disguise capture latency methodology for SDI and NDI

Introduction

This document outlines the test setup and methodology that disguise employs in order to measure the capture latency for the range of machines available in its catalogue.

Scope

The measurements will be conducted on the currently available range of servers from disguise (4x4pro, gx 1 & gx 2). Older servers such as the 2x2, 4x2 and the 2.5 are not included in this measurement exercise.

The recent release r15.1.2 will be used as a baseline to measure against future releases in order to ensure that no regressions have occurred.

Latency will only be measured in frames, smaller denominations such as lines are beyond the current scope. Conversion to milliseconds can be done with this equation (Number of frames x (1/ refresh rate)) x 1000.

Methodology / Environment

The test has been constructed to be completely self contained, only relying on disguise hardware, nullifying any uncertainties that can be introduced by third party equipment.

The environment here is the server under test with an SDI VFC card. The VFC card outputs an SDI signal that is looped back into the capture system. The captured signal gets compositied inside a feed map with the original video and we export a frame capture (see diagram below).
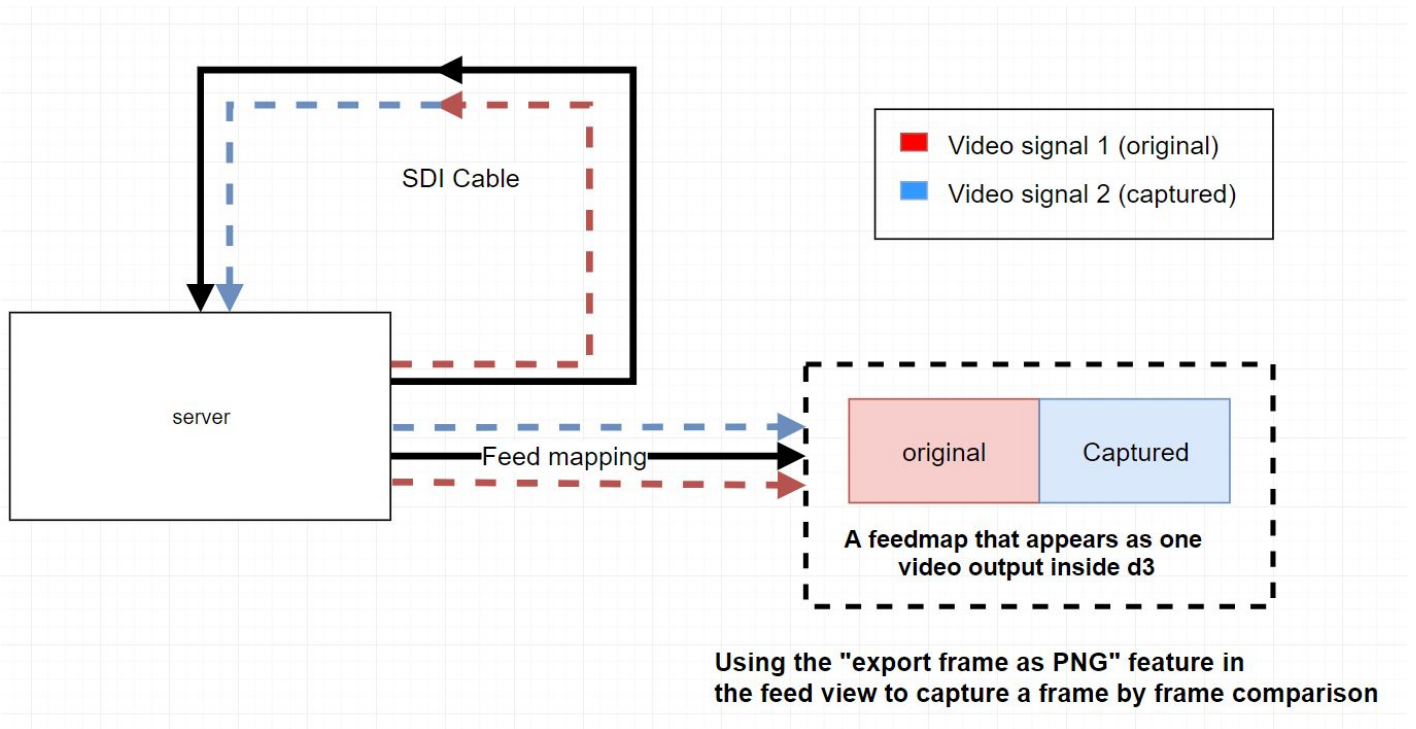
The latency is measured via the content which has a bar progressing along one frame at a time to indicate the current frame - see screenshot below.
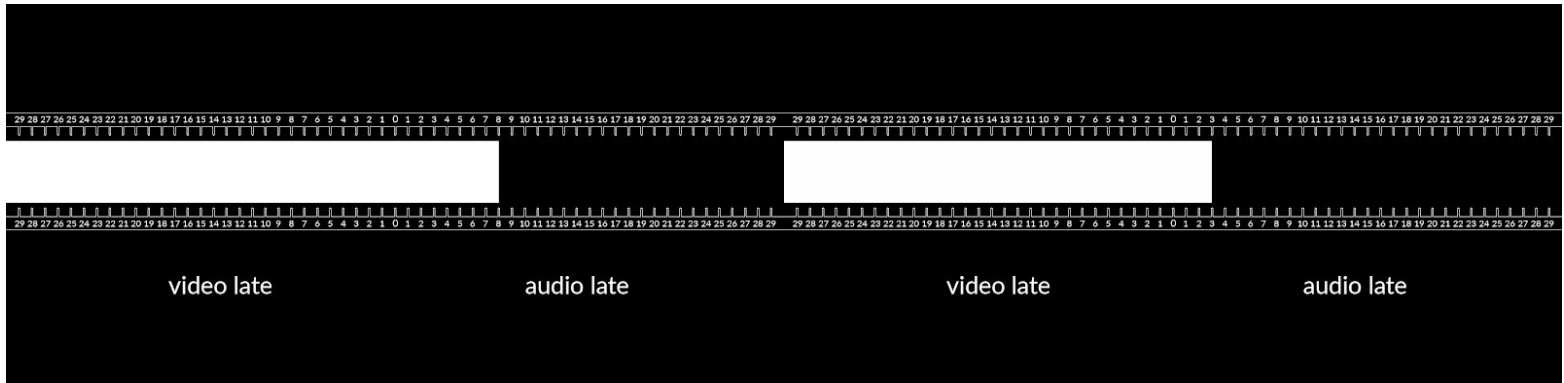
In this combined video output, the original video is on the left and the captured video on the right. The frame counter at the moment this snapshot was taken in the example above is at +8 frames and the counter for the captured video is at +3 frames. The difference between the two demonstrates that the software has 5 frames of latency from output to output in this specific scenario.

