



Megh VAS Performance and Validation Report on Intel® NUC Kit

Report

September 2023



You may not use or facilitate the use of this document in connection with any infringement or other legal analysis concerning Intel products described herein. You agree to grant Intel a non-exclusive, royalty-free license to any patent claim thereafter drafted which includes subject matter disclosed herein.

No license (express or implied, by estoppel or otherwise) to any intellectual property rights is granted by this document.

All information provided here is subject to change without notice. Contact your Intel representative to obtain the latest Intel product specifications and roadmaps.

The products described may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

Copies of documents which have an order number and are referenced in this document may be obtained by calling 1-800-548-4725 or visit www.intel.com/design/literature.htm.

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. No product or component can be absolutely secure. Check with your system manufacturer or retailer or learn more at intel.com.

Performance varies by use, configuration and other factors. Learn more at www.Intel.com/PerformanceIndex.

Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See backup for configuration details. No product or component can be absolutely secure.

Your costs and results may vary.

Intel technologies may require enabled hardware, software or service activation.

Intel® Turbo Boost Technology requires a PC with a processor with Intel Turbo Boost Technology capability. Intel Turbo Boost Technology performance varies depending on hardware, software and overall system configuration. Check with your PC manufacturer on whether your system delivers Intel Turbo Boost Technology. For more information, see <http://www.intel.com/technology/turboboost>

Intel, the Intel logo, OpenVINO and the OpenVINO logo are trademarks of Intel Corporation or its subsidiaries in the U.S. and/or other countries.

*Other names and brands may be claimed as the property of others.

© Intel Corporation

Contents

| | | |
|------------|---|-----------|
| 1.0 | Overview | 6 |
| 1.1 | Objective | 6 |
| 1.2 | Megh VAS Architecture..... | 6 |
| 2.0 | System Configuration | 8 |
| 2.1 | Video Stream Configuration..... | 8 |
| 2.2 | Video Analytics Algorithm Description and Parameters..... | 9 |
| 3.0 | Profiling..... | 10 |
| 3.1 | Validation Steps..... | 10 |
| 3.2 | Checklist for Results Validation | 10 |
| 4.0 | Performance Test Results | 11 |
| 4.1 | Analysis..... | 11 |
| 4.2 | Practical Maximum FPS | 11 |
| 4.3 | Max FPS on CPU..... | 11 |
| 4.4 | Max FPS on iGPU | 12 |
| 4.5 | CPU and Memory Utilization 1080p - CPU Pipeline | 12 |
| 4.5.1 | Intel® Core™ i9-11900KB | 12 |
| 4.5.2 | Intel® Core™ i7-1260P..... | 13 |
| 4.5.3 | Intel® Core™ i5-1135G7..... | 13 |
| 4.5.4 | Intel® Core™ i3-1115G4..... | 13 |
| 4.6 | CPU and Memory Utilization 1080p - iGPU Pipeline..... | 14 |
| 4.6.1 | Intel® Core™ i9-11900KB | 14 |
| 4.6.2 | Intel® Core™ i7-1260P..... | 15 |
| 4.6.3 | Intel® Core™ i5-1135G7 | 15 |
| 4.6.4 | Intel® Core™ i3-1115G4..... | 15 |
| 4.7 | CPU and Memory Utilization 720p - CPU Pipeline..... | 16 |
| 4.7.1 | Intel® Core™ i9-11900KB | 16 |
| 4.7.2 | Intel® Core™ i7-1260P..... | 17 |
| 4.7.3 | Intel® Core™ i5-1135G7 | 17 |
| 4.7.4 | Intel® Core™ i3-1115G4..... | 17 |
| 4.8 | CPU and Memory Utilization 720p - iGPU Pipeline..... | 18 |
| 4.8.1 | Intel® Core™ i9-11900KB | 18 |
| 4.8.2 | Intel® Core™ i7-1260P..... | 18 |
| 4.8.3 | Intel® Core™ i5-1135G7 | 19 |
| 4.8.4 | Intel® Core™ i3-1115G4..... | 19 |
| 4.9 | CPU and Memory Utilization 480p - CPU Pipeline..... | 20 |
| 4.9.1 | Intel® Core™ i9-11900KB | 20 |
| 4.9.2 | Intel® Core™ i7-1260P..... | 21 |
| 4.9.3 | Intel® Core™ i5-1135G7 | 21 |
| 4.9.4 | Intel® Core™ i3-1115G4..... | 21 |



| | | |
|--------|--|-----------|
| 4.10 | CPU and Memory Utilization 480p - iGPU Pipeline..... | 22 |
| 4.10.1 | Intel® Core™ i9-11900KB..... | 22 |
| 4.10.2 | Intel® Core™ i7-1260P..... | 22 |
| 4.10.3 | Intel® Core™ i5-1135G7..... | 23 |
| 4.10.4 | Intel® Core™ i3-1115G4..... | 23 |
| 5.0 | Conclusion..... | 24 |

Figures

| | | |
|-----------|---|---|
| Figure 1. | Megh Open Analytics Platform..... | 7 |
| Figure 2. | Accuracy level of various models on Megh VAS..... | 9 |

Tables

| | | |
|----------|---------------------------|---|
| Table 1. | System Configuration..... | 8 |
|----------|---------------------------|---|

Revision History

| Date | Revision | Description |
|----------------|----------|--|
| September 2023 | 1.1 | Added content to Section 5.0 Conclusion. |
| August 2023 | 1.0 | Initial release. |

1.0 Overview

This document provides an overview and performance results for validation of a Megh Video Analytics Solution by Megh Computing running on Intel® NUC Kits with 11th or 12th Generation Intel® Core™ Processors.

