



FAQ • 02/2015

Help for Planning Plants with PCS 7 OPC DA /OPC UA

SIMATIC PCS 7

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Question

What is the performance of OPC DA / OPC UA in a PCS 7 standard configuration?

Answer

Observe the performance data listed in this document for a detailed answer to the above question.

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1 Reason

OPC is the standard communication channel between a PCS 7 plant and a third-party system. Here, questions are often asked about the performance of the OPC DA / OPC UA server components of the PCS 7 system.

In this test description we have selected three PCS 7 configurations and examined them for their OPC DA / OPC UA performance.

WARNING **The measured data applies only to the tested configurations under the given conditions.**
Other configurations and conditions can lead to different measured values.

2 Goals

The documentation is designed to help you plan a PCS 7 plant in which OPC communication is to be used.

The focus here is on showing the OPC DA / OPC UA performance in the PCS 7 standard configurations

3 General Information on the Topic of OPC DA / OPC UA Performance in the PCS 7 Environment

In the PCS 7 environment, the WinCC OPC DA / OPC UA server components can be used on an OS Single Station, an OS Server or an OS Client.

The PCS 7 OPC DA / OPC UA server components can be used on an Open PCS 7 Station.

We recommend using the Open PCS 7 OPC server components, because these are completely system tested and released.

The performance of an OPC DA / OPC UA server depends on the parameters below:

- Computer hardware used
- PCS 7 configuration
- Network performance
- PCS 7 configuration
- How the OPC client logs on the OPC tags
- OPC client used
- Implementation of other components that put a load on the OPC computer hardware

Due to the multiple possible configuration options it is impossible to give a generally valid statement about performance.

4 Explanation of Performance Measurements

PCS 7 V8.1 was used for the measurements featured in this FAQ response. A detailed description of the hardware and software used is available in the relevant chapters.

Table 4-1

Measuring Point	Meaning
OPC DA tags [s] of AS1	Logged-on OPC tags by means of the Matrikon OPC Explorer
OPC Data Change Rate [s] of the AS1 of the OPC client	Values calculated by Matrikon OPC client
Data Change Rate AS1 [s]	Through configuration of a sine value in the AS
OPC Data Change Rate [s] of the AS2 of the OPC client	Values calculated by Matrikon OPC client
OPC DA tags [s] of AS2	Logged-on OPC tags by means of the Matrikon OPC Explorer
Data Change Rate AS2 [s]	Through configuration of a sine value in the AS
Change of screen opening time [%] over 5 measurements. Percentage with reference to measurement 1.	Value measured with stopwatch
Reaction time of OS channel (OS1 – AS1) [ms], worst case	Value measured with OS script
Reaction time of OS channel (OS1 – AS2) [ms], worst case	Value measured with OS script
Telegram rate from OS1 to AS1 (50)	Value measured with WhireShark
Telegram rate from OS1 to AS2 (25)	Value measured with WhireShark
Total processor load of OS1 (average on screen change in 10s cycle)	Value measured with MS Performance Monitor
Network load of terminal bus	Value measured with MS Performance Monitor

Table 4-2

Channel Diagnosis	
Tags in 1s cycle AS1	Counter in the OS Channel Diagnosis
Cycle overload 1s AS1	Counter in the OS Channel Diagnosis
Requests 1s AS1	Counter in the OS Channel Diagnosis
Tags in 2s cycle AS1	Counter in the OS Channel Diagnosis
Cycle overload 2s AS1	Counter in the OS Channel Diagnosis
Requests 2s AS1	Counter in the OS Channel Diagnosis
Tags in 60min cycle AS1	Counter in the OS Channel Diagnosis
Cycle overload 60min AS1	Counter in the OS Channel Diagnosis
Requests 60min AS1	Counter in the OS Channel Diagnosis
Read Response Time AS1, worst case [ms]	Counter in the OS Channel Diagnosis
Cycle Create Response AS1, worst case [ms]	Counter in the OS Channel Diagnosis
Tags in 1s cycle AS2	Counter in the OS Channel Diagnosis
Cycle overload 1s AS2	Counter in the OS Channel Diagnosis
Requests 1s AS2	Counter in the OS Channel Diagnosis
Tags in 2s cycle AS2	Counter in the OS Channel Diagnosis
Cycle overload 2s AS2	Counter in the OS Channel Diagnosis
Requests 2s AS2	Counter in the OS Channel Diagnosis
Tags in 60min cycle AS2	Counter in the OS Channel Diagnosis
Cycle overload 60min AS2	Counter in the OS Channel Diagnosis
Requests 60min AS2	Counter in the OS Channel Diagnosis
Read Response Time AS2, worst case [ms]	Counter in the OS Channel Diagnosis
Cycle Create Response AS2, worst case [ms]	Counter in the OS Channel Diagnosis
Request Queue Size AS1	Counter in the OS Channel Diagnosis
Request Queue Size AS2	Counter in the OS Channel Diagnosis
Own Cycles AS1	Counter in the OS Channel Diagnosis
Own Cycles AS2	Counter in the OS Channel Diagnosis

