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WaitTime* Performance and Validation Report for Integration on Dell Technologies PowerEdge* R750

Report

September 2022

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Revision History

Date	Revision	Description
September 2022	1.0	Initial release.

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1.0 Overview

This document provides an overview and results for validation of multiple versions of WaitTime* software running on an enterprise server solution (Dell Technologies PowerEdge* R750) installed with a production version of WaitTime application software.

The focus of this report will be running the WaitTime algorithm on the CPU.

Testing was completed with and without video being recorded to local server disk drives. Sizing estimates will be provided for configurations with and without video storage in the *Conclusion* section of this document.

The objective of the validation process is to:

i. Validate and Size the system configuration for concurrent multi-stream video analytics.
ii. Validate that WaitTime algorithms' is evenly distributed across all compute units.
iii. Confirm that maximum video analytics channel density is achieved at 90-95% of maximum compute capacity
iv. Confirm that overall software/hardware solution is steady and operates without fail(s) for at least 24 hours.
v. Measure and log key system running parameters:
   - Overall system CPU load: average and standard deviation.
   - Video analytic inference performance in frames per second: Average and deviation

1.1 WaitTime Overview

WaitTime provides real-time data and historical analytics on crowd behavior.

WaitTime's patented artificial intelligence allows operations personal to monitor crowd movement and density in real-time, while providing guests with useful information they can use to navigate the venue they are in.

For more information, visit https://www.thewaittimes.com/ .

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2.0   *System Configuration*

Table 1.   System Configuration

Components	Version
Hardware	
Chassis	Dell Technologies PowerEdge R750
CPU	2x Intel® Xeon® Gold 6338N CPU @ 2.20GHz, 32 Core(s), 64 Logical Processor(s)
Memory	Installed Physical Memory (RAM) of 256 GB
Hard drives	512GB Total Storage but not leveraged for Storage
HDDL card	None
Network card	Intel® Ethernet Network Adapter E810-DA4 QP 25GbE SFP28 OCP 3.0
Others	N/A
Software	
BIOS	Dell Inc. 1.4.4
iDRAC	5.00.20.00 (Build 22)
Operating System	Windows Server 2019
Application Software	WaitTime application – multiple versions
Others	Hyper Threading (Logical Processor in BIOS)
Others	Enabled dynamic CPU frequency

2.1   Processor Details

Name	Processor	Version	Current Speed	Core Count
CPU1 Status	Intel® Xeon® Gold 6338N CPU @ 2.20GHz	Model 106 Stepping 6	2.20Gz	32
CPU2 Status	Intel® Xeon® Gold 6338N CPU @ 2.20GHz	Model 106 Stepping 6	2.20GHz	32

2.2   Dell iDRAC Processor Settings

Dell iDRAC Processor Settings	
Logical Processor	Enabled
CPU Interconnect Speed	Maximum data rate
Virtualization Technology	Enabled
Kernel DMA Protection	Disabled
Directory Mode	Enabled
Adjacent Cache Line Prefetch	Enabled
Hardware Prefetcher	Enabled
DCU Streamer Prefetcher	Enabled
DCU IP Prefetcher	Enabled
Sub NUMA Cluster	Enabled
MADT Core Enumeration	Round Robin
UPI Prefetch	Enabled
XPT Prefetch	Enabled
LLC Prefetch	Enabled
Dead Line LLC Alloc	Enabled
Directory AtoS	Disabled
Logical Processor Idling	Disabled
AVX P1	Normal
Intel SST-BF	Disabled
Intel SST-CP	Disabled
x2APIC Mode	Enabled
AVX ICCP Pre-Grant License	Disabled
AVX ICCP Pre-Grant Level	128 Heavy
Number of Cores per Processor	All
Processor Core Speed	2.20 GHz
Processor Bus Speed	11.2 GT/s
Local Machine Check Exception	Disabled
Family-Model-Stepping	6-6A-6
Brand	Intel® Xeon® Gold 6338N CPU @ 2.20GHz
Level 2 Cache	32x1280 KB
Level 3 Cache	48 MB
Number of Cores	32
Maximum Memory Capacity	6 TB
Microcode	0xD000311