Variables

When testing there are a number of variables that need to be accounted for:

- the global latency mode which affects the number of buffered frames the software keeps on the graphics card
- the refresh rate. The lower the refresh rate the more milliseconds per frame the software has to process data
- VFC cards. If there any other VFC cards are present inside the system, ensuring they all have the same raster resolution allows the system to process more efficiently by preventing d3 from dropping frames when keeping all the outputs synchronised
- the refresh rate needs to match the frame rate of the video, as the software may skip or double some frames to keep everything in synchronisation with the refresh rate
- frame blending needs to be turned off throughout the tests, otherwise results can arise that will be less accurate

Latency modes

Global latency modes affects the number of buffered frames d3 stores on the graphics memory before outputting them. These buffered frames help absorb sudden spikes in rendering time helping d3 avoid dropping frames, the trade off is that the Latency increases with the number of buffered frames.

- In the "normal" mode d3 buffers 2 frames before outputting
- In the "low latency" mode d3 only buffers 1 frame before outputting
- In "ultra low latency" mode d3 does not buffer any frames.

N.B - we have observed a quirk with the AMD driver where if more than 4 displays are connected to the graphics card, such as in a fully kitted out 4x4 with quad output VFC cards, the AMD driver will force d3 to use 1 buffered frame.

Content

The original content used for testing is formatted as a TIFF sequence. This will guarantee that a new frame will be present every time the software outputs a frame.

The test project used to measure latency can be downloaded from here (17.4MB, unzips to 2.84GB)

It is also worth noting that the Displayport to SDI conversion inside the VFC card only takes 7 lines, which can be considered negligible within the scope of this test.

