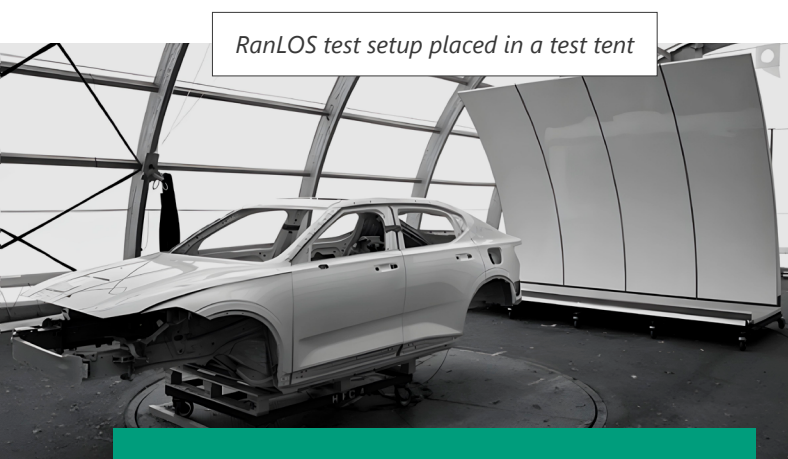


Full-Scale Vehicle Antenna and OTA Measurements

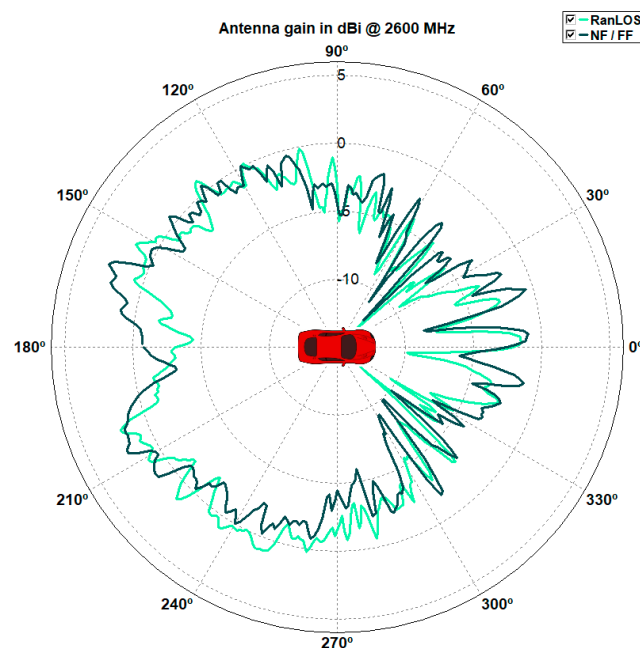
Ready-to-Measure Solution

In today's automotive landscape, reliable wireless communication is critical to overall vehicle performance. Ensuring high-quality antenna and wireless performance typically demands access to advanced test environments with precise, sophisticated equipment. However, such facilities are often costly and limited in availability – making it challenging for manufacturers and engineers to verify and optimize their systems.



RanLOS test setup placed in a test tent

To mitigate these challenges, RanLOS and Anritsu offer a cost-effective alternative to expensive advanced chambers, delivering nearly the same measurement quality as a sophisticated test facility.



