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The Impact of Electronic Noise on 10 Gigabit Ethernet

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High Speed Networks are Susceptible to Noise.

In order to transmit higher and higher data rates, more complex signal encoding schemes have been developed to more fully utilize the noise and bandwidth properties of Category cables. As the data rates have increased, continued optimization of clock rates and the number of voltage levels has evolved.

For 100Mbps Ethernet, a 3 level encoding system is used, requiring the receiver to discern which of the 3 levels of voltage were transmitted for each and every bit. Category 5e and 6 cables and components can easily support 100Mbps Ethernet.

Gigabit Ethernet (1000Mbps) increased the encoding levels to 5, making the distinction between the different voltage levels more challenging. This increase in encoding levels required slightly better performance out of the passive network components. Category 6 tested to 250 MHz and with improved crosstalk, takes an advantage over Category 5e.

10Gbps Ethernet (10,000Mbps) encoding required expanding the frequency range as well as adding more, smaller voltage changes in order to provide the bandwidth required. Each of the four pairs transmits 2.5Gbps with an encoding scheme using 16 voltage steps. Due to the much smaller voltage steps, the sensitivity to noise with the encoding system resulted in the addition of Alien Crosstalk requirements for Category 6A cables. Category 6A components are rated and tested up to 500MHz to ensure support of the 16 voltage steps.

The encoding sequence of bits for 10Gbps Ethernet builds a 128DSQ (Double Square coset-partition constellation) that enables each bit to send greater amounts of information (Figure 1). However, this complex encoding relies on a low noise environment. With excessive noise, the points in the constellation become “blurred” together, resulting in high bit error rates or loss of the communication link (Figure 2). However, the 10Gbit devices are smart enough to realize when the message was compromised and sends it again. So, although your 10Gbit network is operating at 10Gbps, it is not working as effectively as it could because the data consists of “desired ongoing data” as well as “undesired repeated data.” The latency that results from the resending of signals may or may not be noticeable. Your network is so smart that you may not realize it is not functioning to optimal levels. What is clear is that isolation from outside noise, be it from adjacent cables or nearby devices, will help ensure maximum throughput.

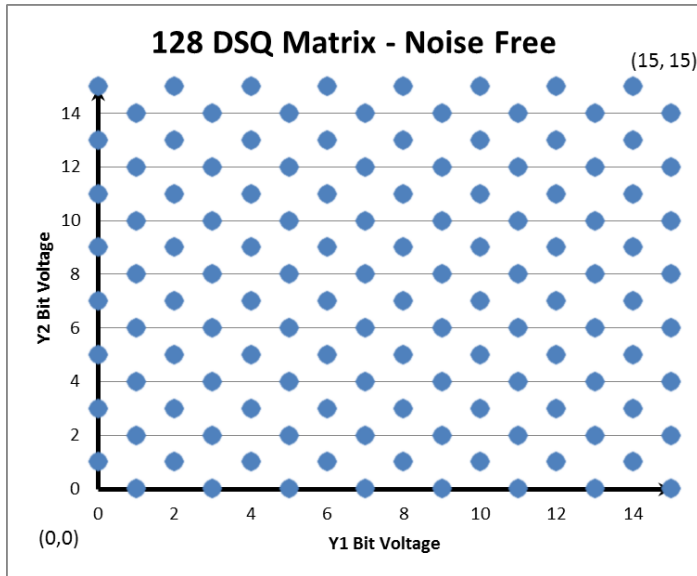


Figure 1.

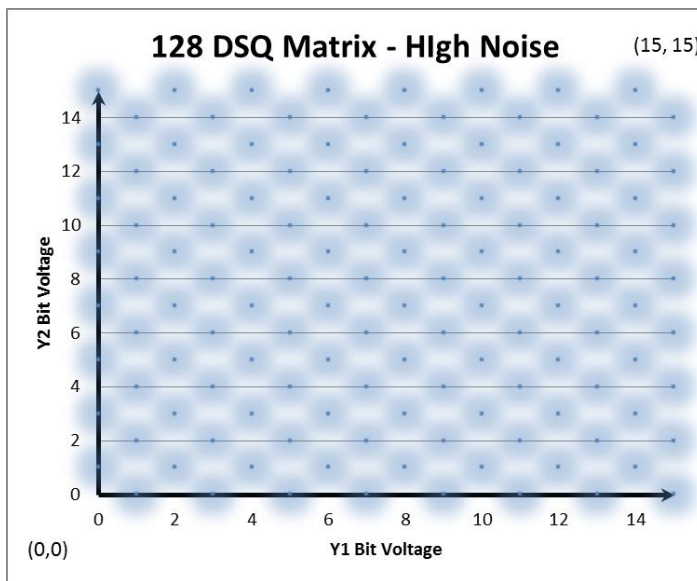


Figure 2.

One of the best methods for isolation of a 10Gbps link from any outside noise is to utilize a fully shielded solution. Shielded cables and connectivity are widely available and are very easy to install. There is little that has to be done to accommodate its installation versus an unshielded solution. Shielded cabling has been proven to be extremely effective in blocking outside noise. Shielded Category 6A solutions have been installed in a wide variety of environments where noise is significant and where maximum performance is desired. Military, financial, aerospace, casinos, and other industrial applications have benefitted from the advantages that a shielded Category 6A solution offers.