



412th Test Wing



War-Winning Capabilities ... On Time, On Cost



U.S. AIR FORCE

Video Performance in a Virtualized Environment

15 May 2019

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Integrity - Service - Excellence



Overview



- **A virtualized system uses either zero, thin, or thick clients as display endpoints. This presentation will document the journey to measure video performance of many different clients attached to a virtualized system. Preliminary results of this study have produced some surprising results.**



Generally Acceptable Video Frame Rates



- **Movies 24 fps**
- **Television 30 fps (interlaced 60)**



Data Flow



Hardware

Physical Computer

Virtual Computer

Virtual CPU

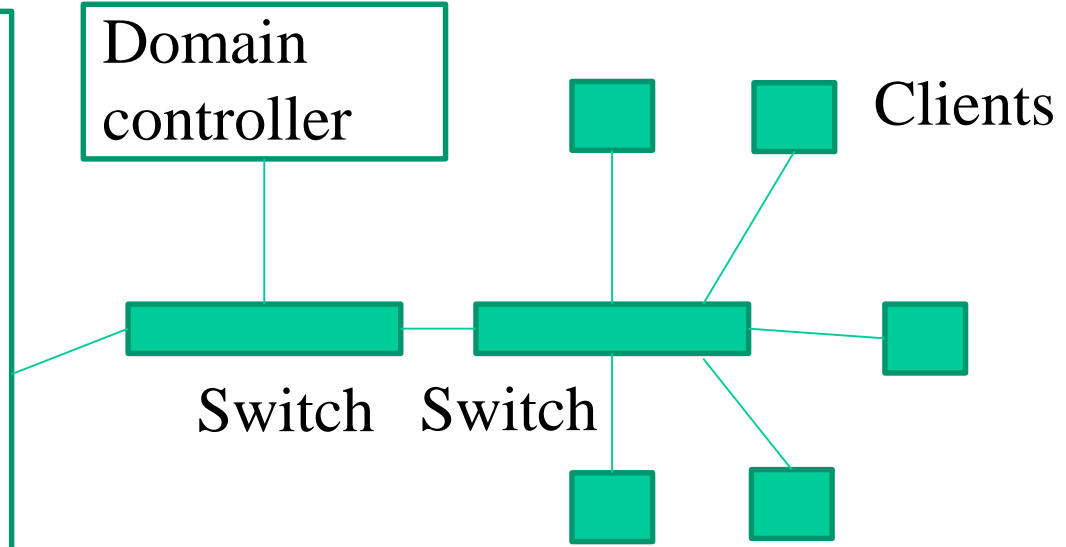
Virtual GPU

Virtual Memory

Virtual network

VSAN

Domain controller





Test System Description



Hardware

- **Dell EMC VxRail**
- **HP Simplivity**
- **Dell 730 Servers**
- **NVIDIA P40 Cards**
- **Dell and Juniper network switches**

Software

- **VMWare 6.5, 6.7**
- **Horizon Enterprise / Advanced**
- **Windows 10**
- **Server 2016**



Hardware / VMs Measured



Zero Clients – Dell Wyse 5030, 5070

Thin Clients – 10Zig 78XX, HP T730, Dell Wyse 5070, Dell Wyse 7040

Thick Clients – Dell 5810, Dell T5500, HP Z800, Dell T7500

- **Graphics Quadro K4200, Intel HD, Quadro 4000,**

VM – 4 cores, 8GB RAM, Nvidia Grid Profile(varies), 40 Gb drive space



End Clients



- **Zero client**
 - Video only
- **Thin client**
 - Small OS
 - Video + application + storage
- **Thick client**
 - Full PC
 - Full OS
 - Plenty of updates





Protocols Tested



- **VMBlast – GPU encoded – GPU decoded**
- **PCOIP – Software encoded – GPU decoded**



Tools Used



- **60 fps video of Big Buck Bunny - two copies**
- **VLC – open source video player**
- **CPUBenchmark – CPU, video, memory, disk performance benchmark software**
- **Windows Perfmon – windows built in performance monitor - can gather frame rate from nvidia grid card**
- **RivaTuner & Afterburner – measures records and displays frame rate on the local hardware – GPU tuning software**
- **Horizon performance tracker – did not work but helps if it is loaded on the client**