Antenna radiation pattern comparison

Design Challenges

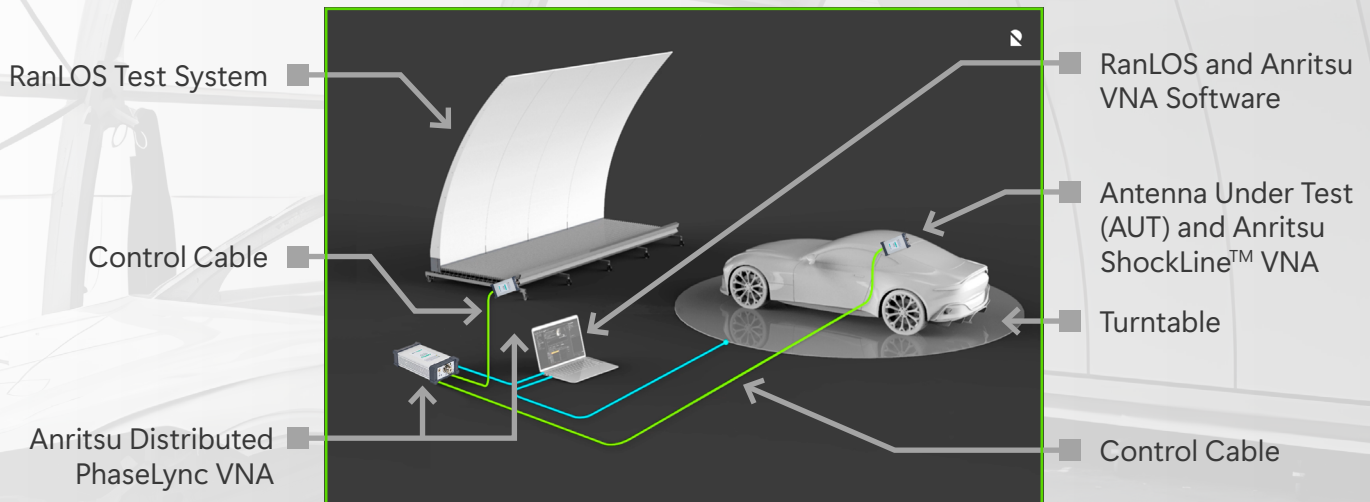
A robust test philosophy ensures the quality of wireless communication systems. Given the complexity of these systems, which integrate digital and analog subsystems along with software, thorough testing is essential. Simulating real environments is key for measuring cellular or V2X communication which typically occurs in Over-The-Air (OTA) far-field conditions. Antenna positioning, which will be influenced by vehicle type and body material, significantly impacts overall performance.

■ Aspects Being Considered in Vehicular Antenna Design:

- Optimal position of antenna on vehicle
- Support of multiple communication technologies and radio frequency bands
- Vehicle type (e.g., sedan or convertible)
- Body material (e.g., glass, metal, or carbon fiber)

The Test Process

The test system enables efficient testing and evaluation of antenna radiation patterns and communication system throughput.

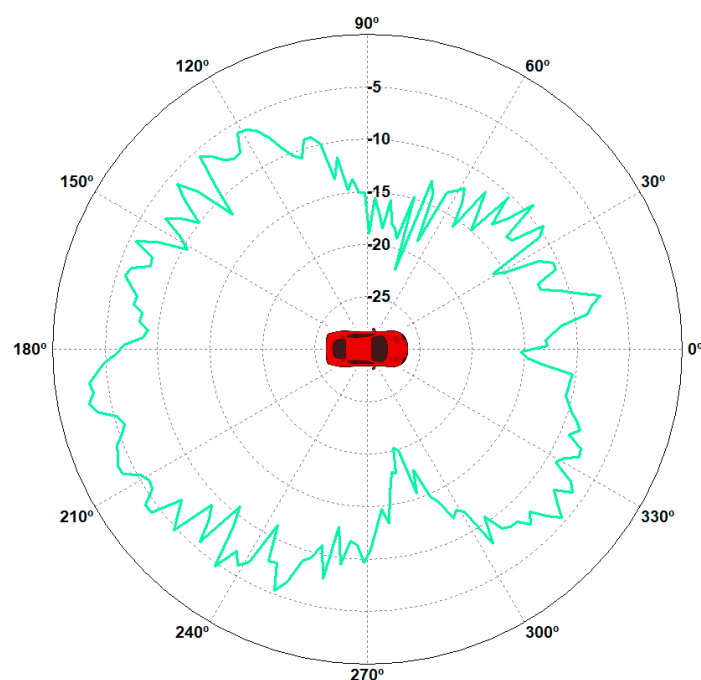


RanLOS and Anritsu Passive Test Setup

■ Passive Measurements

The passive configuration is used to measure the antenna radiation pattern, with the primary focus on the antenna mounted on a vehicle. Anritsu's Vector Network Analyzer functions as both the radio signal source (Tx) and analyzer (Rx). In combination with RanLOS components, it measures the antenna's radiation and reception characteristics.