Video Analytics can be performed either on CPU, or on the integrated GPU. The focus of this report will be running the video analytics on the CPU as well as iGPU as the accelerator.

Configuration for multi-stream in-process analytics (no video stored) includes a pipeline process of video decode, video analytics via AI model with video analytics metadata creation, and injection of metadata.

1.1 Objective

The objective of the validation process is to:

- i. Validate and size the system configuration for concurrent multi-stream video analytics.
- ii. Confirm CPU/RAM usage at maximum video analytics channel density.
- iii. For Video analytics, channels are added till total output frames continue to be above 90% of input frames**.
- 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 and memory load: average and standard deviation. Sampling at a cadence of every 5-secs.
 - Video analytic inference, performance in frames per second.

** To maintain the integrity of the analytics, we recommend maintaining an efficiency of 90% and higher to prevent skipping frames or ignoring potential events.

1.2 Megh VAS Architecture

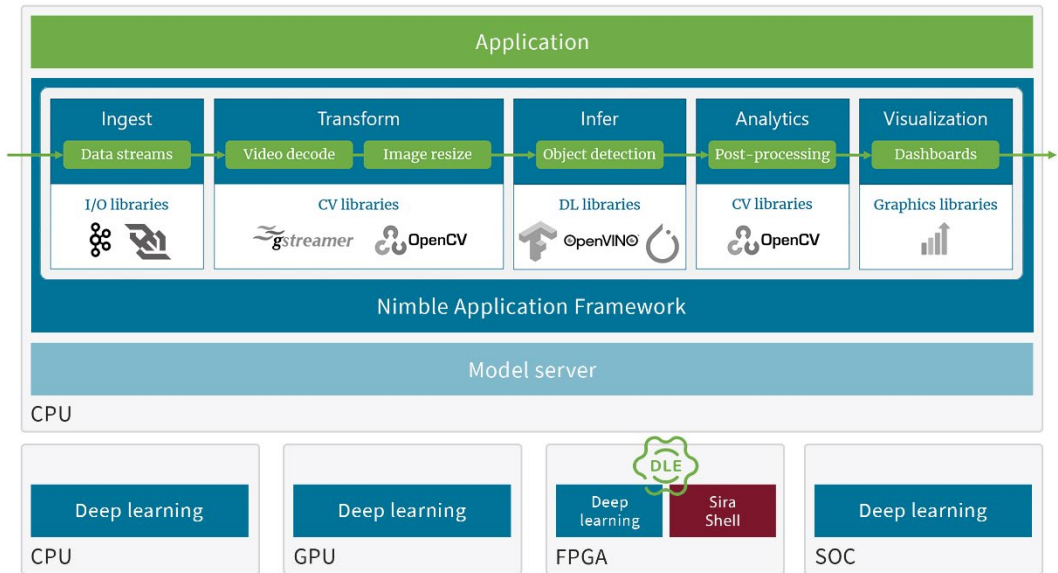
The Megh VAS platform is designed as a distributed microservice architecture. This system supports pipelines on CPU/iGPU/GPU/FPGA/ASIC and a pipeline constitutes a video source, AI, video retention, and analytics dashboards.

For the purpose of this report, we'll focus on the pipelines deployed on a CPU and iGPU.

The video is generated by the camera, in this case we are using a camera emulator that generates a H.264 stream based on a video file.

The video is ingested by the GStreamer service using a camera reader.

Figure 1. Megh Open Analytics Platform



2.0 System Configuration

Table 1. System Configuration

| Components | Intel® NUC Mini PCs | | | |
|------------------|----------------------------------|-------|---------------------------|---------|
| Hardware | | | | |
| Model | Processor | RAM | LAN | Storage |
| NUC11BTMi9 | Intel® Core™ i9-11900KB | 32 GB | I225-LM, Wi-Fi 6 AX210 | 512 GB |
| NUC11TNKi3 | Intel® Core™ i3-1115G4 | 16 GB | I225-LM, Wi-Fi 6 AX201 | 250 GB |
| NUC11TNHi5 | Intel® Core™ i5-1135G7 | 16 GB | I225-LM, Wi-Fi 6 AX201 | 500 GB |
| NUC12WSHi7 | Intel® Core™ i7-1260P | 16 GB | I225-V, Alder Lake -P | 500 GB |
| Software | | | | |
| Operating System | Ubuntu 22.04 LTS | | | |
| Kernel | 5.15.0-60-generic | | | |
| Firmware | 20220329.git681281e4-0ubuntu3.10 | | | |
| Megh VAS | Release 0.16.1 | | | |

2.1 Video Stream Configuration

| Component | Settings | Comments |
|---|--|--|
| Video Analytic Input Video Stream Parameters | 1920x1080@25fps (1080p) 1280x720@25fps (720p) 640x480@25fps (480p) | FHD, HD, and SD video streams |
| Number of Input Video Streams for Analytics (Virtual cameras) | 1-n | Each virtual camera stream has high-resolution and low-resolution videos |