Group Policy



- **End client performance parameters are set through group policy**
- **Default parameters are not adequate for high performance on the client**
- **VMWare provides an add on with the Group Policy Objects – the version must match**



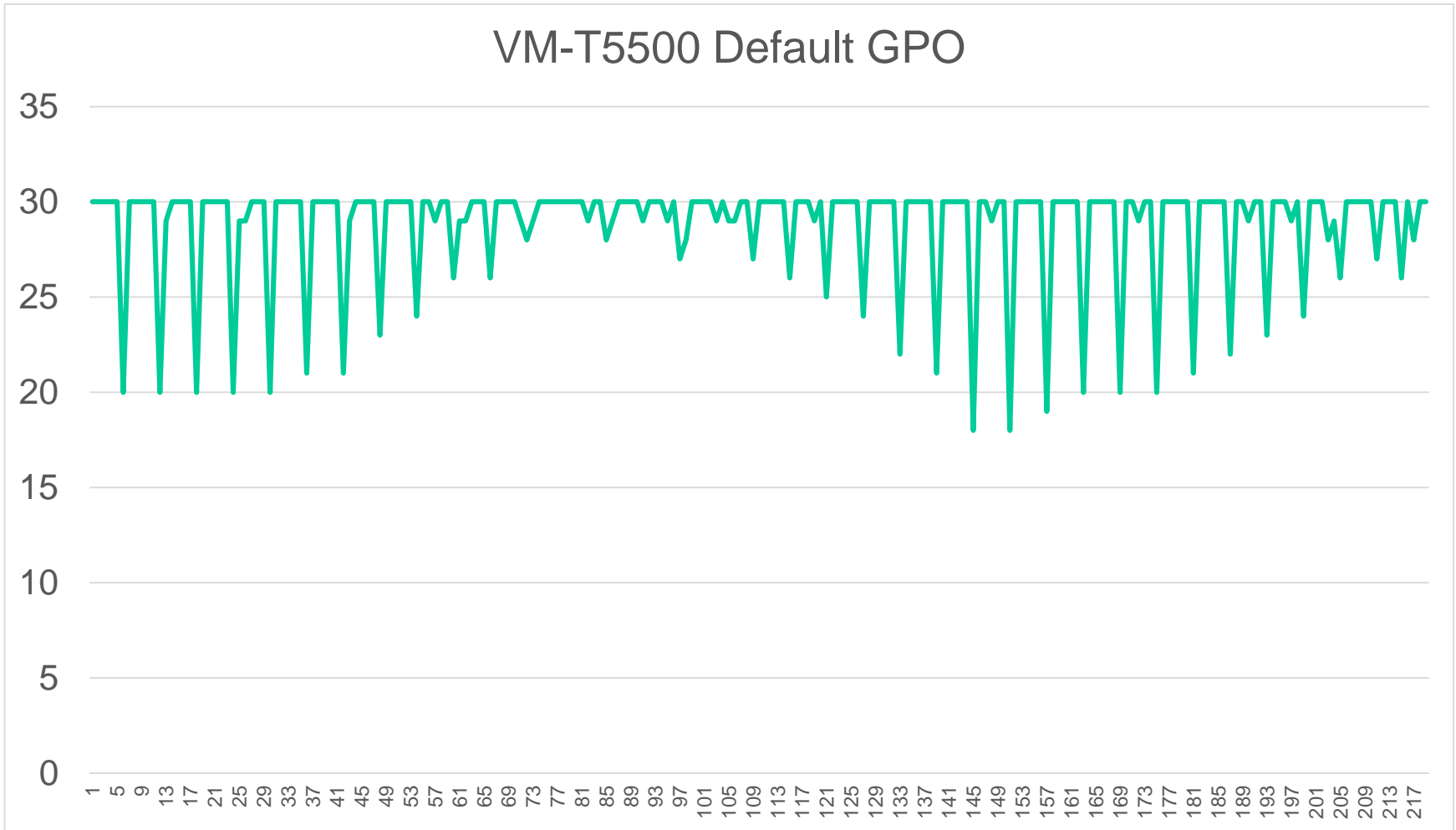
GPO Default vs Test Values



Parameter	Protocol	Default	Value Used
EncoderMaxFPS	VMBlast	30	60*
EncoderH264Enabled	VMBlast	1	1
H264maxQP	VMBlast	36	36
H264minQP	VMBlast	10	10
MaxBandwidthKbps	VMBlast	1000	2147483635*
MaxBandwidthKbpsPerMegaPixelSlope	VMBlast	100	100000*
MinBandwidthKbps	VMBlast	TBD	8000
pcoip.max_link_rate	PCOIP	10	70
pcoip.maximum_frame_rate	PCOIP	30	80*
pcoip.maximum_initial_image_quality	PCOIP	80	40
pcoip.minimum_image_quality	PCOIP	40	40
pcoip.use_client_img_settings	PCOIP	0	0



GPO Limits Performance





Test Setup & Process