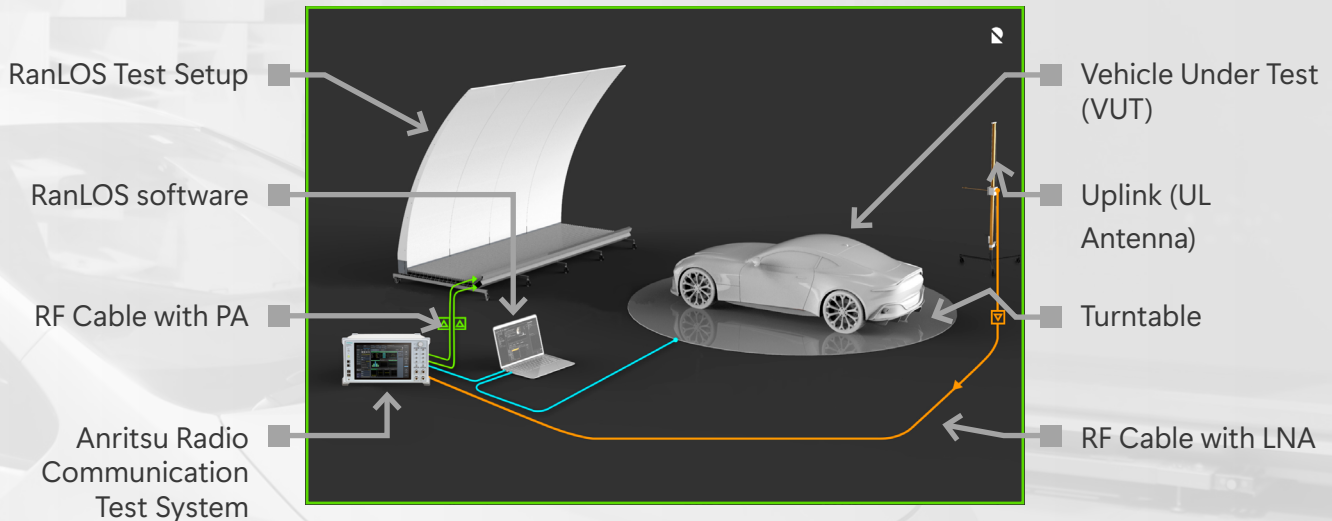
Measurement results are used to evaluate the performance of both the antenna design and its placement on a vehicle. A key aspect is identifying "blind spots", or areas where the antenna's radiation or reception is minimal.



Radiation pattern of LTE antenna mounted on the front roof

Active Measurements

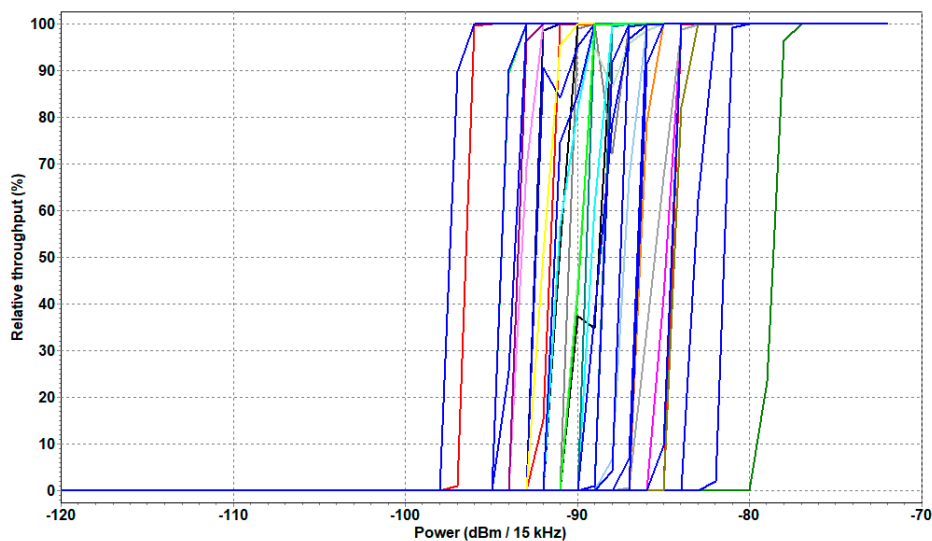
The active configuration is used to measure the performance of the entire communication system consisting of antennas, RF cables, and the communication unit with modem. The test focuses not only on the antenna system but primarily on assessing the communication unit, its modem, and software under OTA conditions.



