Hyper Historian v10.85 Performance

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Contents

1. About This Document

1.1. Copyright and Confidentiality

1.2. Introduction

Companies today are faced with the need to perform better and to be more competitive with fewer resources. For plant-level operations, today's systems need to connect to different infrastructures for data gathering and users need to analyze and visualize data in real time. Access to plant data is fundamental to staying competitive and efficient. The demand to produce products faster or streamline operations is increasing across the globe. ICONICS' Hyper Historian™ enterprise-wide plant historian allows you to gain that competitive advantage, by organizing all your real-time information from across the enterprise.

1.3. Name, Version and Author

Document Id	Hyper Historian v10.85 Performance.docx		
Document Title	Hyper Historian v10.85 Performance		
Document Revision	A		
Authors	*Petr Votava*	**Function**	QA Manager
Issue date	17th September 2014		

1.4. List of Changes

Document Version	Application Version	Paragraph Modified	Description	Change Category
A	10.85	- New document	First revision – 09/17/2014	MAJOR
A	10.87	- Add new test results for 3.1.3, 3.2.4, 3.4.4 and 3.5.4 - Add new tests 3.8	11/5/2015	

1.5. Reference Documents

Document Title	Description
HH 10.8 performance tests.xlsx	Raw tabular data used to create charts in this document

1.6. Overview

This document provides the results of Hyper Historian performance tests. This includes the Standard edition (Collector running In-Process) and Enterprise edition (Collector running Out-Process). Performance tests were done for raw data, and also for the Performance Calculations and Merged Tags (Hyper to Hyper).

The following parameters were monitored:

- Hyper Historian Logger CPU usage
- Hyper Historian Logger Memory usage
- Hyper Historian disk space usage
- Hyper Historian Collector CPU usage
- Hyper Historian Collector Memory usage
- FrameWorX Server CPU usage
- FrameWorX Server Memory
- Unified Data Manager64 CPU usage
- Unified Data Manager64 Memory usage

2. Test Setup

2.1 Hardware

These computers were used for the tests:

- PC1 - Intel® Core™ 2 Quad Q6600 2.4 GHz, 8 GB RAM, Windows 7 x64 SP1
- PC2 - AMD® Athlon™ 64 x2 Dual Core 4600+ 2.4 GHz, 8 GB RAM, Windows 7 x64 SP1
- PC3 - Intel® Core™ i7 950 3.07 GHz, 8 GB RAM, Windows 8 x64
- PC4 - Intel® Core™ i7 950 3.07 GHz (Multi-thread), 16 GB RAM, Windows 8 x64
- PC5 - Intel® Core™ i7 950 3.07 GHz (Multi-thread), 16 GB RAM, Windows 8.1 x64
- PC6 - Intel® Core™ i7 950 3.07 GHz (Multi-thread), 16 GB RAM, Windows 8.1 x64, SSD
- PC7 - AMD® Phenom™ 9850 Quad Core 2.81 GHz, 8 GB RAM, Windows 8.1 x64
- PC8 - AMD® Athlon™ 64 x2 Dual Core 5200+ 2.89 GHz, 6 GB RAM, Windows 8 x64
- PC9 - Intel® Core™ i7 950 3.07 GHz, 8 GB RAM, Windows 8.1 x64
- PC10 - Intel® Core™ i7 950 3.07 GHz, 8 GB RAM, Windows 8.1 x64
- PC11 - Intel® Core™ 2 Duo 2 x 2 GHz, 4 GB RAM, Windows 8.1 x64
- PC12 - Intel® Xeon™ E3-1245 v3 3.4 GHz, 32 GB RAM, Windows Server 2012 R2
- VM1 - Intel® Core™ i7 2600 3.40 GHz, 4 GB RAM, Windows 7 x64 SP1 hosted on Hyper-V server
- VM2 - Intel® Core™ i7 2600 3.40 GHz, 4 GB RAM, Windows 8.1 x64 hosted on Hyper-V server

2.2 Software

- Operating Systems:
  - Windows 7 x64 SP1 Enterprise
  - Windows 8 x64 Enterprise
  - Windows 8.1 x64 Enterprise Update 1
- SQL Server 2012 SP1 Enterprise
- Hyper Historian v10.85 prerelease builds (see specific test cases)
- ICONICS Simulation OPC Server 3.12
- OPC Kepware UA Server 5.11
- Unified Data Manager64 v10.85 prerelease builds (see specific test cases)

2.3 OPC Server Configurations

ICONICS Simulator OPC Server 3.12, OPC Kepware UA Server 5.11 and Unified Data Manager 64 v10.85 were used as the data sources for the performance tests.

2.3.1 OPC Kepware UA Server

There were 50,000 configured tags, which were distributed in five (5) folders where each folder contained 10,000 analog simulated tags with Ramp signal, data type Long, with low range 0 and high range 1,000, which incremented by 1 every 50 msecs. The scan rate was set to 100 msecs.

2.3.2 Unified Data Manager

There was no specific configuration prepared for the tests in the Unified Data Manager (64-bit). Only the configuration for Hyper Historian was done, where a certain number for tags (300,000) were configured in a certain number of folders (30). There were 10,000 Hyper Historian Tags configured in each Hyper Historian Folder.

Example of used Signal Name:

@sim64:Double.Ramp(100,1,100,00435).Value

2.3.3 ICONICS Simulator OPC Server

a. Standard tests

There were 50,000 configured tags which were distributed in five (5) folders, where each folder contained 10,000 analog simulated tags with Ramp signal, data type R8, with low range 0 and high range 100, period 100,000 msecs and amplitude 100.

b. Burst tests

There were 300,000 configured tags which were distributed in 30 folders where each folder contained 10,000 analog simulated tags with Ramp signal, data type R8, with low range 0 and high range 100, period 10,000 msecs and amplitude 100.

2.4 System and Network Architecture

These tests were run during normal office hours to ensure normal network load conditions. The specific network or system architecture is noted in the description of the Performance Test Results.

2.5 Testing Methodology

There were seven performance test cases. All of these test cases used the OPC Data Source located on the same workstation where Hyper Historian Logger was running for the Standard Edition (In-Proc) or where Hyper Historian Collector was running as part of the Enterprise Edition (Out-Proc).

Tests were run to measure the performance of Hyper Historian and other related applications. The tables in Section 3 provide the results of the various combinations of number tags, the rate at which tags changed and the number of clients that were used.

GraphWorX64™ with TrendWorX™ Viewer 64 and Hyper Historian SQL Interface can be considered to be the clients in most of the cases. These applications are used to check that the data was being logged.

The CPU usage, memory usage and test duration were obtained from the Windows Performance Monitor. The CPU usage numbers in the result tables are already calculated per one Core. It is possible that there are CPU percentage usages bigger than 100%, which shows that the test was performed on a multi-thread machine.

All test cases were performed on Hyper Historian Version 10.85. Most of the steady-state throughput benchmark tests were performed minimally overnight.

During the testing, hardware license keys were used for licensing the Hyper Historian and other ICONICS products, in most cases.

List of Used Abbreviations in Document:

- PC – name of the used computer
- HH version – version number of tested Hyper Historian
- # of configured tags – number of configured HH tags in Hyper Historian configuration
- Samples/sec – number of logged samples per second
- Trigger rate – frequency of triggers for Performance Calculations
- Data collection rate – collection frequency of samples
- Merge interval – interval of merging data in Hyper to Hyper feature in minutes
- Logging period – period of logging time for burst tests in seconds
- Time to log – time needed to log all samples from OPC Server for bursts tests in seconds
- OPC Server – name of used OPC Server for data source
- HH CPU – average usage of Hyper Historian CPU in %
- HH RAM – average usage of memory of Hyper Historian in Mbytes
- HH CPU peak – highest number of used Hyper Historian CPU in %
- HH RAM peak – highest number of used memory by Hyper Historian in Mbytes
- FWX CPU – average usage of IcoFwxServer CPU in %
- FWX RAM – average usage of memory of IcoFwxServer in Mbytes
- UDM CPU – average usage of UDM64 CPU in %
- UDM RAM – average usage of memory of UDM64 in Mbytes
- Duration – test duration in hours
- Size of hhd – size of the HHD file of 1 hour data in Mbytes
- HHD – binary file where the data from Hyper Historian Logger are stored
- Result – test result comment
- SUMMARY – the average of measured values
- CTs – Hyper Historian Calculated Tags
- HH – Hyper Historian
- OPC UA – OPC Unified Architecture

3. Performance Test Results

3.1. Raw data - Standard Edition (In-Proc)

3.1.1. Overview

These test cases provide a performance overview for logging the data in steady throughput when Standard Edition was used for a various number of configured tags and data collection rate. Standard Edition means that the Hyper Historian Collector runs inside Hyper Historian Logger.

There are three sections:

a) **Basic tests** – set of standard tests with various configurations
b) **Fast tests** – set of tests where 50,000 configured tags were logged with faster data collection rates
c) **Huge tests** – set of tests where big configurations were logged by very slow data collection rates

3.1.2. System and Network Architecture

Everything is running on a single workstation.

3.1.3. Testing Methodology

An OPC Server installed on the same machine provides the data to Hyper Historian through FrameWorX Server (GenClient). Hyper Historian collects the data according to a specified data collection rate. The number of the **configured Hyper Historian tags** divided by the **data collection rate** provides the **samples/sec** rate.

3.1.4. Performance Results – Basic Tests

The following Table 1 provides the measured data from the basic performance tests.