Key

- n. a. = not available
- **green = OK**
No queue. More than 98 % of tags are updated
- **yellow = limit**
A queue is forming. More than 90 % of tags are updated
- **red = overload**
There is a permanent queue. Fewer than 90 % of tags are updated

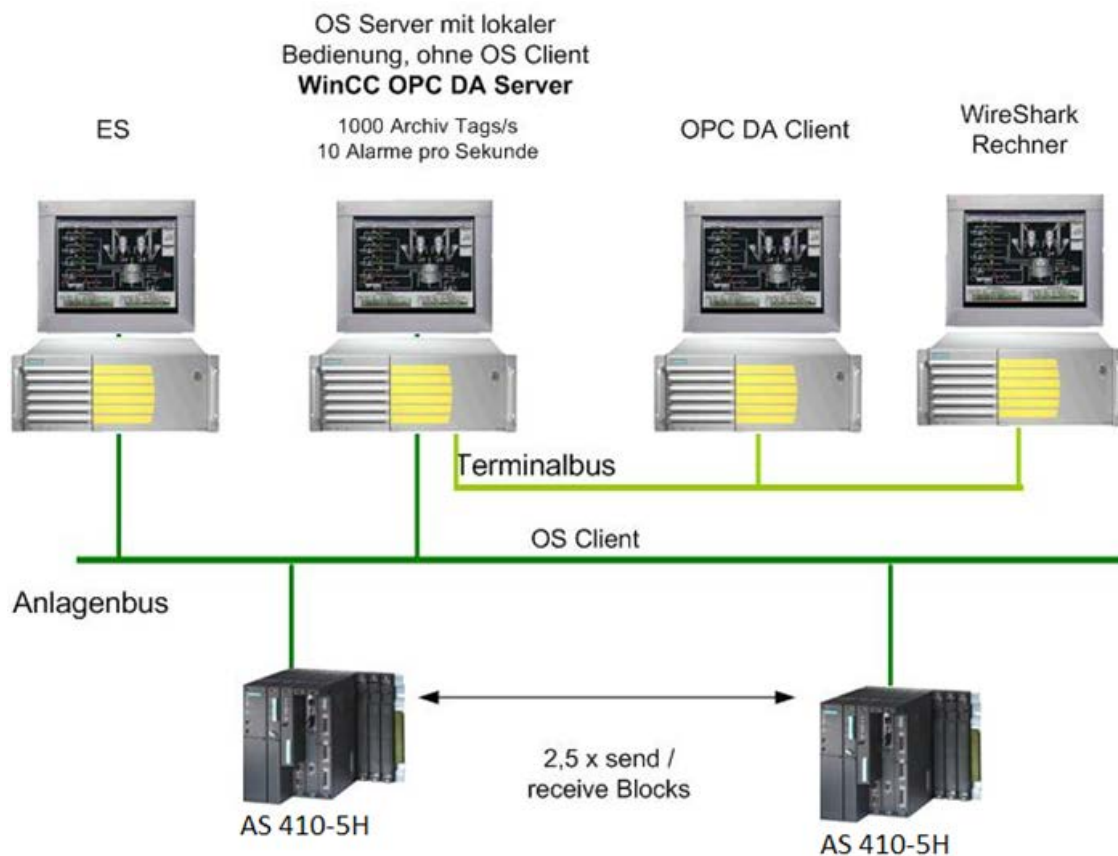
5 PCS 7 Test Configuration 1

Configuration 1 is an OS server system for operating and monitoring. An OS client is not in operation. This configuration corresponds to an OS Single Station, but is operated with a Microsoft Server 2008 R2 operating system.

The PCS 7 functions below were executed during the OPC test:

- 2.5 telegrams/s through AS-AS communication
- 10 alarms/s were triggered
- 1000 OS tags/s were archived

Figure 5-1



5.1 Conditions Configuration 1

Table 5-1

Computer	Computer hardware	Software installation	Computer name
ES	SIMATIC IPC 547E, Core i7-4770S, 3.1 GHz, 32 DDR3 1600 SDRAM	Windows 7 Ultimate SP1	ES01
OS server	SIMATIC IPC 547E, Core i7-4770S, 3.1 GHz, 32 DDR3 1600 SDRAM	Windows Server 2008 R2 Standard	OSSRV1
OPC client	SIMATIC IPC 547E, Core i7-4770S, 3.1 GHz, 32 DDR3 1600 SDRAM	Windows 7 Ultimate SP1	ES03
Wireshark computer	SIMATIC IPC 547E, Core i7-4770S, 3.1 GHz, 32 DDR3 1600 SDRAM	Windows 7 Ultimate SP1	ES04

Table 5-2

Network components	Network hardware plant bus	Network hardware terminal bus
Switch	SCALANCE X212-2	SCALANCE X308-2
ES	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
OS	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
OPC client	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
Wireshark computer	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
Plant bus = 100 Mbps		
Terminal bus = 100 Mbps		
Alarm logging / Tag logging		
Archive tags	Approx. 500 tags / s from AS1 + 500 tags / s from AS2	Archive tags
Message incidence	Approx. 10 messages / s	Message incidence
PCS 7 version		
V8.1		
OPC client components		
OPC DA client = Matrikon OPC Explorer V5.0		
Process screens		
Most process screens have 36 process symbols.		
Screens with 100 process symbols are used for the screen opening time test.		