- **Benchmarks run on both bare metal clients and VMs**
- **Frame rate sampled at 5 second intervals using Perfmon(VM)**
- **Frame rate sampled at 1 second intervals using Rivatuner(Bare metal)**
- **Data collected for approximately 10 minutes**
- **The data file is exported to a CSV**
- **The CSV file is imported into excel**
- **Statistics are cropped for start and stop**
- **Any require scaling is applied**



Big Buck Bunny video





Results VM Based



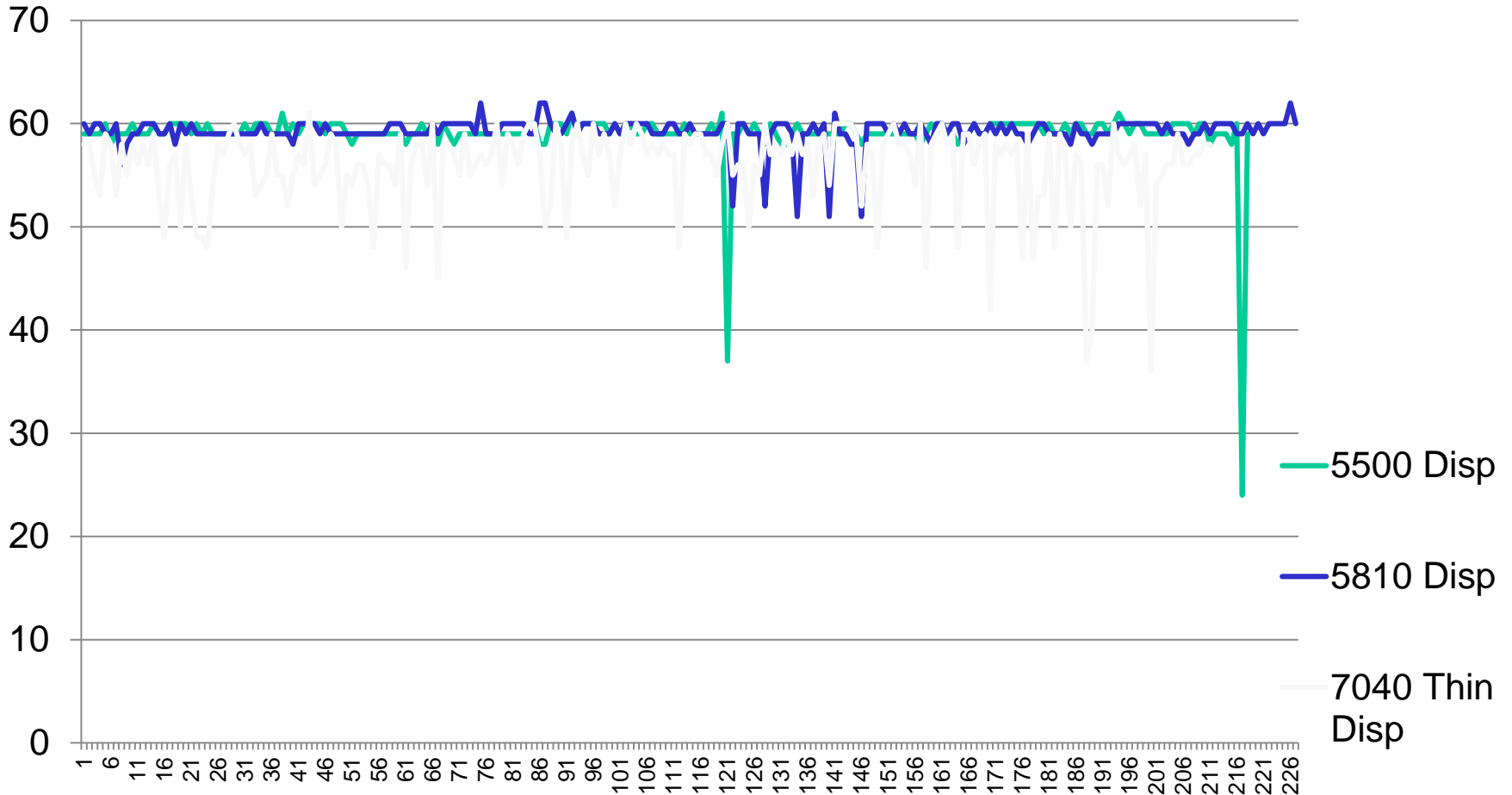
Model	Decode GPU	Type	Dual Mon Avg FPS	Dual Mon Min FPS
Dell 5810	K4200	Thick	59	41
DW 7040	I5	Thin	56	36
Dell T7500	4000	Thick	20	9
Dell T5500	4000	Thick	20	9
HP Z800	4000	Thick	18	10
10zig 78xx	Rad R5E	Thin	27	19
HP T730	Rad R7	Thin	36	25
DW 5070	Unknown	Thin	16	9
DW 5070	Teradici	Zero	19	11
DW 5030	Teradici	Zero	31	22



