BLACKBIRD FOR TRAINING

Advanced Wireless Networks, Systems and Technologies Course

26 – 30 July 2027
Düsseldorf (Germany)



Advanced Wireless Networks, Systems and Technologies Course

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Introduction:

Advanced wireless networks, systems and technologies cover how radio links, access technologies and backhaul are designed and integrated so that Wi-Fi, cellular, IoT and fixed wireless connections deliver the coverage, capacity and reliability an organisation needs. This 1-week course is for managers and engineering professionals who plan, build or run wireless infrastructure, and delegates finish with a Multi-Technology Wireless System Design Blueprint. It is taught at expert level through a modelling build that applies link budgets, MIMO and beamforming to IEEE 802.11be Wi-Fi 7, the latest Wi-Fi generation, alongside 3GPP private 5G and low-power wide-area options.

Course Objectives:

- Define the elements of a wireless link budget and interpret how path loss, fading and receiver sensitivity set usable range and margin
- Distinguish OFDM from OFDMA and SU-MIMO from MU-MIMO, and explain how each difference changes capacity in dense deployments
- Compare Wi-Fi 7, private 5G, LPWAN and mmWave fixed wireless by range, capacity, latency, power use and ownership model
- Select mitigation methods for co-channel and adjacent-channel interference where several wireless technologies share a site
- Interpret key performance indicators and drive-test results to prioritise optimisation actions, security controls and backhaul upgrades
- Justify an integrated wireless system design with a link budget, capacity model and technology selection matrix

Target Audience:

- Wireless and RF engineers who design coverage and decide which technology serves each area and device class
- Telecom and network infrastructure managers who own wireless budgets and judge whether to extend Wi-Fi, deploy private cellular or add IoT networks
- Network planning and optimisation specialists who model coverage and capacity and decide where interference or backhaul limits performance
- IoT and operational technology engineers who connect sensors and machines and choose between LPWAN and cellular IoT options
- Network security analysts who assess wireless exposure and decide which authentication and monitoring controls each network needs
- Technical project managers who integrate wireless systems across sites and weigh cost, risk and delivery trade-offs



Course Outline:

Day 1: Radio Foundations at System Level: Propagation, Link Budgets and the Technology Landscape

- Free-Space vs Multipath Propagation: Path Loss, Fading and Shadowing on Real Sites
- Link Budget Elements: Transmit Power, Antenna Gain, Losses and Receiver Sensitivity
- SINR and Noise Floor: Linking Measured Radio Conditions to Achievable Data Throughput
- Licensed vs Unlicensed Spectrum: Control, Cost and Interference Exposure for Wireless Systems
- Wireless Technology Landscape Map: Range, Capacity, Latency and Power by Use Case

Day 2: Physical-Layer Architectures: OFDM, MIMO and Beamforming Compared

- OFDM vs OFDMA: Subcarriers, Resource Units and Multi-User Scheduling Efficiency
- Adaptive Modulation and Coding: Selecting QAM Order Against Measured Link Margin
- SU-MIMO vs MU-MIMO: Spatial Streams, Channel Rank and User Grouping
- Analogue vs Digital Beamforming: Hardware Cost, Flexibility and mmWave Suitability
- Massive MIMO Arrays: Antenna Count, Channel State Feedback and Cell Capacity

Day 3: Applying Wi-Fi 7, Private 5G, LPWAN and Fixed Wireless in System Design

- IEEE 802.11be Wi-Fi 7: Multi-Link Operation, 320 MHz Channels and 4096-QAM
- Wi-Fi 7 vs Private 5G: Scheduling, Mobility and Ownership Models Compared
- Private 5G Architecture: Local Core, Edge Computing and Campus Network Slicing
- LoRaWAN vs NB-IoT vs LTE-M: Range, Battery Life and Data Rate Trade-Offs
- mmWave Fixed Wireless Access: Line-of-Sight Paths, Rain Fade and Link Capacity

Day 4: Analysing Coexistence, Interference, Security and Performance Optimisation

- Co-Channel vs Adjacent-Channel Interference: Detection, Spectrum Analysis and Mitigation Methods
- Multi-Technology Coexistence: Wi-Fi, Cellular and IoT Networks Sharing Sites and Bands
- Wireless Security Architecture: Authentication, Encryption and Rogue Device Detection Controls
- Microwave vs Fibre Backhaul: Capacity Planning for Aggregated Wireless Traffic
- Key Performance Indicators: Throughput, Latency, Packet Loss and Coverage Drive Testing

Day 5: Modelling Build: Producing the Multi-Technology Wireless System Design Blueprint

- Requirements Capture Matrix: Users, Devices, Applications and Service Levels for a Case Site
- Predictive Planning Tool Model: Coverage and Capacity Heat Maps for the Case Site
- Link Budget and Capacity Spreadsheet: Sizing Access Points, Cells and IoT Gateways
- Integrated vs Single-Technology Design: Scoring Cost, Risk and Performance in a Selection Matrix
- Wireless System Design Blueprint: Finalising Architecture, Backhaul, Security and Optimisation Plan



Skills You Will Gain:

- Link Budget Analysis
- MIMO and Beamforming Design
- Multi-Technology Coexistence Planning
- LPWAN Technology Selection
- Private Cellular Network Architecture
- Backhaul Capacity Sizing
- Wireless Performance Optimisation
- Wireless Security Assessment

Why Attend This Course:

- From designing each wireless network in isolation to planning Wi-Fi, private cellular, IoT and backhaul as one integrated system
- From estimating coverage by rule of thumb to calculating link budgets and margins that predict real range and throughput
- From reacting to complaints about slow or dropped connections to tracing them to interference, capacity or backhaul causes with measured indicators
- From choosing technologies by habit or vendor preference to presenting a Multi-Technology Wireless System Design Blueprint that justifies each choice

Conclusion:

Designing wireless infrastructure at an advanced level means treating radio propagation, access technology, backhaul and security as parts of one system rather than as separate projects. The course makes three distinctions clear: OFDM versus OFDMA and SU-MIMO versus MU-MIMO in capacity terms, Wi-Fi 7 versus private 5G for critical connectivity, and co-channel versus adjacent-channel interference where several technologies share a site. It suits managers and engineering professionals who already work with wireless networks daily and now need to select, integrate and optimise several technologies in one justified design.

Frequently Asked Questions FAQ:

What should delegates know before joining an advanced wireless networks, systems and technologies course?

Delegates should already work with wireless or IP networks and be comfortable with decibels, basic radio terms and spreadsheets. Experience with Wi-Fi, cellular or IoT connectivity helps, because the course moves quickly into link budgets, MIMO and multi-technology design.



How does an advanced wireless networks, systems and technologies course differ from a course on a single wireless technology?

It integrates several technologies in one design. A single-technology course goes deep into one standard, such as one Wi-Fi generation or a mobile radio access network; this course compares Wi-Fi, private cellular, LPWAN and fixed wireless and decides how they share sites, spectrum and backhaul.

Is private 5G always a better choice than Wi-Fi 7 in advanced wireless networks and systems?

No. Private 5G offers scheduled access, wide-area mobility and spectrum control but needs a core network and specialist skills. Wi-Fi 7 is simpler and usually cheaper for dense indoor data. Many sites combine both, matching each technology to its devices and applications.

What do delegates take back to work from an advanced wireless networks, systems and technologies course?

Delegates take back a Multi-Technology Wireless System Design Blueprint: a requirements matrix, link budget and capacity model, technology selection scoring, backhaul sizing, security controls and an optimisation plan, built on a case site and ready to adapt to their own organisation.