General information	
The reaction of the AS-OS connection is determined with a cyclic GetTagWait command.	
Automation systems	
AS1	CPU 410-5H V8.0.0
AS2	CPU 410-5H V8.0.0

5.2 Measurement Series Configuration 1

Table 5-3

Configuration 1	Measurement												
	1	2	3	4	5	6	7	8	9	10	11	12	13
OPC DA tags [s] of AS1	0	1000	2000	5000	8000	11000	12000	13000	15000	20000	30000	40000	50000
OPC Data Change Rate [s] of the AS1 of the OPC client	0	1050	2050	5000	8000	10600	11600	12400	12400	12400	12600	12800	12800
OPC DA tags [s] of AS2	0	1000	2000	5000	8000	11000	12000	13000	15000	20000	30000	40000	50000
OPC Data Change Rate [s] of the AS2 of the OPC client	0	1040	2000	5000	8000	10700	11600	12200	12200	12400	12600	12700	12700
Change of screen opening time as a percentage over 5 measurements.	1,2	1,5	1,5	1,6	1,6	1,6	1,7	1,8	2	2	2,2	2,2	2,2
Reaction time of OS channel (OS1 - AS1) [ms], worst case	6	7	10	7	13	37	101	131	321	857	1859	2913	4035
Reaction time of OS channel (OS1 - AS2) [ms], worst case	7	10	7	10	18	48	88	139	355	871	1880	2986	4084
Total processor utilization of OSSRV1 (on average for screen change (100 POs) in a 5 s cycle, average value Perfmon)	3,00%	7,00%	7,00%	8,00%	10,00%	13,00%	14,00%	14,00%	14,00%	15,00%	15,00%	15,00%	15,00%
Network utilization of terminal bus	0,00%	0,81%	1,60%	3,90%	6,00%	8,00%	8,70%	9,20%	9,40%	9,50%	9,60%	9,80%	9,90%

Table 5-4

Channel Diagnosis	Measurement												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Tags in 1 s cycle AS1	490	1490	2490	5490	8490	11353	12251	13194	15151	19965	29689	39422	49113
Cycle overload 1 s AS1	0	0	0	0	0	0	0	0	0	0	0	0	0
Requests 1s AS1	7	16	25	53	81	107	116	124	143	187	277	367	457
Tags in 2s cycle AS1	10	10	154	154	154	154	10	10	10	154	404	10	154
Cycle overload 2s AS1	0	0	0	0	0	0	0	0	0	0	0	0	0
Requests 2s AS1	3	3	3	3	3	3	3	3	3	3	7	1	3
Tags in 60min cycle AS1	0	0	36	36	36	36	0	0	0	36	100	0	36
Cycle overload 60min AS1	0	0	0	0	0	0	0	0	0	0	0	0	0
Requests 60min AS1	0	0	1	1	1	1	0	0	0	1	2	0	1
Read Response Time AS1, worst case [ms]	16	19	17	41	47	47	49	47	49	44	52	50	45
Cycle Create Response AS1, worst case [ms]	20	27	n.a.	19	23	23	27	22	n.a.	n.a.	n.a.	n.a.	n.a.
Tags in 1s cycle AS2	490	1490	2490	5490	8490	11335	12226	13164	15128	19990	29707	39332	48991
Cycle overload 1s AS2	0	0	0	0	0	0	0	0	0	0	0	0	0
Requests 1s AS2	7	16	26	53	81	107	116	124	143	188	278	367	456
Tags in 2s cycle AS2	10	10	10	10	10	10	10	10	10	10	10	10	10
Cycle overload 2s AS2	0	0	0	0	0	0	0	0	0	0	0	0	0
Requests 2s AS2	1	2	2	2	2	2	2	2	2	3	3	3	1
Tags in 60min cycle AS2	0	0	0	0	0	0	0	0	0	0	0	0	0
Cycle overload 60min AS2	0	0	0	0	0	0	0	0	0	0	0	0	0
Requests 60min AS2	0	0	0	0	0	0	0	0	0	0	0	0	0
Read Response Time AS2, worst case [ms]	7	7	10	43	41	44	42	52	45	53	49	48	49

Channel Diagnosis	Measurement												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Cycle Create Response AS2, worst case [ms]	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.
Request Queue Size AS1	0	0	0	0	0	3	4	7	23	70	160	248	340
Request Queue Size AS2	0	0	0	0	0	3	4	7	23	70	160	248	335
Own Cycles AS1	0	0	0	25	52	78	87	95	114	159	254	336	429
Own Cycles AS2	0	0	0	23	51	77	86	94	113	159	249	338	425

