefits
- Use cases: traffic steering, QoS optimization, Massive MIMO
- Operator deployment case studies

TRAINING 12: 5G SECURITY



Covers 5G security concepts, threats, LTE security weaknesses, 5G vs 4G security improvements, SBA/non-SBA interface security, signaling security, and O-RAN security.

Duration	1 Day
Audience	Telecom Engineers, Security Professionals
Format	Live Virtual / On-Site

COURSE CONTENT

5G Security

- Security concepts and requirements
- Security goals and common threats
- Three pillars of security
- LTE security weaknesses (UP integrity, subscriber privacy, network spoofing)
- Why 5G security matters
- Security in 5G vs 4G
- Main players in the 5G security landscape
- 5G Non-SBA and SBA interface security
- 5G signaling and security
- O-RAN architecture and security

TRAINING 13: 5G PRIVATE NETWORK USE CASES



Deep dive into 5G private network use cases including Industry 4.0, predictive maintenance, AR, supply chain, robotics/AGVs, UAVs, and disaster recovery.

Duration	2 Days
Audience	CTOs, Enterprise Architects, Network Managers
Format	Live Virtual / On-Site

COURSE CONTENT

5G Private Networks and Use Cases

- What is private 5G network
- Advantages and challenges
- Frequencies for 5G private networks
- 5G private network situation by country
- 5G FWA offers and deployments
- Industry 4.0 overview
- Advanced predictive maintenance use case
- Augmented reality use cases
- Supply chain management with 5G
- 5G robotics and AGVs use cases
- MEC Cloud AGV project
- Network KPIs for robotics and AGVs
- UAVs delivering 5G
- Search, rescue, and disaster recovery
- Drone entertainment

TRAINING 14: EVOLVED MOBILE CORE NETWORKS: EPC TO 5GC



Comprehensive 5-day training from 4G EPC through 5G Core, covering architecture, call flows, virtualization, security, migration strategies, and real-world deployments.

Duration	5 Days
Audience	Core Network Engineers, Architects, Technical Managers
Format	Live Virtual / On-Site
Prerequisites	Basic mobile network knowledge

COURSE CONTENT

Introduction to Mobile Networks

- Mobile generations overview (2G-5G)
- Key features and evolution
- Importance of core networks
- 5G Core network basics

4G Evolved Packet Core (EPC)

- EPC introduction and key elements
- Interfaces and protocols (S1, S11, S5/S8)
- 4G call flow and packet data handling
- Registration, session establishment, mobility
- QoS management and data offloading
- Security protocols and authentication

5G Core Network Architecture

- 5GC architecture and components
- Network functions (AMF, SMF, UPF)
- Control and User Plane Separation (CUPS)
- Network Slicing
- 5G call flow and service orchestration

Virtualization Technologies in 5G

- Cloud and edge computing
- MEC in 5G and use cases

- Containerization (Docker, Kubernetes)
- Container orchestration and VNF deployment
- SDN and network slicing

Advanced 5G Security

- Threats in virtualized environments
- Security protocols and encryption
- 5G security architecture (AUSF, SEAF)
- Authentication, privacy, and slice security

Migration from 4G to 5G Core

- 4G EPC and 5GC coexistence
- Dual connectivity and handover
- Legacy network interworking
- Transition strategies for operators

Performance, Use Cases, and Future Trends

- Network monitoring and management
- QoS and QoE considerations
- IoT, Industry 4.0, Smart Cities use cases
- Real-world deployments and challenges
- AI/ML impact and edge computing evolution

TRAINING 15: LANDSCAPE ENGINEERING OF IoT



Comprehensive IoT training covering architecture, sensors, communication protocols, data analytics, security, application development (Arduino, Raspberry Pi), edge computing, and future trends.

Duration	5 Days
Audience	Engineers, IoT Architects, System Integrators
Format	Live Virtual / On-Site

COURSE CONTENT

Introduction to IoT

- IoT definition and evolution
- Key concepts and components
- IoT impact across industries
- Standardization (OPC UA, OCF)
- Regulatory and ethical considerations

IoT Architecture and Components

- Architecture layers (perception, network, data, application)
- Sensors and actuators
- Connectivity: Wi-Fi, LoRa, Zigbee
- Microcontrollers and embedded systems
- Hardware selection and integration

Communication Technologies and Data Handling

- IoT protocols: MQTT, CoAP, HTTP
- Network topologies
- Data collection, storage, and processing
- Edge and cloud computing
- Real-time analytics and visualization

IoT Security and Application Development

- Security challenges and best practices
- Secure device configuration and data transmission
- GDPR compliance
- Development with Embedded C, Python, JavaScript

- Hands-on with Arduino, Raspberry Pi, Node-RED

Use Cases and Future Trends

- Manufacturing, smart buildings, infrastructure
- Edge devices and fog computing
- Emerging technologies: 5G, LPWAN
- AI/ML in IoT
- Future: 6G, Quantum IoT

TRAINING 16: 5G O-RAN PROCEDURES AND USE CASES



Deep 5-day O-RAN training covering architecture, functional splits, virtualization, RIC (xApps/rApps), transport, network slicing, use cases, and AI/ML in O-RAN.

Duration	5 Days
Audience	Technical Engineers, RAN Architects, Network Managers
Format	Live Virtual / On-Site
Prerequisites	Basic 5G and RAN knowledge

COURSE CONTENT

Introduction and Evolution to Open RAN

- Open RAN terminologies and standards
- Design goals and O-RAN Alliance
- RAN evolution: traditional to Open RAN
- D-RAN vs C-RAN vs Cloud RAN
- Horizontal disaggregation

RAN Splits and O-RAN Architecture

- Protocol layer overview
- Functional splits (Option 1 to 8)
- Option 7.2x for Open RAN
- eCPRI protocol
- Control/User Plane disaggregation
- O-RAN entities, interfaces, and control loops
- O-DU and O-CU functionality

Virtualization and Detailed Architecture

- PNFs, VNFs, and cloud-native functions
- O-Cloud deployment options
- DevOps CI/CD in O-RAN
- SMO and Non-RT RIC (rApps)
- Near-RT RIC (xApps)
- A1 policy format and examples

Transport, Slicing, and Use Cases

- Fronthaul and midhaul connectivity
- eCPRI transport
- Network Slicing in O-RAN (S-NSSAI, NSSI, ONAP)
- Traffic steering use case
- UAV resource allocation use case
- Massive MIMO beamforming optimization

AI/ML in O-RAN

- Supervised learning and linear regression
- Neural networks and gradient descent
- K-Mean clustering in mobile networks
- Reinforcement learning in RAN
- AI/ML framework for O-RAN
- ML model lifecycle implementation

TRAINING 17: EMERGING TECHNOLOGIES



Broad technology overview covering 5G enablers, IoT, Open RAN, private networks, MEC, security, AI, V2X, satellite/NTN, and 6G.