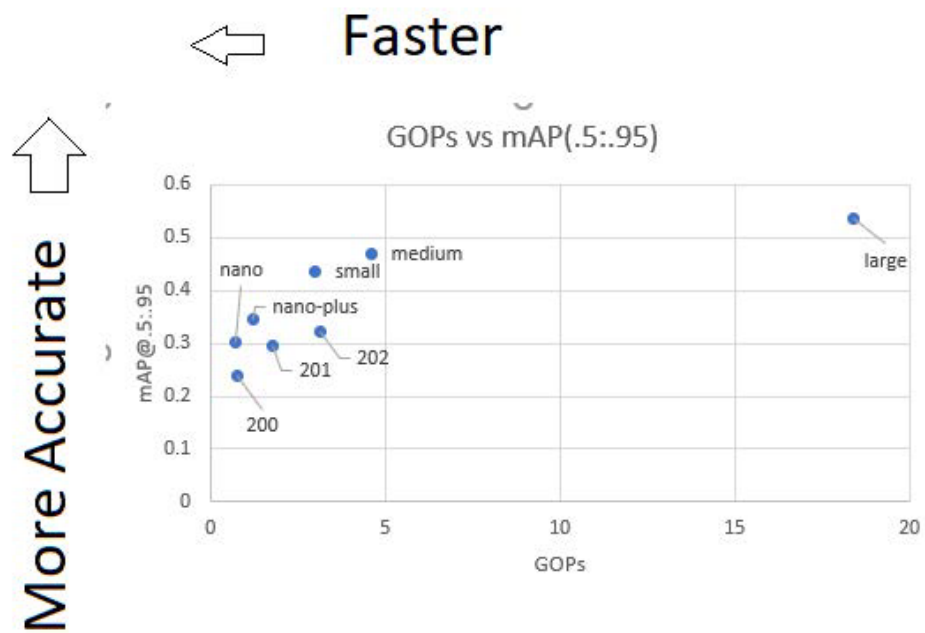
2.2 Video Analytics Algorithm Description and Parameters

| Item | Person Detection |
|----------------------------|--------------------------------------|
| Description | Video ingestion and person detection |
| Detection CNN Architecture | yolov5n6-640 |
| Service Name | Megh Nimble Interference Engine |
| Version | 0.16.1 |
| Date | February 2022 |

The model used in the person detection is the second-best model in terms of accuracy.

In this performance test we are using the medium model. The figure below shows the accuracy level of various models available on the Megh VAS platform.

Figure 2. Accuracy level of various models on Megh VAS



3.0 Profiling

3.1 Validation Steps

1. Deploy and Configure Intel® NUC 11 Kit with 11th Generation Intel® Core™ Processors as server.
2. Install Ubuntu* 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 Megh VAS video analytics to process the virtual video streams.
3. Run the profiler tools to record hardware usage and other metrics over a given period of time.
4. Process results to generate tabulated data using multiple readings.
5. Analyze results and report.

3.2 Checklist for Results Validation

- i. Megh VAS is utilizing the optimum amount of CPU/iGPU without compromising the system accuracy.
- ii. Processing frame rate is matching the expectations (>90% of input).
- iii. CPU usage and Memory consumption values are consistent during the test.

§

4.0 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 frame output for each stream.

4.1 Analysis

The total memory used by the system grows almost linearly based on the number of streams. Certain services are shared among all AI services, which explains why the growth is not fully linear. In the case of a single stream, the memory usage increment produced by a single AI service is insignificant compared to the idle system.

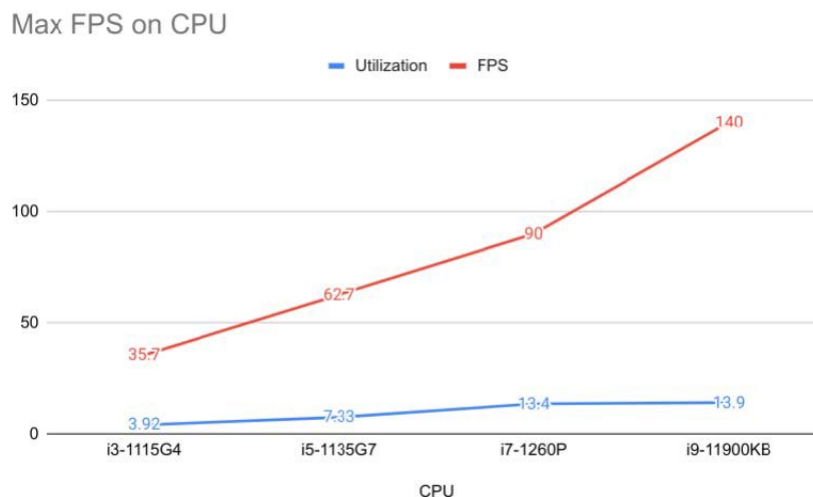
The memory utilization per stream is almost constant and the small variations are due to the dynamic memory allocation as the system processes the streams.

The increment in the CPU is almost linear.