Table 5-5

Result	Measurement												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Total Tag Load AS1/s	495	1495	2567	5567	8567,01	11430	12256	13199	15156	20042	29891	39427	49190
Total Tag Load AS2/s	495	1495	2495	5495	8495	11340	12231	13169	15133	19995	29712	39337	48996
Total Tag Load WinCC channel/s	990	2990	5062	11062	17062	22770	24487	26368	30289	40037	59603	78764	98186
Subscribed to OPC DA tags/s	0	2000	4000	10000	16000	22000	24000	26000	30000	40000	60000	80000	100000
Updated OPC tags/s	0	2090	4050	10000	16000	21300	23200	24600	24600	24800	25200	25500	25500
Updated tags in relation to subscribed OPC tags/s		104,5%	101,3%	100,0%	100,0%	96,8%	96,7%	94,6%	82,0%	62,0%	42,0%	31,9%	25,5%

Notes If there are more than a total of 80,000 subscribed OPC-DA tags and a group change on the OPC client, it may not be possible to use the Matrikon client at times, however it stabilizes again after a few seconds.

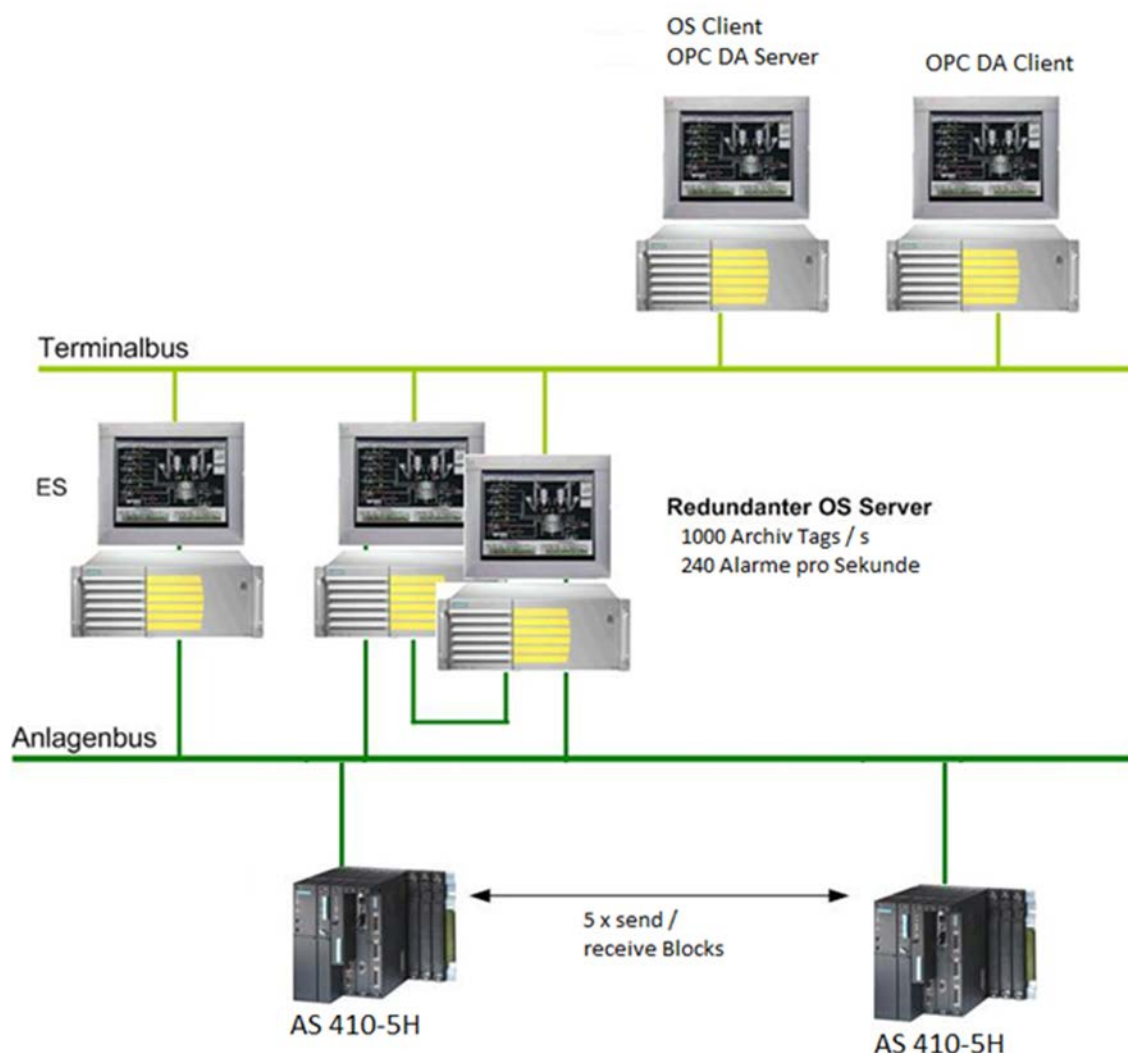
6 PCS 7 Test Configuration 2

Configuration 2 is a setup with a redundant OS server, an Engineering System, an OS client, on which the WinCC OPC DA server installed by default is used and an OPC client computer. Two redundant automation systems were used.