Duration	3 Days
Audience	All Telecom Professionals
Format	Live Virtual / On-Site

COURSE CONTENT

Module 1: 5G Enablers and Architecture

- 5G concepts and technology enablers
- 5G end-to-end architecture
- 5G Slicing
- 5G EMF

Module 2: Internet of Things

- IoT LPWA networks
- IoT technologies: NB-IoT, LTE-M, LoRa
- IoT use cases and evolution to 5G

Module 3: Open RAN Technologies

- From D-RAN to Open RAN
- O-RAN architecture and RIC
- Benefits and current deployments

Module 4: Private Networks and MEC

- Private network challenges and use cases
- Spectrum requirements
- MEC architecture and drivers

Module 5: Security

- Three pillars of security
- Addressing mobile security weaknesses
- 5G security players and threats

Module 6: Artificial Intelligence

- AI fundamentals and applications
- Machine learning and deep learning
- ChatGPT and applications
- AI adoption in telcos
- 4G/5G AI use cases

Module 7: V2X (Vehicle-to-Everything)

- V2X trends and ITS architecture
- 3GPP NR-V2X architecture and PC5
- V2X services and use cases

Module 8: Satellite and NTN

- Satellite technology fundamentals
- NTN in 3GPP standards
- NTN frequencies and commercial market
- 5G NTN architecture

Module 9: 6G Technology

- 6G requirements and use cases
- Future of mobile devices
- 6G deployment challenges

TRAINING 18: ARTIFICIAL INTELLIGENCE FOR TELECOM



Comprehensive AI training covering fundamentals, ML, deep learning, ChatGPT, Python, big data, AI frameworks, telecom adoption, data-driven networks, and 4G/5G AI use cases.

Duration	3 Days
Audience	All Engineers and Managers
Format	Live Virtual / On-Site

COURSE CONTENT

AI Fundamentals

- What is AI
- AI classification
- Machine learning introduction
- AI in telecom

Application Fields and Machine Learning

- AI in smart homes, cities, retail, self-driving cars, industry
- Supervised, unsupervised, semi-supervised, reinforcement learning

Deep Learning

- Neural networks and architectures
- CNNs, LSTMs, RNNs, GANs, RBFNs, DBNs, RBMs, MLPs, SOMs, Autoencoders

Python and Big Data

- Python basics: types, variables, strings, tuples, lists, dictionaries
- Big data: types, characteristics, roles

AI Frameworks and ChatGPT

- TensorFlow, PyTorch, DeepLearning4J, CNTK, Keras, ONNX, MXNet, Caffe
- ChatGPT evolution and technology
- ChatGPT applications: language generation, sentiment analysis, summarization, medical diagnosis

AI in Telecom

- AI adoption with service providers
- Challenges for adoption

- AI for data-driven networks
- ETSI-ENI architecture
- 4G/5G AI use cases: RAN management, fault detection, QoS, optimization, operations

TRAINING 19: 5G AND SATELLITES (NTN)



Covers 5G-satellite communications: NTN architecture, 3GPP standardization (Release 15-18), spectrum, commercial constellations, RF propagation, protocol adaptations, and IoT over NTN.

Duration	3 Days
Audience	Telecom Engineers, Satellite Engineers, Consultants
Format	Live Virtual / On-Site

COURSE CONTENT

5G and Satellite Fundamentals

- Satellite myths vs truths
- NTN definition, categories, and backhaul
- Evolution from NTN to 5G NTN
- Use cases and challenges

NTN in 3GPP Standards

- 3GPP NTN work: RAN, SA, Core
- NTN Release 15 through 18
- NR NTN enhancements for Release 18/19

NTN Spectrum and Commercial Market

- Satellite spectrum allocation (L/S/C/Ku/Ka/Q/V bands)
- 5G and NTN band coexistence
- Commercial constellations: Starlink, OneWeb, Kuiper, Telesat

NTN Architecture and RF Propagation

- Transparent and regenerative NTN architectures
- ISL, QoS, ephemeris, beam footprints
- NTN channel modeling, propagation delay, Doppler shift
- Rain attenuation, atmospheric absorption, scintillation
- NTN link budget and beamforming advantages

NTN Protocols and IoT

- Protocol stack modifications for 5G NTN
- HARQ solutions, UL synchronization, satellite mobility

- IoT over NTN: use cases, architecture, challenges

TRAINING 20: MASSIVE MIMO TECHNICAL WORKSHOP (ADVANCED)



Advanced hands-on workshop covering Massive MIMO beamforming principles, link budget comparison, SU/MU-MIMO pairing, coverage analysis (8T/32T/64T), optimization, and EMF.

Duration	2 Days
Audience	RF Engineers, Optimization Engineers
Format	Live Virtual / On-Site
Prerequisites	5G RAN knowledge required

COURSE CONTENT

Day 1: Beamforming and Massive MIMO

- 5G 3GPP update and bands
- Massive MIMO and beamforming principles
- Beamforming types: analog, digital, hybrid
- 8T8R link budget and drive test comparison
- SU/MU-MIMO with 64T64R
- Practical pairing and capacity assessment

Day 2: Planning, Optimization, and EMF

- Massive MIMO link budget vs 4G
- Beam planning with coverage scenarios
- Coverage: 8T8R vs 32T32R vs 64T64R
- Optimization issues and solutions
- Interference analysis
- Throughput impact analysis
- EMF limits, control features, simulation

TRAINING 21: 5G RAN SHARING



Covers RAN sharing models (passive, active, MORAN, MOCN), 5G NSA/SA sharing challenges, CAPEX/OPEX savings, business case simulation, and country case studies.