4.2 Practical Maximum FPS

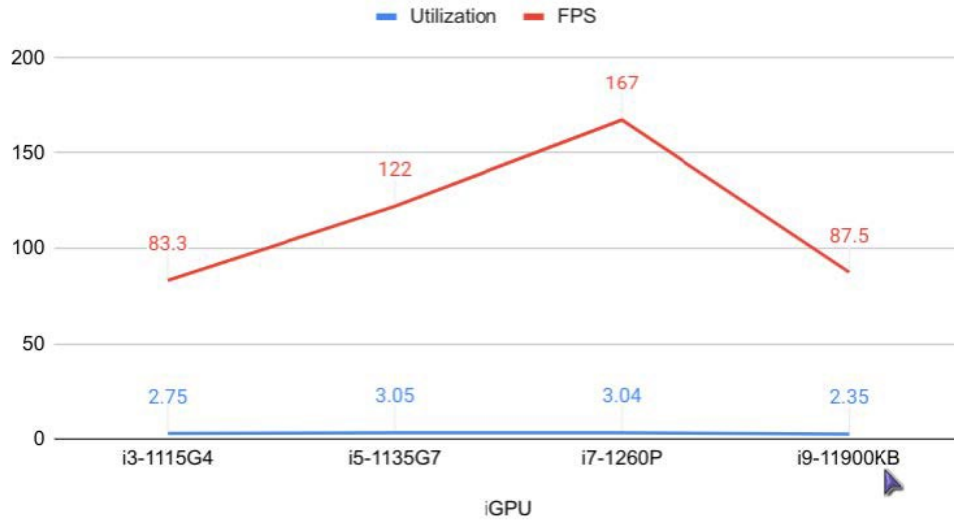
For establishing the maximum FPS throughput possible on the system with the model we can push a random 2D array of 640x480 integers and measure the CPU utilization and FPS output. In this configuration the pipeline does not perform any analytics, thus we can assume that further steps in the pipeline can be at best equal or will be less than this practical FPS limit, for video input of 640x480 or greater.

4.3 Max FPS on CPU



4.4 Max FPS on iGPU

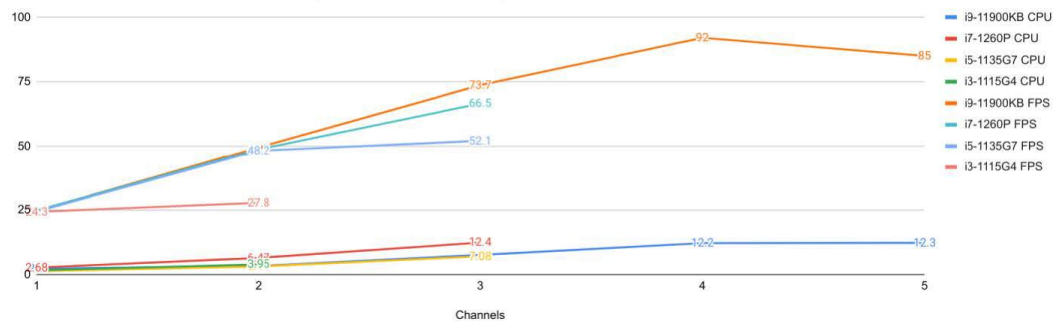
Max FPS on iGPU



Observation: The lower FPS of the iGPU on the Intel® Core™ i9-11900KB processor compared to the Intel® Core™ i5 and Intel® Core™ i7 processors was caused by the lower number of execution units in the CPU package (of the Intel® Core™ i9 processor).

4.5 CPU and Memory Utilization 1080p - CPU Pipeline

i3-1115G4 vs i5-1135G7 vs i7-1260p vs i9-11900KB 1080p 25 FPS on CPU



4.5.1 Intel® Core™ i9-11900KB

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|--------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 2.3 | 816 MB | 25 | 24.7 |



| | | | | |
|---|------|---------|-----|------|
| 2 | 3.34 | 980 MB | 50 | 49.4 |
| 3 | 7.64 | 1.34 GB | 75 | 73.7 |
| 4 | 12.2 | 2.12 GB | 100 | 92 |
| 5 | 12.3 | 2.36 GB | 125 | 85 |

4.5.2 Intel® Core™ i7-1260P

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 2.68 | 706 MB | 25 | 24.8 |
| 2 | 6.47 | 1.00 GB | 50 | 48.7 |
| 3 | 12.4 | 1.95 GB | 75 | 66.5 |