Table 1. – Basic Tests

PC	# of configured tags	samples/sec	Data collection rate	OPC Server	HH CPU	HH RAM	HH CPU peak	HH RAM peak	FWX CPU	FWX RAM	duration	result
PC1	10,000	2,000	5 secs	OPC Sim	**2.8**	**1,135**	n/a	n/a	**0**	**361**	64	OK
PC1	10,000	10,000	1 sec	OPC Sim	**7.45**	**1,370**	n/a	n/a	**0**	**391**	36	OK
PC1	10,000	20,000	500 msec	OPC Sim	**9.04**	**1,489**	n/a	n/a	**0**	**360**	18	OK
PC1	10,000	40,000	250 msec	OPC Sim	**17.5**	**1,896**	n/a	n/a	**0**	**360**	23	OK
PC1	10,000	50,000	200 msec	OPC Sim	**19.9**	**2,027**	n/a	n/a	**0**	**361**	24	OK
PC5	10,000	10,000	1 sec	OPC Sim	**3.6**	**1,431**	n/a	n/a	**0**	**370**	65	OK
PC5	10,000	20,000	500 msec	OPC Sim	**5.7**	**1,515**	n/a	n/a	**0**	**370**	17	OK
PC5	10,000	40,000	250 msec	OPC Sim	**9.4**	**1,706**	n/a	n/a	**0**	**370**	16	OK
PC1	20,000	4,000	5 secs	OPC Sim	**6.71**	**1,466**	n/a	n/a	**0**	**370**	24	OK
PC1	20,000	20,000	1 sec	OPC Sim	**13.6**	**2,004**	n/a	n/a	**0**	**382**	22	OK
PC5	20,000	20,000	1 sec	OPC Sim	**8.1**	**2,020**	n/a	n/a	**0**	**407**	15	OK
PC5	20,000	40,000	500 msec	OPC Sim	**13.7**	**2,395**	n/a	n/a	**0**	**427**	63	OK
PC5	20,000	80,000	250 msec	OPC Sim	**23.8**	**2,727**	n/a	n/a	**0**	**381**	16	OK
PC5	30,000	30,000	1 sec	OPC Sim	**14**	**2,571**	n/a	n/a	**0**	**451**	14	OK
PC5	30,000	60,000	500 msec	OPC Sim	**21.6**	**3,048**	n/a	n/a	**0**	**455**	15	OK
PC5	30,000	6,000	5 secs	OPC Sim	**7.9**	**2,131**	n/a	n/a	**0**	**470**	63	OK
PC5	40,000	8,000	5 secs	OPC Sim	**11.1**	**2,475**	n/a	n/a	**0**	**470**	15	OK
PC5	40,000	40,000	1 sec	OPC Sim	**19.8**	**3,204**	n/a	n/a	**0**	**470**	16	OK
PC5	50,000	50,000	1 sec	OPC Sim	**25.5**	**3,622**	n/a	n/a	**0**	**471**	15	OK
PC5	50,000	10,000	5 secs	OPC Sim	**14**	**2,810**	n/a	n/a	**0**	**474**	14	OK
PC5	50,000	3,333	15 secs	OPC Sim	**5.8**	**2,158**	n/a	n/a	**0**	**470**	63	OK
PC4	80,000	80,000	1 sec	UDM Simulations	**29.3**	**5,409**	**75**	**9,474**	**0**	**498**	114	OK
PC4	100,000	100,000	1 sec	UDM Simulations	**38.9**	**6,583**	**77**	**8,075**	**0**	**493**	20	OK
PC4	150,000	150,000	1 sec	UDM Simulations	**68.3**	**9,720**	**127**	**12,882**	**0**	**505**	28	around ~50 sfb files in the Buffer in the end of the test
PC4	120,000	120,000	1 sec	UDM Simulations	**51.3**	**7,913**	**110**	**12,480**	**0**	**513**	112	OK

3.1.5. Performance Results – Fast tests

The following Table 2 provides the measured data from the Fast performance tests. One Hyper Historian configuration was prepared with 50,000 Tags. Only the Data Collection rate was changed according to the table. OPC UA communication was used, but, unfortunately, there were many of samples lost via this method.

Table 2. – Fast Tests

PC	# of configured tags	samples/sec	Data collection rate	OPC Server	HH CPU	HH RAM	HH CPU peak	HH RAM peak	FWX CPU	FWX RAM	duration	Size of HHD	result
PC5	50,000	200,000	250 msecs	OPC Sim	**60.3**	**6,554**	**90**	**10,710**	**0**	**505**	20	7155	OK
PC5	50,000	250,000	200 msecs	OPC Kepware UA	**144.2**	**6,258**	**157**	**10,461**	**1**	**557**	65	4717	OK - but really logged ~120,000 samples per sec
PC5	50,000	200,000	250 msecs	OPC Kepware UA	**138.6**	**6,050**	**155**	**8,365**	**1**	**565**	19	4450	OK - but really logged ~99,000 samples per sec
PC5	50,000	100,000	500 msecs	OPC Kepware UA	**70.9**	**5,572**	**95**	**9,289**	**0**	**389**	20	3533	OK - but really logged ~85,500 samples per sec

3.1.6. Performance Results – Huge Tests

Following Tab 3 provides the measured data from the Huge performance tests. Couple of big Hyper Historian configurations (>300,000 tags) were prepared and logged with slower data collection rate (>30 seconds).

Tab 3. – Huge Tests

PC	# of configured tags	samples/sec	Data collection rate	OPC Server	HH CPU	HH RAM	HH CPU peak	HH RAM peak	FWX CPU	FWX RAM	UDM CPU	UDM RAM	duration	Size of HHD	result
PC4	300,000	10,000	30 seconds	UDM Simulations	16.7	6,251	64	10,526	0	839	13	253	66	1,200	OK
PC4	400,000	13,333	30 seconds	UDM Simulations	21.3	8,299	80	12,843	0	479	16	292	23	1,600	OK
PC4	500,000	16,666	30 seconds	UDM Simulations	28.1	9,705	107	13,667	0	801	20	356	21	2,000	OK*
PC4	500,000	8,333	60 seconds	UDM Simulations	18.5	8,976	84	12,048	0	580	19	320	24	2,000	OK
PC4	600,000	10,000	60 seconds	UDM Simulations	22	10,146	102	13,762	0	614	21	382	18	2,400	OK *
PC12	600,000	10,000	60 seconds	UDM Simulations	17	10,559	77	18,331	0	763	24	1149	72	2,400	OK
PC12	600,000	20,000	30 seconds	UDM Simulations	22.4	12,085	80	21,516	0	734	24	1146	24	2,400	OK
PC12	600,000	40,000	15 seconds	UDM Simulations	41.4	15,671	131	27,936	0	767	23	1,154	24	2,400	OK
PC12	600,000	60,000	10 seconds	UDM Simulations	58.2	17,803	148	28,565	0	781	22	1,152	23	4,800	OK
PC12	700,000	2,333	300 seconds	UDM Simulations	6.6	9,414	52	14,109	0	801	25	1,328	23	2,800	OK
PC12	700,000	4,666	150 seconds	UDM Simulations	12.8	8,916	55	20,408	0	806	25	1,337	119	2,800	OK
PC12	700,000	11,666	60 seconds	UDM Simulations	19.1	12,377	74	20,570	0	749	24	1,317	23	2,800	OK
PC12	700,000	23,333	30 seconds	UDM Simulations	26.1	13,641	91	23,780	0	792	24	1,342	23	2,800	FAIL**
PC12	800,000	2,666	300 seconds	UDM Simulations	7.6	10,103	57	15,414	0	783	25	1,532	23	3,200	OK

PC12	800,000	5,333	150 seconds	UDM Simulations	**14.5**	**10,113**	**68**	**16,245**	**0**	**770**	**25**	**1,532**	**23**	**3,200**	OK
PC12	800,000	13,333	60 seconds	UDM Simulations	**21.4**	**13,653**	**87**	**22,229**	**0**	**794**	**24**	**1,528**	**23**	**3,200**	OK
PC12	800,000	26,666	30 seconds	UDM Simulations	**29.7**	**15,704**	**104**	**25,631**	**0**	**762**	**24**	**1,522**	**22**	**3,200**	FAIL**
PC12	1,000,000	1,666	600 seconds	UDM Simulations	**5**	**11,080**	**62**	**17,547**	**0**	**751**	**25**	**1,912**	**23**	**4,000**	OK
PC12	1,000,000	3,333	300 seconds	UDM Simulations	**9.5**	**11,159**	**66**	**17,455**	**0**	**771**	**25**	**1,917**	**23**	**4,000**	OK
PC12	1,000,000	6,666	150 seconds	UDM Simulations	**17.2**	**12,249**	**78**	**20,281**	**0**	**781**	**25**	**1,909**	**23**	**4,000**	FAIL**
PC12	1,000,000	16,666	60 seconds	UDM Simulations	**26.8**	**16,524**	**103**	**25,183**	**0**	**860**	**23**	**1,909**	**65**	**4,000**	FAIL**

**The disk was used for 100%, which concludes a very slow response of the whole computer.*

*** Computer overloaded and the logging was stopped.*

3.1.7. Summary

a) Basic Tests

According to Tab 1, Hyper Historian is able to log 120,000 samples per second. The limit is most likely somewhere between **120,000 to 150,000 samples per second**. During the test where Hyper Historian was logging 150,000 samples per second, there was some Store and Forward files that were not properly logged and the number of these Store and Forward files was constantly increasing. This points out that the CPU of the computer hit its limit. The test also hit the limit size of the RAM usage. Stronger hardware configuration of the computer will result in better results.

Another important point is that Hyper Historian has better performance results when logging a lower number of configured tags, but with a faster data collection rate.

b) Fast Tests

This test case confirms that the Hyper Historian is able to log **up to 120,000 samples per second**. These tests were done with OPC UA communication, which provided the lower data scan rates. Unfortunately, there were still a lot of lost samples in the communication.

c) Huge Tests

These test cases prove that Hyper Historian is able to handle **600,000 tags in configuration**. The bottleneck here was the speed of the disk, where the data were logged, and also RAM. With the stronger hardware configuration (for example, SSD and bigger RAM) Hyper Historian should be able to handle many more configured tags.

3.2. Raw Data - Enterprise Edition (Out-Proc)

3.2.1. Overview

These test cases provide a performance overview for logging the data in steady throughput when Enterprise Edition was used for various number of configured tags and data collection rate. Enterprise Edition means that Hyper Historian Collector runs as a standalone service. The following tests were divided into two sections, one focused on tests with one standalone Hyper Historian Collector and a second one with two or more standalone Hyper Historian Collectors.