Duration	2 Days
Audience	CTOs, Directors, Senior Managers, Technical Managers
Format	Live Virtual / On-Site

COURSE CONTENT

Passive and Active Sharing

- Site sharing, feeder/antenna, cabinet sharing
- MORAN, MOCN, national roaming, core sharing
- SWOT analysis

5G NSA and SA Sharing

- Constraints and technical challenges for NSA sharing
- Constraints and technical challenges for SA sharing
- Recommendations

Business Case and Products

- CAPEX/OPEX savings from passive and active sharing
- Real business case simulation
- 8-year TCO impact
- RAN products for sharing: RRU, AAU, basebands, RTU, OSS

RAN Sharing by Country

- RAN Sharing in Spain, France, Italy
- RAN Sharing in MEA countries

TRAINING 22: 5G FIXED MOBILE CONVERGENCE



Covers 5G Core network capabilities for wireline access, FWA, Wi-Fi integration, residential gateway functions, registration, session management, QoS, and IPTV delivery.

Duration	2 Days
Audience	Core Network Engineers with telecom knowledge
Format	Live Virtual / On-Site
Prerequisites	Basic telecom knowledge

COURSE CONTENT

Convergence Options and Architecture

- 5G fixed wireline and wireless access
- 5G/Wi-Fi integration
- UE behind 5G-RG
- 5G Residential Gateway and Fixed Network RG
- Wireline Access Gateway Function
- Non-3GPP Interworking Function
- Trusted Network Gateway Function

Registration and Session Management

- 5G-RG and FN-RG wireline access registration
- QoS model and flow parameters
- 5G-RG and FN-RG PDU session establishment
- Connection management
- 5G-RG service request
- Delivering IPTV

TRAINING 23: 5G SA CHARGING



Comprehensive 5G charging training covering OCS, SBA charging architecture, offline/online charging, network slice charging, converged charging, and CHF/SMF network functions.

Duration	2 Days
Audience	Core Network Engineers, Billing Professionals
Format	Live Virtual / On-Site
Prerequisites	5G knowledge required

COURSE CONTENT

5G Charging

- 5G charging solution introduction
- Charging in 3GPP and OCS
- 5G SA architecture and SBA
- 5G charging function module and features
- Impact of 5G charging in NSA and SA
- Billing and provisioning solution
- Offline charging and subscriber lifecycle
- Key considerations for billing providers
- Charging for 4G/5G interworking
- Charging of network slices
- Converged charging specifications
- Online event-based charging example
- SMF and CHF network functions
- Network interfaces for 5G charging

TRAINING 24: 5G ROAMING



Holistic roaming training covering 4G/5G roaming in NSA and SA, regulatory frameworks, interconnection, billing, fraud, MVNO, IMS voice/SMS impact, and roaming agreements.

Duration	2 Days
Audience	Core Network Engineers, Roaming Managers
Format	Live Virtual / On-Site
Prerequisites	5G knowledge required

COURSE CONTENT

Roaming Fundamentals and 5G

- Context, drivers, and basic scenarios
- International roaming and interconnection
- MVNO and national roaming
- Regulation and network impacts
- Service, billing, and fraud impacts
- Performance measurement
- 5G NSA/SA business requirements and architectures
- Radio, transport, and core network impacts
- Roaming in 5G NSA (Option 3x) and SA (Option 2)
- IMS voice and SMS service impact
- Roaming agreements and billing overview
- IREG technical and billing validation
- IR.21 handling for network evolutions

TRAINING 25: VoNR TECHNICAL TRAINING



Comprehensive VoNR training covering voice solutions in NSA/SA, IMS architecture, SIP protocols, codecs, registration, signaling procedures, and 5G New Calling.

Duration	3 Days
Audience	Telecom Engineers, Core Network Professionals
Format	Live Virtual / On-Site
Prerequisites	5G knowledge required

COURSE CONTENT

Module 1: VoNR Deployment and Architecture

- Evolution to Vo5G
- VoNR drivers and challenges
- VoNR standardization and architecture

Module 2: 5G Voice Solutions

- CSFB, VoLTE, RAT Fallback, EPS Fallback, VoNR
- 5G fallback and handover
- VoLTE as prerequisite for SA
- VoNR vs EPS Fallback comparison

Module 3: IMS Architecture

- IMS architecture and requirements for VoNR
- Control and user plane protocols
- P-CSCF, I-CSCF, S-CSCF
- VoNR application servers

Module 4: Voice Identifiers and SIP

- IMS identifiers and SIP protocol
- Diameter base protocol
- 5G voice codecs

Module 5: IMS Registration

- SA VoNR/EPS Fallback registration

- IMS registration process, call flow, SIP messages with traces

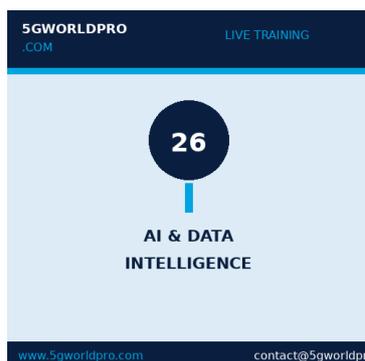
Module 6: VoNR Signaling

- Basic VoNR and EPS Fallback signaling procedures
- VoNR to VoLTE handover procedure

Module 7: 5G New Calling

- New calling services, features, and technology
- New nodes and GSMA evolution

TRAINING 26: AI AND DATA INTELLIGENCE FOR 5G NETWORKS



Explores AI and data analytics within the 5G ecosystem, covering real-time capabilities, operations optimization, applied case studies, and evolving standards.