4.5.3 Intel® Core™ i5-1135G7

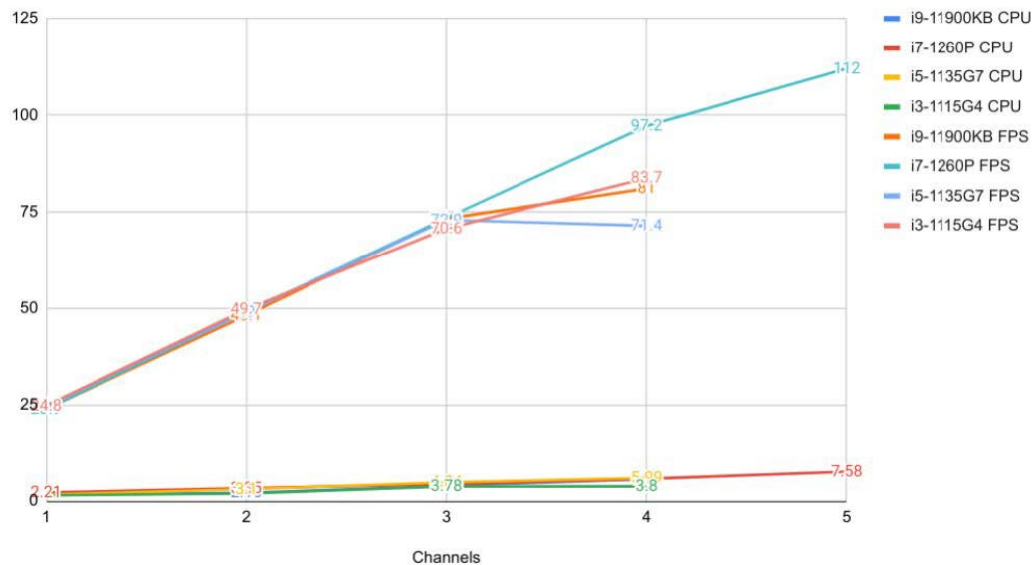
| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.45 | 824 MB | 25 | 24.7 |
| 2 | 6.51 | 1.59 GB | 50 | 48.3 |
| 3 | 7.31 | 2.23 GB | 75 | 42.9 |

4.5.4 Intel® Core™ i3-1115G4

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.67 | 767 MB | 25 | 24.3 |
| 2 | 3.95 | 1.95 GB | 50 | 27.8 |

4.6 CPU and Memory Utilization 1080p - iGPU Pipeline

i3-1115G4 vs i5-1135G7 vs i7-1260p vs i9-11900KB 1080p 25 FPS on iGPU



4.6.1 Intel® Core™ i9-11900KB

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.58 | 1.12 GB | 25 | 23.9 |
| 2 | 2.15 | 1.42 GB | 50 | 48.1 |
| 3 | 3.94 | 1.67 GB | 75 | 73.2 |
| 4 | 5.64 | 2.51 GB | 100 | 81 |

4.6.2 Intel® Core™ i7-1260P

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 2.21 | 1.02 GB | 25 | 23.9 |
| 2 | 3.35 | 1.38 GB | 50 | 49.0 |
| 3 | 4.37 | 1.41 GB | 75 | 73.4 |
| 4 | 5.74 | 1.65 GB | 100 | 97.2 |
| 5 | 7.58 | 2.43 GB | 125 | 112 |

4.6.3 Intel® Core™ i5-1135G7

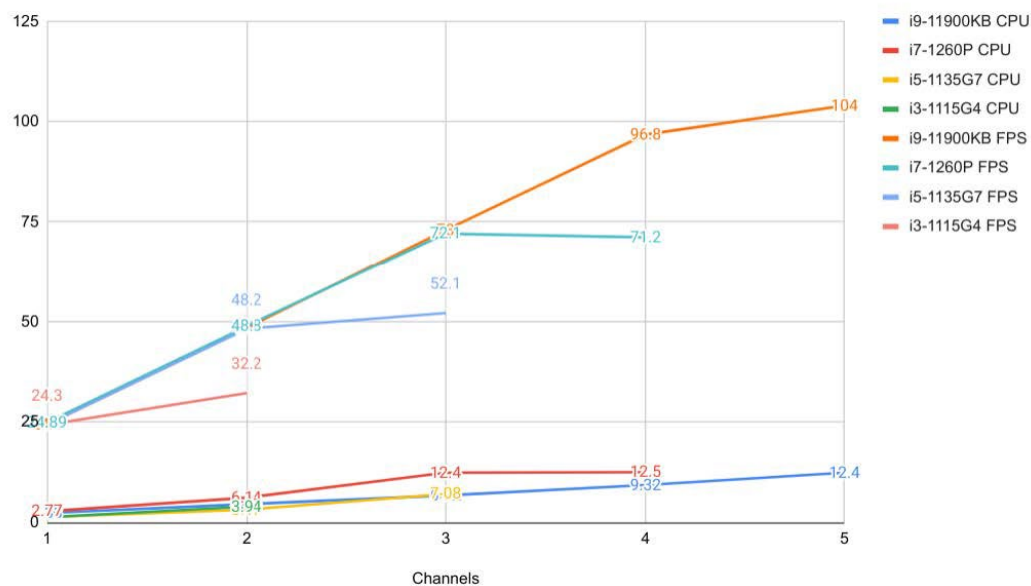
| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.66 | 914 MB | 25 | 24.8 |
| 2 | 3.10 | 1.18 GB | 50 | 49 |
| 3 | 4.84 | 1.75 GB | 75 | 72.9 |
| 4 | 5.99 | 2.27 GB | 100 | 71.4 |

4.6.4 Intel® Core™ i3-1115G4

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.48 | 915 MB | 25 | 24.8 |
| 2 | 1.95 | 1.21 GB | 50 | 49.7 |
| 3 | 3.78 | 1.87 GB | 75 | 70.6 |
| 4 | 3.80 | 2.49 GB | 100 | 83.7 |