The PCS 7 functions below were executed during the OPC test:

- 5 telegrams/s through AS-AS communication
- 10 alarms/s were triggered
- 1000 OS tags/s were archived

Figure 6-1



6.1 Conditions Configuration 2

Table 6-1

Computer	Computer hardware	Software installation	Computer name
ES	SIMATIC IPC 547E, CPU Core i7-4770S, 3.1GHz, 32 GB DDR3 1600 SDRAM	Windows 7 Ultimate SP1	ES01
OS server A	SIMATIC IPC 547E, CPU Core i7-4770S, 3.1GHz, 32 GB DDR3 1600 SDRAM	Windows Server 2008 R2 Standard	OSSRV1
OS server B	SIMATIC IPC 547E, CPU Core i7-4770S, 3.1GHz, 32 GB DDR3 1600 SDRAM	Windows Server 2008 R2 Standard	OSSRV2
OPC client	SIMATIC IPC 547E, CPU Core i7-4770S, 3.1GHz, 32 GB DDR3 1600 SDRAM	Windows 7 Ultimate SP1	ES03
WireShark computer	SIMATIC IPC 547E, CPU Core i7-4770S, 3.1GHz, 32 GB DDR3 1600 SDRAM	Windows 7 Ultimate SP1	ES04
OS client	SIMATIC IPC 547E, CPU Core i7-4770S, 3.1GHz, 32 GB DDR3 1600 SDRAM	Windows 7 Ultimate SP1	ES05

Table 6-2

Network components	Network hardware plant bus	Computer name
Switch	SCALANCE X212-2	SCALANCE X308-2
ES	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
OS server	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
OS server	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
OS client	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
OPC client	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
Wireshark computer	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
Plant bus = 100 Mbps		
Terminal bus = 100 Mbps		
Alarm logging / Tag logging		
Archive tags	Approx. 500 tags / s from AS1 + 500 tags / s from AS2	
Message incidence	Approx. 10 messages / s	
PCS 7 version		
V8.1		

OPC client components	
OPC DA client = Matrikon OPC Explorer V5.0	
Process screens	
Most process screens have 36 process symbols.	
Screens with 100 process symbols (MonAnL Block Icon) are used for the screen opening time test.	
General information	
The reaction of the AS-OS connection is determined with a cyclic GetTagWait command.	
Automation systems	
AS1	CPU 410-5H V8.0.0
AS2	CPU 410-5H V8.0.0

6.2 Measurement Series Configuration 2

Table 6-3

Configuration 2	Measurement										
	1	2	3	4	5	6	7	8	9	10	11
OPC DA tags [s] of AS1	0	1000	2000	5000	8000	11000	12000	13000	15000	20000	30000
Data Change Rate AS1 [s] (measured by OPC Explorer)	0	1050	2060	5000	8000	10800	11600	11600	11600	11600	11600
OPC DA tags [s] of AS2	0	1000	2000	5000	8000	11000	12000	13000	15000	20000	30000
Data Change Rate AS2 [s] (measured by OPC Explorer)	0	1040	2060	5000	8000	10700	11600	11600	11600	11600	11600
Change of screen opening time on the master OS server as a percentage over 5 measurements.	2	2	2	2	2	2	2	2	2,1	2,3	3,7
Change of screen opening time on the OS client as a percentage over 5 measurements.	2,1	2,1	2,2	2,2	2,2	2,2	2,2	2,2	2,3	2,6	3,3
Reaction time of OS channel (OS1 – AS1) [ms], worst case	8	9	8	17	20	87	139	224	426	1001	2076
Reaction time of OS channel (OS1 – AS2) [ms], worst case	7	9	7	22	16	70	121	270	448	990	2089
Total processor load of the master OS (OSSRV1, average on screen change in 10s cycle of the OS client)	7,00%	8,00%	8,00%	9,00%	10,00%	13,00%	13,00%	14,00%	15,00%	15,00%	16,00%
Total processor load of the standby OS (OSSRV1) (empty screen opened)	4,00%	4,00%	6,00%	3,00%	3,00%	4,00%	3,00%	4,00%	4,00%	3,00%	4,00%
Network load of the terminal bus master OS (OSSRV2, empty screen, no screen change on the OS client)	0,70%	1,90%	1,90%	2,00%	2,00%	2,20%	2,20%	2,20%	2,20%	2,20%	2,30%

Configuration 2	Measurement										
	1	2	3	4	5	6	7	8	9	10	11
Total processor load of the terminal bus standby OS (OSSRV2) (empty screen)	0,90%	1,70%	1,70%	1,70%	1,70%	1,72%	1,74%	1,72%	1,72%	1,72%	1,74%
Total processor load of the OS client when the process screen is updated with 100 POs (MonAnL) in the screen cycle	1,00%	1,00%	1,00%	1,00%	1,00%	1,00%	1,50%	1,50%	1,50%	1,50%	1,50%
Total processor load of the OS client on average without screen change, empty screen opened	1,00%	1,00%	1,00%	1,00%	1,00%	1,00%	1,00%	1,00%	1,00%	1,00%	1,00%
Network load of terminal bus client	0,05%	0,90%	1,70%	4,00%	6,20%	8,40%	9,10%	9,00%	9,20%	9,30%	9,50%