3 Best clients



Frame Rate
3 Best Clients

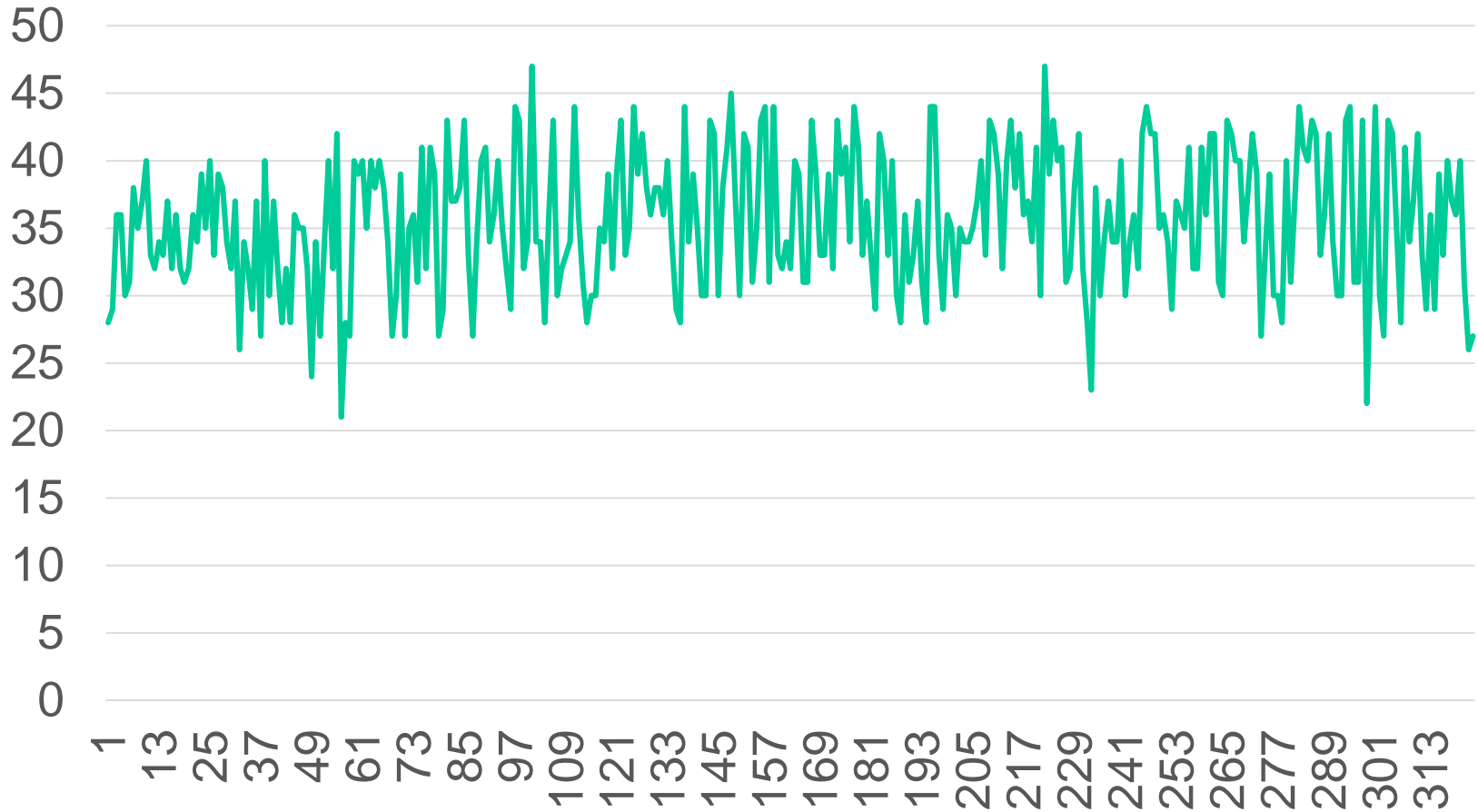




Typical Results

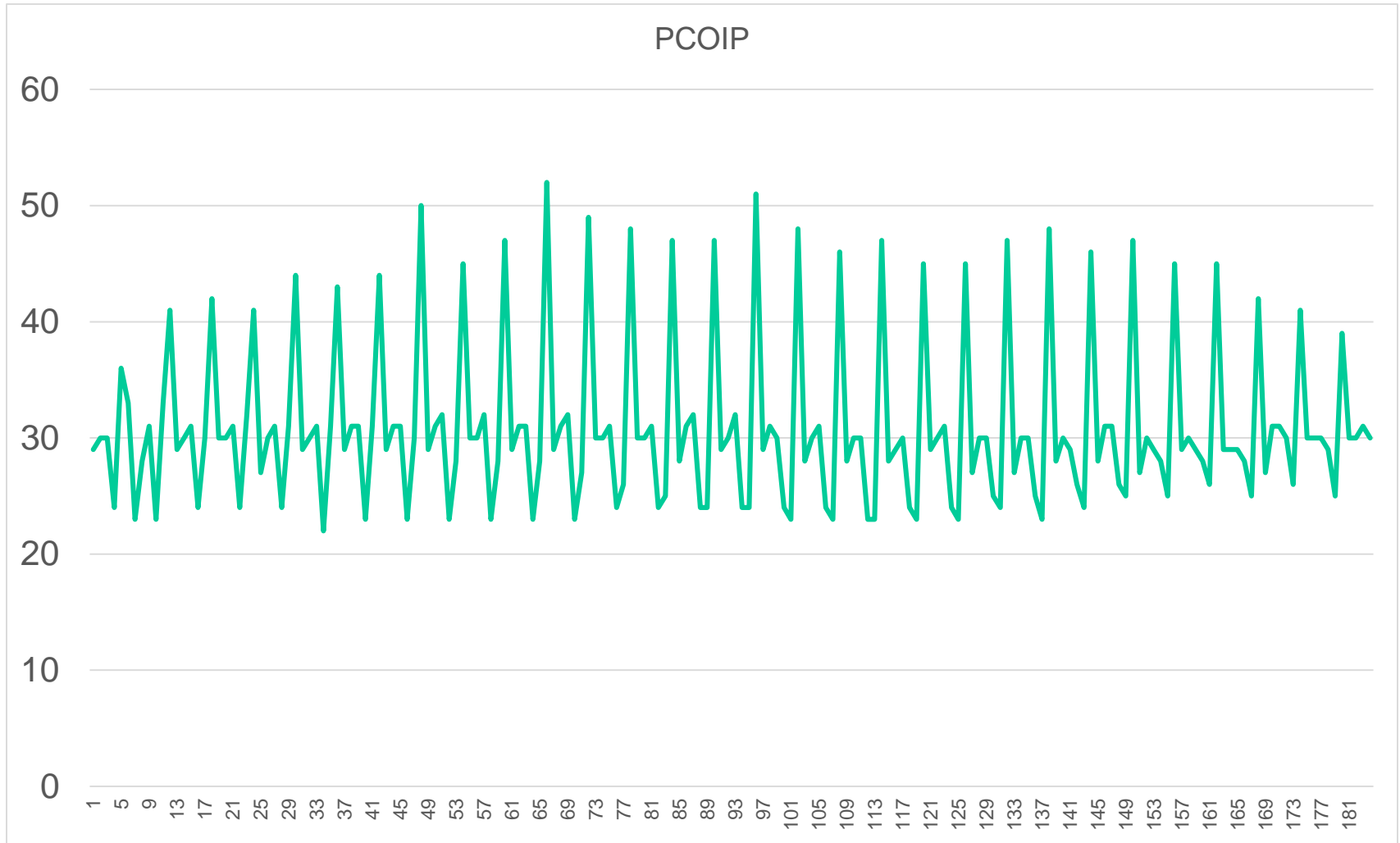


HP T730





PCOIP





Results VM Based



Model	Decode GPU	Type	Single Mon Avg FPS	Single Mon Min FPS
Dell 5810	K4200	Thick	xx	xx
DW 7040	I5	Thin	60	51
Dell T7500	4000	Thick	xx	xx
Dell T5500	4000	Thick	xx	xx
HP Z800	4000	Thick	xx	xx
10zig 78xx	Rad R5E	Thin	26	17
HP T730	Rad R7	Thin	48	26
DW 5070	Unknown	Thin	16	9
DW 5070	Teradici	Zero	TBD	TBD
DW 5030	Teradici	Zero	TBD	TBD



Does the Virtual GPU matter?



- **Tested a configuration without a source GPU - NVIDIA Grid card**