4.7 CPU and Memory Utilization 720p - CPU Pipeline

i3-1115G4 vs i5-1135G7 vs i7-1260p vs i9-11900KB CPU 720p 25 FPS on CPU



4.7.1 Intel® Core™ i9-11900KB

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 2.33 | 539 MB | 25 | 24.4 |
| 2 | 4.55 | 743 MB | 50 | 48.3 |
| 3 | 6.72 | 882 MB | 75 | 73 |
| 4 | 9.32 | 1.01 GB | 100 | 96.8 |
| 5 | 12.4 | 1.36 GB | 125 | 104 |



4.7.2 Intel® Core™ i7-1260P

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 2.77 | 548 MB | 25 | 24.89 |
| 2 | 6.14 | 693 MB | 50 | 48.8 |
| 3 | 12.4 | 1.07 GB | 75 | 72.1 |
| 4 | 12.5 | 1.18 GB | 100 | 71.2 |

4.7.3 Intel® Core™ i5-1135G7

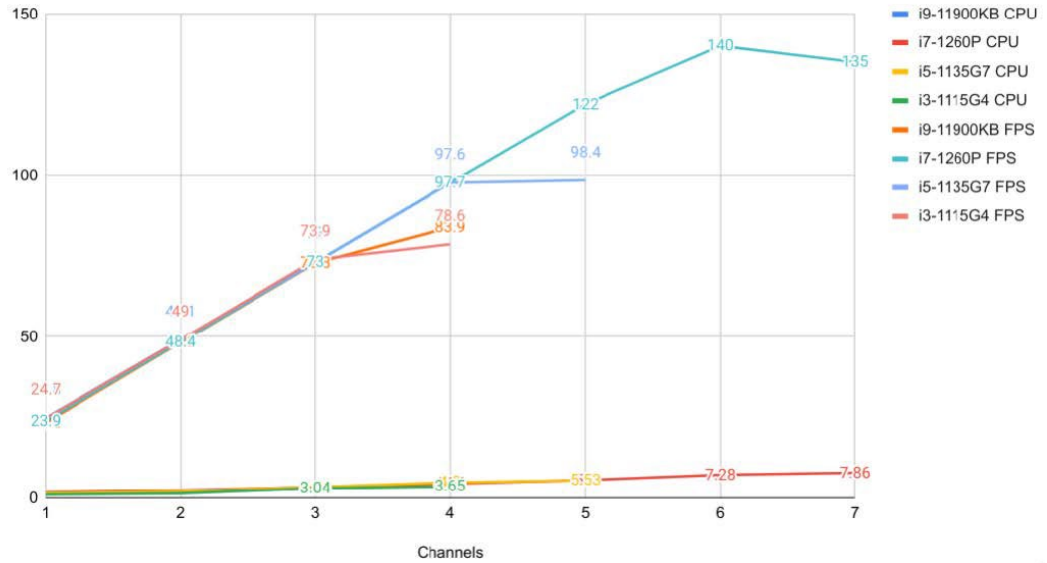
| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.30 | 615 MB | 25 | 24.4 |
| 2 | 3.17 | 744 MB | 50 | 48.2 |
| 3 | 7.08 | 1.26 GB | 75 | 52.1 |

4.7.4 Intel® Core™ i3-1115G4

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.29 | 618 MB | 25 | 24.3 |
| 2 | 3.94 | 1.07 GB | 50 | 32.2 |

4.8 CPU and Memory Utilization 720p - iGPU Pipeline

i3-1115G4 vs i5-1135G7 vs i7-1260P vs i9-11900KB 720p 25 FPS on iGPU



4.8.1 Intel® Core™ i9-11900KB

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.37 | 825 MB | 25 | 23.3 |
| 2 | 1.93 | 970 MB | 50 | 48.2 |
| 3 | 2.85 | 1.08 GB | 75 | 72.8 |
| 4 | 4.56 | 1.49 GB | 100 | 83.9 |

4.8.2 Intel® Core™ i7-1260P

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|--------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.76 | 833 MB | 25 | 23.9 |



| | | | | |
|---|------|---------|-----|------|
| 2 | 2.41 | 999 MB | 50 | 48.4 |
| 3 | 3.43 | 1.07 GB | 75 | 73 |
| 4 | 4.53 | 1.14 GB | 100 | 97.7 |
| 5 | 5.60 | 1.24 GB | 125 | 122 |
| 6 | 7.28 | 1.50 GB | 150 | 140 |
| 7 | 7.86 | 1.66 GB | 175 | 135 |

