JDSU's Validator™ Ethernet System Speed Certifier

The Validator Ethernet System Speed Certifier is designed to stress and test Ethernet network systems to certify speed performance capability of the cabling installations. It uses two separate metrics and cross-checking testing methods that work in concert with each other for evaluation of true cable speed performance.

The first method of cross-checking is done measuring **noise** that could degrade or hinder data transmission. The second method is to use a **bit error rate test** (BERT) to send actual data packets across the cable run being tested at up to 1 Gbit speed to confirm that data will travel as fast as the connected equipment in the system will allow.

Noise
Noise, either internally generated or absorbed from outside the cabling, is the major enemy of performance of Ethernet systems. Beyond verifying that the attachment of the cables to the connectors and jacks (opens, shorts, miswires, etc.) is correct in the cable run being tested, the Validator tests and produces a **signal-to-noise ratio** measurement which is displayed in the results of each cable run test.

A signal-to-noise ratio (SNR) is a measure of signal strength relative to background noise. The background noise measured comes from all sources of coupling into a received signal. The Validator SNR is measured at the **relevant frequencies** for the actual signal used to propagate the Ethernet data on the cable. It measures the SNR at the frequencies used for 1Gbit Ethernet systems if there are 4 functional pairs in the cable. If fewer than 4 pairs are functional it will shift to 100Mbit testing, just as an actual Ethernet device, such as a router, would do.

Note: Validator uses a Gigabit Ethernet transceiver chipset with a full physical interface (PHY). All Ethernet physical interface chipsets (PHYs) transmit and measure data between 1 MHz and 62.7 MHz. Validator double samples between the main unit and the remote which results in sampling from 1 MHz to 125 MHz, thus giving an extra headroom testing performance under marginal cable conditions. Thus, all relevant frequencies to Ethernet systems are addressed at each noise test. Other extraneous frequencies are not measured because they do not have any influence in Ethernet systems.

Noise types and how they relate to the SNR

NEXT and PSNeXT
Near-end crosstalk (NEXT) is one source of background noise on the cable. It is noise on one pair in a cable caused by coupling the transmit signal from another pair in the same cable. Since 1Gbit Ethernet simultaneously transmits and receives all four pairs in a cable, the NeXT from the other three pairs all add into the noise, interfering with the received signal from the fourth pair. In this sense, the SNR measurements of Validator includes the sum of all the crosstalk in a cable, both far-end and near-end. Thus, NEXT and FEXT are both accounted for as well as other combined noise measurements.

PSNeXT
PSNeXT (Power Sum Near-End Crosstalk) is the "mathematical sum" of the NeXT from three pairs into the fourth pair. Again, it is traditionally measured by conventional TIA568 certification testers over a wide frequency range, without regard for the specific **relevant frequencies** used by the Ethernet architecture. Because the Validator is transmitting true data on all four pairs, as mentioned above, it obtains all measurements from all four pairs and uses these to produce a PSNeXT measurement which is then accounted for in the overall SNR.

ELFeXT
Known as alien crosstalk ELFeXT is noise generated outside the cable under test without enough shielding. AC motors, such as hand drills or other AC powered equipment, can also cause noise due to signal reflections. Once again, ALL noise is taken into account in the overall SNR measured by the Gigabit Ethernet transceiver within Validator, including alien crosstalk.

PSELFeXT
Power Sum ElFeXT is a calculation and not an actual measurement. PSELFeXT is derived from an summation of individual ElFeXT effects on each pair by the other pairs, which are accounted for in the Validator SNR measurement.

Thus the SNR measurement, which is displayed on all test results on Validator and the Plan-Um software, addresses, and measures, **all** affecting noise, both internal and external, and combines the individual measurement results under one resulting measurement. This is the true signal-to-noise ratio. The advantage of Validator's SNR method over other certification tester approaches is that the customer is presented with an actual measurement of speed capability.

By actual measurement of capability, we mean that the traditional general TIA568 metrics for noise measured in other certification testers each have ceilings which will fail a cable run even if other noise metrics are lower and well within tolerances to allow excellent data transmission and speed. The SNR of the Validator shows all elements of noise against a general performance standard that takes all levels of noise from all sources into account and produces with a level that assures efficient and trouble free data transmissions. False failures are thus eliminated.

To crosscheck this result the Validator then does a bit error rate test (BERT) which sends true data packets down the cable run and back and measures this against the speed up to 1Gbit as per IEEE802.3.

BERT (Bit Error Rate Test)
At the time of each cable test, the SNR, physical connections and length tests are performed. Upon completion of these tests, if they are passed without problems, the Validator begins transmitting data to a remote unit that has the same physical interface chip (PHY) that resides in the main unit. The remote unit captures the sent data, checks for errors and speeds, and transmits this information back to the main unit along with more active data packets. The main unit analyzes the results of this interchange and either passes the cable at 1 Gbit, if four pairs are used, or 100Mbit, if fewer than four pairs are used. If too many errors or delays are found a FAIL indication will result.

The Gigabit Ethernet transceiver used in Validator correlates the information it receives from the data transmission with the noise measurements found in the SNR. It then produces a result with a clear PASS or FAIL indication on its screen. This is duplicated on the Plan-Um software cable test schedules.

The use of two separate metrics of measurement, a complete signal-to-noise ration and a Gigabit speed BERT measurement, gives the Validator the ability to crosscheck its measurements and to correlate their results. The outcome is a guarantee of performance based on both measurements. It is a guarantee of performance unmatched by other certification testers that assume performance without actually measuring for it.

Conclusion
In conclusion, the two different methods of measuring a cable run capability and their ability to cross-check each other gives the user of Validator unprecedented assurance of a cable run's capability to transmit data up to 1Gbit as called for in IEEE802.3.