## APPLICATION NOTE - HDMI® HDCP ENCRYPTION STATUS SIGNALING

Some industry experts have said that "HDCP is the hardest thing about HDMI interoperability." One of the most challenging aspects of HDCP interoperability—whether implemented in HDMI or MHL—is to ensure that the encryption enable pulse is occurring and that it is occurring only within the "window of opportunity." Related to this, is the need to ensure that the encryption "keep-out" region is not violated.
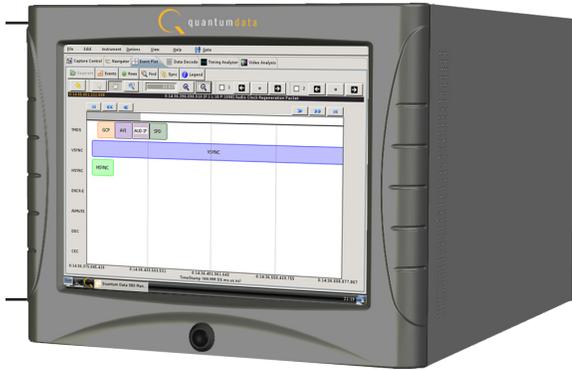
" HDCP is the hardest thing about HDMI interoperability "

ENCRYPTION STATUS SIGNALING

Most commercially available HDMI test equipment that support analysis functions cannot verify the precise location—timing—of encryption status signaling. These HDMI analyzers are reliant on commercial silicon chips. Because they are reliant on commercial chips, they do not provide visibility into all the protocol data, metadata and events occurring over the HDMI stream. And the timestamps they assign are on a "best-effort" basis. In some cases these analyzers may miss packets or events that occur in the HDMI stream. When they are able to identify these packets or events, they are often unable to precisely determine when these packets or events occurred in the HDMI stream.

The 980 Protocol Analyzer can assign precise time stamps
Competitive analyzers assign timestamps on a "best effort basis".

The Quantum Data 980 Protocol Analyzer test instrument however, uses a proprietary solution and therefore can provide complete visibility into all metadata and events in the HDMI or MHL stream and can determine, and therefore assign, precise timestamps of encryption status signaling events. You can verify that the encryption pulse occurs on all frames and also verify the restrictions of the window of opportunity and the keep-out region related to encryption status signaling.
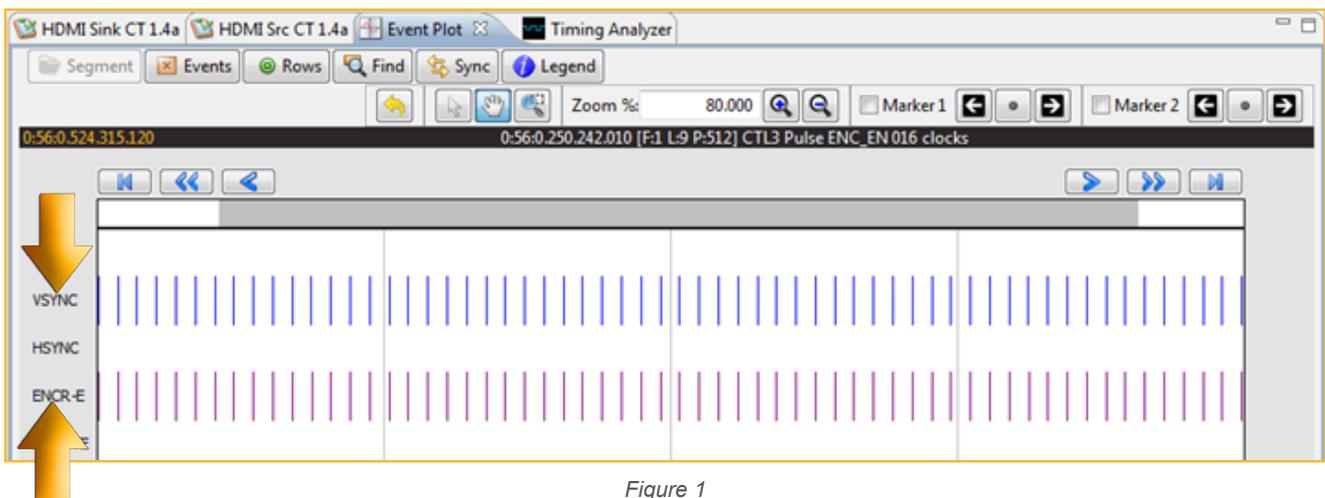

