

Keysight Technologies

Innovative Test Solutions for the Connected Car



## Verify Connectivity in the Connected Car Using Established Lab-Based Test Methodologies

Automotive manufacturers are equipping new vehicles with multiple wireless systems, leading to increased testing complexity and potentially more complicated, expensive and time-consuming test procedures. In order to address these challenges, developers of new designs can benefit from adopting test methodologies already used by the mobile industry, including Virtual Drive Testing, Over-the-Air (OTA) antenna performance testing as well as interoperability and WLAN testing.

## Create Realistic RF Network Conditions with Full Simulation Capabilities

The connected car needs to integrate a wide range of cellular, Wi-Fi and satellite technologies to support emergency and navigation services, management of traffic flow and vehicle relationship as well as capabilities for vehicle tracking and infotainment. This challenging radio environment means developers need to pay explicit attention to how they design and integrate adjacent technologies in order to deliver these services reliably and cost-effectively.

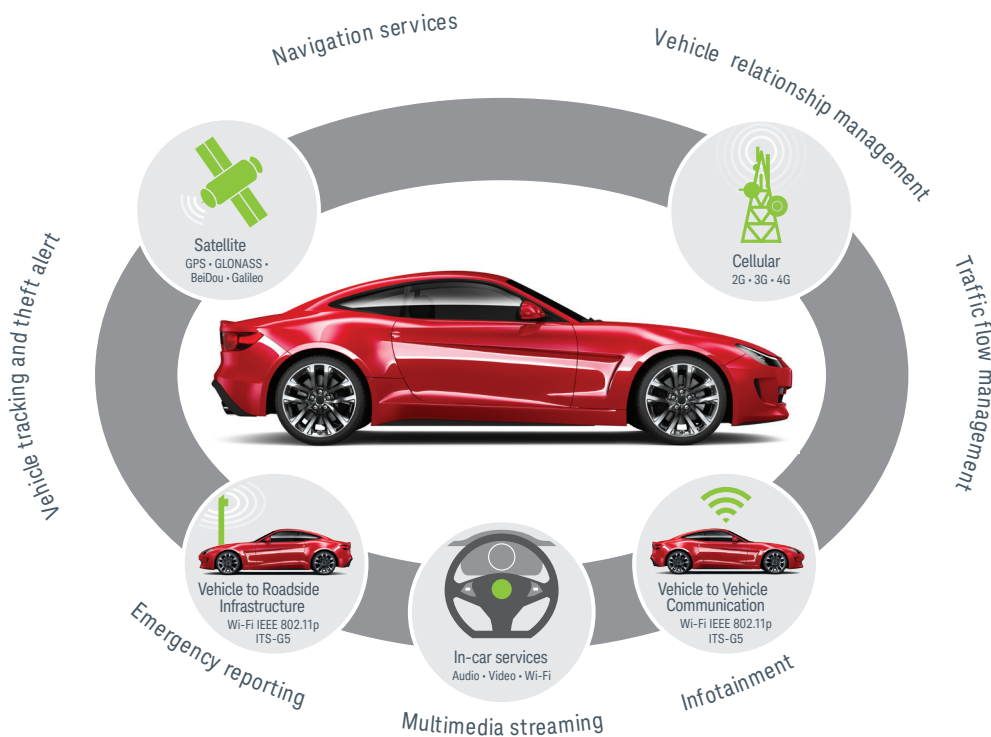


Figure 1. Increased car connectivity complexity requires additional testing

## Reduce Development Cost and Time Through Early Testing in a Laboratory Environment

The automotive industry can easily adopt test methodologies from the mobile industry, where testing is typically conducted in the early stages of the development cycle when issues are less complicated, less time-consuming and less expensive to rectify. By performing repetitive testing in a laboratory environment using a simulated network, you can reduce test times and costs. With lab-based testing you can verify how well connectivity is established, taking into account vehicle motion as well as environmental conditions. Keysight Technologies, Inc. offers the automotive industry wireless connectivity test solutions with full network simulation capabilities.

### Accelerate product development and reduce extensive vehicle field testing

Keysight's Anite Virtual Drive Testing Toolset is a lab-based automated performance and interoperability test solution that accelerates product rollouts by integrating industry-leading field-to-lab test tools with a sophisticated test automation environment. The solution offers a more cost-effective approach to quality assurance testing during various test phases.

Virtual drive testing significantly reduces the need for vehicle drive testing by accurately replicating field mobility scenarios. You can capture data in the field to build tests that replay drive routes in a virtual environment that emulates real-world RF network conditions in the laboratory using a full network simulator. By adopting Virtual Drive Testing, automotive manufacturers can significantly reduce the shipping of prototypes around the world, which in turn cuts development time and costs and helps keep new prototypes secret.