Duration	1 Day
Audience	Telecom Engineers, Data Scientists, Network Managers
Format	Live Virtual / On-Site

COURSE CONTENT

AI and Data Intelligence for 5G

- Introduction to AI, data science, and 5G landscape
- AI and data use cases in 5G networks
- Real-time capabilities with AI in 5G
- Optimizing 5G operations and maintenance with AI
- Applied case studies and simulations
- Evolving AI standards and future applications

TRAINING 27: DEEP LEARNING AND REINFORCEMENT LEARNING



Hands-on training covering deep learning (CNNs, RNNs, GANs, transfer learning) and reinforcement learning (Q-Learning, DQNs, policy gradients) with practical exercises.

Duration	2 Days
Audience	AI Engineers, Data Scientists, Developers
Format	Live Virtual / On-Site
Prerequisites	AI fundamentals required

COURSE CONTENT

Day 1: Deep Learning

- Introduction to deep learning and terminology
- Neural network structure and activation functions
- Training: loss functions, optimization, regularization
- CNNs for image classification
- RNNs for sequential data and text generation
- Transfer learning and pretrained models
- GANs for image generation
- Hands-on exercises throughout

Day 2: Reinforcement Learning

- RL concepts: agent, environment, states, actions, rewards
- Markov Decision Processes
- Q-Learning and TD learning
- Deep Q-Networks (DQNs)
- Policy gradient methods and REINFORCE
- Hands-on exercises throughout

TRAINING 28: MACHINE LEARNING PRACTICAL APPLICATIONS



Hands-on training using XGBoost, Scikit-Learn, and OpenAI Gym. Covers time series prediction, clustering, text classification, and reinforcement learning with Google Colab.

Duration	3 Days
Audience	Engineers, Data Scientists, AI Practitioners
Format	Live Virtual / On-Site
Prerequisites	Basic ML knowledge

COURSE CONTENT

Session 1: ML Frameworks Introduction

- Overview of XGBoost, Scikit-Learn, OpenAI Gym
- Environment setup and key concepts
- Framework workflows: training and inference

Session 2: Time Series Prediction

- Time series forecasting with XGBoost
- Hyperparameter tuning and model evaluation
- Hands-on forecasting exercise

Session 3: Unsupervised Clustering

- Clustering techniques: K-means, DBSCAN
- Building and evaluating clustering models
- Real-world data exercise

Session 4: Text Classification

- Text classification with NLP techniques
- Building and evaluating classification models
- Accuracy measurement on new datasets

Session 5: Reinforcement Learning

- RL concepts and agents
- Training an agent with OpenAI Gym
- Design your own RL agent exercise

TRAINING 29: 6G TRAINING FOR EVERYONE



Comprehensive 6G overview covering standardization, spectrum, devices, air interface, AI-native networks, JCAS, RIS, and deployment challenges.

Duration	2 Days
Audience	Telecom Professionals, Researchers, Strategists
Format	Live Virtual / On-Site

COURSE CONTENT

Module 1: 6G Standardization and Ecosystem

- From 5G Advanced to 6G
- 6G ecosystem and research framework
- 6G 3GPP and ITU timelines
- Challenges for mobile service providers

Module 2: 6G Use Cases and Requirements

- 6G: evolution or revolution?
- 6G driven by value and sustainability
- 6G use cases, performance and societal requirements

Module 3: 6G Spectrum

- 6G spectrum strategy
- Refarming and new spectrum
- Sub-THz frequency challenges
- WRC-27 frequencies

Module 4: 6G Devices

- 6G smartphones and wearables
- Extended Reality (XR)
- mMTC communications

Module 5: 6G Key Design Principles

- 6G objectives, services, architecture
- 6G air interface and lean signaling
- AI-native air interface

Module 6: 6G Technology Enablers

- New spectrum, radio sensing
- Satellite and HAPs
- RIS, Zero Energy Devices, JCAS

Module 7: 6G Deployment Challenges

- Cost, security, sustainability considerations
- AI and machine learning integration

TRAINING 30: 5G APPLICATION PROGRAMMING INTERFACES (APIs)



Deep dive into 5G APIs within SBA, covering RESTful APIs, HTTP/2, service registration/discovery, NEF, use cases (PDU sessions, subscriber data), troubleshooting, and future trends.

Duration	2 Days
Audience	Telecom Engineers with LTE/5G knowledge
Format	Live Virtual / On-Site
Prerequisites	LTE System Engineering or equivalent

COURSE CONTENT

Module 1: 5G API Introduction

- RESTful APIs and principles
- Service-Based Architecture (SBA)
- SBI protocol stack and HTTP/2
- 5G SBI API standardization

Module 2: Applying REST to 5G Core

- RESTful APIs for 5GC network function communication
- Service registration and discovery
- Network Exposure Function (NEF)
- External application integration

Module 3: 5G API Use Cases

- PDU session establishment: registration, discovery, session setup
- Subscriber data management: AMF registration, data acquisition, subscription

Module 4: API Optimization and Troubleshooting

- HTTP/2 efficiency enhancements
- Common API issues in PDU sessions and subscriber management
- Debugging and troubleshooting API failures
- Best practices for RESTful API integration

Module 5: Real-World Applications and Future

- API integration in enterprise and industrial 5G

- APIs for IoT, Network Slicing, external platforms
- 3GPP Release 17+ API evolution
- APIs and 5G/6G convergence

TRAINING 31: AI AGENT TRAINING



Master AI-powered agents for automation, research, and business intelligence. Covers CrewAI, OpenInterpreter, Perplexity AI, multi-agent collaboration, and emerging trends.