Capturing and compiling data

The final form of the data will be in a table per server covering differing refresh rates and latency modes. Each test will be run a number of times to ensure that there is consistency in the data. See, for example, the 4x4pro table below

|	4x4pro SDI		
Refresh rate	Normal mode (frames)	Low latency mode (frames)	Ultra low latency (frames)
60Hz	4-5	4	3
50hz	4-5	4	3
30Hz	4-5	4	3

Exceptions / limitations

The solo has options for SDI capture but does not support VFC cards. disguise can still conduct latency tests in the same manner using inhouse tools, but users should be aware that they will not be able to replicate the environment and tests independently. Our inhouse findings demonstrate similar data to the gx 1

Additional notes

If a scenario occurs where the test needs to use multiple VFC cards to provide a source signal, the machine in question needs to be genlocked or internally locked. This allows for the future expansion of our product range and guarantees that the GPU will push out frames at identical times across all its outputs.

Modifying the current methodology for measuring latency with NDI.

This test can be easily modified to capture latency when using NDI
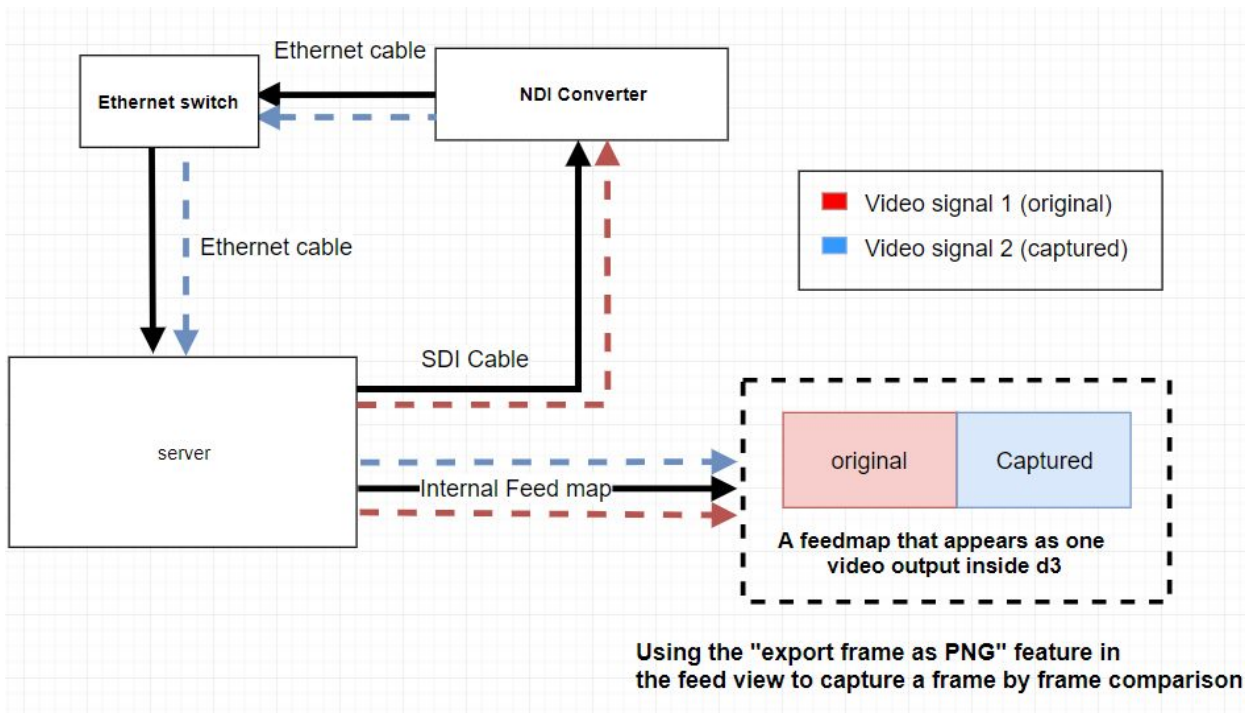
The converter that we use for testing is the Bird dog studio 2: Which has a claimed latency of 1 frame when going from SDI to NDI.