Table 6-4

Channel Diagnosis (without cyclic screen change)	Measurement										
	1	2	3	4	5	6	7	8	9	10	11
Tags in 1s cycle AS1	492	1492	2492	5492	8492	11489	12467	13437	15380	20305	29692
Cycle overload 1s AS1	0	0	0	0	0	0	0	0	0	0	0
Requests 1s AS1	5	14	24	51	79	107	116	125	143	189	275
Tags in 2s cycle AS1	10	10	10	10	10	10	10	10	10	10	10
Cycle overload 2s AS1	0	0	0	0	0	0	0	0	0	0	0
Requests 2s AS1	1	1	1	1	1	1	1	1	1	1	1
Tags in 60min cycle AS1	0	0	0	0	0	0	0	0	0	0	0
Cycle overload 60min AS1	0	0	0	0	0	0	0	0	0	0	0
Requests 60min AS1	0	0	0	0	0	0	0	0	0	0	0
Read Response Time AS1, worst case [ms]	6	13	27	39	42	48	44	43	50	48	41
Cycle Create Response AS1, worst case [ms]	n. a.	n. a.	n. a.	10	11	n. a.	n. a.	n. a.	19	26	34
Tags in 1s cycle AS2	491	1491	2491	5491	8491	11464	12438	13408	15348	20345	29691
Cycle overload 1s AS2	0	0	0	0	0	0	0	255	0	0	255
Requests 1s AS2	5	14	24	51	79	107	116	125	143	189	275
Tags in 2s cycle AS2	10	10	10	10	10	10	10	10	10	10	10
Cycle overload 2s AS2	0	0	0	0	0	0	0	0	0	0	0
Requests 2s AS2	1	1	1	1	1	1	1	1	1	1	1
Tags in 60min cycle AS2	0	0	0	0	0	0	0	0	0	0	0
Cycle overload 60min AS2	0	0	0	0	0	0	0	0	0	0	0
Requests 60min AS2	0	0	0	0	0	0	0	0	0	0	0
Read Response Time AS2, worst case [ms]	10	13	12	41	46	51	53	51	48	48	48
Cycle Create Response AS2, worst case	n. a.	n. a.	n. a.	15	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.

Channel Diagnosis (without cyclic screen change)	Measurement											
	1	2	3	4	5	6	7	8	9	10	11	
[ms]												
Request Queue Size AS1	0	0	0	0	3	5	6	15	33	75	160	
Request Queue Size AS2	0	0	0	0	2	5	6	15	33	77	160	
Own Cycles AS1	0	0	0	26	54	82	91	100	118	164	250	
Own Cycles AS2	0	0	0	26	54	82	91	100	118	164	250	
Tags in 1s cycle AS1	240	240	240	240	240	240	240	240	240	240	240	
Cycle overload 1s AS1	4,00%	5,00%	6,00%	9,00%	11,00%	13,00%	13,00%	13,00%	13,00%	13,00%	13,00%	

Table 6-5

Result	Measurement										
	1	2	3	4	5	6	7	8	9	10	11
Total Tag Load AS1/s	497	1497	2497	5497	8497	11494	12472	13442	15385	20310	29697
Total Tag Load AS2/s	496	1496	2496	5496	8496	11469	12443	13413	15353	20350	29696
Total Tag Load WinCC channel/s	993	2993	4993	10993	16993	22963	24915	26855	30738	40660	59393
Subscribed to OPC DA tags/s	0	2000	4000	10000	16000	22000	24000	26000	30000	40000	60000
Updated OPC tags/s	0	2090	4120	10000	16000	21500	23200	23200	23200	23200	23200
Updated in relation to subscribed OPC tags/s		104,5%	103,0%	100,0%	100,0%	97,7%	96,7%	89,2%	77,3%	58,0%	38,7%

7 PCS 7 Test Configuration 3

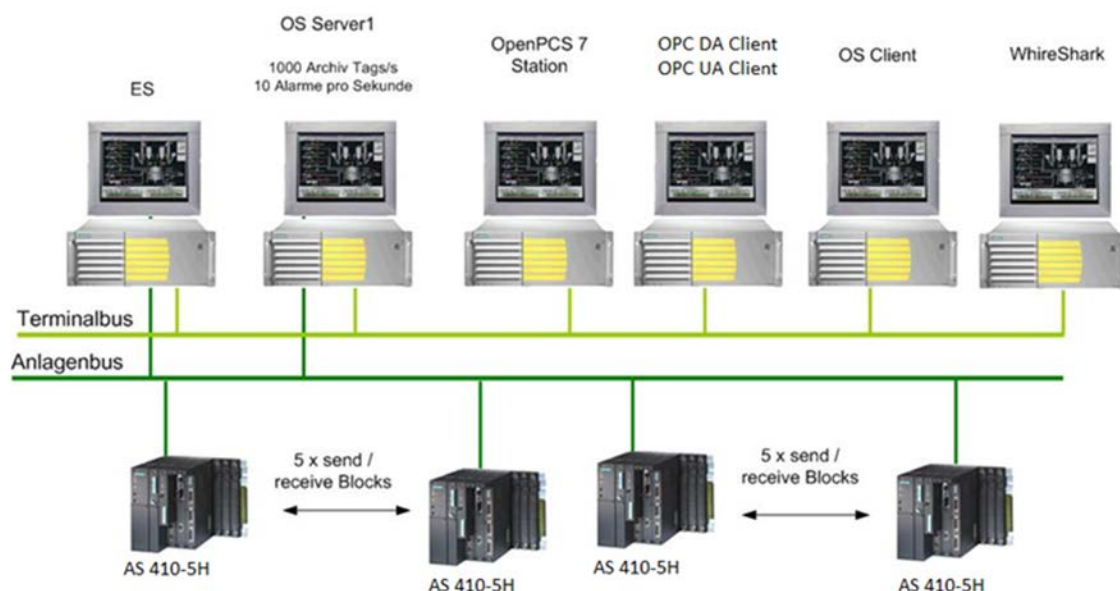
Configuration 3 is a setup with an OS server, an Engineering System, an OS client, an Open PCS 7 station, a Wireshark computer and an OPC client computer. Four automation systems were used.