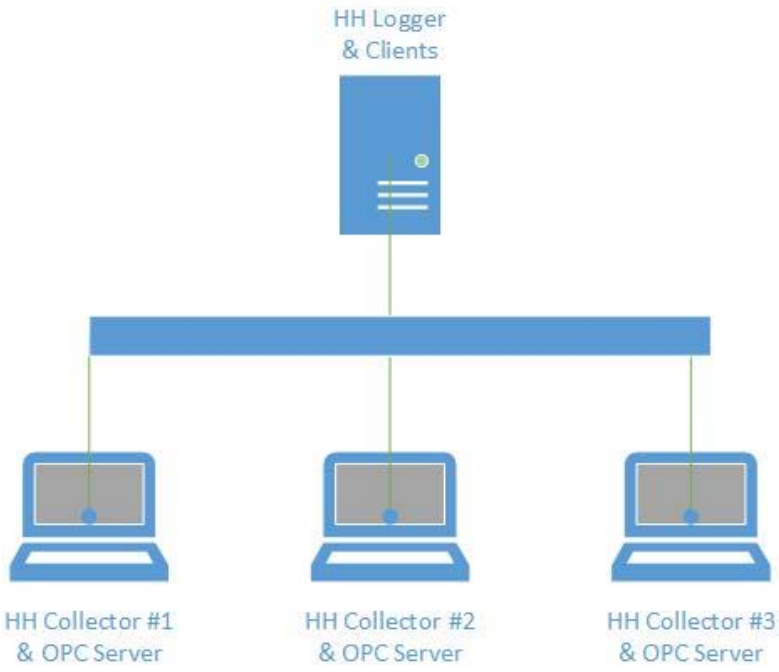
3.2.2. System and Network Architecture

Hyper Historian Logger was running mostly on a separate computer than the Hyper Historian Collectors. The OPC Server data sources were installed on the same computer as the Hyper Historian Collectors.

Tests were done and measured in separated domains designed for testing purposes only. The network used Gigabit Ethernet.

See Image 1 below to see how the Network Architecture was set up for these tests.

Image 1



3.2.3. Testing Methodology

The OPC Servers installed on the machines provided the data to a Hyper Historian Collector through FrameWorX Server (GenClient). Hyper Historian collected the data according to the specified data collection rate. The number of **configured Hyper Historian tags** divided by **data collection rate** provided the **samples/sec** rate. The communication bandwidth between the Hyper Historian Collector and Hyper Historian Logger were also measured, where the first number is the upload from the Logger, the second is the download from the Collector and the third configuration is the upload from the Logger to the Collector.

3.2.4. Performance Results – single Collector

The following Table 4 provides the measured data from the performance tests with the single Hyper Historian Collector.

PC	# of configured tags	samples/sec	Data collection rate	OPC Server	HH CPU	HH RAM	HH CPU peak	HH RAM peak	FWX CPU	FWX RAM	UDM CPU	UDM RAM	duration	Size of HHD	Result HH Bandwidth [down/upld/cfg]
PC4	Logger 600,000 tags	10,000			**19.4**	**8,693**	**100**	**13,624**	**0**	**648**	**0**	**22**	64	2400	OK
PC1	Collector 600,000 tags	10,000	60 secs	UDM Simulations	**5.1**	**3,879**	**30**	**4,813**	**0**	**438**	**2**	**340**	66	n/a	OK
PC12	Logger 1,000,000 tags				**7.9**	**7,937**	**82**	**25,473**	**0**	**785**			65	4,000	OK
PC6	Collector 1,000,000 tags	3,333	300 secs	UDM Simulations	**1.5**	**6,345**	**29**	**7,849**	**0**	**503**	**4**	**1,905**	65		OK
PC12	Logger 1,000,000 tags				**6.2**	**9,772**	**82**	**19,242**	**0**	**759**			16	4,000	
PC6	Collector 1,000,000 tags	6,666	150 secs	UDM Simulations	**2.7**	**6,422**	**30**	**7,457**	**0**	**504**	**5**	**1,967**	16		OK
PC12	Logger 1,000,000 tags				**24**	**14,334**	**96**	**25,134**	**0**	**776**			**16**	**4,000**	
PC6	Collector 1,000,000 tags	16,666	60 secs	UDM Simulations	**4.5**	**6,576**	**38**	**8,031**	**0**	**579**	**5**	**1,907**	**16**		FAIL**
PC12	Logger 1,000,000 tags				**48**	**10,887**	**102**	**24,829**	**0**	**768**			**16**	**4,000**	
PC6	Collector 1,000,000 tags	33,333	30 secs	UDM Simulations	**6.3**	**5,781**	**45**	**6,586**	**0**	**503**	**5**	**1,907**	**16**		FAIL**
PC12	Logger 900,000 tags				**23.2**	**12,858**	**86**	**23,200**	**0**	**733**			**15:44**	**3,600**	51MB/1.5 GB/245 MB
PC6	Collector 900,000 tags	15,000	60 secs	UDM Simulations	**4**	**6,088**	**29**	**6,803**	**0**	**595**	**4**	**1,713**	**15:44**		FAIL**
PC12	Logger 900,000 tags				**13.5**	**8,607**	**68**	**16,958**	**0**	**771**			**15:24**	**3,600**	21GB/924MB/245MB
PC6	Collector 900,000 tags	6,000	150 secs	UDM Simulations	**2.3**	**5,783**	**35**	**6,839**	**0**	**594**	**4**	**1,737**	**15:24**		OK
PC12	Logger 800,000 tags				**21.1**	**11,888**	**97**	**19,645**	**0**	**655**			**15:59**	**3,200**	43GB/1.3GB/217MB cfg
PC6	Collector 800,000 tags	13,333	60 secs	UDM Simulations	**3.3**	**5,583**	**18**	**6,499**	**0**	**596**	**4**	**1,562**	**15:59**		FAIL**
PC12	Logger 800,000 tags				**12.8**	**7,757**	**70**	**16,746**	**0**	**771**			**63:40**	**3,200**	74GB/2.7GB/217MB
PC6	Collector 800,000 tags	5,333	150 secs	UDM Simulations	**1.7**	**5,424**	**21**	**6,236**	**0**	**579**	**4**	**1,523**	**63:40**		OK

PC12	Logger 700,000 tags				**23.2**	**11,086**	**79**	**19,636**	**0**	**769**			**15:56**	**2,800**	38GB/1.2GB/189MB
PC6	Collector 700,000 tags	11,666	60 secs	UDM Simulations	**2.7**	**5,170**	**17**	**6,191**	**0**	**580**	**4**	**1,358**	**15:56**		FAIL**
PC12	Logger 700,000 tags				**11.5**	**7,027**	**48**	**12,003**	**0**	**800**			**15:17**	**2,800**	14GB/722MB/189MB
PC6	Collector 700,000 tags	4,666	150 secs	UDM Simulations	**1.5**	**5,085**	**16**	**5,745**	**0**	**580**	**3**	**1,356**	**15:17**		OK
PC12	Logger 600,000 tags				**16.4**	**9,182**	**78**	**18,225**	**0**	**771**			**17:38**	**2,400**	31GB/1.1GB/162.6MB c
PC6	Collector 600,000 tags	10,000	60 secs	UDM Simulations	**2.3**	**4,433**	**15**	**4,932**	**0**	**605**	**3**	**1,151**	**17:38**		FAIL**
PC12	Logger 600,000 tags				**9.6**	**6,477**	**43**	**10,976**	**0**	**756**			**15:33**	**2,400**	12.3GB/686MB/162.2MI
PC6	Collector 600,000 tags	4,000	150 secs	UDM Simulations	**1.2**	**4,306**	**13**	**4,829**	**0**	**520**	**3**	**1,148**	**15:33**		OK
PC12	Logger 500,000 tags				**14.4**	**7,798**	**67**	**15,141**	**0**	**745**			**63:36**	**2,000**	83.5GB/2.9GB/135MB
PC6	Collector 500,000 tags	8,333	60 secs	UDM Simulations	**1.9**	**3,916**	**12**	**4,592**	**0**	**622**	**2**	**957**	**63:36**		FAIL**
PC5	Logger 150,000 tags	150,000			**48.1**	**7,508**	**102.6**	**13,280**	**0**	**528**			15	n/a	OK*
PC2	Collector 150,000 tags	150,000	1 sec	UDM Simulations	**65.6**	**1,673**	**71**	**2,270**	**1**	**224**	**13**	**283**	15	n/a	OK
PC5	Logger 130,000 tags	130,000			**41.3**	**6,583**	**97**	**12,184**	**0**	**529**			63	n/a	OK
PC2	Collector 130,000 tags	130,000	1 sec	UDM Simulations	**62**	**1,554**	**74**	**2,253**			**12**	**248**	63	n/a	OK
PC5	Logger 100,000 tags	100,000			**30.7**	**5,633**	**78**	**10,784**	**0**	**531**			15	n/a	OK
PC2	Collector 100,000 tags	100,000	1 sec	UDM Simulations	**47.2**	**1,249**	**56**	**1,688**			**10**	**197**	15	n/a	OK
PC5	Logger 80,000 tags	80,000			**23.2**	**4,643**	**66**	**9,962**	**0**	**487**			15	n/a	OK
PC2	Collector 80,000 tags	80,000	1 sec	UDM Simulations	**38.5**	**1,099**	**48**	**1,652**	**1**	**286**	**16**	**162**	15	n/a	OK