Family-Model-Stepping	6-6A-6
Brand	Intel® Xeon® Gold 6338N CPU @ 2.20GHz
Level 2 Cache	32x1280 KB
Level 3 Cache	48 MB
Number of Cores	32
Maximum Memory Capacity	6 TB
Microcode	0xD000311

Settings	Current Value
System Profile	Performance Per Watt (DAPC)
CPU Power Management	System DBPM (DAPC)
Memory Frequency	Maximum Performance
Turbo Boost	Enabled
C1E	Enabled
C States	Enabled
Memory Patrol Scrub	Standard
Memory Refresh Rate	1x
Uncore Frequency	Dynamic
Energy Efficient Policy	Balanced Performance
Monitor/Mwait	Enabled
Workload Profile	Not configured
CPU Interconnect Bus Link Power Management	Enabled
PCI ASPM L1 Link Power Management	Enabled
OS ACPI Cx	OS Cx C2
GPSS Timer	500 us
CPU C1 Auto Demotion	Disabled
CPU C1 Auto UnDemotion	Disabled
Workload Configuration	Balance
Dynamic L1	Disabled
Package C States	Enabled
Package C State Latency Negotiation	Disabled
Power and System Criteria for Package C State	Disabled

NOTES:

1. iDRAC = Integrated Dell Remote Access Controller.

3.0   WaitTime System Configuration

3.1   Video Stream Configuration

Component	Settings	Comments
Video Analytic Input video stream parameters	1920x1080@24fps (1080p)	High-resolution video stream
Number of input video streams for analytics (virtual cameras)	1-120 based on video resolution and FPS	Each virtual camera stream has high-resolution and low-resolution videos
Video analytic inference framerate per video channel	Variable based on the load	Each AI service is set to process the max amount
Number of active video analytics streams at maximum testing	120 max (refer to *Performance Test Results* for details)	Maximum Number of Streams where video analytics were applied

3.2   Video Analytics Algorithm Description and Parameters

Item	Vehicles Detection and Tracking – Intel® Xeon® Gold CPU
Description	OpenCV
Version	Opencv_videoio_ffmpeg451_64.dll, Opencv_videoio_ffmpeg452_64.dll
Date	09/2022

Figure 1. Enter/Exit (Occupancy Tracking) Algorithm
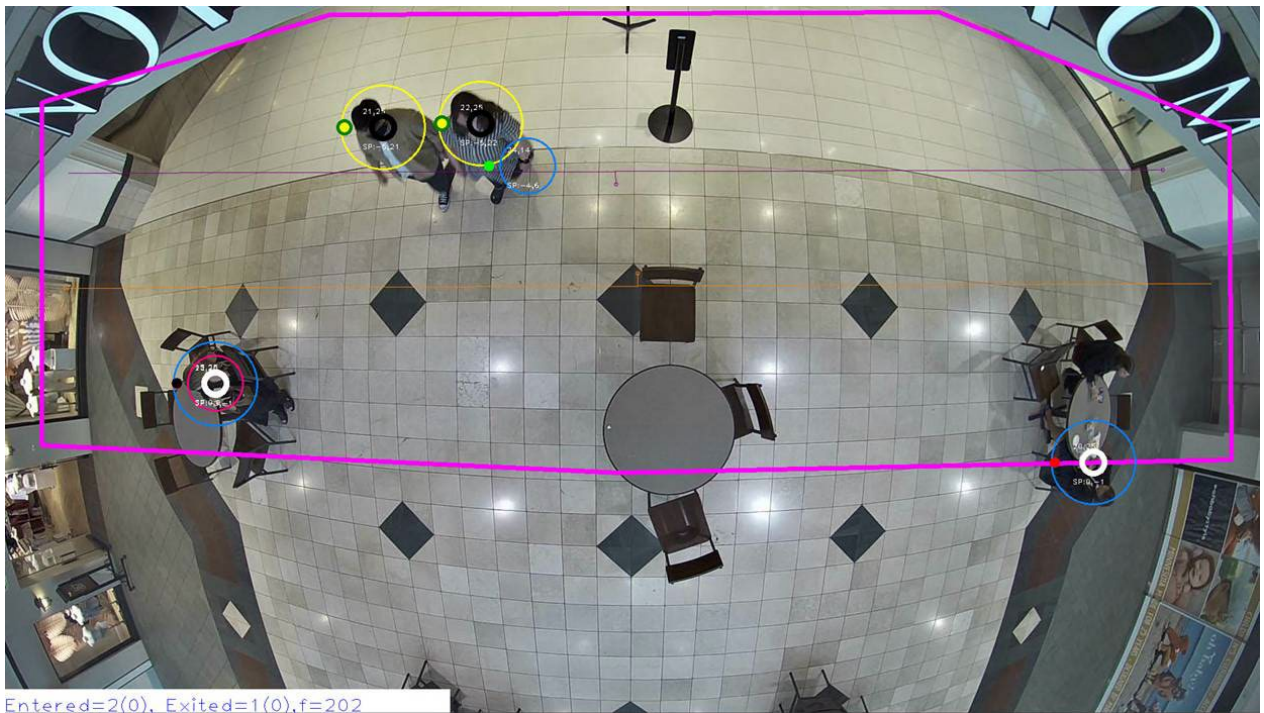
The *Enter/Exit (Occupancy Tracking)* algorithm was used for testing as it the most server resource-intensive algorithm compared to other WaitTime algorithms, namely *Stanchion, Queue*, and *Massing*.

