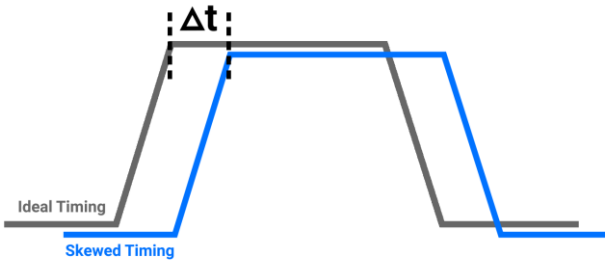
Latency & Timing Measurements for 5G TDD Satellite Networks

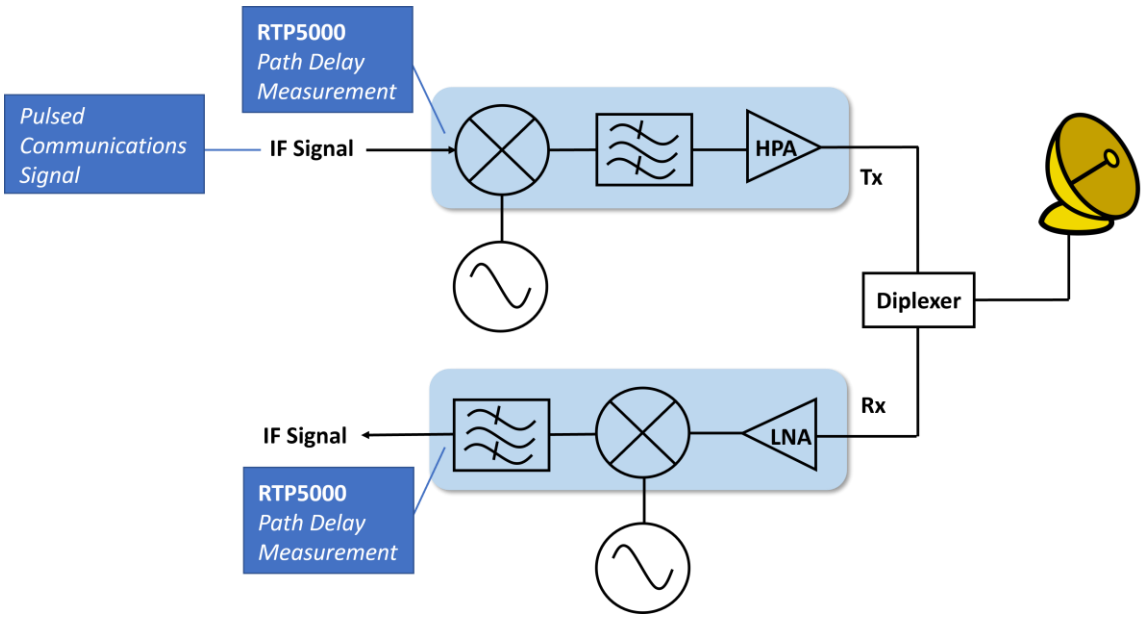
5G satellite communications networks utilize time division duplex (TDD) to optimize spectrum management, where uplink and downlink signals rapidly switch between different time slots on the same frequency band. Uplink/downlink handover requirements become tighter and tighter as applications move up in frequency. Test instruments need to be able to characterize the behavior of high-speed 5G TDD switches and measure network latency to avoid uplink/downlink overlap, interference, and a deterioration in performance.

Boonton RTP5000 Series Real-Time USB Peak Power Sensors have 3-nanosecond rise time capabilities to capture the response time of 5G TDD switches. Response time is equal to the rise time (10% to 90 % of the signal magnitude) plus the settling time (90% to within < 0.1 dB of the signal magnitude). Using the Boonton Power Analyzer (BPA) software, developers can place vertical and horizontal markers to pinpoint the exact settling time period.