PC5	Logger 70,000 tags	70,000			**21.3**	**4,316**	**50**	**7,753**	**0**	**488**			63	n/a	OK
PC2	Collector 70,000 tags	70,000	1 sec	UDM Simulations	**36.2**	**1,027**	**45**	**1,741**	**1**	**286**	**15**	**147**	63	n/a	OK
PC5	Logger 60,000 tags	60,000			**17.18**	**3,774**	**56**	**7,399**	**0**	**487**			16	n/a	OK
PC2	Collector 60,000 tags	60,000	1 sec	UDM Simulations	**32.1**	**906**	**39**	**1,300**	**1**	**286**	**13**	**129**	16	n/a	OK
PC5	Logger 50,000 tags	50,000			**15.8**	**3,309**	n/a	n/a	**0**	**438**			15	n/a	OK
PC5	Collector 50,000 tags	50,000	1 sec	OPC Sim	**8.9**	**1,319**	n/a	n/a			n/a	n/a	15	n/a	OK
PC5	Logger 50,000 tags	50,000			**14.5**	**3,560**	n/a	n/a	**0**	**437**			63	n/a	OK
PC2	Collector 50,000 tags	50,000	1 sec	OPC Sim	**33.6**	**1,101**	n/a	n/a			n/a	n/a	63	n/a	OK
PC5	Logger 40,000 tags	40,000			**11.9**	**3,320**	**54.9**	**4,829**	**0**	**422**			16	n/a	OK
PC2	Collector 40,000 tags	40,000	1 sec	OPC Sim	**26**	**823**	**30.5**	**1,150**			n/a	n/a	16	n/a	OK
PC5	Logger 30,000 tags	30,000			**8.2**	**2,805**	**36.2**	**4,234**	**0**	**423**			20	n/a	OK
PC2	Collector 30,000 tags	30,000	1 sec	OPC Sim	**18.7**	**735**	**23**	**984**			n/a	n/a	20	n/a	OK
PC5	Logger 20,000 tags	20,000			**5.5**	**2,186**	**23.7**	**3,532**	**0**	**423**			114	n/a	OK
PC2	Collector 20,000 tags	20,000	1 sec	OPC Sim	**12.1**	**612**	**15.2**	**786**			n/a	n/a	114	n/a	OK
PC5	Logger 10,000 tags	10,000			**2.6**	**1,281**	n/a	n/a	**0**	**420**			63	n/a	OK
PC2	Collector 10,000 tags	10,000	1 sec	OPC Sim	**5.9**	**500**							63		OK

Table 4. – Single Collector tests

** ~50 Store and Forward files (sfb) in the Buffer in the end of the test*

*** Not all samples properly logged (from 49 to 56 from total 60 in hour)*

3.2.5. Performance Results – Multiple Collectors

The following Table 5 provides the measured data from the performance tests with multiple Hyper Historian Collectors.

Table 5 – Multiple Collector Tests

PC	# of configured tags	samples/sec	Data collection rate	OPC Server	HH CPU	HH RAM	HH CPU peak	HH RAM peak	FWX CPU	FWX RAM	UDM CPU	UDM RAM	duration	Size of HHD	result
PC4	**Logger 400,000 tags**	**13,333**		n/a	**17.3**	**6,800**	**85**	**11,240**	**0**	**491**	n/a	n/a	**64**	**1,600**	**OK**
PC1	Collector 100,000 tags	3,333	30 secs	UDM Simulations	**1.4**	**1,317**	**5**	**1,455**	**0**	**437**	**1**	**188**	64	n/a	OK
PC8	Collector 100,000 tags	3,333	30 secs	UDM Simulations	**2.1**	**1,072**	**7**	**1,372**	**0**	**270**	**2**	**192**	64	n/a	OK
PC7	Collector 100,000 tags	3,333	30 secs	UDM Simulations	**0.9**	**1,317**	**4**	**1,450**	**0**	**361**	**1**	**197**	64	n/a	OK
VM1	Collector 100,000 tags	3,333	30 secs	UDM Simulations	**2.2**	**805**	**7**	**867**	**0**	**159**	**2**	**191**	64	n/a	OK
PC4	**Logger 50,000 tags**	**50,000**		n/a	**11.3**	**2,908**	**36**	**4,540**	**0**	**540**	n/a	n/a	**64**	**1270**	**OK**
PC4	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**0.6**	**707**	**1**	**761**	**0**	**540**	**0**	**39**	64	n/a	OK
PC1	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**2.2**	**607**	**3**	**651**	**0**	**342**	**1**	**40**	64	n/a	OK
PC9	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**0.3**	**633**	**1**	**673**	**0**	**369**	**0**	**38**	64	n/a	OK
PC10	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**0.7**	**622**	**1.2**	**651**	**0.1**	**340**	**0.2**	**39**	64	n/a	OK
VM1	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**5.1**	**178**	**16.4**	**235**	**0.1**	**139**	**2.6**	**35**	64	n/a	OK
PC4	**Logger 60,000 tags**	**60,000**		n/a	**13.4**	**3,245**	**47**	**5,350**	**0**	**411**	n/a	n/a	**16**	**1470**	**OK**
PC4	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**0.7**	**712**	**1**	**761**	**0**	**411**	**0**	**35**	16	n/a	OK
PC1	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**2.3**	**586**	**3**	**627**	**0**	**351**	**1**	**39**	16	n/a	OK

PC9	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**0.3**	**592**	**1**	**622**	**0**	**366**	**0**	**38**	16	n/a	OK
PC10	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**0.5**	**858**	**1.1**	**633**	**0.1**	**406**	**0.2**	**38**	16	n/a	OK
VM1	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**4.8**	**169**	**9.8**	**199**	**0.6**	**142**	**2.3**	**35**	16	n/a	OK
PC6	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**0.5**	**612**	**1.1**	**634**	**0.1**	**347**	**0.2**	**39**	16	n/a	OK
PC4	**Logger 70,000 tags**	**70,000**		n/a	**29.2**	**3,662**	**99**	**6,194**	**0**	**422**	n/a	n/a	**63**	**1750**	**OK**
PC4	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**0.7**	**723**	**2**	**792**	**0**	**488**	**0**	**41**	63	n/a	OK
PC1	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**2.1**	**603**	**3**	**666**	**0**	**369**	**1**	**42**	63	n/a	OK
PC9	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**0.6**	**808**	**2**	**844**	**0**	**473**	**0**	**39**	63	n/a	OK
PC10	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**0.4**	**776**	**1.3**	**832**	**0.1**	**440**	**0.4**	**38**	63	n/a	OK
VM1	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**4.3**	**282**	**8.3**	**296**	**0.4**	**159**	**2**	**36**	63	n/a	OK
VM2	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**4.2**	**262**	**8.5**	**277**	**0.3**	**149**	**1.9**	**74**	63	n/a	OK
PC6	Collector 10,000 tags	10,000	1 sec	UDM Simulations	**0.5**	**738**	**1.2**	**788**	**0.1**	**402**	**0.2**	**38**	63	n/a	OK

3.2.6. Summary

a. Single Collector Tests

The performed tests proved that a single Collector is able to handle the configuration of **600,000 Hyper Historian Tags**, which is similar to Hyper Historian In-Proc. Hyper Historian should perform better on stronger hardware.

The tests also proved that there are similar limitations related to samples logged per seconds, like for Hyper Historian In-Proc. These configurations also offload some resources from Hyper Historian Logger compared to when running as In-Proc.

b. Multiple Collector Tests

Multiple Hyper Historian Collectors are supported to provide the collected data to Hyper Historian Logger.

3.3. Raw data - Redundancy (Out-Proc)

3.3.1. Overview

These test cases provide a performance overview for collecting and logging the data in steady throughput when a redundancy scenario, using Enterprise Edition, was used for various numbers of configured tags. A four-node scenario was used for these redundancy performance tests, which means that each Hyper Historian service (Primary and Secondary Logger and Primary and Secondary Collector) ran on a standalone machine.

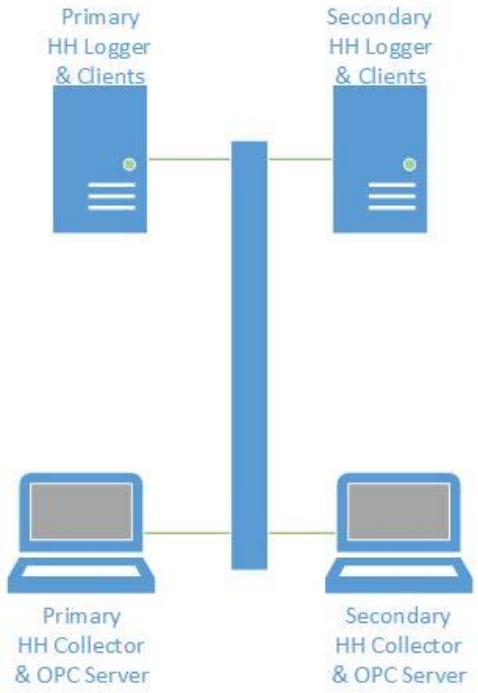
3.3.2. System and Network Architecture

Hyper Historian Loggers were running on separate computers from the Hyper Historian Collectors. The OPC Servers, as data sources, were installed on the same computer as the Hyper Historian Collectors. A four-node scenario was used for these redundancy performance tests.

Tests were done and measured in a separated domain that is designed for testing purposes only. This network used Gigabit Ethernet.

See Image 2 for how the Network Architecture was set up for these tests.

Image 2



3.3.3. Testing Methodology

The OPC Servers installed on the machines provided the data to Hyper Historian Collector through FrameWorX Server (GenClient). Hyper Historian collected the data according to the specified data collection rate. The number of **configured Hyper Historian tags** divided by the **data collection rate** provided the **samples/sec** rate.

3.3.4. Performance Results

The following Table 6 provides the measured data from the performance tests with a single Hyper Historian Collector.