Duration	2 Days
Audience	Professionals, Developers, AI Enthusiasts
Format	Live Virtual / On-Site

COURSE CONTENT

Module 1: Introduction to AI Agents

- What are AI agents?
- Evolution from chatbots to AI workers
- AI-driven future of work
- Devin (AI Software Engineer), SIMA (Google)

Module 2: Getting Started with AI Development

- Setting up your first AI project
- Building your first AI agent
- Connecting open-source models (LLaMA-3)
- Creating a custom research AI agent

Module 3: AI Agents for Research

- OpenInterpreter Light 01
- Tasking AI for workflow automation
- Perplexity AI features
- AI-assisted market and academic research

Module 4: Advanced AI Agent Capabilities

- Perplexity AI Focus and Attach features
- AI research management (Collections and Library)
- Privacy and security considerations

Module 5: Domain-Specific AI Agents

- Business analyst, content creation, financial research agents
- Pre-sales and new product research agent
- Student research and academic assistant

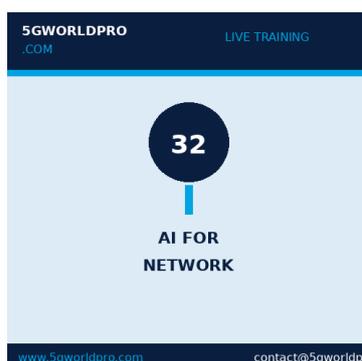
Module 6: Multi-Agent Collaboration

- CrewAI for multi-agent collaboration
- Voice of the User and Wolfram Alpha agents
- AI agents for workflow optimization

Module 7: Future of AI Agents

- GPT-4o and Mistral AI innovations
- 2025 AI roadmap
- Emerging trends in AI-agent automation

TRAINING 32: AI FOR NETWORK



Explores AI and GenAI in telecom networks: ML/DL fundamentals, network automation, optimization, predictive maintenance, OpenAI use cases, 5G/6G applications, and AI-powered security.

Duration	2 Days
Audience	Telecom Engineers, Network Architects, IT Managers
Format	Live Virtual / On-Site
Prerequisites	Basic telecom knowledge

COURSE CONTENT

Module 1: Foundations of AI for Networks

- AI technologies in telecom
- ML and DL fundamentals
- Generative AI in telecommunications

Module 2: GenAI in Telecom

- Synthetic data generation and network simulation
- AI-driven chatbots for customer support
- GenAI for performance analytics

Module 3: Network Automation with AI

- Zero-touch provisioning and orchestration
- Automated configuration and management
- OpenAI tools for intelligent decision-making

Module 4: Network Optimization and Maintenance

- Predictive maintenance
- Real-time traffic and bandwidth optimization
- Energy-efficient AI solutions

Module 5: OpenAI Use Cases in Telecom

- Real-time monitoring with OpenAI APIs
- AI-generated documentation for support
- OpenAI Codex for programming and decisions

Module 6: AI for 5G and 6G

- Network slicing and edge computing
- URLLC enhancement
- QoS improvement with AI

Module 7: AI-Powered Network Security

- Real-time threat detection
- GenAI for security intelligence
- Fraud prevention and anomaly detection

TRAINING 33: AUTONOMOUS NETWORK



Covers autonomous network maturity levels (L0-L5), evaluation methodology, practical use cases (fault management, provisioning, optimization), strategic implementation, and emerging AI/ML trends.

Duration	2 Days
Audience	Telecom Managers, Network Architects, Solution Providers
Format	Live Virtual / On-Site
Prerequisites	Basic telecom knowledge

COURSE CONTENT

Module 1: Introduction to Autonomous Networks

- Need for automation in telecom
- Evolution from manual to fully autonomous
- Six-step maturity model overview

Module 2: Autonomous Network Levels

- Level 0 (Manual) through Level 5 (Full Automation)
- Self-discovery, self-healing, intent-driven management
- Dimensions: strategy, processes, tools, data, people, CX

Module 3: Evaluation Methodology

- Operational flow domains
- Task assessment based on autonomy levels
- Scoring methods and operational metrics

Module 4: Practical Use Cases

- Alarm correlation, fault diagnosis, auto-recovery
- AI-driven deployment and provisioning workflows
- Predictive analytics for performance
- Vertical applications: smart factories, autonomous vehicles

Module 5: Strategic Implementation

- Maturity assessments (basic, update, full)
- Gap analysis and roadmap creation

- Transformation objectives and ROI
- Industry case studies

Module 6: Emerging Trends

- AI/ML integration in autonomous networks
- Intent-driven automation and self-learning
- Cross-domain challenges and full autonomy

TRAINING 34: 5G ADVANCED (3GPP RELEASE 18/19)



Deep dive into 5G Advanced (5.5G) covering 3GPP Release 18 and 19 features including RedCap evolution, AI/ML-native RAN, XR enhancements, network energy saving, NTN enhancements, MIMO evolution, positioning, sidelink relay, and the roadmap towards 6G.

Duration	3 Days
Audience	Telecom Engineers, RAN Architects, Technical Managers
Format	Live Virtual / On-Site
Prerequisites	5G NR knowledge required

COURSE CONTENT

Module 1: 5G Advanced Overview and Standardization

- From 5G to 5G Advanced: what changes
- 3GPP Release 18 scope and timeline
- 3GPP Release 19 scope and early features
- 5G-A market drivers and operator roadmaps
- Relationship between 5G Advanced and 6G

Module 2: AI/ML-Native RAN (3GPP AI Framework)

- 3GPP AI/ML framework for NR air interface
- AI-based CSI feedback and beam management
- AI-based positioning enhancements
- AI model lifecycle management in RAN
- Data collection and model transfer mechanisms

Module 3: RedCap and RedCap Evolution (eRedCap)

- RedCap (Reduced Capability) device classes
- RedCap use cases: wearables, sensors, cameras, industrial
- RedCap vs NB-IoT vs LTE-M positioning
- eRedCap in Release 19: further cost and power reduction
- RedCap deployment strategies and coexistence

Module 4: XR and Media Enhancements

- Extended Reality (XR) traffic characteristics

- XR-specific capacity and scheduling enhancements
- Power saving for XR devices
- Multi-modal communication support
- Haptic and immersive media requirements

Module 5: MIMO Evolution and Spectrum

- Massive MIMO enhancements in Rel-18/19
- 8Tx UE and coherent JT improvements
- Multi-panel UE operation
- DSS enhancements and NR-NR coexistence
- Upper mid-band (7-24 GHz) studies

Module 6: Network Energy Saving

- 3GPP network energy saving features
- Cell DTX/DRX and SSB-less operation
- AI/ML for energy efficiency optimization
- Spatial and temporal energy adaptation
- Green network KPIs and measurement framework

Module 7: NTN, Positioning, and Sidelink

- NTN enhancements in Rel-18/19
- Sidelink relay and UE-to-network relay
- High-accuracy positioning (cm-level)
- Ambient IoT (zero-energy devices)
- Roadmap to 6G: key study items

TRAINING 35: GREEN NETWORK AND ENERGY EFFICIENCY



Covers telecom network energy efficiency strategies including 5G power saving features, AI-driven energy optimization, green KPIs, renewable energy integration, EMF management, and ESG reporting frameworks for telecom operators.