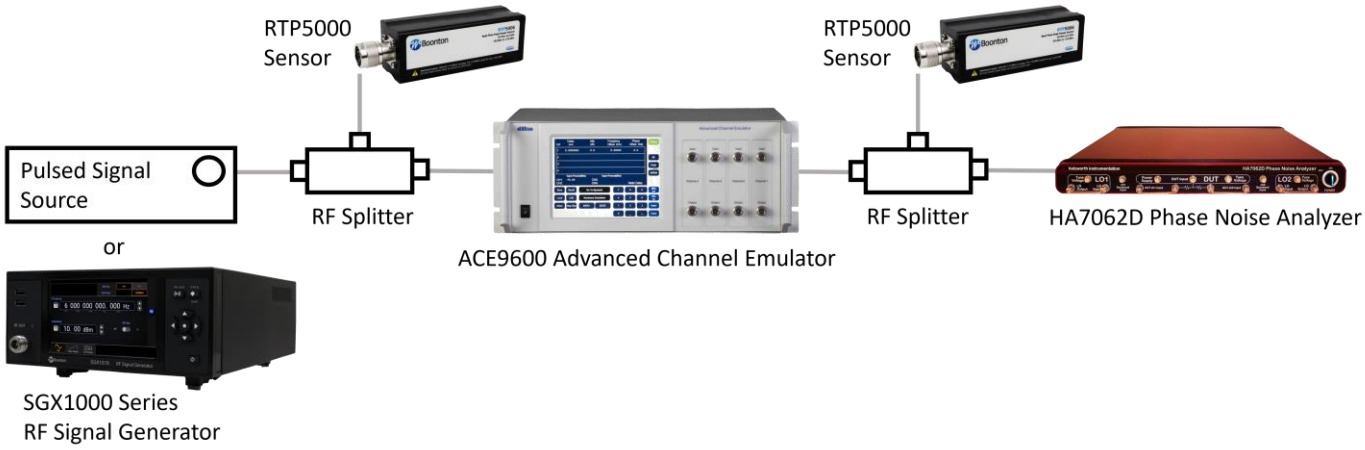
Combining this performance with the fastest measurement rate of 100,000 per second, 100 picosecond time resolution, and superior trigger stability, the RTP5000 Series can also measure any delay experienced at various points along a satellite communications path. Clients can even use their actual signals during testing to pinpoint delay and apply the necessary corrections.

The dBm ACE9600 Advanced Channel Emulator can insert phase continuous varying propagation delays with 0.1 ps resolution and emulate Doppler, signal attenuation, and other impairments experienced by uplinks/downlinks to satellites in LEO, MEO, or GEO orbits.



SATELLITE 2024 Test Setup:

First, two RTP5000 Series sensors are calibrated to eliminate trigger delay. An RTP5000 Series sensor then measures the incident pulsed signal. Fixed or dynamic propagation delay is added after passing through the ACE9600, simulating the latency experienced after traveling through a satellite network. A second RTP5000 Series sensor captures the output signal to measure and analyze the delay. Boonton sensors can resolve timing differences between TDD switches down to a nanosecond.



Product Overviews:

Boonton RTP5000 Real-Time USB Peak Power Sensors:
Boonton RTP5000 Series sensors utilize Real-Time Power Processing™ technology to deliver the fastest measurement rate of 100,000 measurements per second with zero latency or gaps in acquisition. RTP5000 Series power sensors provide an excellent means of confirming power levels and delays throughout the up and downlink chains.

dBm ACE9600 Advanced Channel Emulator:
The dBm ACE9600 Advanced Channel Emulator can add RF link impairments (delay, Doppler, path loss, AWGN, multipath fading) and hardware-in-the-loop impairments (amplifier compression/distortion, phase noise, IMUX/OMUX filter shaping) to fully emulate satellite uplinks/downlinks.

More Resources:

Visit info.wtcom.com/satellite-2024 to learn more about T&M solutions for satellite communications systems.