Table 6 – Single Collector Tests

PC	# of configured tags	samples/sec	Data collection rate	OPC Server	HH CPU	HH RAM	FWX CPU	FWX RAM	duration	result
PC3	Pri Logger 50,000 tags	50,000			**15.5**	**3,612**	**0**	**486**	15	OK
PC1	Sec Logger 50,000 tags	50,000	1 sec	OPC Sim	**22.2**	**3,513**	**0**	**294**	15	OK
PC2	Pri Collector 50,000 tags	50,000			**31.5**	**976**	n/a	n/a	15	OK
PC11	Sec Collector 50,000 tags	50,000	1 sec	OPC Sim	**29.6**	**997**	n/a	n/a	15	OK
PC3	Pri Logger 40,000 tags	40,000			**11.9**	**2,938**	**0**	**493**	14	OK
PC1	Sec Logger 40,000 tags	40,000	1 sec	OPC Sim	**32.9**	**3,702**	**1**	**318**	14	OK
PC2	Pri Collector 40,000 tags	40,000			**26**	**911**	n/a	n/a	14	OK
PC11	Sec Collector 40,000 tags	40,000	1 sec	OPC Sim	**23.6**	**923**	n/a	n/a	14	OK
PC3	Pri Logger 30,000 tags	30,000			**8**	**2,376**	**0**	**493**	15	OK
PC1	Sec Logger 30,000 tags	30,000	1 sec	OPC Sim	**23.1**	**2,436**	**1**	**320**	15	OK
PC2	Pri Collector 30,000 tags	30,000			**16.2**	**630**	n/a	n/a	15	OK
PC11	Sec Collector 30,000 tags	30,000	1 sec	OPC Sim	**17.3**	**624**	n/a	n/a	15	OK
PC3	Pri Logger 20,000 tags	20,000			**5.7**	**1,764**	**0**	**405**	112	OK
PC1	Sec Logger 20,000 tags	20,000	1 sec	OPC Sim	**7.6**	**2,062**	**0**	**330**	112	OK
PC2	Pri Collector 20,000 tags	20,000			**11.8**	**609**	n/a	n/a	112	OK
PC11	Sec Collector 20,000 tags	20,000	1 sec	OPC Sim	**10.6**	**691**	n/a	n/a	112	OK
PC3	Pri Logger 10,000 tags	10,000			**2.7**	**1,322**	**0**	**412**	15	OK
PC1	Sec Logger 10,000 tags	10,000	1 sec	OPC Sim	**3.7**	**1,275**	**0**	**338**	15	OK
PC2	Pri Collector 10,000 tags	10,000			**5.8**	**481**	n/a	n/a	15	OK
PC11	Sec Collector 10,000 tags	10,000	1 sec	OPC Sim	**4.6**	**503**	n/a	n/a	15	OK

3.3.5. Summary

The performed tests proved that Hyper Historian in four-node redundancy is able to handle **50,000 samples** logged per second. The measured variables are very similar to the same non-redundant configurations.

Hyper Historian can handle much more, but it will require more tests to be performed.

3.4. Performance Calculations (In-Proc)

3.4.1. Overview

Hyper Historian's Performance Calculation Engine is a powerful module that allows users to configure complex calculations that can be triggered periodically or on any data change event, using flexible new date/time, mathematical, string and historical data retrieval functions that are part of ICONICS Expression Editor. Calculations can use scalar values, historical values, or string operations, along with a wide variety of functions within an enhanced version of the ICONICS Expression Engine, and results are calculated automatically on each trigger, or can be recalculated manually on demand.

3.4.2. System and Network Architecture

Everything is running on a single workstation.

3.4.3. Testing Methodology

OPC Server installed on the same machine provides the data of one OPC tag to Hyper Historian through FrameWorX Server (GenClient). Hyper Historian collects the data with a one (1) second data collection rate. Based on the specified trigger rate, the Performance Calculations were performed. Each Calculation Tag was using this expression:

```
(220 + sin({{data:Data.Sine}})) * (ln({{data:Data.Sine}}))
```

Tests marked as PC6+, were performed with the customer specific expression:

```
IF (setvalue({{var:ConsVal}},tagdelta({{par:HHTag}}, now()-
    fromseconds({{par:SecondsLookback}}), now())))
```

3.4.4. Performance Results

Tab 7. – Performance Calculations performance tests

PC	# of configured tags	samples/sec	Trigger rate	HH CPU	HH RAM	HH CPU peak	HH RAM peak	FWX CPU	FWX RAM	Size of HHD	Duration	result
PC5	10,000 CTs	10,000	1 sec	**51**	**1,602**	**70**	**2,624**	**0**	**616**	**1,302**	63	OK
PC5	10,000 CTs	2,000	5 secs	**9.7**	**1,205**	**18**	**1,659**	**0**	**507**	n/a	15	OK
PC5	10,000 CTs	1,000	10 secs	**5.4**	**1,109**	**12**	**1,616**	**0**	**409**	**n/a**	15	OK
PC5	10,000 CTs	167	1 min	**1.5**	**1,012**	**7**	**1,189**	**0**	**561**	**40**	15	OK
PC5	20,000 CTs	20,000	1 sec	**97.8**	**2,028**	**108**	**2,906**	**0**	**394**	**400**	15	OK, but replayed data delayed for ~1 hour
PC5	20,000 CTs	4,000	5 secs	**20.7**	**1,551**	**34**	**2,381**	**0**	**403**	**560**	16	OK
PC5	20,000 CTs	2,000	10 secs	**10.3**	**1,481**	**25**	**2,003**	**0**	**402**	**320**	16	OK
PC5	20,000 CTs	333	1 min	**2.8**	**1,211**	**29**	**1,728**	**0**	**433**	**80**	16	OK
PC4	30,000 CTs	30,000	1 sec	**141**	**2,445**	**180**	**3,830**	**0**	**628**	**n/a**	15	OK, but replayed data delayed for ~2 hour
PC4	30,000 CTs	6,000	5 secs	**35.3**	**1,908**	**57**	**2,913**	**0**	**621**	**840**	65	OK
PC2	30,000 CTs	3,000	10 secs	**24.5**	**1,395**	**91**	**2,197**	**1**	**344**	**480**	65	OK
PC4	40,000 CTs	8,000	5 secs	**48.1**	**2,201**	**66**	**3,537**	**0**	**421**	**1,120**	17	OK
PC4	50,000 CTs	10,000	5 secs	**60.3**	**2,517**	**91**	**4,017**	**0**	**448**	**1,400**	8	OK
PC4	60,000 CTs	12,000	5 secs	**72.5**	**2,858**	**112**	**4,898**	**0**	**448**	**1,680**	16	OK
PC4	80,000 CTs	16,000	5 secs	**99.2**	**3,597**	**132**	**7,046**	**0**	**447**	**2,240**	66	OK
PC4	100,000 CTs	20,000	5 secs	**123**	**4,140**	**142**	**7,455**	**0**	**466**	**2,800**	17	OK
PC4	120,000 CTs	24,000	5 secs	**123.6**	**4,868**	**147**	**8,622**	**0**	**435**	**3,360**	24	OK, but replayed data delayed for 4.5 hours
PC6	10,000 CTs with 10,000 Data Triggers	10,000	1 sec	**97**	**1,586**	**124**	**3,081**	**0**	**488**	**n/a**	17	FAIL, then computer became overload
PC6	10,000 CTs with 10,000 Data Triggers	2,000	5 secs	**32.1**	**1,360**	**74**	**2,485**	**0**	**569**	**286**	15	OK
PC6	10,000 CTs with 10,000 Data Triggers	1,000	10 secs	**18.2**	**1,361**	**52**	**2,616**	**0**	**530**	**159**	15	OK
PC6	5,000 CTs based on Historical data and 5,000 CTs calculated with already Calculated data	1,000	1 sec	**23.5**	**1,593**	**41**	**2,226**	**0**	**475**	**696**	15	OK

PC6	20,000 CTs with 20,000 Data Triggers	20,000	1 sec	**33.6**	**1,965**	**115**	**4,897**	**0**	**704**	**n/a**	5	FAIL, computer restarted after 3 days
PC6	20,000 CTs with 20,000 Data Triggers	2,000	10 secs	**44.5**	**1,949**	**109**	**5,763**	**0**	**477**	**160**	63	OK
PC6	20,000 CTs with 20,000 Data Triggers	1,333	15 secs	**24.4**	**2,075**	**98**	**5,277**	**0**	**667**	**336**	63	OK
PC6	20,000 CTs with 20,000 Data Triggers	666	30 secs	**11.9**	**1,576**	**61**	**2,756**	**0**	**664**	**82**	64	OK
PC6+	4,000 tags collected every 1 second and 52,000 CTs triggered every 15 minutes	4,057	15 mins	**6.5**	**1,673**	**41**	**2,180**	**0**	**369**	**336**	18	OK
PC6+	8,000 tags collected every 1 second and 52,000 CTs triggered every 15 minutes	8,057	15 mins	**13.4**	**2,144**	**79**	**3,021**	**0**	**347**	**672**	15	OK
PC6+	40,000 tags collected every 1 second and 52,000 CTs triggered every 15 minutes	40,057	15 mins	**73.2**	**7,201**	**175**	**12,055**	**0**	**396**	**3360**	15	OK, but calculation delayed for 30 minutes
PC6+	40,000 tags collected every 1 minute and 52,000 CTs triggered every 15 minutes	724	15 mins	**13.5**	**5,856**	**137**	**10,510**	**0**	**426**	**2240**	63	OK

3.4.5. Summary

As seen from the results, the calculation of the Performance Calculations uses the **CPU** a lot. It is not depending on the memory in this case. Hyper Historian is able to calculate and log **~20,000 samples per second** when the calculation was triggered every five (5) seconds and the logged data are not delayed. The number of logged samples per second decreases with the higher trigger rate (one [1] second).

Hyper Historian is also able to handle configuration with **120,000** (or more) Calculated Tags.

3.5. Raw Data - Burst tests (In-Proc)

3.5.1. Overview

These test cases provide a performance overview for logging the data in burst throughput when Standard Edition was used for a various number of configured tags. The burst test means that a higher number of samples are logged with a given scan period for a limited time. Besides the common measured variables, the important variable is also time to log all samples.

3.5.2. System and Network Architecture

Everything ran on a single workstation.

3.5.3. Testing Methodology

An OPC Server installed on the same machine provided the data to Hyper Historian through FrameWorX Server (GenClient) on demand. Hyper Historian collected the data according to a specified data collection rate. The number of the **configured Hyper Historian tags** divided by **data collection rate** provided the **samples/sec** rate.

The OPC Server was forced to provide the data for a limited time period (Logging Period) when Hyper Historian was already subscribed to that OPC Server.

