The Dell Precision T3620 tower as a Smart Client leveraging GPU hardware acceleration

Dell IP Video Platform Design and Calibration Lab

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Reference Architecture

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Document overview

This document provides an overview for using the Dell T3620 mini tower as a smart client that leverages NVIDIA GPU hardware acceleration.

The T3620 tower is a fully configurable, affordable tower workstation for professional performance, which also includes support for NVIDIA GPU adapters. It is an ideal platform for the surveillance industry. Milestone has also introduced support for GPU rendering with their 2018 R1 release of the Smart Client.

Dell IP Video Platform Design and Calibration Lab

In collaboration with Milestone Systems, the Dell IP Video Platform Design and Calibration Lab is an environment that provides a scalable controlled loading facility that is tailored to IP camera architectures. Platform design concepts can be implemented and calibrated to validate their potential capability.

Based at the Dell Customer Solution Centre in Ireland, using a network of global Customer Solution Centers, Dell helps customers strategize, design, validate, and build solutions.

Milestone Systems

Milestone Systems is the world's leading provider of open platform IP video surveillance software. Milestone has provided easy-to-use, powerful video management software in more than 100,000 installations worldwide.

Milestone XProtect products are designed with open architecture and are compatible with more IP cameras, encoders, and digital video recorders than any other manufacturer. Because Milestone provides an open platform, you can integrate today's best business solutions and expand what is possible with future innovations. Go to www.milestonesys.com for more information.

XProtect Corporate

XProtect Corporate is IP-based video management software designed for large-scale and high-security installations. It is built with innovative technology designed to ensure end-to-end protection of video integrity and boost the overall performance of your system with hardware accelerated video decoding.

In addition to the central management of all servers, cameras and users in a multi-site set-up, XProtect Corporate includes an integrated video wall for operators demanding supreme situational awareness of any event. The software supports failover recording servers, making it the perfect choice for mission-critical installations that require continued access to live and uninterrupted video recordings. Running on the industry's best performing recording engine with a recording rate of minimum 3.1 Gb/s, XProtect Corporate is ideal for installations with 24/7 operation requirements, such as airports and casinos.

Release 2018 R1 implements support for NVIDIA GPU decoding.

XProtect Smart Client

XProtect Smart Client is the main client for the VMS, offering a full set of advanced features and designed for day-to-day use by dedicated operators.

XProtect Smart Client is designed to run remotely from the operator's computer and supports multiscreen usage in full screen mode as shown below or in floating windows mode.

Hardware overview

Dell Precision T3620

The Dell Precision 3620 tower is an ideal platform to leverage for the Milestone Smart Client.

- Intel i-Core based platform
- Built in hardware accelerator, Quick Sync, which is part of the Intel graphics adapter
- Enterprise-grade platform, reliable for sustained, extreme workloads
- Expandable up to 2 local 3.5" high density disks for off-loading of data

Table 1 Dell Precision T3620 platform

System configuration	T3620
CPU model	Intel i5 6500 3.2G (with 530 graphics)
RAM	2 x 8 GB DIMM
Disks	1 x 250G M2
Graphic card	Quick Sync Intel + NVIDIA P2000
OS	Win10 pro 1709
OS disks	C:/ - OS - 200 GB - 4 KB
Milestone XProtect release	2018 R1 2.1a build 7751
BIOS/Drivers	OS Update, + system updates with BIOS

NVIDIA Quadro

Add GPU acceleration by including an NVIDIA based GPU graphics adapter. On tests, we used both the NVIDIA P2000 and P600 adapters.

- Designed for enterprise-grade reliability and 24x7 operation
- Fully tested and qualified on Dell's workstation platforms
- Quad display ports for multi monitor support
- Long product life cycle
- H.264 and H.265 decoding, supported by Milestone
- Scalable to enable multi-GPU, multimonitor, and additional GPU decoding acceleration

Table 2 NVIDIA P2000 specification

Adapter	P2000	P600
CUDA Parallel-Processing Cores	1024	384
GPU Memory	5 GB GDDR5	2 GB GDDR5
FP32 Performance	3.0 TFLOPS	—
Max Power Consumption	75 W	40 W
Graphics Bus	PCI Express 3.0 x 16	CI Express 3.0 x 16
Display Connectors	DP 1.4 (4)	4x mDP 1.4
Form Factor	4.4" H x 7.9" L Single Slot	2.713" H x 5.7" L, Single Slot, Low Profile

NVIDIA cards v3.0 and newer (codename Kepler) support hardware accelerated decoding of H.264 and JPEG streams in the XProtect Smart Client, including the following:

- GeForce GTX 660, GTX 670, GTX 780, GTX 680M, GTX 750M, Quadro K5000, Quadro K4200, Quadro K4000, Quadro K2200, K3100M, Quadro K4000M, and Quadro K5000M.

