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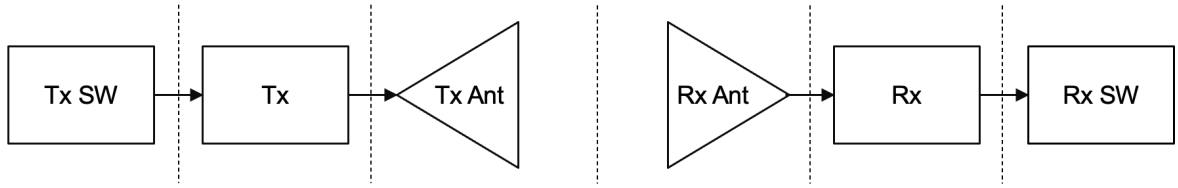
Recommended Practices for Millimetre-Wave Channel Sounder Verification

David G. Michelson and Xin Chen
The University of British Columbia, Vancouver, BC, Canada

Various hardware and software defects may distort or impair the channel-measurement data produced by wireless channel sounders. These effects may be especially pronounced at millimeter-wave frequencies. Users, developers and manufacturers of such instruments require standardized methods either to identify and correct such defects or to give confidence that a set of channel measurement data produced by a given channel sounder is suitable for inclusion in a pooled database. The ad hoc and incomplete verification methods in common use today are inadequate for the task. The IEEE Standard Association P2982 standards development effort and its consensus-based approach is the best method to achieve methods that are complete, effective, and economical and which will be widely accepted and adopted. The P2982 standard will recommend methods for verifying millimeter-wave channel sounder performance based upon comparison of processed channel measurement data to either theory or an artifact having known characteristics. Such measurement data may be collected in situ, under controlled conditions or by comparison to a reference measurement. The verification results may be used to: 1) identify and correct shortcomings in channel sounder performance and/or post-processing techniques or 2) give confidence that a given set of channel measurement data is suitable for inclusion in a pooled database.

As part of this effort, the University of British Columbia has recently developed a VNA-based multi-mode and multi-band millimetre-wave channel sounder (MMMCS) that is capable of operating in five bands from 26.5-40 GHz, 40-60 GHz, 55-95 GHz, 90-140 GHz, and 140-220 GHz with dual polarization in both transmission and reception in most bands. Notable features include the use of millimetre-wave extension heads that permit the transmitter and receiver to be located up to 30 metres apart with conventional coaxial cables connecting the heads to the VNA and RF over fibre extenders that allow the transmitter to be placed up to a few hundred metres away from the receiver. Our verification strategy for this channel sounder is based on setting up verification planes that allow us to de-embed elements of the system and thereby verify their function and operation by comparing actual and expected results. Simulated signal tests verify the signal processing software in the transmitter and receiver by eliminating the hardware components from the test, using a signal simulator to generate a facsimile of the signal that would normally be supplied to the received signal processing software given specified transmitter and receiver hardware settings and parameters, and multipath distortion, and comparing the actual and expected results. Conducted tests move the verification planes forward and simply eliminate the transmitting and receiving antennas from the test but are otherwise conducted similarly. They allow the effects of hardware imperfections to be assessed and the system link budget and dynamic range to be verified. Both simulated signal and conducted tests may be conducted at a lab bench. Over the air tests include all components of the system and involve comparison of actual and expected results in a carefully surveyed test environment. Such a methodical and structured approach allows hardware and software defects to be identified and remedied in the shortest possible time.



Potential issues:

- cables and connectors
- system non-linearities
- limited DAC/ADC resolution
- limited dynamic range
- frequency or timing errors
- software logic or coding errors