



5G and Satellites Training

This course about 5G and satellites or NTN is designed to introduce the main concepts behind 5G and satellite communications. We will focus on the key components, 5G and satellite access architecture options and considerations. We will also provide Highlights of satellite radio propagation and Use cases and technical challenges associated with 5G New Radio (NR) in non-terrestrial networks (NTN), we will then finish the training by discussing about the integration of IoT with non terrestrial networks.

Content of the Training:

1) The need of 5G and Satellite

1. Satellite myths versus truths
2. Definition of Non Terrestrial Network
3. NTN categories
4. NTN Backhaul and Connectivity
5. Evolution from NTN to 5G NTN
6. 5G Satellite Use Cases and challenges

2) NTN in 3GPP Standards

7. 5G NTN at 3GPP
8. 3GPP NTN Work : RAN, SA & CORE
9. Focus on NTN Release 15
10. Focus on NTN Release 16
11. Focus on NTN Release 17
12. Focus on NTN Release 18
13. NR NTN enhancements for Rel-18/Rel-19

3) 5G NTN frequencies and NTN commercial market

1. Satellite Spectrum Allocation
2. L-band, S-band, C-band
3. Ku/Ka bands, Q/V bands
4. Co-existence, 5G and NTN band
5. Commercial satellite constellations
6. Starlink Space X, OneWeb,
7. Amazon Kuiper, Lightspeed Telesat
8. Benefits and dangers of satellite constellations

4) 5G NTN architecture and terminologies

1. 5G NTN System architecture
2. Transparent NTN NG-RAN architecture
3. Regenerative NTN NG-RAN architecture
4. Inter-satellite link (ISL)
5. 5G NTN quality of service
6. Ephemeris parameters
7. Beam footprints and phased arrays

5) NTN RF propagation models Vs with Terrestrial Network

1. NTN channel modeling
2. NTN Propagation delay
3. Doppler Shift
4. Rain Attenuation, Atmospheric Absorption & Scintillation
5. Large scale fading effect
6. NTN Link Budget
7. Beamforming and NTN advantages

6) NTN protocols and procedure updates

1. 5G protocol stacks & channels
2. NTN NR PHY/MAC-layer challenges
3. Modification of protocol stacks for 5G NTN
4. HARQ Solutions for NTN
5. UL Synchronization in NTN
6. Satellite mobility in NTN

7) 5G Internet of Things and NTN

1. Internet of Things in 5G
2. Use cases of IoT over NTN
3. 3GPP Work on NTN IoT
4. IoT Architecture Supported by NTN
5. NTN IoT challenges