Duration	2 Days
Audience	CTOs, Network Planning Managers, Strategy Directors, Sustainability Officers
Format	Live Virtual / On-Site

COURSE CONTENT

Module 1: The Energy Challenge in Telecom

- Telecom energy consumption landscape
- 5G energy paradox: more capacity, more power?
- Operator TCO breakdown and energy share
- Regulatory pressure and ESG requirements
- Industry commitments: GSMA climate targets

Module 2: 5G Network Energy Saving Features

- 5G Deep Sleep and micro sleep modes
- Cell DTX/DRX mechanisms
- SSB-less operation and lean carrier design
- Massive MIMO power optimization
- Symbol and channel shutdown techniques
- Energy saving in SA vs NSA modes

Module 3: AI/ML for Energy Optimization

- AI-driven traffic prediction for power management
- ML-based sleep mode activation
- Power-efficiency heatmaps and analytics
- Autonomous energy management use cases
- Real-world results: 30-70% power reduction examples

Module 4: Green Network Design and Planning

- Energy-efficient site design
- Renewable energy integration (solar, wind, hybrid)

- Battery and backup optimization
- Liquid cooling vs air cooling for 5G equipment
- Network densification vs energy trade-offs

Module 5: Green KPIs, Measurement, and ESG Reporting

- ITU and ETSI energy efficiency metrics
- Energy Efficiency Ratio (EER) per bit/joule
- Carbon footprint calculation methodology
- ESG reporting frameworks for telcos
- Scope 1, 2, 3 emissions in telecom
- Sustainability roadmap best practices

TRAINING 36: 5G NETWORK SLICING MONETIZATION AND ORCHESTRATION



Covers the business and technical dimensions of 5G Network Slicing monetization, including slice-as-a-service models, SLA management, E2E orchestration (ONAP, OSM), assurance, charging, and enterprise go-to-market strategies.

Duration	2 Days
Audience	Product Managers, Strategy Directors, Core Engineers, Enterprise Sales
Format	Live Virtual / On-Site
Prerequisites	Basic 5G knowledge

COURSE CONTENT

Module 1: Network Slicing Business Case

- Why slicing matters for 5G SA monetization
- Slice-as-a-Service business models
- Slicing revenue projections and market sizing
- Vertical-specific slice offerings
- Pricing models: subscription, pay-per-use, SLA-based

Module 2: End-to-End Slice Orchestration

- E2E slice lifecycle management
- ONAP and OSM orchestration platforms
- CSMF, NSMF, NSSMF roles
- Slice template design and instantiation
- Cross-domain orchestration: RAN, transport, core

Module 3: Slice SLA and Assurance

- SLA definition for network slices
- Real-time SLA monitoring and enforcement
- Slice-level KPIs and performance metrics
- Automated SLA breach remediation
- Slice assurance architecture

Module 4: Slice Charging and Enterprise Integration

- 5G charging for network slices
- CHF and converged charging for slices
- NSSAI-based billing models
- Enterprise self-service slice portals
- API exposure for slice management (NEF/CAPIF)

Module 5: Use Cases and Go-to-Market

- Slicing for Industry 4.0 and manufacturing
- Slicing for autonomous vehicles and V2X
- Slicing for healthcare and emergency services
- Slicing for gaming and media
- Enterprise go-to-market strategies and case studies

TRAINING 37: TELCO CLOUD AND CLOUD-NATIVE NETWORKS



Advanced training on telco-grade cloud infrastructure covering cloud-native network functions (CNFs), Kubernetes for telecom, Helm charts, CI/CD pipelines, multi-cloud strategies, and the path to fully disaggregated networks.

Duration	3 Days
Audience	Cloud Architects, Core Engineers, DevOps Engineers, IT Managers
Format	Live Virtual / On-Site
Prerequisites	Basic cloud and telecom knowledge

COURSE CONTENT

Module 1: Telco Cloud Fundamentals

- From VNFs to CNFs: the cloud-native shift
- Telco cloud vs enterprise cloud
- Telco-grade requirements: latency, reliability, SLA
- Infrastructure layers: bare metal, VM, container
- Major telco cloud platforms: Red Hat, VMware, Wind River

Module 2: Kubernetes for Telecom

- Kubernetes architecture deep dive
- Telco-specific Kubernetes challenges
- Multus and SR-IOV for network acceleration
- DPDK and hardware acceleration in K8s
- Kubernetes resource management for real-time workloads
- Kubernetes Federation and multi-cluster management

Module 3: CNF Design and Lifecycle

- Cloud-native network function design principles
- Microservices architecture for telecom
- Helm charts for CNF packaging
- Operator framework for stateful CNFs
- CNF certification and testing (CNTT, Anuket)

Module 4: CI/CD and DevOps for Telco

- CI/CD pipeline design for telecom
- GitOps for network function deployment
- Automated testing and canary deployments
- Blue/green and rolling upgrade strategies
- Zero-downtime upgrade patterns

Module 5: Multi-Cloud and Edge Deployment

- Hybrid and multi-cloud strategies for operators
- Edge cloud architecture for MEC
- Far edge, near edge, and regional cloud
- Cloud-native core deployment models
- Cost optimization and capacity planning

TRAINING 38: AGENTIC AI FOR TELECOM OPERATIONS



Covers the application of Agentic AI systems in telecom operations, including autonomous NOC agents, self-healing networks, AI-driven trouble ticket resolution, intent-based automation, and multi-agent orchestration for network management.