4.8.3 Intel® Core™ i5-1135G7

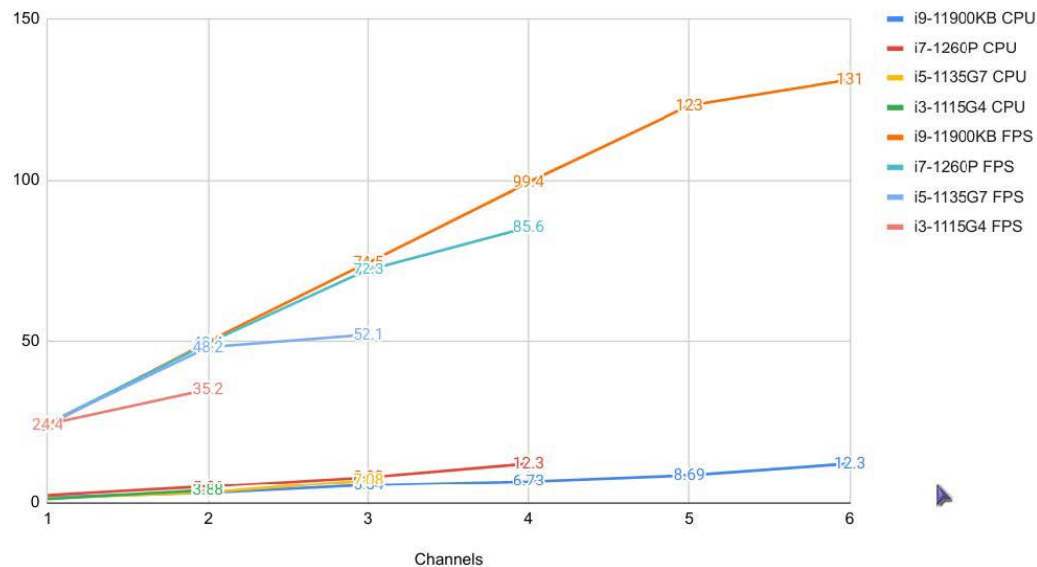
| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.50 | 679 MB | 25 | 24.8 |
| 2 | 2.05 | 887 MB | 50 | 49.1 |
| 3 | 3.46 | 1.07 GB | 75 | 73 |
| 4 | 4.90 | 1.34 GB | 100 | 97.6 |
| 5 | 5.53 | 1.46 GB | 125 | 98.4 |

4.8.4 Intel® Core™ i3-1115G4

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.05 | 713 MB | 25 | 24.7 |
| 2 | 1.39 | 831 MB | 50 | 49.0 |
| 3 | 3.04 | 1.05 GB | 75 | 73.9 |
| 4 | 3.65 | 1.31 GB | 100 | 78.6 |

4.9 CPU and Memory Utilization 480p - CPU Pipeline

i3-1115G4 vs i5-1135G7 vs i7-1260p vs i9-11900KB 480p 25 FPS on CPU



4.9.1 Intel® Core™ i9-11900KB

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|--------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.65 | 485 MB | 25 | 24 |
| 2 | 3.01 | 581 MB | 50 | 49.8 |
| 3 | 5.54 | 544 MB | 75 | 74.5 |
| 4 | 6.73 | 585 MB | 100 | 99.4 |
| 5 | 8.69 | 603 MB | 125 | 123 |
| 6 | 12.3 | 742 MB | 150 | 131 |



4.9.2 Intel® Core™ i7-1260P

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|--------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 2.29 | 432 MB | 25 | 24.5 |
| 2 | 5.06 | 467 MB | 50 | 49.4 |
| 3 | 8.02 | 532 MB | 75 | 72.3 |
| 4 | 12.3 | 645 MB | 100 | 85.6 |

4.9.3 Intel® Core™ i5-1135G7

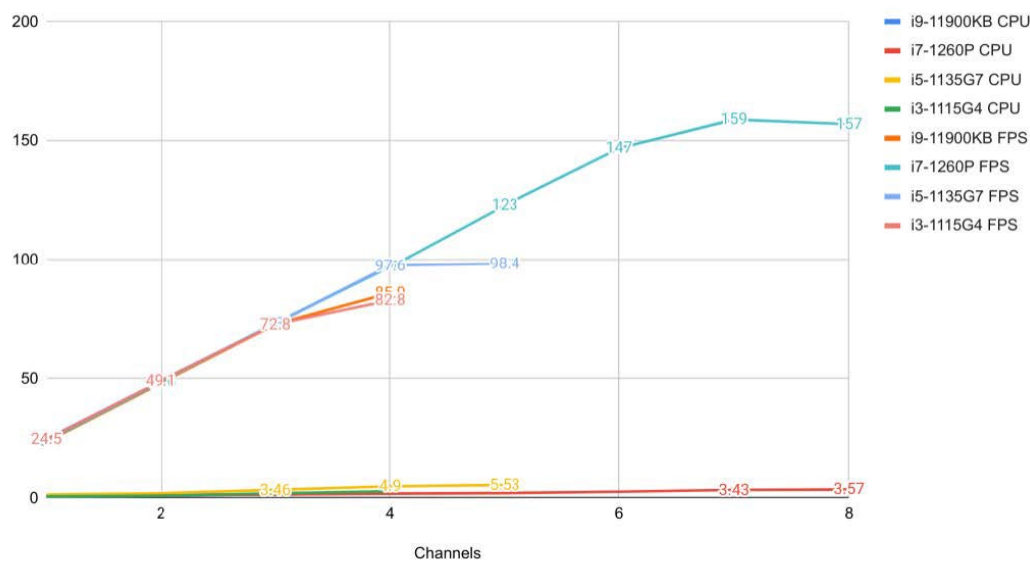
| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.30 | 615 MB | 25 | 24.4 |
| 2 | 3.17 | 744 MB | 50 | 48.2 |
| 3 | 7.08 | 1.26 GB | 75 | 52.1 |

4.9.4 Intel® Core™ i3-1115G4

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|--------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.07 | 475 MB | 25 | 24.4 |
| 2 | 3.88 | 627 MB | 50 | 35.2 |