3.5.4. Performance Results

Tab 8. – Burst Performance Tests

PC	OPC Server	# of configured tags	samples/sec	Data collection rate	Logging period	Time to log	HH CPU	HH RAM	HH CPU peak	HH RAM peak	FWX CPU	FWX RAM	Size of HHD	results
PC5	OPC Sim	150,000	150,000	1 sec	60	**129**	**3.1**	**1,852**	**60**	**3,558**	**1**	**435**	600	OK
					60	**124**	**4.5**	**2,024**	**50**	**4,011**	**0**	**518**	600	OK
					60	**125**	**2.9**	**1,908**	**49**	**3,691**	**0**	**585**	600	OK
	SUMMARY					***126***	***4***	***1,928***	***53***	***3,753***	***1***	***513***		
PC5	OPC Sim	150,000	150,000	1 sec	300	**365**	**7.3**	**2,039**	**98**	**8,370**	**9**	**515**	600	OK - 6 sfd files remained
					300	**391**	**3.5**	**1,881**	**89**	**7,276**	**6**	**530**	600	OK - 11 sfd files remained
					300	**382**	**7.1**	**2,019**	**89**	**8,628**	**2**	**494**	600	OK - 8 sfd files remained
	SUMMARY					***379***	***6***	***1,980***	***92***	***8,091***	***6***	***513***		
PC5	OPC Sim	150,000	150,000	1 sec	600	**794**	**6.9**	**2,005**	**112**	**10,382**	**1**	**412**	600	OK - 22 sfd files remained
					600	**784**	**7.8**	**2,034**	**105**	**10,156**	**8**	**553**	600	OK - 18 sfd files remained
	SUMMARY					***789***	***7***	***2,020***	***108***	***10,269***	***5***	***483***		
PC5	OPC Sim	200,000	200,000	1 sec	60	**198**	**4.1**	**2,266**	**65**	**4,946**	**1**	**534**	n/a	OK
					60	**200**	**8.7**	**2,203**	**69**	**5,156**	**1**	**623**	n/a	OK
					60	**194**	**2.9**	**2,188**	**56**	**4,923**	**1**	**590**	n/a	OK
	SUMMARY					***197***	***5***	***2,219***	***63***	***5,008***	***1***	***582***		
PC5	OPC Sim	200,000	200,000	1 sec	300	**610**	**3.4**	**2,407**	**111**	**8,417**	**1**	**624**	800	OK - 22 sfd files remained
					300	**633**	**1.2**	**2,205**	**105**	**8,290**	**1**	**574**	800	OK - 30 sfd files remained
					300	**636**	**8.6**	**2262**	**101**	**9,219**	**1**	**581**	800	OK - 30 sfd files remained
	SUMMARY					***626***	***4***	***2,291***	***106***	***8,642***	***1***	***593***		

PC5	OPC Sim	200,000	200,000	1 sec	600	**1,296**	**4**	**2,260**	**130**	**10,603**	**2**	**565**	1600	OK - 73 sfd files remained
					600	**1,365**	**9.5**	**2,173**	**110**	**8,964**	**1**	**569**	1600	OK - 72 sfd files remained
					600	**1,340**	**10.8**	**2,233**	**107**	**10,526**	**3**	**487**	1600	OK - 71 sfd files remained
	SUMMARY					***1,334***	***8***	***2,222***	***116***	***10,031***	***2***	***540***		
PC5	OPC Sim	250,000	250,000	1 sec	60	**437**	**9.9**	**1,920**	**67**	**5,266**	**1**	**638**	1000	OK - 4 sfd files remained
					60	**256**	**10.8**	**2,882**	**85**	**5,153**	**1**	**651**	1000	OK - 3 sfd files remained
					60	**258**	**13.8**	**2,755**	**83**	**5,226**	**1**	**684**	1000	OK - 3 sfd files remained
	SUMMARY					***317***	***12***	***2,519***	***78***	***5,215***	***1***	***658***		
PC5	OPC Sim	250,000	250,000	1 sec	300	**937**	**12.4**	**2,935**	**115**	**9,241**	**2**	**653**	1000	OK - 43 sfd files remained
					300	**1,096**	**9.1**	**2,851**	**114**	**9,366**	**2**	**632**	1000	OK - 45 sfd files remained
	SUMMARY					***1,017***	***11***	***2,893***	***115***	***9,304***	***2***	***643***		
PC5	OPC Sim	250,000	250,000	1 sec	600	**2,160**	**13**	**2,855**	**127**	**13,832**	**6**	**577**	1000	OK – 97 sfd files remained
PC5	OPC Sim	300,000	300,000	1 sec	60	**300**	**16**	**3,680**	**90**	**6,142**	**1**	**666**	1200	OK - 3 sfd files remained
					60	**439**	**12.4**	**3,222**	**82**	**6,527**	**1**	**813**	1200	OK - 1 sfd file remained
					60	**429**	**15.3**	**2,986**	**91**	**5,570**	**1**	**580**	1200	OK - 3 sfd files remained
	SUMMARY					***389***	***15***	***3,296***	***88***	***6,080***	***1***	***686***		
PC5	OPC Sim	300,000	300,000	1 sec	300	**2,020**	**11.5**	**3,520**	**66**	**9,069**	**1**	**507**	2400	OK - 40 sfd files remained
					300	**2,876**	**16**	**4,127**	**93**	**9,945**	**1**	**724**	2400	OK - 49 sfd files remained
	SUMMARY					***2,448***	***14***	***3,824***	***80***	***9,507***	***1***	***616***		

PC12	OPC Sim	300,000	300,000	1 sec	60	**75**	**15.1**	**3,754**	**86**	**7,325**	**0**	**844**	1200	OK
					60	**74**	**12.3**	**3,800**	**98**	**7,032**	**0**	**844**	1200	OK
					60	**70**	**13.5**	**4,919**	**96**	**7,522**	**0**	**844**	1200	OK
	SUMMARY					***73***	***13.6***	***4,157***	***93***	***7,293***	***0***	***844***		

3.5.5. Summary

Hyper Historian is able to **log 200,000 samples per second**, which are generated in 60 seconds and it took ~197 seconds and no sfd (Store and Forward) files remained in the buffer. All other test case results showed that at least some sfd files remained after the test.

One sfd file contains data for all Hyper Historian tags collected in 5 seconds.

The bottleneck of this test is the HDD speed, so the next step is to test with an SSD.

3.6. Raw Data – Hyper to Hyper (In-Proc)

3.6.1. Overview

Hyper to Hyper technology is a powerful new feature that enables users to aggregate and merge data from any plant historian server. Hyper Historian servers can now exchange data hierarchically with other Hyper Historian servers or with third-party historians as well. These data exchanges can be triggered on a schedule or manually on demand, regardless of whether the server is located on premise or in the cloud. This enables remote access to the most critical information with maximum flexibility and control.

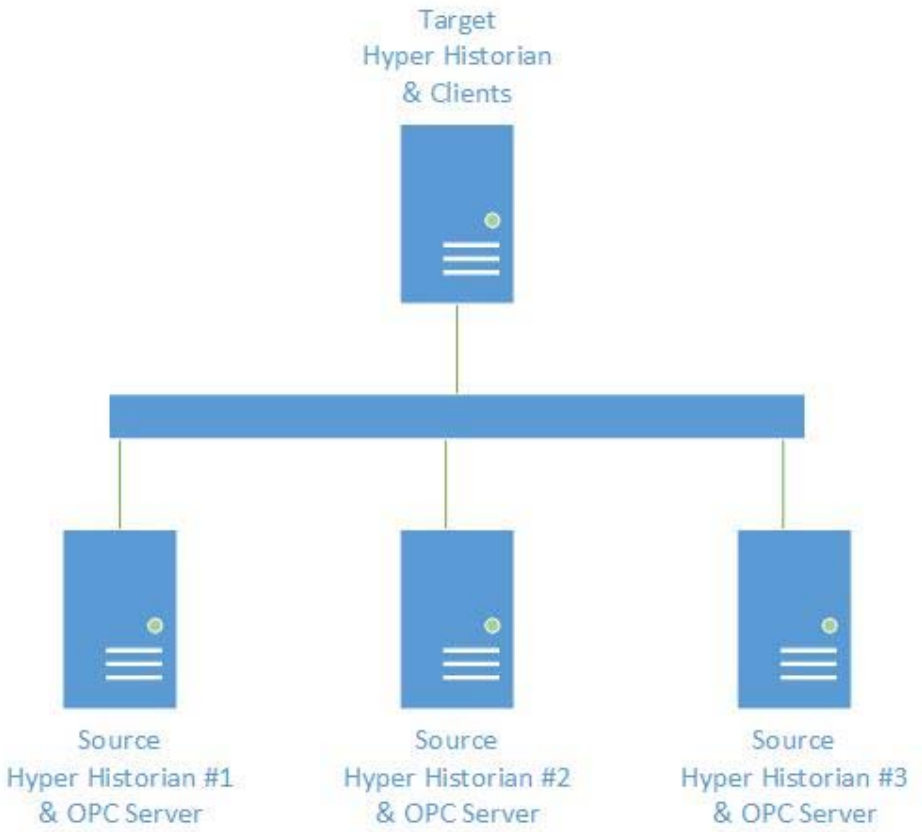
3.6.2. System and Network Architecture

The target Hyper Historian was running on a separate computer than the Source Hyper Historians. The OPC Servers, as data sources, were installed on the same computer as the Source Hyper Historian.

Tests were done and measured in a separate domain designed for testing purposes only. This network used Gigabit Ethernet.

See Image 3 for how the Network Architecture was set up for these tests.

Image 3



3.6.3. Testing Methodology

OPC Servers installed on the machines provided the data to Source Hyper Historians through FrameWorX Server (GenClient). Hyper Historian collected the data according to the specified data collection rate. The number of **configured Hyper Historian tags** divided by **data collection rate** provided the **samples/sec** rate.

Target Hyper Historians merged the data from the Source Hyper Historians based on a specified merge interval. Also, the Snapshot feature was enabled for all merged Hyper Historian Tags.

