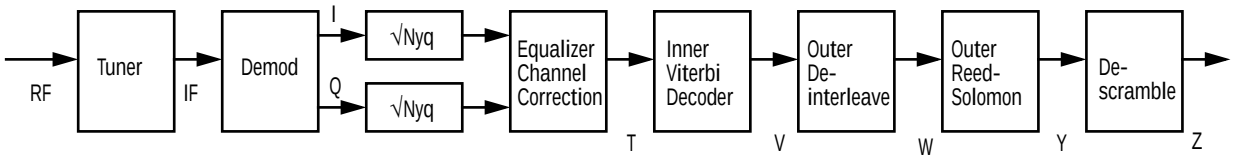
Application Note – AN103

BER Measurements for QPSK Satellite

Patrick Wilson
Hardware Manager, Pixelmetrix Corporation

Satellite transmission is adversely affected by atmospheric conditions such as rain, humidity, man made interference from power sources or industrial plants, as well as sun spots and other solar phenomena. These sources of interference all provide significant obstacles to delivering a clean digital signal to its destination.

Management of satellite service delivery requires controlling signal quality through continuous monitoring of bit error rate and the quality of the modulation constellation.



Background

The DVStation platform provides monitoring and validation of the signal and service integrity of digital broadcast networks. The system provides interfaces for ASI, ATM, as well as RF interfaces for satellite and terrestrial communications.

Satellite delivery of MPEG-2 encoded data streams most commonly uses QPSK (Quadrature Phase Shift Keying) modulation.

However, satellite transmission is adversely affected by atmospheric conditions such as rain, humidity, man made interference from power sources or industrial plants, as well as sun spots, etc. These sources of interference all provide significant obstacles to delivering a clean digital signal to its destination.

Management of satellite service delivery focuses on controlling signal quality through continuous monitoring of bit error rate and the quality of the modulation constellation.

DVStation QPSK Measurements

DVStation can be fitted with any combination of 21 different modules. The QPSK module for DVStation is available in two configurations: PSK090 – which monitors RF parameters only, and PSK110 – which monitors RF parameters and also extracts the embedded transport stream for MPEG-2 transport and content monitoring. All monitoring is done in real time, simultaneously across all interfaces.

The figure at right shows the user interface display for the QPSK monitor function.

DVB Reference Receiver

To simplify the definition of various measurements DVB has established a standardized reference receiver, shown above.

The objective of any receiver is to recover the signal and, as best as possible, deliver an error free bit stream. Since that is difficult in practice, the receiver implements error correction techniques to deliver what is known as a *Quasi Error Free State* of an MPEG stream from the receiver.

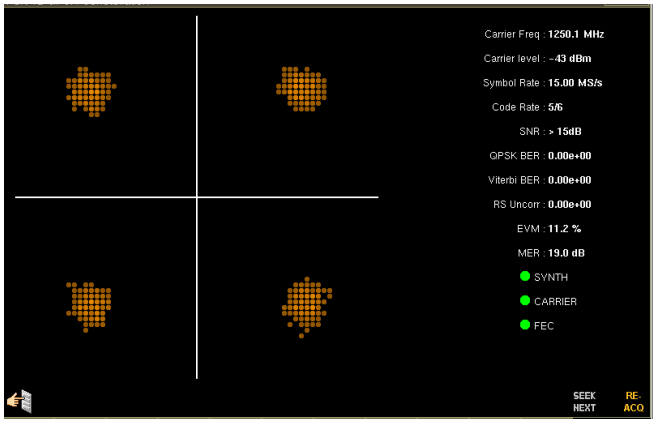
DVStation BER Measurement Methodology

DVStation implements pure measurements of bit error rate in accordance with the defined in TR 101 290. The system utilizes a chipset which implements the measurements automatically.

The DVstation PSK product displays two types of BER:

- QPSK BER
- Viterbi BER

These two readings correspond to Pre-Viterbi BER and Post-Viterbi BER.



Pre-Viterbi BER is measured at point "T" and corresponds to the bit error rate before any error correction and/or decoding is applied.

