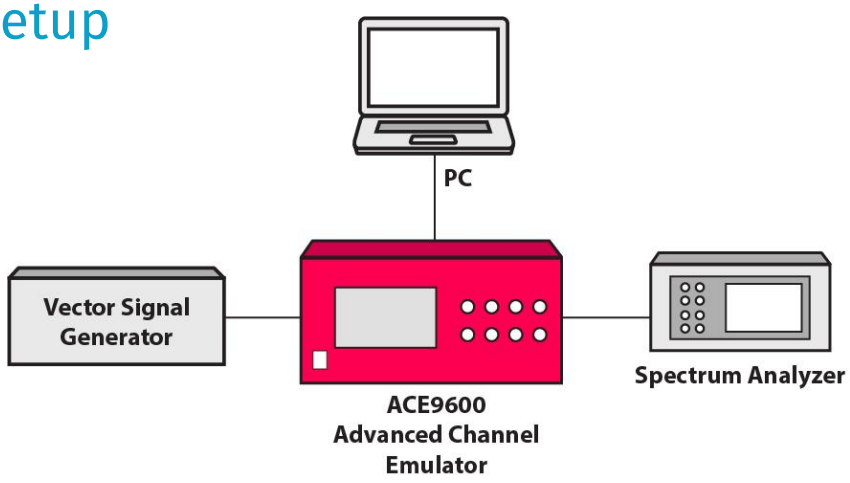
High-Performance Satellite Channel Emulation for System Testing

Satellite systems operate in complex, dynamic environments where roundtrip delay, fast-moving orbital paths, and atmospheric disturbances introduce effects such as Doppler shifts, fading, and other link impairments onto the received signal. Combined with distortions caused by hardware in the communications link, these real-world effects can significantly degrade performance and even cause failures in service. With LEO, MEO, GEO deployments continuing to grow, identifying and correcting these issues in the lab ensures satellite constellations and complex 5G non-terrestrial network (NTN) architectures perform reliably in realistic conditions.

This demonstration showcases the leading-edge capabilities of the Maury Microwave ACE9600 Advanced Channel Emulator, a non-terrestrial RF channel emulation solution that simulates various link- and hardware-generated impairments on a signal's path. Emulated impairments and capabilities span hardware-in-the-loop testing, additive white Gaussian noise (AWGN), frequency-dependent signal Doppler with the resultant expansion/compression of the passband, and multipath fading (Rayleigh, Rician, etc.). With advanced impairment modeling and flexible scenario configuration, the ACE9600 along with its control software (ACE Client) allows engineers to confidently evaluate system performance in challenging operating conditions and rapidly validate satellite payloads and modems.

Demo Setup



Target Users

Target users include design engineers and system integrators for satellite communications systems and NTN.

2900 Inland Empire Blvd., Ontario, CA 91764 USA
+1 909 987 4715 +1 909 987 1112 sales@maurymw.com maurymw.com

Product Overview

ACE9600 Advanced Channel Emulator

The ACE9600 Advanced Channel Emulator (ACE) is the most advanced non-terrestrial RF channel emulation solution to date. The emulated impairments include delay, signal Doppler, attenuation, phase offset, AWGN, frequency hopping, payload, and multipath fading. The instrument can house up to four 600 MHz instantaneous bandwidth channels. Impairment emulation can be set to fixed values in Static Mode or continuously changed in real time in Dynamic Mode without any phase discontinuities.

KEY SPECIFICATIONS AND FEATURES:

- 600 MHz of instantaneous bandwidth per channel
- Timing synchronization up to 16 channels
- Link emulation including:
    - Phase continuous delay, Doppler, and attenuation changes
    - AWGN and Eb/No
    - 12 tap (path) multipath fading with Rayleigh, Rician, and CW. Angle of Arrival (AOA), k-factor, and correlation controls
    - RF frequency-agile up/down converters
- Payload emulation including:
    - IMUX/OMUX amplitude and group delay distortion
    - Amplifier compression (AM/AM and AM/PM)
    - Phase noise
- Static and dynamic link emulation
- Ephemeris data generation using SATGEN
- Remote instrument control through ACE Client application

ACE Client Application

The ACE Client is a comprehensive application that enables the remote control of all ACE9600 functions, graphically displays impairment file contents, and provides wizards for creating custom profiles for payload impairments. The ACE Client also enables signal capture, which generates both time and frequency domain plots of the excitation signal and the output signal after the application of impairments.

More Resources

Visit maurymw.com/info/mapcon-2025 to learn more about Maury solutions.

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