NVIDIA cards v6.0 (codename Pascal) and newer support hardware accelerated decoding of H.265 streams in the XProtect Smart Client, including the following:

- GeForce TITAN Xp, Titan X, GTX 1080, GTX 1070, GTX 1060, GTX 1050Ti, GTX 1050, GT 1030, Quadro P6000, Quadro P5000, Quadro P4000, Quadro P2000, Quadro P1000, Quadro P600, Quadro P400, Quadro P5000 (Mobile), Quadro P4000 (Mobile), and Quadro P3000 (Mobile).

For more information NVIDIA hardware acceleration support, see Using hardware acceleration (NVIDIA, Intel) in XProtect Smart Client 2018 R1 and newer versions.

Test setup

The test environment includes a dedicated Milestone VMS server, Milestone XProtect Smart Client 2018 R1 (build 7751) running on Microsoft Windows 2010 pro (1709), and the remote focus client system for test.

The server is running an emulation environment that can be calibrated to induce precise scaling to the focus test platform. In this case, the video streams are calibrated to provide a 4.4 Mb/s throughput that comprises a H.264, 1080p, feed at 30 fps. We leveraged the Milestone hardware diagnostics within the smart client to monitor the frame performance. We also compared live streaming versus playback.

When the optimum level is reached, the Dell LiveOptics tool gathers the system performance information over a 24 hour period. LiveOptics is a vendor, hardware, and platform-agnostic standard for IT professionals to record and communicate their achieved benchmarks, workloads, or support concerns to others to accelerate decision time and reduce risk. Furthermore, Milestone Performance and Microsoft Performance Resource Monitor (Perfmon) tools monitor performance and frame loss.

We used the NVIDIA_SMI.exe, Microsoft Task Manager, and Perfmon to monitor the system and GPU performance.

Test criteria

The criteria for stopping the testing were sustained frame drops on the playback feeds, which was in line with the maximum load on the GPU and CPU.

Data points gathered

Data points were gathered for Microsoft Resource Monitor, application diagnostics, and GPU.

Microsoft system resource monitor

- CPU % utilization
- GPU % utilization
- Memory usage
- GPU memory utilization

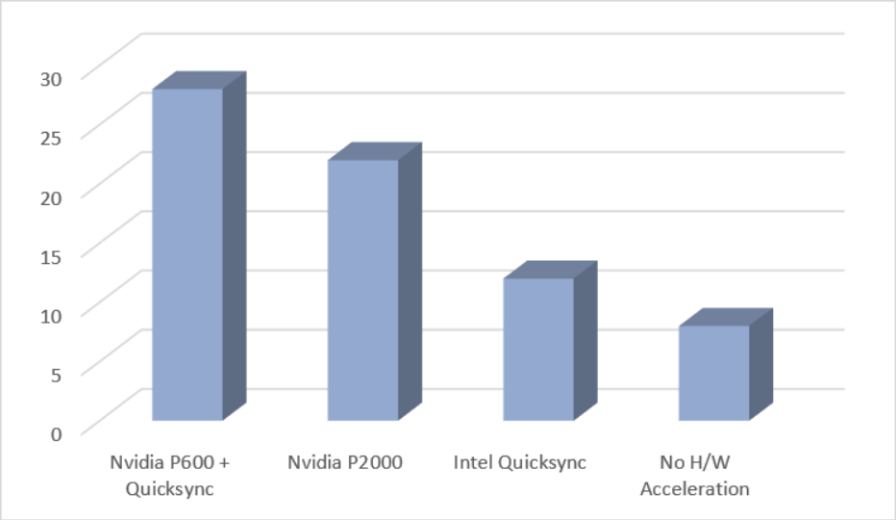
Application diagnostics measuring

- Frames per Second
- Codec
- Resolution
- Hardware Acceleration
- Frames per second, for playback and live view