- **Client GPUs were still used**
- **Single monitor performance may be acceptable**
- **Dual monitor – one monitor is frozen**



No GPU video





Other lessons from the data



- **Grid profile does not matter for high video rates(h.264) 1q, 2q, 4q**
- **As long as the CPU speed is sufficient, frames per second are not impacted**
- **Any component can be the limiting factor eg CPU, GPU, memory, disk, bus speed in the end client**
- **The series of GPU card did not seem to matter - NVIDIA M series vs P series.**



Low Performance Video





Summary



In virtualization:

- **Encode side GPUs help for all applications**
- **The end client is all important for performance applications**



Questions





Backup



412TW



Client Hardware Specs/Benchmarks



Model	Co res	SP EE D	RAM GB	Deco de GPU	CPU	RAM	DISK	2D GRAP HICS	FPS AVG
D 5810	4	3.1	32	4200	7528	2526	1019	677	59
DW 7040	4	2.3	8	I5	6933	1918	3163	621	56
D T7500	8	2	6	4000	4921	1050	1146	323	52
D T5500	6	3.5	8	4000	7368	1883	1808	598	59
HP Z800	TB D	TB D	TBD	4000	4540	1730	2672	435	53
10Z 78xx	4	2.4	4	R5E	3067	763	1895	263	xx
HPT730	4	2.7	7	R7	4602	895	1480	465	36
DW 5070				Unk					16
DW 5070				Tera					19
DW 5030				Tera					31

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