Figure 1

ENCRYPTION WINDOW OF OPPORTUNITY

The encryption enable pulse is not permitted prior to the 512th pixel (Figure 2) following the rising edge of vsync. It must occur within the "window of opportunity" which is a period of 16 pixel clocks (Figure 3) beginning on or following the 512th pixel. Verifying that the encryption enable pulse occurs only within this window of opportunity requires test equipment that can assign precise timestamps to all events in the HDMI or MHL stream.
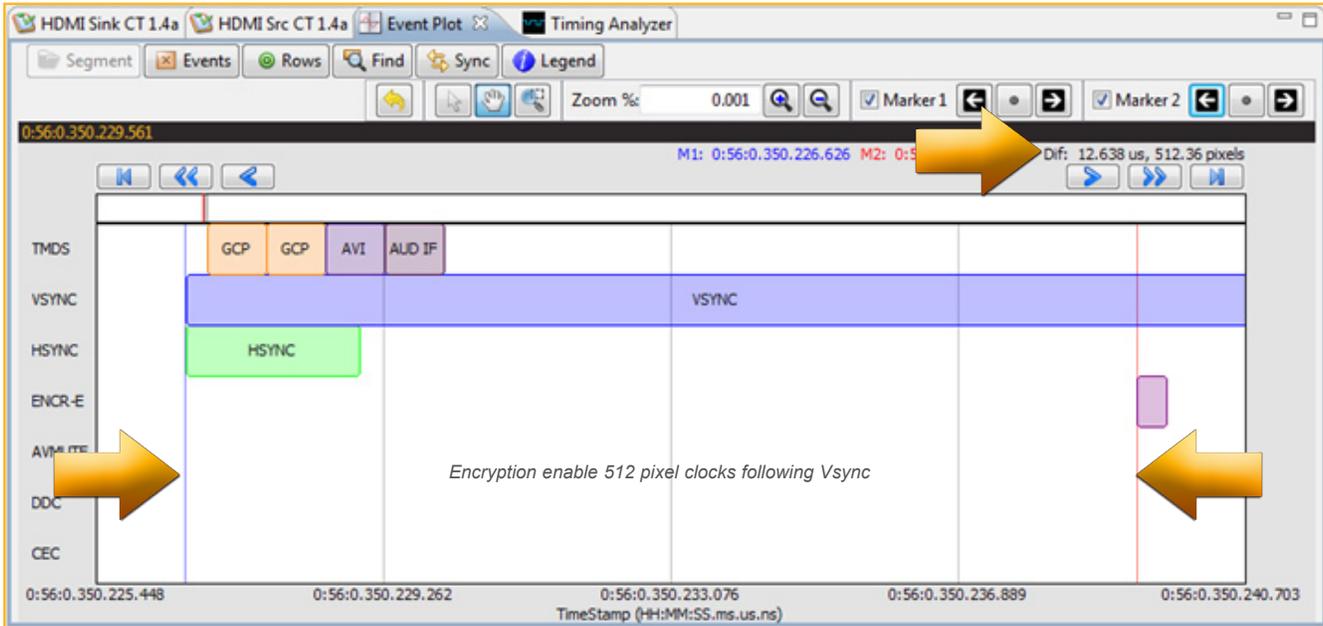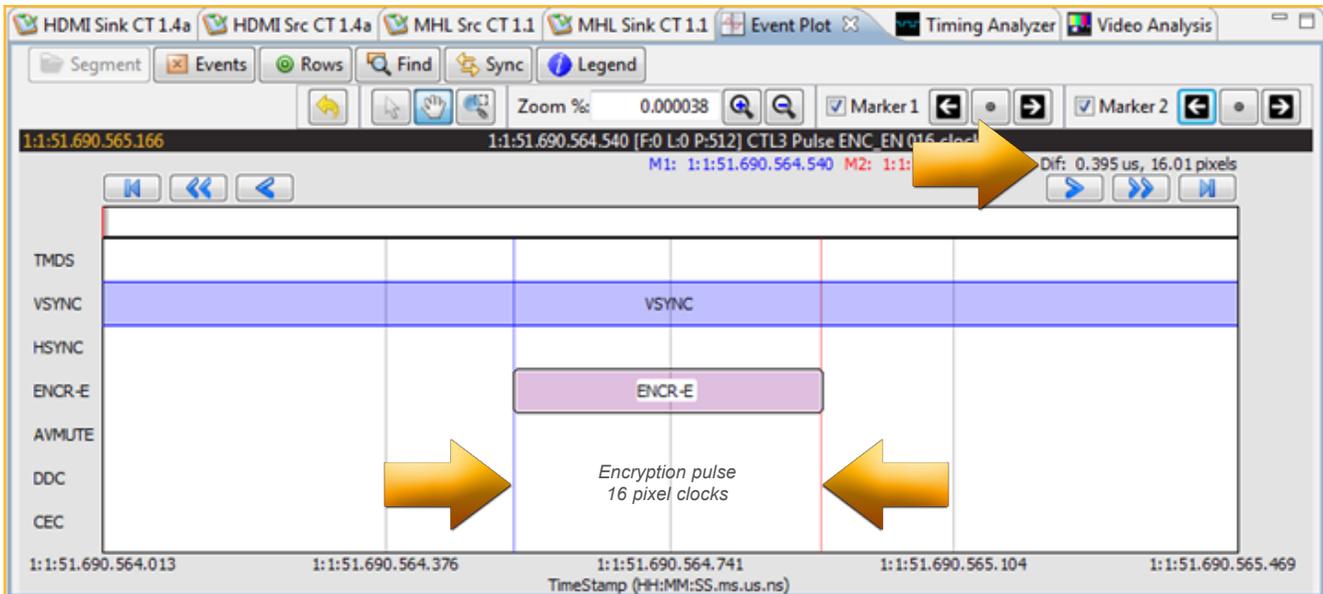