The Viterbi BER (Post-Viterbi BER) corresponds to the bit error rate at point "W" and is typically is the one of most interest to operators. This error rate is sometimes called *BER before RS decoder.*

Target Performance Parameters

It is most important the receiver delivers a *quasi error free (QEF)* bitstream to the MPEG decoder. In order to do that, a Viterbi BER of $2x10^{-4}$ is a critical target value.

The QEF state means that less than one uncorrected error-event per transmission per hour is received at the receiver. To achieve this QEF state one must have a Viterbi BER of less than $2x10^{-4}$ before the RS decoder.

If the Viterbi BER is greater than $2x10^{-4}$ then the RS decoder can't correct all the errors in the packet. These errors will show up as an error count as indicated on the DVstation's *RS uncorr* reading. This is an error count of the number of uncorrected packets out of the RS decoder (and therefore the receiver). This directly corresponds to errored packets at the transport stream level, resulting in TS Errors reported by DVStation.

Measurement Reporting

Of course QPSK performance parameters can be directly observed from the built-in LCD screen of the DVStation. In addition directly monitoring performance information, alarms can be set on any of the parameters.

If a particular value exceeds the user-set alarm threshold, any combination of alarms such as audible beep, log file entry, GPI closure, and SNMP trap can be set. The *user script* alarm action allows user-definable alarms, such as sending an email message, to be triggered when the threshold is exceeded.

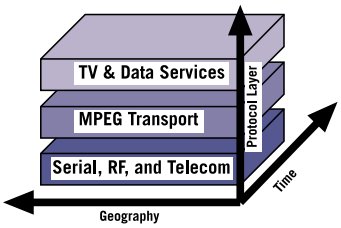
DVStation also incorporates a flexible log system. Measurements can be periodically logged to log files stored within the system. The logging period and measurement details can be individually specified.

Log files can be accessed and downloaded in HTML, XML, and CSV formats from anywhere in your facility via a standard web browser.

Finally, programmatic access to performance data is possible through the DVStation CORBA API. This allows any network-attached computer to directly access measurement values in real time.

About DVStation

Pixelmetrix has focused on creating a single self-contained monitoring station that can analyze thousands of parameters within hundreds of digital television signals. Through the use of plug-in modules and parallel processing, we monitor all these parameters in real time, simultaneously and continuously. We've targeted our development efforts to insure the quality of the signal, the integrity of the program service and the delivery of essential technical information to the right people in a timely and meaningful manner.



Our engineers began with a simple premise: Effective monitoring of digital television networks – just as with telecom networks – requires the use of real-time, continuous and simultaneous evaluation of hundreds of points along the transmission chain. To receive this necessary network intelligence, adequate data collection, analysis and correlation is needed on three axis – time, layer and geography. Monitoring of all layers – physical, transport, coding, and quality – is essential for a complete maintenance picture.

Plug-in modules allow flexibility and accommodate changes in a fast evolving technical infrastructure. So far, we've focused on three categories of plug-in modules: physical line interfaces (ASI, SPI, RF, ATM etc.); a transport stream processor (TSP); and picture quality processors.

In our design, a line interface module extracts the MPEG-2 transport stream from the native RF or telecom signals and passes that data to a TSP – Transport Stream Processor. Line interface modules provide monitoring capability on the physical layer. For RF interfaces (QPSK, QAM, COFDM, 8VSB) monitoring means to check carrier level, C/N (carrier-to-noise ratio), bit error rate and EVM (Error Vector Magnitude), or other parameters that may be applicable. Additionally, a simple constellation diagram indicates overall modulation health.

Our ATM interface connects to a 155 Mb/s optical fiber and extracts MPEG transport streams from several VP/VCs (virtual path/virtual circuit). In addition to this basic functionality, the interface detects physical layer errors and parameters with the optical and Sonet/SDH signals.

References

"Measurement Guidelines for DVB Systems", Draft TR 101 290, DVB.

"Framing Structure, channel coding and modulation for 11/12 GHz satellite services", ETSI EN 300 421 V1.1.2. (1997-08), DVB

For More Information

On the Internet: sales@pixelmetrix.com
www.pixelmetrix.com

North America: 1-877-71-PIXEL
Europe: +41-79742-7454
Asia Pacific: +65-547-4935

About the Author

Patrick Wilson is the Hardware Manager for Pixelmetrix Corporation, manufacturer of the DVStation, a preventative monitoring solution for digital broadcast networks.