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4.0 Profiling

4.1 Validation Steps

1. Deploy and Configure Dell Technologies* PowerEdge* R750 Server.

2. Install Windows 2019 Operating System and Analytics Platform with Testing Criteria.

   a. Set up maximum virtual video streams with specified video sources for high-resolution streams.

   b. Set up WaitTime video analytics to process the virtual video streams.

3. Utilize batch files to run analytics on video files.

4. Analyze results and report.

4.2 Checklist for Results Validation

i. WaitTime is utilizing the maximum amount of CPU without compromising the system accuracy.

ii. Processing frame rate is matching the expectations.

iii. CPU usage and Memory consumption values are consistent during the test.

iv. Increase analytics workload until frame loss occurs.

v. Test with recording enabled/disabled[1].

[1] See *Section 5.0 Performance Test Results* for results with and without recording.

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5.0 Performance Test Results

To measure system scalability, we sequentially increased the number of streams being processed in parallel while keeping records about hardware utilization and processing time for each stream.

Multiple versions of WTFA were tested:

- Section 5.1 **WTFA version 2.1.3900**

- Section 5.2 **WTFA version 2.3.597**

5.1 WTFA version 2.1.3900

5.1.1 1080p@24FPS

Streams	CPU Utilization (per stream)	CPU Utilization (overall)	Memory (per stream)
10	1.5% to 1.6%	17%	490MB to 500MB
20	1.7% to 2.8%	41%	490MB to 500MB
25	1.8% to 2.9%	61%	480MB to 510MB
28	2.0% to 3.2%	77%	480MB to 510MB
30[1]	2.5% to 3.4%	96%	480MB to 500MB (most streams at 500MB)

NOTES:
1. Increasing streams further will cause loss of frames.

5.1.2 1080P@24FPS with Recordings

Streams	CPU Utilization (per stream)	CPU Utilization (overall)	Memory (per stream)
22	2.5% to 3.5%	75%	500MB to 530MB Verified that 100% of frames were recorded

5.1.3 1080P@15FPS

Streams	CPU Utilization (per stream)	CPU Utilization (Overall)	Memory (per stream)
10	1.0% to 1.1%	11%	420MB to 450MB
20	1.0% to 1.1%	21%	420MB to 450MB
30	1.0% to 1.1%	34%	420MB to 450MB
40	1.1% to 1.6%	53%	420MB to 450MB
50[1]	1.7% to 2.0%	94%	420MB to 450MB

NOTES:
1. Increasing streams further will cause loss of frames.