Figure 2

Figure 3

ENCRYPTION KEEP-OUT PERIOD

The encryption "keep-out" period is a period where no data island, video data or guard band is permitted. The keep-out period is from the 508th pixel (Figure 4) past the active edge of vsync to the 650th pixel (Figure 5) past this active edge. Verifying that there are no data islands, video data periods or guard bands in the keep-out period also requires an HDMI or MHL analyzer that can provide full visibility into all the protocol and metadata and also verify the precise timing of each.
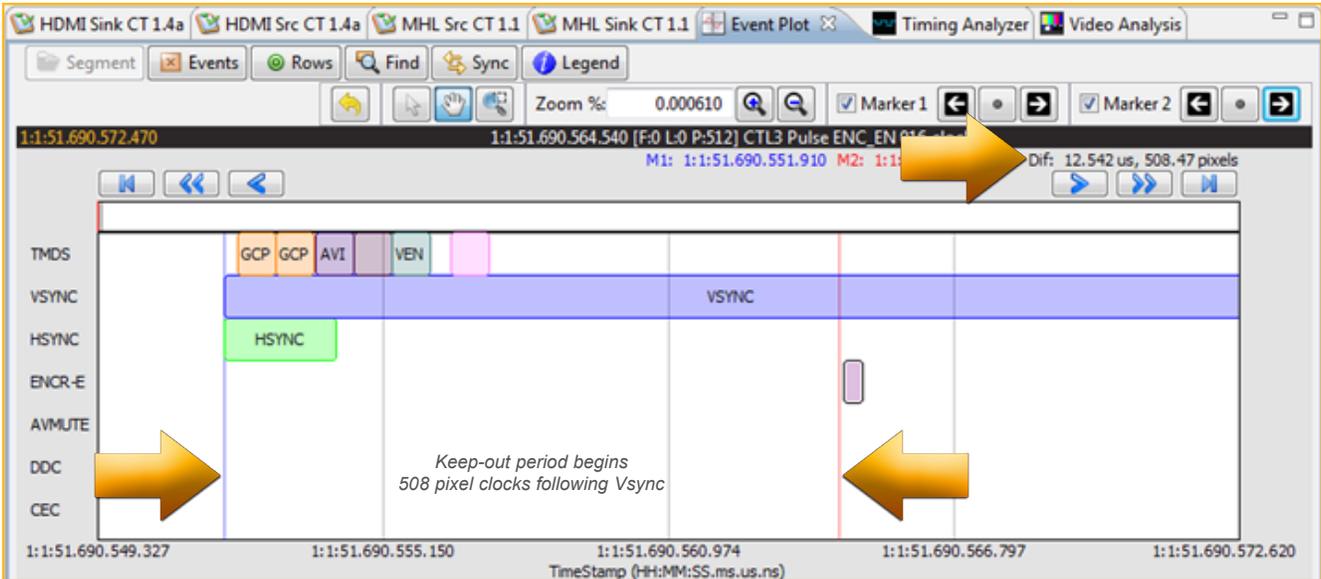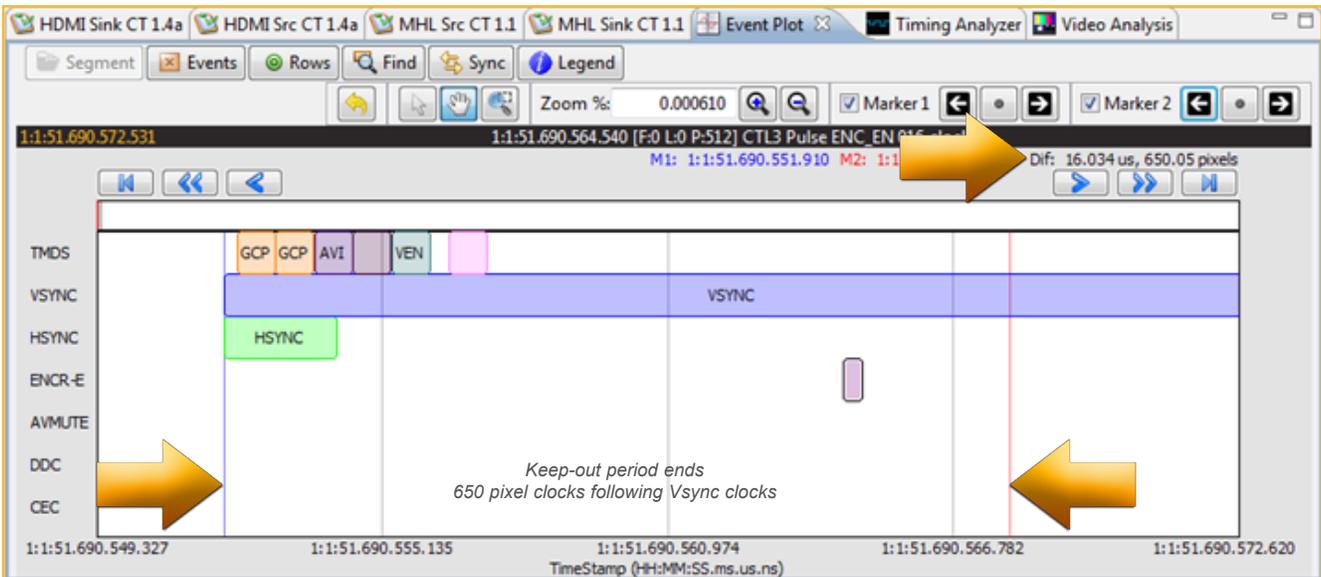

Figure 4

Figure 5

VERIFYING ENCRYPTION ENABLE ON 4K BY 2K RESOLUTIONS

The 980 Protocol Analyzer is the only commercially available HDMI analyzer that can provide the visibility to verify encryption status signaling even at the higher HDMI 1.4a resolutions of 4K x 2K. The higher speeds of HDMI 1.4a for 4K by 2K resolutions—which competitive analyzers do not support—present even greater challenges in verifying the timing of the encryption enable pulse and the restrictions of the keep-out region and window of opportunity.

