Selecting the Right Bit Error Rate Tester (BERT)

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For any digital communications link, the ultimate measure of its physical layer performance is whether the bits sent are received correctly. Bit Error Rate (or Ratio, as it is more correctly called) measures this performance, and BERTs are a common feature in many test labs either as BER measuring devices, or as test pattern sources for other measurements.

Many pieces of test equipment claim to be able to measure BER at 1 Gb/s or above. The two most common classes are:

- High Speed BERTs, typically used in design and manufacturing of high-speed components and the early phases of design of boards and systems.
- Protocol Analyzers and SONET functional testers that come into play when a board or system is at a stage where the circuits 'need to speak the right language'. Typically, such testers measure the BER of data bits that are contained within protocol frames.

The first category is the focus of this article, and within this single class there is a spectrum of capability and cost. One big deciding factor can be the degree of flexibility required. Flexibility comes in many guises, from being able to vary voltage, termination, pattern, and bit rate, through to more advanced functions such as SONET jitter measurements, optical interfaces, stressed eye jitter tolerance capabilities and eye diagram measurements.

Is your application design or manufacturing? Some manufacturing systems require only fixed voltages, fixed bit rate, and simple patterns. BERT instruments are available that offer limited capabilities at much reduced capital cost. It is important to examine your current and future needs to be certain that a limited-flexibility instrument purchase does not become a trapped investment. For example, does the prospective purchase cover the bit rates and patterns of future stages of your company's technology roadmap? Will you need capabilities beyond simple error counting such as jitter testing?

Assuming flexibility is needed, the following are common selection criteria:

- **Bit Rate Coverage:** Common High Speed BERT products are offered with maximum bit rates of 1.5 Gb/s, 3 Gb/s, 7 Gb/s and around 12 Gb/s. Protecting your investment is important here - does the technology you are testing have a future roadmap to higher data rates? Does the BERT you are considering have an upgrade strategy to higher rates, or is your investment trapped?
- **Usability:** Many people find BERTs difficult to use. This has improved recently, so that modern designs can enable even novice users to be productive quickly. Try the BERT you are considering – see for yourself whether you can set up simple parameters such as patterns, terminations etc.
- **Waveform Shape or Input Bandwidth?** The pattern generator waveform performance of High Speed BERTs used to be considered the main figure of merit for the quality of one BERT over another. This is no longer true for a couple of reasons: Firstly, most flexible High Speed BERTs have waveform performance so far beyond the devices they are testing that the beauty of one over another is academic. Secondly, most of the advanced functions people want from a BERT these days rely on the quality of the receive side of the BERT rather than the transmit side. Generally, Error Detector input bandwidth is not specified, but this may change over time.

- **Robustness:** Another difficult aspect to specify, but one of great importance, is robustness. BERTs have fragile microwave components in them that are easily damaged by statis discharge or over-voltage, and may have to be away for months being repaired because of some mishap. For the BERT you are considering, ask what steps have been taken to ensure it doesn't spend significant time away being repaired.
- **Simple Error Counting, or More Advanced Functions?** Manufacturers of some instruments have enhanced their offerings by adding extra capabilities that go beyond just error counting. These can make a huge difference to productivity and include:
    - **SONET jitter compliance testing:** This often uses an external test set to provide the necessary filtering, etc. BERT-related systems have an advantage over SONET functional testers of being flexible in bit rate in a way that can't usually be matched.
    - **Stressed eye jitter tolerance testing:** Sometimes this can be a capability provided with a custom rack of equipment, or it can be fully integrated. Ask how much this capability will cost, how it can be kept calibrated, and how easy it is to upgrade as new standards emerge.
    - **Eye diagrams:** In troubleshooting of designs it is often difficult to bridge the information gap between what a BER measurement and a scope tells you. Integrated capability can be a big help in bridging this gap and saving development time.
    - **BER Contour:** This can be exceptionally revealing as a measurement that shows whether you have lurking performance issues in a system. Is it offered? Is it fast enough to be practical? Is it accurate enough to be repeatable?

After seeming to stagnate for more than a decade, new high speed BERTs are emerging that either offer reduced capability at lower capital cost, or more comprehensive functionality that enables faster time to market. It's a good time to ask hard questions of your test vendor.