5.1.4 1080P@15FPS with Recording

Streams	CPU Utilization (per stream)	CPU Utilization (Overall)	Memory (per stream)
35	1.6% to 1.8%	67%	440MB to 460MB
38	2.1% to 2.7%	93%	440MB to 460MB **Observation**: Sub Numa Cluster = 2-Way Clustering Verified that 100% of frames were recorded

5.1.5 1080P@10FPS

Streams	CPU Utilization (per stream)	CPU Utilization (Overall)	Memory (per stream)
10	0.6% to 0.8%	8%	420MB to 440MB
20	0.6% to 0.8%	14%	420MB to 450MB
30	0.6% to 0.8%	20%	420MB to 450MB
40	0.6% to 0.8%	28%	420MB to 450MB
50	0.6% to 0.8%	33%	420MB to 450MB
60	0.7% to 1.1%	52%	420MB to 450MB
70[1]	0.8% to 1.2%	74%	420MB to 450MB

NOTES:
1. Increasing will cause streams to start losing frames.

5.1.6 1080P@10FPS with Recording

Streams	CPU Utilization (per stream)	CPU Utilization (Overall)	Memory (per stream)
55	1.0% to 1.6%	74%	440MB to 460MB
60	1.3% to 1.8%	96%	440MB to 460MB **Observation**: Sub Numa Cluster = 2-Way Clustering Verified that 100% of frames recorded

5.1.7 720P@20FPS

Streams	CPU Utilization (per stream)	CPU Utilization (Overall)	Memory (per stream)
60	0.4% to 0.6% **Observation**: Reduced performance when increased to 70 streams, possible bandwidth issue	57%	200MB to 220MB **Observation**: Sub Numa Cluster = 2-Way Clustering

5.1.8 720P@15FPS

Streams	CPU Utilization (per stream)	CPU Utilization (Overall)	Memory (per stream)
90	0.5% to 0.9%	60%	190MB to 200MB **Observation**: Sub Numa Cluster = 2-Way Clustering

5.1.9 720P@10FPS

Streams	CPU Utilization (per stream)	CPU Utilization (Overall)	Memory (per stream)
120	0.7% to 1.1%	55%	190MB to 200MB **Observation**: Sub Numa Cluster = 2-Way Clustering

5.2   WTFA version 2.3.597

5.2.1   1080p@24FPS

Streams	CPU Utilization (per stream)	CPU Utilization (overall)	Memory (per stream)
10	1.6% to 1.8%	18%	490MB to 510MB
20	1.6% to 2.8%	46%	490MB to 500MB
25[1]	1.7% to 3.2%	71%	480MB to 510MB

NOTES:
1.   Increasing will cause streams to start losing frames.

5.2.2   1080p@15FPS

Streams	CPU Utilization (per stream)	CPU Utilization (overall)	Memory (per stream)
10	1.0% to 1.1%	11%	420MB to 450MB
20	1.0% to 1.1%	23%	420MB to 450MB
30	1.2% to 1.5%	41%	420MB to 450MB
40	1.4% to 2.1%	70%	420MB to 450MB
43[1]	1.4% to 2.8%	91%	420MB to 450MB

NOTES:
1.   Increasing will cause streams to start losing frames.

5.2.3   1080p@10FPS

Streams	CPU Utilization (per stream)	CPU Utilization (overall)	Memory (per stream)
10	0.6% to 0.8%	8%	420MB to 440MB
20	0.6% to 0.8%	14%	420MB to 450MB
30	0.6% to 0.8%	22%	420MB to 450MB
40	0.6% to 0.8%	30%	420MB to 450MB
50	0.6% to 0.8%	42	420MB to 450MB
60	0.7% to 1.1%	63	420MB to 450MB
65[1]	1.0% to 1.5%	82%	420MB to 450MB

NOTES:
1.   Increasing will cause streams to start losing frames.

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6.0   Conclusion

Based on the analysis in this report, we can define the specifications required per stream/camera to be deployed using the Dell Technologies PowerEdge R750 with the dual socket Intel® Xeon® Gold 6338N CPU.

Testing confirms that Xeon SP 3rd Generation has allowed a 60% increase in overall performance.

We have also determined proper minimum sizing guidelines for multiple versions of WaitTime using video streams parameters consistent with production requirements.

Please consult with your WaitTime and Dell technical sales representative for final sizing recommendations.

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