4.10 CPU and Memory Utilization 480p - iGPU Pipeline

i3-1115G4 vs i5-1135G7 vs i7-1260p vs i9-11900KB 480p 25 FPS on iGPU



4.10.1 Intel® Core™ i9-11900KB

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|-------|--------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 0.614 | 721 MB | 25 | 23.5 |
| 2 | 0.969 | 751 MB | 50 | 48.1 |
| 3 | 1.62 | 824 MB | 75 | 72.8 |
| 4 | 2.43 | 917 MB | 100 | 85.9 |

4.10.2 Intel® Core™ i7-1260P

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|-------|--------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 0.721 | 650 MB | 25 | 23.9 |
| 2 | 1.23 | 722 MB | 50 | 48.6 |



| | | | | |
|---|------|---------|-----|------|
| 3 | 1.54 | 748 MB | 75 | 73.3 |
| 4 | 1.86 | 774 MB | 100 | 97 |
| 5 | 2.08 | 813 MB | 125 | 123 |
| 6 | 2.65 | 887 MB | 150 | 147 |
| 7 | 3.43 | 934 MB | 175 | 159 |
| 8 | 3.57 | 1.01 GB | 200 | 157 |

4.10.3 Intel® Core™ i5-1135G7

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|------|---------|-----------|------------|
| Idle | - | - | - | - |
| 1 | 1.50 | 679 MB | 25 | 24.8 |
| 2 | 2.05 | 887 MB | 50 | 49.1 |
| 3 | 3.46 | 1.07 GB | 75 | 73 |
| 4 | 4.9 | 1.34 GB | 100 | 97.6 |
| 5 | 5.53 | 1.46 GB | 125 | 98.4 |

4.10.4 Intel® Core™ i3-1115G4

| Number of Streams | vCPU | RAM | Input FPS | Output FPS |
|-------------------|-------|-----|-----------|------------|
| Idle | - | - | - | - |
| 1 | 0.708 | 557 | 25 | 24.5 |
| 2 | 0.951 | 590 | 50 | 49.1 |
| 3 | 2.05 | 625 | 75 | 72.8 |
| 4 | 2.85 | 786 | 100 | 82.8 |

5.0 Conclusion

This report validates Megh Computing's VAS solution running on Intel® NUC Kits with 11th or 12th Generation Intel® Core™ processors. The Intel® NUC Kits are a cost-effective, small-form factor hardware that provides customers with the performance, power, and the accuracy they need to run Megh VAS at the edge. Intel and Megh Computing have validated that the Megh VAS solution enables customer to leverage Intel® NUC Kits to scale the solutions with long term stability.

The total number of streams supported by a system will depend on the camera's resolution (e.g., FHD 1080p or HD 720p) and frame rate in terms of Frames Per Second (e.g., 30 FPS or lower) of the video stream. The resolution and frame rate required for a solution will depend on the use cases deployed. Most physical security use cases like intrusion detection and loiter detection only require 720p resolution at 5 FPS. Other use cases like license plate recognition may require higher resolutions and frame rates.

We demonstrated that by utilizing both the CPU and iGPU simultaneously to analyze video streams, we can scale the solution by varying the resolution and frame rate of the camera streams. Megh VAS supports down sampling of video stream FPS at the inference engine, which allows for more streams to be analyzed on a system by configuring the video stream to a lower FPS than the original stream, for instance a 25 or 30 FPS input stream can be configured to process at 5 FPS after decoding of the video streams. Also, independent of the input resolution, the images are resized to 640x480 pixels before they are analyzed by the inference engine to detect objects. Thus, the change in resolution from 1080p to 720p has less impact on the throughput compared to reducing the frame rate to 5 or 10 FPS. By managing both the resolution and frame rate in the processing pipeline, Megh's VAS is able to deliver very high throughput on the Intel® NUC Kits.

Summary of key results:

- The max FPS using CPUs only (Section 4.3) to implement the complete video analytics pipeline scales linearly with number of cores from 35 FPS on an Intel® Core™ i3 processor to 140/150 FPS on an Intel® Core™ i9 processor while the overall CPU utilization remains low.
- The max FPS using iGPU (Section 4.4) to implement the inferencing while using the CPU to decode the video streams and perform analytics after the detection scales linearly from 83 FPS on an Intel® Core™ i3 processor to 167 on an Intel® Core™ i7 processor but drops to 87 FPS for the Intel® Core™ i9 processor because of the fewer number of iGPU execution units available on an Intel® Core™ i9 processor. The CPU utilization remains low in this configuration also.

Conclusion



- Performance on an Intel® NUC 12 Pro Kit NUC12WSHi7 with an Intel® Core™ i7-1260P processor, the CPU only (Section 4.5.2) throughput for example is 66.5 FPS and the iGPU only (Section 4.6.2) throughput is 112.0 FPS which translates to a maximum of 13 streams and 22 streams respectively at 5 FPS. By utilizing both the CPU and iGPU, up to 35 video streams can be analyzed with the Megh VAS solution on the NUC12WSHi7 kit.

In summary, we have defined the specifications required for the CPU and iGPU hardware to be deployed for scaling the Megh Video Analytics Solution (VAS) running on Intel® NUC Kits with 11th or 12th Generation Intel® Core™ processors.