Test results

Baseline - running 1080p feeds at 30 fps

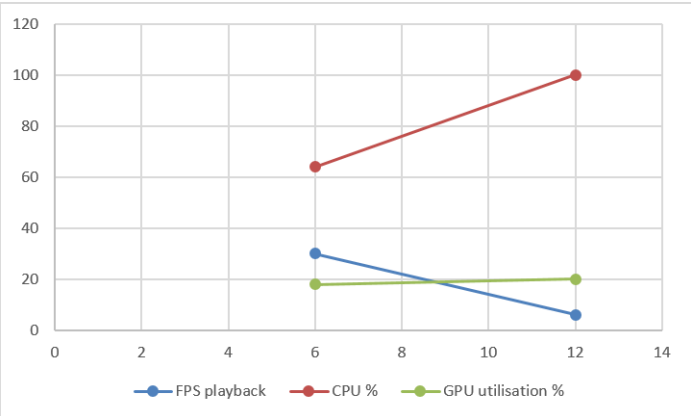
Figure 1 Maximum number of feeds per GPU before frame drops per feed



No hardware acceleration - single display running 1080p feeds at 30 fps

- Hardware acceleration disabled
- Platform saturated quite quickly as the quantity of playback feeds increases
- Sustained frame drops above 6 feeds

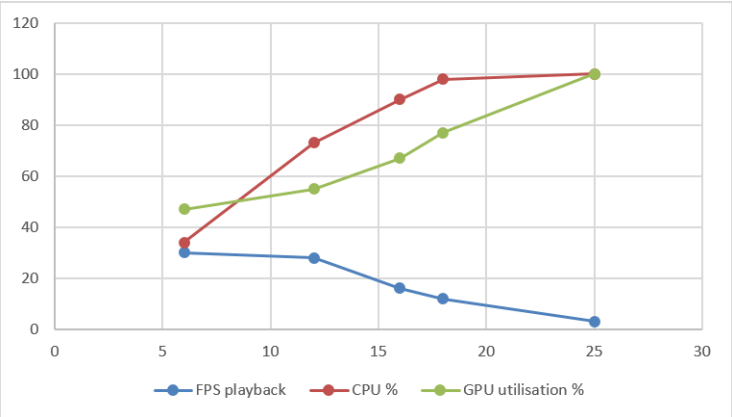
Figure 2 No Hardware Acceleration - 1080p feeds at 30 fps



Intel Quick Sync - single display running 1080p feeds at 30 fps

1. Intel Quick Sync enabled
2. CPU is heavily leveraged
3. Sustained frame drops above 12 feeds

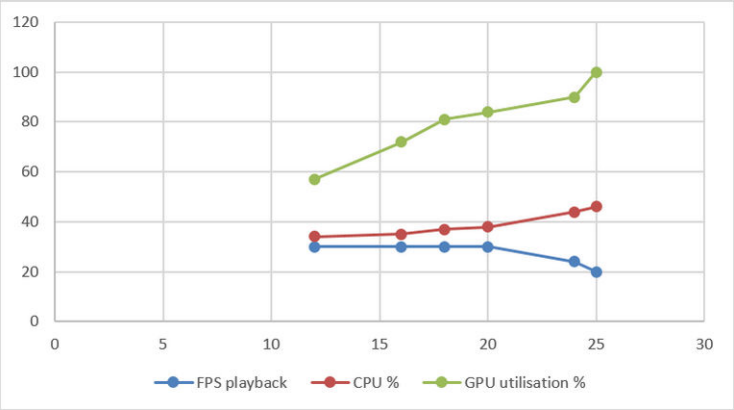
Figure 3 Intel Quick Sync - 1080p feeds at 30 fps



NVIDIA P2000 single display running 1080p feeds at 30 fps

- Leveraging the NVIDIA GPU, the platform reduces the reliance on the CPU, providing a much higher quantity of feeds on playback
- Sustained frame drops above 20 feeds

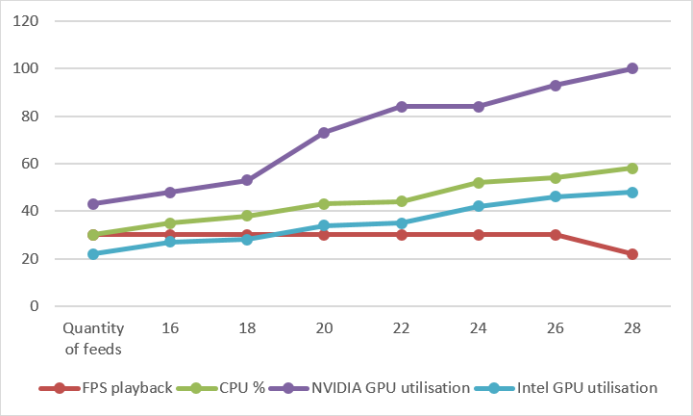
Figure 4 NVIDIA P2000 - 1080p feeds at 30 fps



NVIDIA P600 with Quicksync single display running 1080p feeds at 30 fps

Combining the NVIDIA P600 adapter with Intel Quick Sync enabled 25 feeds before dropping frames.