3.6.4. Performance Results

Tab 9. – Hyper to Hyper Performance Tests

PC	# configured tags	samples /sec	data collection rate / merge interval	OPC Server	HH CPU	HH RAM	HH CPU peak	HH RAM peak	FWX CPU	FWX RAM	duration	size of HHD	size of HHD snapshot	result
PC4	Target HH 10,000	10,000	1 minute		**2.8**	**1,442**	**9.8**	**1,985**	**1**	**527**	15	**400**	**560**	OK
PC5	Source HH 10,000	10,000	1 sec	OPC Sim	**62.5**	**1,774**	**143**	**2,427**	**3**	**521**	15	**400**		OK
PC4	Target HH 20,000	20,000	1 minute		**4.4**	**1,750**	**10.7**	**2,565**	**2**	**526**	22	**800**	**1,114**	OK
PC5	Source HH 20,000	20,000	1 sec	OPC Sim	**140.5**	**2,469**	**173.8**	**3,697**	**7**	**542**	22	**800**		OK
PC4	Target HH 30,000	30,000	1 minute		**4.4**	**1,803**	**12.1**	**2,876**	**2**	**595**	14	**1,200**	**1,660**	Merging was delayed to ~7.5 minutes
PC5	Source HH 20,000	20,000	1 sec	OPC Sim	**86.4**	**2,241**	**178.9**	**4,304**	**6**	**553**	14	**800**		OK
PC2	Source HH 10,000	10,000	1 sec	OPC Sim	**23.3**	**1,219**	**78.4**	**1,660**	**5**	**345**	14	**400**		OK
PC4	Target HH 40,000	40,000	1 minute		**5.1**	**1,978**	**10.9**	**3,235**	**3**	**616**	15	**1,600**	**2,200**	Merging was delayed to ~10 minutes
PC5	Source HH 20,000	20,000	1 sec	OPC Sim	**50.8**	**2,306**	**160**	**4,150**	**4**	**549**	15	**800**		OK
PC2	Source HH 20,000	20,000	1 sec	OPC Sim	**41.6**	**1,936**	**80**	**3,134**	**8**	**366**	15	**800**		OK
PC4	Target HH 50,000	50,000	1 minute		**6.1**	**2,457**	**17.6**	**4,661**	**3**	**703**	64	**1,400**	**2,000**	Merging delayed to ~ 1 day
PC5	Source HH 50,000	50,000	1 sec	OPC Sim	**167**	**4,466**	**183**	**7,094**	**7**	**590**	64	**1,400**		OK
PC4	Target HH 60,000	60,000	1 minute		**5.4**	**2,031**	**13.5**	**3,159**	**5**	**683**	24	**1,600**	n/a	Merging was delayed to ~7 minutes
PC1	Source HH 20,000	20,000	1 sec	OPC Sim	**27.3**	**2,161**	**71**	**3,447**	**3**	**457**	24	**800**		OK
PC8	Source HH 20,000	20,000	1 sec	OPC Sim	**31.9**	**1,747**	**79.5**	**3,061**	**4**	**405**	24	**800**		OK

PC7	Source HH 20,000	20,000	1 sec	OPC Sim	**17.9**	**2,185**	**72**	**3,511**	**3**	**364**	24	**800**		OK
PC4	Target HH 80,000	80,000	1 minute		**6.9**	**2,477**	**28.3**	**7,274**	**6**	**576**	16	**2,989**	n/a	Merging was delayed to ~12 minutes
PC1	Source HH 20,000	20,000	1 sec	OPC Sim	**25.6**	**2,164**	**70.2**	**3,436**	**3**	**460**	16	**800**		OK
PC8	Source HH 20,000	20,000	1 sec	OPC Sim	**33.2**	**1,724**	**74**	**2,758**	**4**	**407**	16	**800**		OK
PC7	Source HH 20,000	20,000	1 sec	OPC Sim	**16.3**	**2,209**	**58**	**3,652**	**3**	**359**	16	**800**		OK
PC5	Source HH 20,000	20,000	1 sec	OPC Sim	**23**	**2,117**	**134**	**4,210**	**3**	**593**	16	**640**		OK

3.6.5. Summary

Hyper to Hyper worked without any delay for the logged **20,000 samples per second** when merged every one (1) minute. The higher rates of samples per second still had the delay in the merging process.

The Hyper to Hyper feature is very demanding on the **CPU usage** of the Source Hyper Historian, as it periodically requests all logged samples. Better performance results are achieved with more Source Hyper Historians with smaller configurations.

3.7. Raw Data - Version Benchmark (Out-Proc)

3.7.1. Overview

These test cases provide a performance overview for logging the data in steady throughput when Enterprise Edition was used for the same number of configured tags and data collection rate across the released versions of Hyper Historian. Enterprise Edition means that Hyper Historian Collector runs as a standalone service, in this case, on the same machine, like Hyper Historian Logger.

3.7.2. System and Network Architecture

Everything is running on a single workstation.

3.7.3. Testing Methodology

The OPC Server, installed on the same machine, provides the data to Hyper Historian through FrameWorX Server (GenClient). Hyper Historian collected the data according to the specified data collection rate. The number of **configured Hyper Historian tags** divided by **data collection rate** provided the **samples/sec** rate.

The Hyper Historian configuration was created in version 10.51 and then upgraded for all newer versions.

Tests were performed on a Virtual Machine.

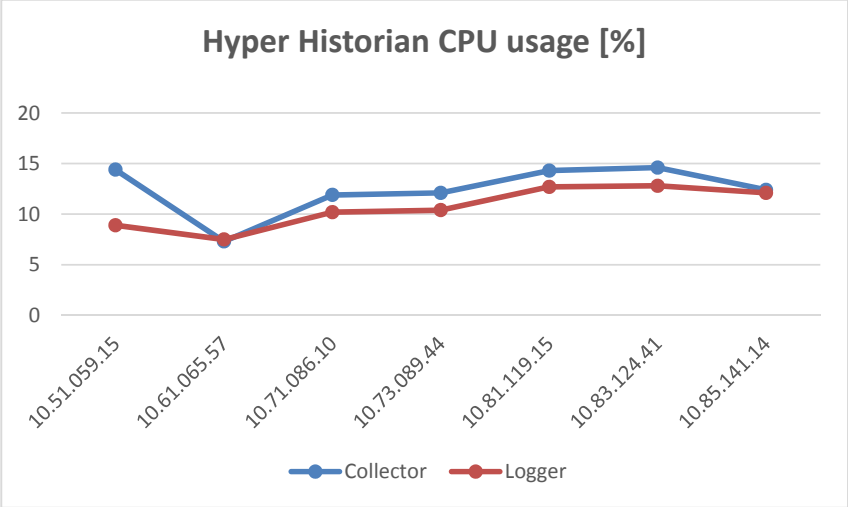
3.7.4. Performance Results

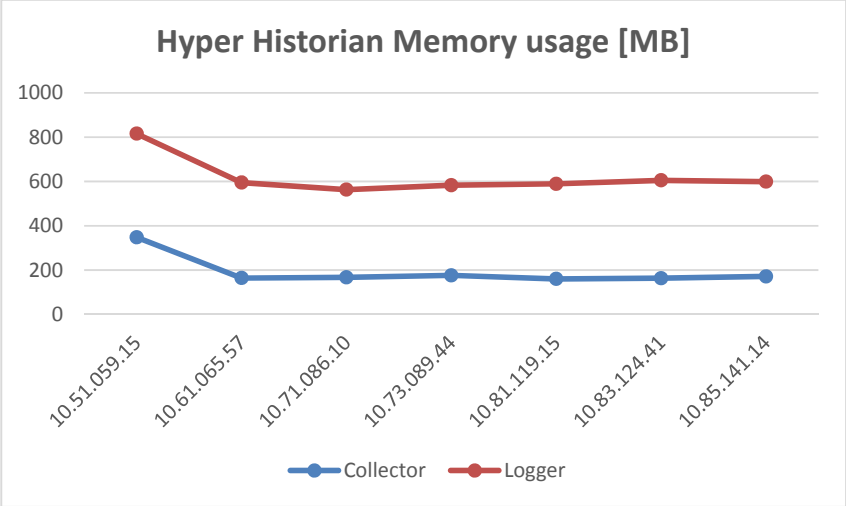
Tab 10. – Hyper Historian Benchmark Tests

PC	HH version	# of configured tags	Samples/sec	data collection rate	OPC Server	HH CPU	HH RAM	HH CPU peak	HH RAM peak	size of HHD	duration	result
VM1	10.51.059.15	Logger 10,000				**8.9**	**816**	**20**	**888**	**560**	1	OK
		Collector 10,000	10,000	1 sec	OPC Sim	**14.4**	**348**	**21**	**361**			OK
VM1	10.61.065.57	Logger 10,000				**7.5**	**595**	**22**	**1,102**	**400**	**1**	OK
		Collector 10,000	10,000	1 sec	OPC Sim	**7.3**	**164**	**14**	**193**			OK
VM1	10.71.086.10	Logger 10,000				**10.2**	**563**	**28**	**1,233**	**400**		OK
		Collector 10,000	10,000	1 sec	OPC Sim	**11.9**	**167**	**19**	**208**		**13**	OK
VM1	10.73.089.44	Logger 10,000				**10.4**	**583**	**25**	**1,020**			OK
		Collector 10,000	10,000	1 sec	OPC Sim	**12.1**	**176**	**18**	**260**	**320**	**1.5**	OK
VM1	10.81.119.15	Logger 10,000				**12.7**	**589**	**27**	**1,001**			OK
		Collector 10,000	10,000	1 sec	OPC Sim	**14.3**	**160**	**17**	**190**	**400**	**1**	OK
VM1	10.83.124.41	Logger 10,000				**12.8**	**605**	**29**	**1,102**			OK
		Collector 10,000	10,000	1 sec	OPC Sim	**14.6**	**163**	**20**	**183**	**400**	**12**	OK
VM1	10.85.141.14	Logger 10,000				**12.1**	**599**	**25**	**1,111**			OK
		Collector 10,000	10,000	1 sec	OPC Sim	**12.4**	**171**	**19**	**197**	**400**	4	OK

3.7.5. Summary

Hyper Historian CPU usage was slightly improved in the latest v10.85 version. The memory usage is roughly on the same level, like previous versions.