OPC DA and OPC UA (with UAExpert client) were both used for measurements.

The PCS 7 functions below were executed during the OPC test:

- 5 telegrams/s through AS-AS communication between AS1 and AS2
- 5 telegrams/s through AS-AS communication between AS4 and AS5
- 10 alarms/s were triggered
- 1000 OS tags/s were archived

Figure 7-1



7.1 Conditions Configuration 3

Table 7-1

Computer	Computer hardware	Computer name	Software installation
ES	SIMATIC IPC 547E, CPU Core i7-4770S, 3.1GHz, 32 GB DDR3 1600 SDRAM	ES01	Windows 7 Ultimate SP1
OS server	SIMATIC IPC 547E, CPU Core i7-4770S, 3.1GHz, 32 GB DDR3 1600 SDRAM	OSSRV1	Windows Server 2008 R2 Standard
OpenPCS 7 Station without OS client functionality	SIMATIC IPC 547E, CPU Core i7-4770S, 3.1GHz, 32 GB DDR3 1600 SDRAM	ES04	Windows 7 Ultimate SP1
OPC DA / OPC UA client	SIMATIC IPC 547E, CPU Core i7-4770S, 3.1GHz, 32 GB DDR3 1600 SDRAM	ES03	Windows 7 Ultimate SP1
OS client	SIMATIC IPC 547E, CPU Core i7-4770S, 3.1GHz, 32 GB DDR3 1600 SDRAM	ES05	Windows 7 Ultimate SP1

Table 7-2

Network components	Network hardware plant bus	Network hardware terminal bus
Switch	SCALANCE X212-2	SCALANCE X308-2
ES	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
OS server	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
OpenPCS 7 station	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
OS client	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
OPC client	SIMATIC Miniport CP1613 PCI Adapter	Intel(R) I210 Gigabit Network Connection
Plant bus = 100 Mbps		
Terminal bus = 100 Mbps		
Alarm logging / Tag logging		
Archive tags	Approx. 500 tags/s from AS1 + 500 tags/s from AS2	
Message incidence	10 messages/s	
PCS 7 version		
V8.1		
OPC client components		
OPC DA client = Matrikon OPC Explorer V5.0		
OPC UA client = UA expert		

Process screens	
Screens with 100 process symbols (MonAnL Block Icon) are used for the screen opening time test.	
General information	
The reaction of the AS-OS connection is determined with a cyclic GetTagWait command.	
Automation systems	
AS1	CPU 410-5H V8.0.0
AS2	CPU 410-5H V8.0.0
AS3	CPU 410-5H V8.0.0
AS4	CPU 410-5H V8.0.0

7.2 Measurement Series Configuration 3

7.2.1 OPC DA (Matrikon client)

Table 7-3

Configuration 3	Measurement								
	1	2	3	4	5	6	7	8	9
OPC DA tags [s] of AS1	0	1000	4000	8000	11000	12000	13000	15000	20000
OPC Data Change Rate [s] of the AS1 of the OPC client	0	1000	4000	7900	10800	11800	12200	12200	12500
OPC DA tags [s] of AS2	0	1000	4000	8000	11000	12000	13000	15000	20000
OPC Data Change Rate [s] of the AS2 of the OPC client	0	1000	4000	7900	10800	11800	12200	12200	12500
OPC DA tags [s] of AS3	0	1000	4000	8000	11000	12000	13000	15000	20000
OPC Data Change Rate [s] of the AS4 of the OPC client	0	1000	4000	7900	10800	11800	12200	12200	12500
OPC DA tags [s] of AS4	0	1000	4000	8000	11000	12000	13000	15000	20000
OPC Data Change Rate [s] of the AS5 of the OPC client	0	1000	4000	7900	10800	11800	12200	12200	12500
Reaction time of OS channel (OSSRV1 - AS1) [ms], worst case	7	10	11	7	80	83	131	295	832
Reaction time of OS channel (OSSRV1 - AS2) [ms], worst case	7	7	8	10	71	90	155	335	950
Reaction time of OS channel (OSSRV1 – AS3) [ms], worst case	8	7	8	34	90	20	87	250	869
Reaction time of OS channel (OSSRV1 – AS4) [ms], worst case	7	7	7	8	70	40	95	327	837
Change of screen opening time on the OS client as a percentage over 5 measurements.	2	2	2	2	2	2,1	2,3	2,5	2,7
Total processor load of the OSSRV1 without screen change	1,00%	2,00%	6,00%	11,00%	14,00%	15,00%	16,00%	16,00%	16,00%
Total processor load of the Open PCS 7 station without screen change	0,00%	0,50%	0,50%	0,50%	0,50%	0,50%	1,00%	1,00%	1,00%
Network load of the terminal bus on the OS server	0,01%	0,10%	0,28%	0,50%	0,67%	0,73%	0,78%	0,80%	0,80%
Network load of the terminal bus on the Open PCS 7 station	0,02%	1,66%	6,40%	12,00%	16,40%	17,80%	19,00%	19,00%	19,00%