RanLOS and Anritsu Active Test Setup. The Tests can be done with vehicle running on dynamometer

Downlink throughput is a key metric for the measurement indicating communication quality in all directions relative to the vehicle. Anritsu MT8821C Radio Communication Analyzer or MT8000A Radio Communication Test Station serves as a mobile network emulator to which vehicle's communication system connects and then downlink throughput can be measured.

A fundamental part is to find potential "dead angles" where communication with the vehicle may be significantly weakened due to the overall antenna and communication system design.



RanLOS throughput diagram

Both passive and active measurements are fully automated, with RanLOS BeamLab software controlling the Anritsu Vector Network Analyzer, Anritsu Radio Communication Test System, and Turntable. Measurement visualizations then helps engineers to understand the performance of antenna or communication systems, enabling further enhancements of the vehicle's connectivity performance.

Key Benefits of RanLOS and Anritsu Test System



RanLOS BeamForce 42

RanLOS Test System

- Based on practical parameters
- Easy-to-use and portable
- Cost-effective
- Excellent measurement quality
- Enables far-field condition measurements directly, unlike other solutions which measure in near-field conditions and convert results mathematically
- Designed for use in anechoic chambers, semi-anechoic chambers, EMC chambers and open measurement sites
- Suitable for testing cars on dynamometers
- Can supplement existing EMC chambers for measurements
- Fully integrated for Anritsu Vector Network Analyzers and Radio Communication Test Stations



Anritsu ME7869A Distributed VNA and MS46524B ShockLine™ VNA

Anritsu Vector Network Analyzers

- Wide frequency range up to 43.5 GHz
- High dynamic range up to 110 dB
- Power of test signal directly available on SA & AUT
- Fast sweep speeds of 250 us/point
- Unique IF Gain Ranging mode
- Inbuilt factory calibration
- Versatile applications for antenna measurements
- Up to 200m port distance



Anritsu MT8000A Radio Communication Test Station & MT8821C Radio Communication Analyzer

Anritsu Radio Communication Test Stations

- Wide Technology Support: Covers 5G NR, 4G, 3G, 2G, Cat-M1/NB-IoT and more
- High output power: Easy to compensate signal propagation loss in radiated OTA conditions
- MIMO Support: Supports up to 4x4MIMO channel emulation
- High Dynamic Range: Ability to keep connection in dynamic pathloss conditions in OTA environment
- Remote Control Capability: Can be configured for automated testing using GPIB or Ethernet
- Flexible Parameter Settings: Supports RF parametric and simple protocol testing
- Enhanced GUI: Next-generation windows-based GUI for ease of use

Summary

The integration of Anritsu's VNA and Radio Communication Test systems with the RanLOS test system, creates a portable, cost-effective, and user-friendly test system for evaluating a vehicle's connectivity performance in realistic over-the-air conditions. Assessing these characteristics is a crucial step in vehicle development and the design of communication systems to enable connected vehicle technology.



RanLOS provides innovative and cost-effective OTA test solutions for evaluating antennas and wireless communication. With patented hardware and proprietary software, developed through years of research, RanLOS enables fast and reliable testing – helping companies speed up development and optimize real-world wireless performance.

For more information visit ranlos.com