The Anite Virtual Drive Testing Toolset lets you confidently verify numerous types of connectivity and capabilities including Emergency Call (eCall), Breakdown Call (bCall), Stolen Vehicle Tracking (SVT), firmware over-the-air (FOTA) – telematics control unit (TCU) updates and Voice over LTE (VoLTE).

### Verify car-to-car connectivity using IEEE 802.11p models

Intelligent transport systems and vehicle safety solutions such as Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) will use existing Wi-Fi standards and operate on frequencies 5.9 GHz in order to establish wireless connectivity.

Lab-based testing that accurately replicates on-road radio network conditions helps automotive manufacturers verify continuous V2X connectivity. Examples of network conditions that need to be tested include fast motion of radios and reflectors, high speed Doppler as well as urban tunnel and data traffic congestion scenarios.

Keysight's WLAN Toolkit for V2X testing uses its PropSim Channel Emulator to replicate real-world wireless road conditions. This solution enables you to conduct comprehensive V2X WLAN testing by reproducing vehicle ad hoc networks created from car convoys on highways as well as car-to-traffic light configurations.

### Virtual Drive Testing lets you:

- Record mobile network cell settings, network signaling and RF parameters from the live network along with global navigation satellite system (GNSS) data
- Replicate data captured in the field in a laboratory environment
- Run pre-defined test cases or create new test cases, analyze data and produce reports using key performance indicators (KPIs)

## Rapidly evaluate Telematics Control Unit for deployment in a carrier's network

Automotive manufacturers are able to use Keysight's easy-to-use network simulator solution – SAS – to access connected car related test packages mandated by major mobile operators, including tests to verify data throughput levels.

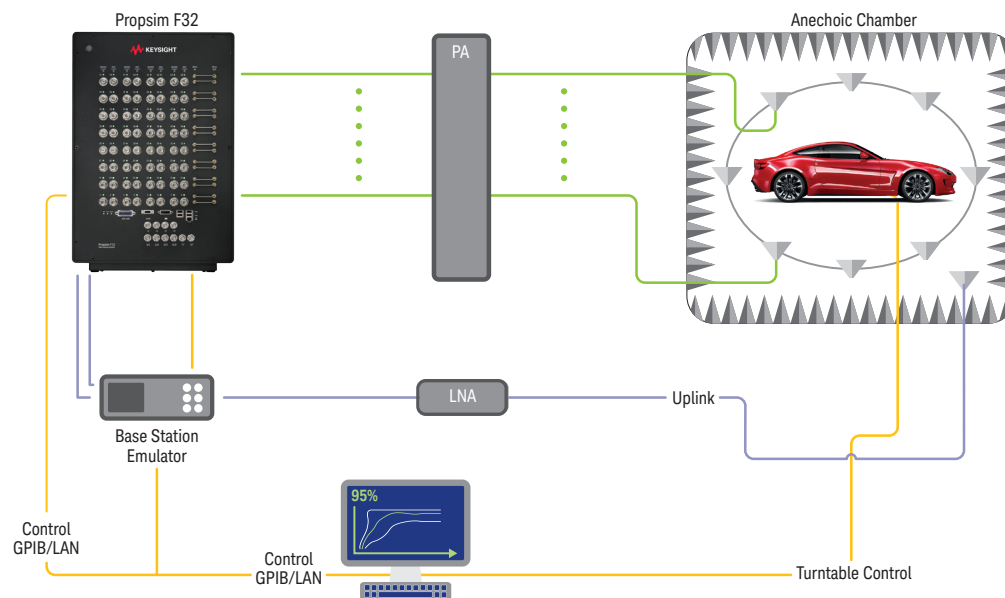
SAS offers the broadest range of mobile operator acceptance test cases for 2G, 3G, LTE and LTE-Advanced, enabling cost-effective, comprehensive verification in a repeatable, controllable environment. With SAS, automotive manufacturers are able to quickly evaluate Telematics Control Unit for deployment in mobile operators' networks across the world. You can access test cases associated with roaming and data throughput.

## Accurately verify wireless connectivity with Automotive Over-the-Air (OTA) performance testing

Both vehicle materials (including any windows with metallic coatings) and antenna design affect the radio performance the end-user experiences when accessing data services while in the vehicle. Tomorrow's vehicles will be equipped with multiple antenna configurations such as MIMO<sup>1</sup> technology to maximize data rate speeds. The majority of a vehicle's wireless connectivity technology resides in an embedded Telematics Control Unit, which needs to be tested in various stages, both on its own and with the antenna cluster when they are integrated in the vehicle.

Automotive manufacturers use OTA performance testing to assess the end-user experience by replicating real-world radio network conditions as seen by the vehicle antenna cluster. OTA testing uses channel emulators in conjunction with either an anechoic chamber or a reverberation chamber to accurately emulate urban, suburban and rural radio environments.

## Automotive OTA Performance Testing



1. MIMO = Multiple Input Multiple Output

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