Avaliant Mercury: Low-Density Parity-Check (LDPC) Validation Service

One of the most effective forms of forward error correction (FEC) codes used in today's commercial and military communication systems is Low-Density Parity-Check codes. These codes offer excellent Bit Error Rate (BER) and Block Error Rate (BLER) performance, with channel capacity approaching the Shannon limit. However, simulating the BER or BLER performance at or below 10^{-6} is challenging, in part, due to LDPC decoder complexity. This results in simulations that frequently take many weeks to months to complete.

Avaliant presents a high-throughput, flexible, and cost-effective LDPC Validation service that allows the user to measure the performance of any LDPC code[1] at lightning speed. The Avaliant Mercury™ is designed to seamlessly take advantage of a massively parallel General Purpose Graphics Processor (GPU) architecture. The table below shows the advantages of our product compared to other technologies. The Avaliant Mercury™ is the ready-to-go solution that provides both *reasonable validation time* and *high flexibility* at reasonable cost.

	PC 	**FPGA** 	**ASIC** 	**GPU** 	**Avaliant Mercury™** 
Implementation Time (LDPC)		**1.5 person year (estimate)**	**3 person year (estimate)**	**1.5 person year**	**None *(Ready-to-go solution)***
Flexibility	**High**	**Medium**	**Low**	**High**	**High**
Validation Time	**Months**	**Hours to Days**	**Hours**	**Hours to Days**	**Hours to Days**
Hardware Costs	**~ $3000**	**~$90,000[2]**	**~ $1 million[2]**	**~$8000**	**Furnished Upon Request[3]**
Software Costs	**~ $4000**			**~$1000**	

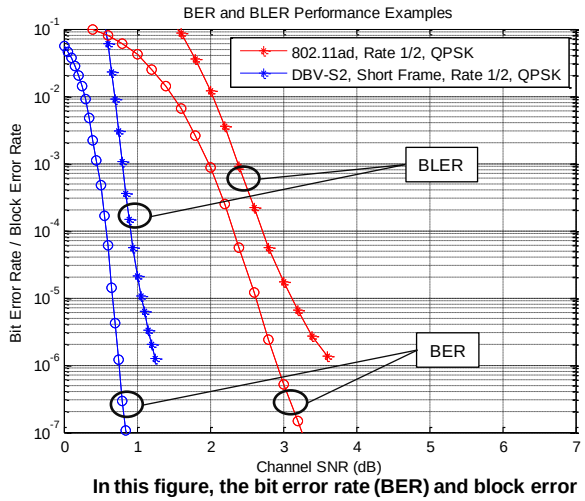
Table 1: LDPC Validation Tools Comparison

The Avaliant Mercury™ LDPC validation service currently supports the following parameters:

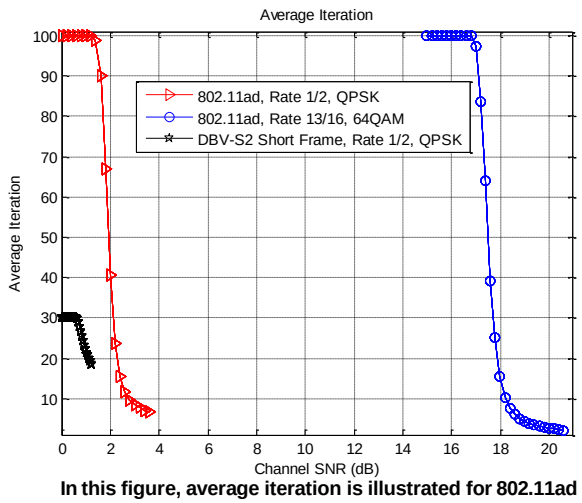
- **LDPC Code Structure**: H parity matrix (regular, irregular, punctured, shortened, varying block size or code rate) and G matrix
- **LDPC Decoder Parameters**: number of iterations, exact or approximate Log-Likelihood Ratio (LLR), received complex signal (I/Q) quantization
- **Modulation (DOCSIS 3.1)**: BPSK, QPSK, 8QAM, 16QAM, 32QAM, 64QAM

[1] LDPC Validator currently supports block sizes 25k and smaller.
[2] Reference: http://slideplayer.com/slide/5728461/
[3] Contact Avaliant for LDPC Validation service costs

The noise type is Additive White Gaussian Noise (AWGN) at specified signal-to-noise ratios (SNR). The Avaliant Mercury™ LDPC validation outputs BER, BLER, and average iterations per SNR. Based on customer interest, other input configuration parameters or output statistics can be incorporated. The software has been validated using known standards including 802.11ad, 802.16, and DVB-S2. The Avaliant LDPC Validation tool has been used in a large aerospace company. The figures below provide output examples.



In this figure, the bit error rate (BER) and block error rate (BLER) performance is illustrated for 802.11ad rate=1/2 QPSK code, and DBV-S2 short frame, rate=1/2 QPSK without outer code.



In this figure, average iteration is illustrated for 802.11ad rate=1/2 QPSK code, 802.11ad rate=13/16 64 QAM code, and DBV-S2 short frame, rate=1/2 QPSK without outer code.

The customer can leverage both the speed and flexibility of the Avaliant Mercury™ LDPC Validation service while designing new codes/waveforms; or optimizing existing communication systems before committing to a final design. Most requests from our customers can be met with a one-day turn-around time. Contact Avaliant for your specific turn-around time. Avaliant takes the security and confidentiality of the customer's data very seriously. We are committed and have built in measures to protect our customer's data.
If you are interested in the LDPC Validation service, please contact us at ldpc@avaliant.com or call Bob Bagshaw at 425-644-7210 extension 21 for more information.

About Avaliant

Avaliant is a world-class solutions provider based in Bellevue, Washington. For more information about Avaliant, please visit us at www.avaliant.com