Duration	2 Days
Audience	Network Operations Managers, AI Engineers, Automation Architects
Format	Live Virtual / On-Site
Prerequisites	Basic AI and telecom knowledge

COURSE CONTENT

Module 1: From Copilots to Autonomous Agents in Telecom

- Evolution of AI in telecom: rules, ML, GenAI, Agentic AI
- What makes AI 'agentic': planning, memory, tool use
- Agentic AI vs traditional automation
- Use case landscape for telecom operators
- Maturity model for AI agent deployment

Module 2: AI Agents for NOC Automation

- Autonomous alarm correlation and root cause analysis
- AI-driven incident triage and escalation
- Natural language interfaces for NOC operations
- Automated runbook execution
- Real-time network health dashboards with AI insights

Module 3: Self-Healing Network Agents

- Predictive fault detection and prevention
- Automated remediation workflows
- Configuration drift detection and correction
- Self-optimizing network parameters
- Closed-loop automation with human-in-the-loop

Module 4: Multi-Agent Orchestration

- Multi-agent architectures for telecom

- Agent-to-agent communication protocols
- Task decomposition and delegation
- Supervisor agents and safety guardrails
- Integration with existing OSS/BSS systems

Module 5: Implementation and Governance

- Building telecom AI agents with LLM frameworks
- RAG (Retrieval-Augmented Generation) for network knowledge
- Testing and validation of autonomous agents
- AI governance and responsible deployment
- ROI measurement and scaling strategies

TRAINING 39: 5G RedCap AND NR-LIGHT



Focused training on 5G Reduced Capability (RedCap) devices covering device classes, UE capabilities, power saving, deployment strategies, use cases (wearables, cameras, sensors), coexistence, and eRedCap evolution in Release 19.

Duration	1 Day
Audience	IoT Engineers, Product Managers, RAN Engineers
Format	Live Virtual / On-Site
Prerequisites	Basic 5G NR knowledge

COURSE CONTENT

Module 1: RedCap Fundamentals

- What is RedCap and why it matters
- 3GPP Release 17 RedCap specifications
- RedCap device classes and UE capabilities
- Bandwidth reduction: 20 MHz FDD, 20 MHz TDD
- Single Rx antenna and reduced MIMO layers
- Half-duplex FDD option

Module 2: RedCap vs Legacy IoT Technologies

- RedCap vs NB-IoT vs LTE-M: feature comparison
- Data rate, latency, and power consumption trade-offs
- When to use RedCap vs other IoT technologies
- Migration strategies from LTE-M/NB-IoT to RedCap
- Coexistence with eMBB traffic in same carrier

Module 3: RedCap Use Cases and Deployments

- Industrial wireless sensors
- Video surveillance cameras
- Wearable devices and health monitors
- Smart grid and utility meters
- Operator deployment strategies and spectrum planning

Module 4: eRedCap (Release 19) and Evolution

- eRedCap: further capability reduction
- 5 MHz bandwidth operation
- 1 Rx antenna baseline
- Ambient IoT and zero-energy devices
- Roadmap towards 6G massive IoT

TRAINING 40: 5G NETWORK EXPOSURE AND CAMARA/OPEN GATEWAY APIS



Covers the GSMA Open Gateway initiative and CAMARA API project, enabling operators to expose 5G network capabilities (QoD, location, number verification) to developers and enterprises via standardized APIs.

Duration	2 Days
Audience	Product Managers, API Developers, Enterprise Solution Architects
Format	Live Virtual / On-Site
Prerequisites	Basic 5G and API knowledge

COURSE CONTENT

Module 1: Network Exposure Fundamentals

- Why network APIs matter for 5G monetization
- 3GPP Network Exposure Function (NEF)
- Common API Framework (CAPIF)
- API gateway architecture in 5G
- Developer ecosystem and API marketplace models

Module 2: GSMA Open Gateway Initiative

- GSMA Open Gateway vision and scope
- Operator participation and global adoption
- Aggregator models and federated APIs
- Business models for API monetization
- Open Gateway vs proprietary API exposure

Module 3: CAMARA API Project

- CAMARA project governance (Linux Foundation)
- Quality on Demand (QoD) API
- Device Location Verification API
- Number Verification and SIM Swap APIs
- Network Slicing API and Carrier Billing API
- API design principles and versioning

Module 4: Technical Deep Dive

- API authentication and authorization (OAuth 2.0, OIDC)
- CAMARA API specification walkthrough
- Edge discovery and MEC APIs
- Real-time event subscription APIs
- Performance, rate limiting, and SLA management

Module 5: Use Cases and Enterprise Integration

- Anti-fraud: SIM swap and number verification
- QoS for gaming and video streaming
- Location APIs for logistics and fleet management
- Network slicing APIs for enterprise self-service
- Developer onboarding and partner ecosystem

TRAINING 41: TELECOM DATA AND ANALYTICS PLATFORM



Covers building telecom data analytics platforms including NWDAF architecture, data lakehouse for telecom, real-time streaming, network digital twin, and AI/ML pipelines for network intelligence.

Duration	2 Days
Audience	Data Engineers, Network Analytics Managers, BI Architects
Format	Live Virtual / On-Site
Prerequisites	Basic data engineering knowledge

COURSE CONTENT

Module 1: Telecom Data Landscape

- Types of telecom data: CDR, KPI, traces, logs, probes
- Data volumes and velocity challenges in 5G
- Data governance and privacy (GDPR, telecom regulations)
- Data mesh vs data lakehouse architecture
- Reference architecture for telecom analytics

Module 2: 5G NWDAF Deep Dive

- NWDAF architecture and network function interactions
- NWDAF services: analytics, prediction, anomaly detection
- NWDAF data collection from NFs (AMF, SMF, PCF)
- ML model training and inference in NWDAF
- NWDAF vendor landscape and deployment options

Module 3: Data Platform Architecture

- Data ingestion: Kafka, Flink, Spark Streaming
- Data storage: data lakehouse (Delta Lake, Iceberg)
- Data processing: batch and real-time pipelines
- Data cataloging and metadata management
- API-based data exposure for downstream consumers

Module 4: Network Intelligence Use Cases

- Real-time network anomaly detection
- Predictive capacity planning

- Customer experience analytics (QoE scoring)
- Network digital twin for simulation
- Churn prediction and revenue assurance

Module 5: ML Pipelines and MLOps for Telecom

- ML pipeline design for network analytics
- Feature engineering from network data
- MLOps: model versioning, monitoring, retraining
- AutoML for telecom use cases
- Scaling AI models across network domains

TRAINING 42: 5G SMART MANUFACTURING AND INDUSTRY 4.0



Deep dive into 5G-powered smart manufacturing covering URLLC for factory automation, TSN integration, AGVs, digital twins, private 5G deployment models, and end-to-end Industry 4.0 architectures.

