CASE STUDY

E-Band microwave backhaul performance field-proven under heavy rainfall

- E-Band microwave backhaul solution for 5G using Nokia Wavence Ultra Broadband Transceiver portfolio
- Over 99.99% availability during the monsoon season
- Robust performance on links up to 1.2 km

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Introduction

This case study describes how Nokia helped one of the leading mobile network operators in India enable a high-capacity E-Band microwave backhaul solution.

The Telecom Regulatory Authority of India released C-Band spectrum for 5G and E-Band (80 GHz) spectrum for microwave transport purposes, in July 2022. The availability of E-Band spectrum represents a strategic enabler for massive 5G deployments in the country.

Earlier wireless backhaul deployments in India were challenged by the limited availability of allocated frequency bands. In addition, the available channel bandwidth was relatively narrow, although it provided enough transport capacity to deploy large-scale 4G networks . The significantly wider channel bandwidth enabled by the E-Band brings the much-needed performance boost to support 5G microwave backhaul deployments. However, the E-Band frequencies are more sensitive to the effects of rain than lower frequencies.

The trial described in this case study was conducted during the monsoon season, which set the bar higher for backhaul capabilities. Nokia was able to demonstrate that the Wavence microwave backhaul portfolio exceeds the operator's requirements for reliable connectivity during heavy rainfall.

OBJECTIVE

Validating the E-Band capabilities for microwave backhaul in challenging weather conditions

Preparing for large-scale 5G deployments, the Indian operator wanted to confirm a reliable and cost-effective backhaul solution to support the foreseen increase in mobile traffic volumes and the co-existence of 4G and 5G services.

Nokia helped the operator implement a microwave backhaul solution on the E-Band to validate its capabilities in severe weather conditions during the monsoon season.

The following aspects were analyzed:

- Microwave link behavior
- Rain attenuation
- Consistency between network design computations and field measurements

Rain attenuation and signal interference

Electromagnetic signals are attenuated when propagating through rainfall. So-called ‘rain fade’ impacts the propagation of microwave radio transmissions. In addition, a storm front can cause electromagnetic interference to the signals, leading to further degradation or loss of connection.

Monsoon season in India

A monsoon is a seasonal change in the direction of the prevailing winds in the region. Typically monsoons are associated with heavy and torrential rainfall. In India, the rainy season lasts from June through to September. During the monsoon, some areas of the country receive more than 90% of their total annual rainfall; a typical monthly average across India is 200-300 mm of precipitation during this season. Thunder storms can frequently occur in the pre-monsoon season.

SETUP

Verification of microwave link availability throughout the monsoon season

The setup used three different radio unit types from the Wavence Ultra Broadband Transceiver portfolio: the UBT-m and UBT-m Urban for best-in-class system gain as well as the high-power UBT-mX for enabling longer links.

The setup encompassed 33 links deployed in three different geographical locations, including Mumbai and other big cities in India over a period of 5 months, spanning the entire monsoon season.

The network design assumptions included the following:

- Rain rate: 120 mm per hour
- Availability: 99.99% on minimum modulation
- Fade Margin: Min 10 dB for the highest modulation
- Adaptive Coding and Modulation (ACM) on all links for maximizing the throughput based on propagation conditions.

Nokia also provided a centralized network management tool for monitoring the microwave links and gathering consistent data across the various sites.

RESULTS

High-capacity E-Band microwave links maintained even under heavy rain conditions

Nokia's solution was proven to carry both 4G and 5G traffic with a single microwave link exceed the expectations set in the design phase for link availability and adaptive modulation.

The trial results included:

- Over 99.99% availability during the most difficult propagation conditions with high rain intensity of 120 mm/h.
- Accuracy of design for link distances up to 1.2 km.
- Maximized throughput during periods of heavy rainfall by using ACM to adapt transmission rates to the prevailing propagation conditions.

As the measured availability of most microwave links during the monsoon season proved to be better than the designed yearly target of 99.99%, the operator will likely achieve even higher yearly availability of the E-Band links once the dry-season starts, bringing more stability to signal propagation.

Moreover, it was demonstrated that a good network design and proper installation of the equipment with stable antenna structures are contributing factors to achieving high microwave performance on E-Band.

Visit the Wavence Microwave Transmission webpage to learn more

Microwave backhaul is a reliable choice also during the monsoon season

As many operators around the world are transitioning to 5G, mobile networks must meet the requirements of more bandwidth-hungry services, which also drives demand for increased backhaul capacity. Typically, microwave links are significantly more cost efficient and faster to deploy than fiber backhaul.

Microwave backhaul performance is dependent on the propagation properties of the allocated frequencies. While the higher frequencies such as E-Band are typically more impacted by rain fade and free-space losses than lower frequencies, they also offer higher throughput.

This case study shows that E-Band spectrum is a suitable alternative for implementing a robust microwave backhaul solution even during the challenging conditions of a monsoon season. With the right selection of microwave radio variants and antennas, achieving stable performance over long links is possible despite the weather conditions.

The future use of higher power radios and higher gain antennas as well as Carrier Aggregation of lower microwave frequencies with the E-Band carriers should enable path lengths exceeding 2 km under heavy rain conditions.

Nokia Wavence radio units are commercially available to implement reliable microwave backhaul networks that can leverage a variety of frequency bands.

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As a B2B technology innovation leader, we are pioneering the future where networks meet cloud to realize the full potential of digital in every industry.

Through networks that sense, think and act, we work with our customers and partners to create the digital services and applications of the future.