The Quantum Data 980 Protocol Analyzer…an essential tool for verifying and diagnosing the root cause of encryption status signaling.
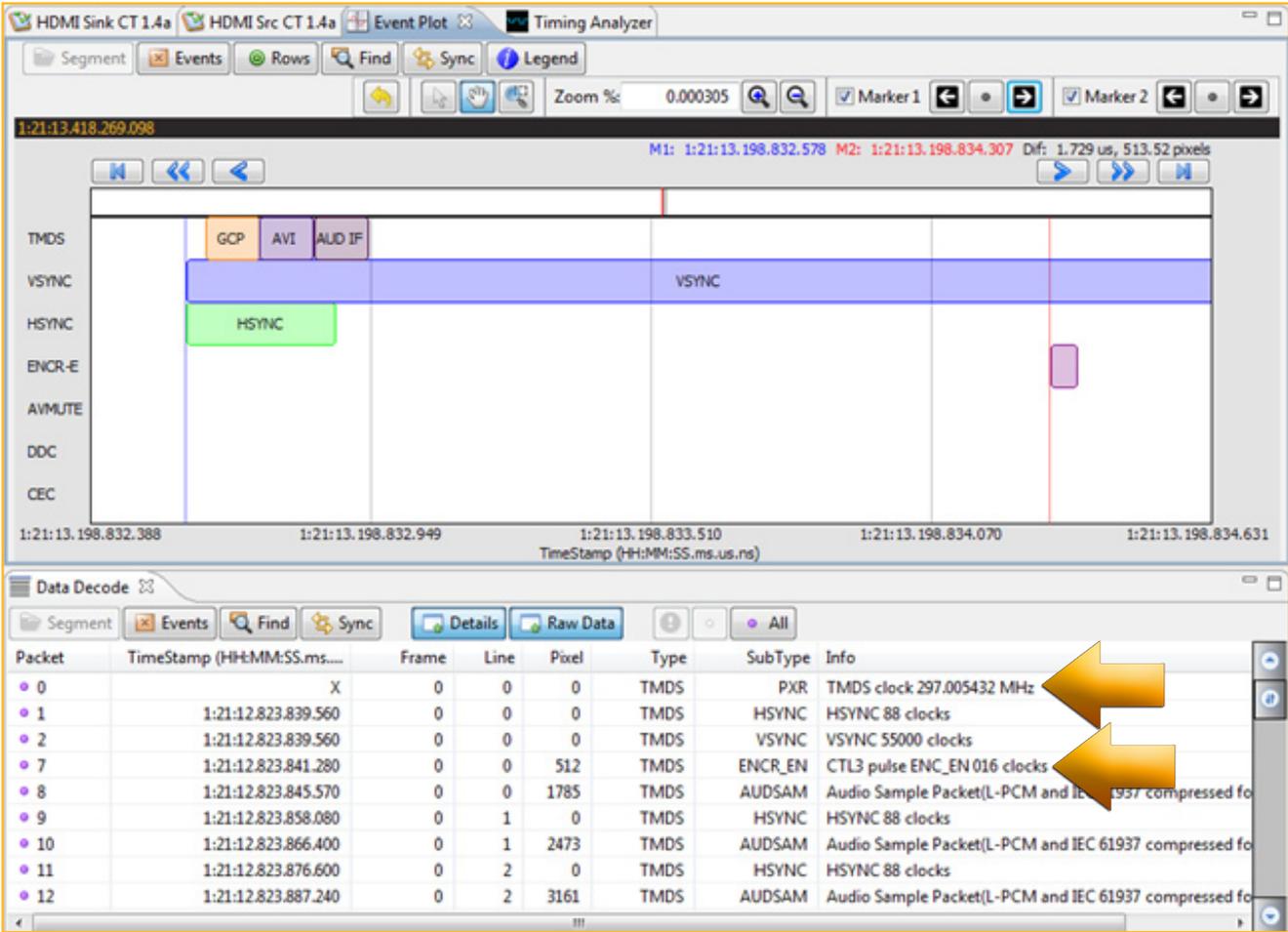

Figure 6