3.8. Merging Data using MergeWorX

3.8.1. Overview

The purpose of this test is to document the performance and capabilities of MergeWorX, which is a tool for merging structured data into Hyper Historian. It should answer the main question, “What are the performance benefits between using a small number of files with a lot of data or a large number of files with a little data?”.

3.8.2. System and Network Architecture

Everything is running on a single workstation – PC6.

3.8.3. Testing Methodology

Hyper Historian was configured with only one non-collected tag. Using the “MergeWorXCsvDataGenerator” tool created, for each Test Case, a set of CSV files that contained 3,600,000 samples. These CSV files contained random float values in a range from 0 to 100. The CSV files were stored on an SSD and, after processing by MergeWorX, moved to a standard HDD. Hyper Historian HHD files were also stored on the standard HDD.

There was a measured time when MergeWorX, based on the trigger, started processing the CSV files and all the CSV files were processed and all data merged into Hyper Historian.

3.8.4. Test Case 1

MergeWorX: 7 csv files, each containing 500,000 samples for one (1) tag, one (1) sample; each one (1) second, 19.5 MB size

Time to process all CSV files: **15:10** (mm:ss)

Average time to process one CSV file: **130** seconds

Time to write all data to HHD files: **15:53** (mm:ss)

	Average CPU [%]	Peak CPU [%]	Average RAM [MB]	Peak RAM [MB]
HHLoggerService	8.31	16.25	517	554
MGXCoreService	55.25	68.54	80	82
IcoFwxServer	6.53	11.46	328	329

3.8.5. Test Case 2

MergeWorX: 35 csv files, each containing 100,000 samples for one (1) tag, one (1) sample; each one (1) second, 3.9 MB size

Time to process all CSV files: **8:49** (mm:ss)

Average time to process one CSV file: **15** seconds

Time to write all data to HHD files: **9:59** (mm:ss)

	Average CPU [%]	Peak CPU [%]	Average RAM [MB]	Peak RAM [MB]
HHLoggerService	10.62	16.77	536	586
MGXCoreService	26.62	29.06	79	81
IcoFwxServer	10.30	11.25	330	361

3.8.6. Test Case 3

MergeWorX: 350 csv files, each containing 10,000 samples for one (1) tag, one (1) sample; each one (1) second, 390 kB size

Time to process all CSV files: **7:59** (mm:ss)

Average time to process one CSV file: **1.4** second

Time to write all data to HHD files: **8:40** (mm:ss)

	Average CPU [%]	Peak CPU [%]	Average RAM [MB]	Peak RAM [MB]
HHLoggerService	12.01	18.54	576	624
MGXCoreService	15.01	16.35	81	82
IcoFwxServer	11.96	13.03	327	327

3.8.7. Test Case 4

MergeWorX: 3,500 csv files, each contains 1,000 samples for one tag, 1 sample each 1 second, 38 kB size. MergeWorX processed 10 csv files in one shot.

Time to process all CSV files: **7:59** (mm:ss)

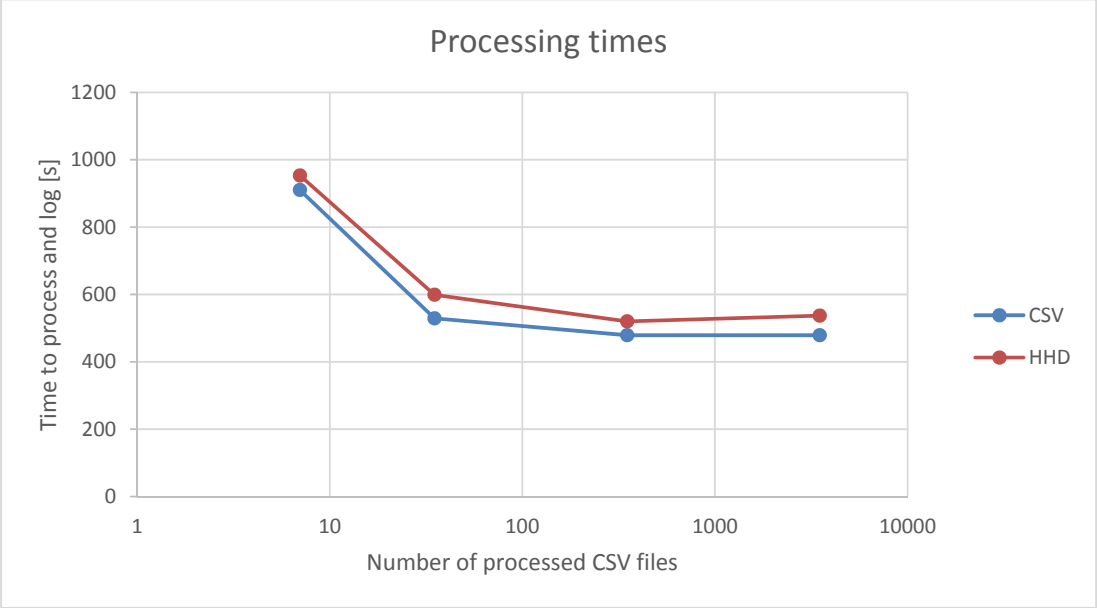
Average to process 10 CSV files: **1.4** seconds

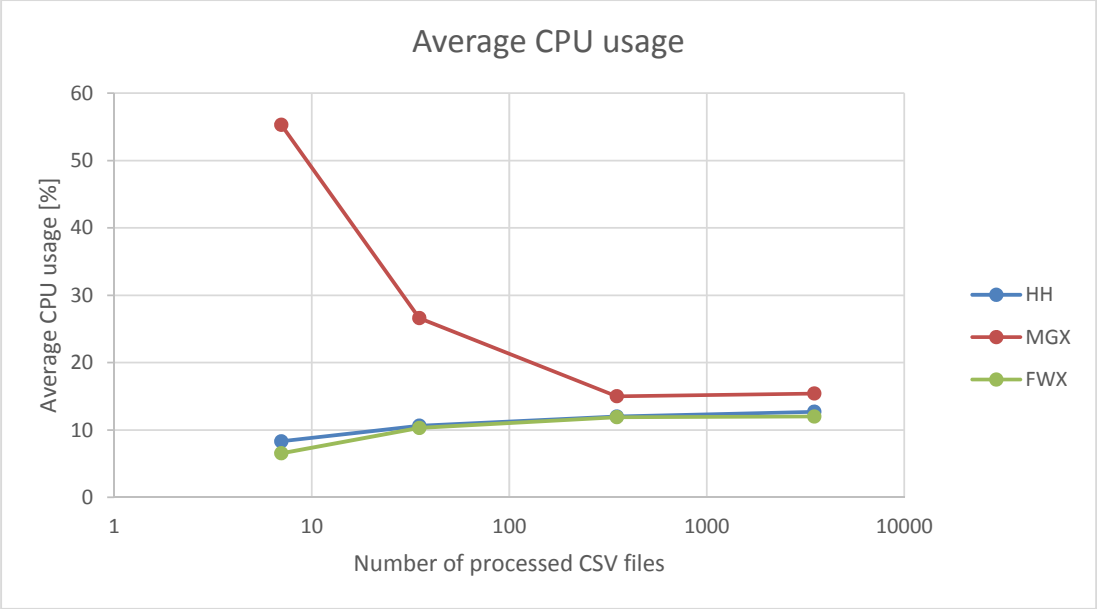
Time to write all data to HHD files: **8:57** (mm:ss)

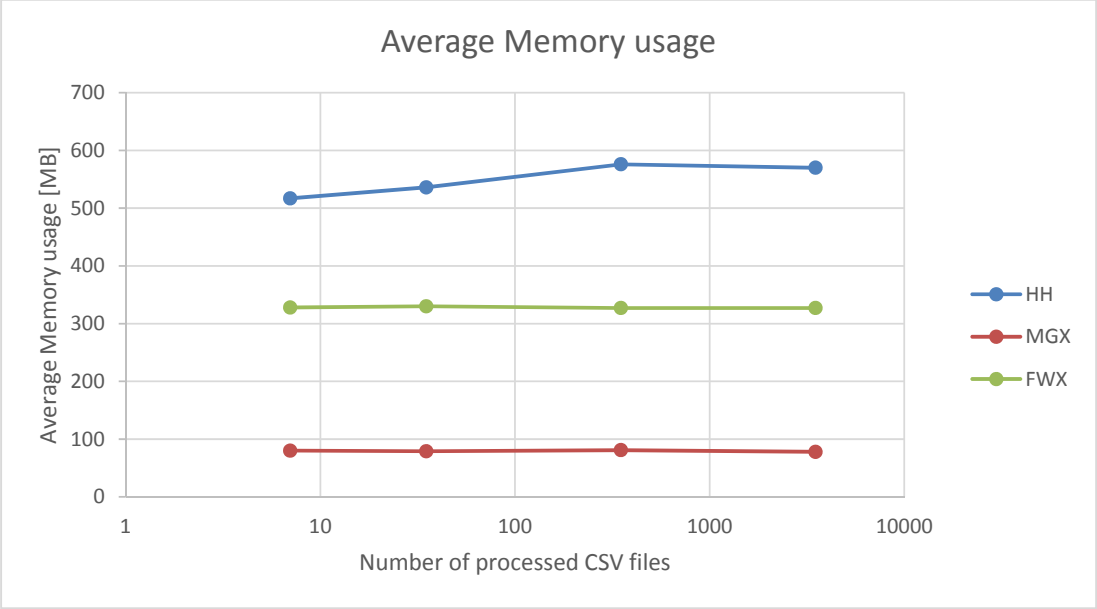
	Average CPU [%]	Peak CPU [%]	Average RAM [MB]	Peak RAM [MB]
HHLoggerService	12.74	22.81	570	609
MGXCoreService	15.44	18.02	78	84
IcoFwxServer	12.03	14.58	327	328

3.8.8. Charts

Measured data in graphs:







3.8.9. Summary

According to the specification, when we were trying to merge 3,600,000 samples from CSV files using MergeWorX into Hyper Historian, the best approach is to use a lot of files with little data (350 CSV files with 10,000 samples each). Its processing time, and also CPU usage, is much better than when using a small number of files with a lot of data.

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