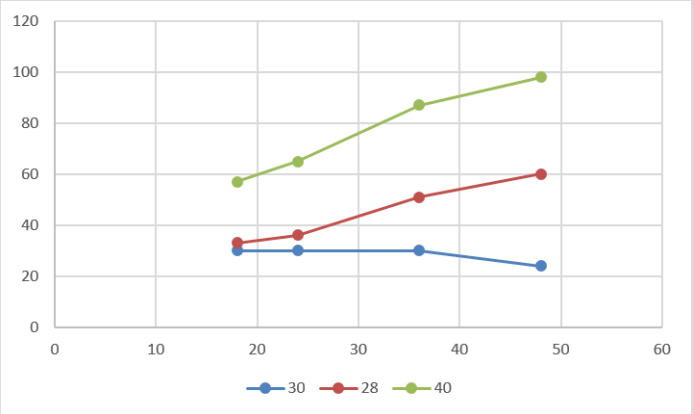
Figure 5 NVIDIA P600 - 1080p feeds at 30 fps



NVIDIA Single Display running 1080p feeds at 20 fps

Decreasing the frame rate of the feeds to 20 increases the quantity of playback feeds to 36 before dropping frames.

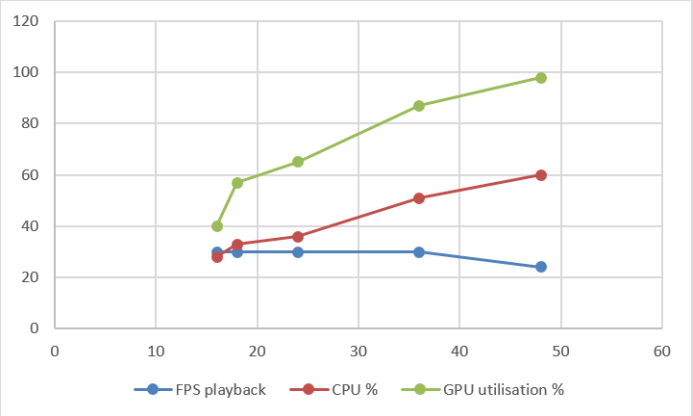
Figure 6 NVIDIA single display - 1080p Feeds at 20 fps



NVIDIA single display running 720p feeds at 30 fps

Reducing the resolution to 720p increases the quantity of feeds to 36 before dropping frames.

Figure 7 NVIDIA single display - 720p feeds at 30 fps



Multiple displays, with multiple instances of Smart Client, running 1080p feeds at 30 fps

GPU utilization is increased with the quantity of feeds. The overall quantity of feeds is in line with the single display.

Display feeds	No. of displays	No. of feeds	CPU%	GPU%	FPS playback
9+9	2	18	56	89	30
9+9+9	3	27	100	92	<20
4+4+4	3	12	65	70	30
4+4+4+4	4	16	85	88	30

Findings and design considerations

- Performance is greatly improved by leveraging GPU hardware acceleration.
- The Smart Client leverages multiple GPU adapters when present, operating them in parallel, effectively doubling the capabilities of the platform when 2 are being used.
- The feeds resolution and frame rate have a linear demand on the playback decoding.
- The best maximum performance of the GPU adapter is at approximately 80 percent before It increases its reliance on the CPU, and starts to decrease the Frame Per Second playback.
- Exporting of video feeds has a minimal impact on the GPU and CPU (approximately 3 percent). Tested with 10 feeds exporting over one hour.
- The Milestone Smart Client primarily leverages the NVDEC decoder chip on the adapters for accelerating the decoding of the video streams. It is important to choose the Pascal chipset or above to include support for H.264, H.265 video streams.
- The Quadro P600 GPU adapter is an excellent choice for a single display that can handle up to 20 HD streams along with Intel Quick Sync.
- If the streams are HD and above, such as 4K, the P2000 GPU adapter performs better.
- Consideration on the playback screen is important, especially when playback of high-resolution images is required.
- On tests, we leveraged multiple display types. The Dell P4317Q monitor, with a native resolution of 3840x2160, is an ideal choice for a physically large display at 43" with high-resolution.