Duration	2 Days
Audience	Enterprise Solution Architects, Industrial IoT Engineers, Manufacturing IT Managers
Format	Live Virtual / On-Site
Prerequisites	Basic 5G knowledge

COURSE CONTENT

Module 1: Industry 4.0 and 5G Convergence

- Industry 4.0 framework and maturity model
- Why 5G for manufacturing: latency, reliability, density
- 5G vs Wi-Fi 6/7 for industrial use
- Factory communication requirements by use case
- OT/IT convergence challenges

Module 2: 5G URLLC and TSN for Factory Automation

- URLLC requirements for industrial control
- Time-Sensitive Networking (TSN) fundamentals
- 5G-TSN integration architecture
- Deterministic communication for motion control
- QoS mapping between 5G and TSN

Module 3: 5G-Enabled Use Cases

- AGVs and AMRs with 5G connectivity
- AR/VR for remote assistance and training
- Machine vision and quality inspection
- Predictive maintenance with 5G and AI
- Digital twin for production simulation
- Intralogistics and asset tracking

Module 4: Private 5G Deployment for Manufacturing

- Spectrum options for industrial 5G
- SNPN vs PNI-NPN deployment models
- Indoor coverage design for factories
- Edge computing architecture for manufacturing
- Integration with MES, ERP, and SCADA systems

Module 5: Business Case and Implementation

- ROI calculation for 5G in manufacturing
- Phased deployment strategy
- Vendor ecosystem: devices, infrastructure, platforms
- Successful deployment case studies
- Future: 5G Advanced features for Industry 4.0

TRAINING 43: Wi-Fi 7 AND 5G/Wi-Fi CONVERGENCE



Covers Wi-Fi 7 (802.11be) technology, MLO, 320 MHz channels, and convergence strategies with 5G for enterprise and indoor deployments including Passpoint, ATSSS, and unified policy management.

Duration	2 Days
Audience	Network Engineers, Enterprise Architects, Indoor Planning Engineers
Format	Live Virtual / On-Site
Prerequisites	Basic wireless knowledge

COURSE CONTENT

Module 1: Wi-Fi 7 (802.11be) Technology

- Wi-Fi evolution: Wi-Fi 6/6E to Wi-Fi 7
- 320 MHz channel width and 4096-QAM
- Multi-Link Operation (MLO)
- Multi-RU and preamble puncturing
- Restricted TWT for deterministic latency
- Wi-Fi 7 device ecosystem and certification

Module 2: Wi-Fi 7 vs 5G: Comparison and Coexistence

- Performance comparison: throughput, latency, reliability
- Spectrum: unlicensed vs licensed advantages
- Indoor vs outdoor deployment trade-offs
- Cost comparison for enterprise deployments
- When to use Wi-Fi 7 vs 5G vs both

Module 3: 5G/Wi-Fi Convergence Architecture

- 3GPP non-3GPP access integration
- ATSSS (Access Traffic Steering, Switching, Splitting)
- Passpoint/Hotspot 2.0 for seamless offload
- Unified authentication and policy (RADIUS, 5G Core)
- Converged indoor solutions: DAS + Wi-Fi

Module 4: Enterprise Deployment Strategies

- Converged indoor planning methodology

- Wi-Fi 7 + 5G for enterprise campus
- Industrial Wi-Fi 7 and TSN considerations
- Unified network management platforms
- Migration planning from Wi-Fi 6/6E to Wi-Fi 7

Module 5: Use Cases and Future Trends

- High-density venues: stadiums, airports
- Healthcare and hospital connectivity
- Education campus deployments
- Wi-Fi 8 (802.11bn) early outlook
- Convergence roadmap towards 6G

TRAINING 44: QUANTUM-SAFE TELECOM SECURITY



Covers quantum computing threats to telecom security, post-quantum cryptography (PQC) algorithms, quantum key distribution (QKD), migration strategies for telecom infrastructure, and regulatory compliance roadmaps.

Duration	2 Days
Audience	Security Architects, CTOs, CISO, Network Security Engineers
Format	Live Virtual / On-Site
Prerequisites	Basic security and telecom knowledge

COURSE CONTENT

Module 1: Quantum Computing and Telecom Threat Landscape

- Quantum computing fundamentals for telecom professionals
- How quantum computers break current encryption (RSA, ECC)
- Harvest-now-decrypt-later attacks
- Timeline: when will quantum computers threaten telecom?
- Impact on 5G security: SBA, signaling, subscriber privacy

Module 2: Post-Quantum Cryptography (PQC)

- NIST PQC standardized algorithms (ML-KEM, ML-DSA, SLH-DSA)
- Lattice-based, hash-based, and code-based cryptography
- PQC performance: key sizes, computation overhead
- Hybrid cryptography: classical + PQC transition
- PQC integration in TLS, IPsec, and 5G protocols

Module 3: Quantum Key Distribution (QKD)

- QKD fundamentals and BB84 protocol
- QKD network architectures for telecom
- Trusted node and measurement-device-independent QKD
- QKD over fiber and satellite links
- QKD vendor landscape and commercial deployments

Module 4: Telecom Migration Strategy

- Crypto-agility: designing for algorithm flexibility

- Cryptographic inventory and risk assessment
- Migration roadmap for telecom infrastructure
- Impact on SIM/eSIM and subscriber authentication
- Testing and validation of quantum-safe implementations

Module 5: Regulatory Landscape and Industry Initiatives

- GSMA and 3GPP quantum security activities
- ETSI QSC (Quantum-Safe Cryptography) group
- National regulations and compliance timelines (US, EU, Asia)
- CNSA 2.0 requirements and timeline
- Building a quantum-safe telecom roadmap



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