Table 7-4

Channel Diagnosis	Measurement								
	1	2	3	4	5	6	7	8	9
Tags in 1s cycle AS1	500	1474	4387	8270	11183	12153	13123	15066	19919
Cycle overload 1s AS1	0	0	0	0	0	0	0	0	0
Requests 1s AS1	5	15	42	78	105	114	122	141	186
Tags in 1s cycle AS2	500	1474	4387	8270	11183	12153	13123	15066	19919
Cycle overload 1s AS2	0	0	0	0	0	0	0	0	0
Requests 1s AS2	5	16	43	79	106	115	122	141	187
Tags in 1s cycle AS3	500	1474	4387	8270	11183	12153	13123	15066	19919
Cycle overload 1s AS3	0	0	0	0	0	0	0	0	0
Requests 1s AS3	5	15	42	78	105	114	122	140	186
Tags in 1s cycle AS4	520	1500	4413	8296	11209	12179	13149	15092	19945
Cycle overload 1s AS4	0	0	0	0	0	0	0	0	0
Requests 1s AS4	5	15	42	78	105	114	122	141	187
Read Response AS1 Worst Case	n. a.	5	38	47	50	46	50	43	52
Read Response AS2 Worst Case	n. a.	6	37	43	46	49	53	46	53
Read Response AS3 Worst Case	n. a.	6	36	47	55	53	53	45	49
Read Response AS4 Worst Case	n. a.	6	37	42	49	53	52	46	51
Request Queue Size AS1	0	0	0	0	1	2	4	23	71
Request Queue Size AS2	0	0	0	0	1	2	4	23	72
Request Queue Size AS3	0	0	0	0	1	2	4	23	70
Request Queue Size AS4	0	0	0	0	1	2	4	22	69
Own Cycles AS1	0	0	10	46	73	82	90	109	154
Own Cycles AS2	0	0	11	47	74	83	90	109	155
Own Cycles AS3	0	0	10	46	73	82	90	108	154
Own Cycles AS4	0	0	10	46	73	82	90	109	155

Table 7-5

Result	Measurement								
	1	2	3	4	5	6	7	8	9
Tags in 1 s cycle AS1	500	1474	4387	8270	11183	12153	13123	15066	19919
Cycle Overload 1 s AS1	0	0	0	0	0	0	0	0	0
Requests 1 s AS1	5	15	42	78	105	114	122	141	186
Total Tag Load AS1/s	500	1474	4387	8270	11183	12153	13123	15066	19919
Total Tag Load AS2/s	500	1474	4387	8270	11183	12153	13123	15066	19919
Total Tag Load AS3/s	500	1474	4387	8270	11183	12153	13123	15066	19919
Total Tag Load AS4/s	520	1500	4413	8296	11209	12179	13149	15092	19945
Total Tag Load WinCC channel/s	2020	5922	17574	33106	44758	48638	52518	60290	79702
Subscribed to OPC DA tags/s	0	4000	16000	32000	44000	48000	52000	60000	80000
Updated OPC DA tags/s	0	4000	16000	31600	43200	47200	48800	48800	50000
Updated in relation to subscribed OPC tags/s		100,00%	100,00%	98,75%	98,18%	98,33%	93,85%	81,33%	62,50%

7.2.2 OPC UA (UaExpert client)

Table 7-6

Configuration 3	Measurement		
	1	2	3
OPC UA tags [s] of AS1	9000	14300	14300
OPC data change rate [s] of AS1 of the OPC client	n. a.	n. a.	n. a.
OPC UA tags [s] of AS2			14300
OPC data change rate [s] of AS2 of the OPC client			n. a.
OS channel response time (OSSRV1 - AS1) [ms], worst case	61	149	123
OS channel response time (OSSRV1 - AS2) [ms], worst case			107
Screen opening time [s], averaged over 5 measurements (100 POs) [s] on OS-client	2	2,2	2,2
Total processor utilization of OSSRV1 without screen change	3,00%	4,50%	8,00%
Total processor utilization of OpenPCS7 station without screen change	0,00%	1,00%	1,00%
Network utilization of terminal bus on OS-server	0,15%	0,22%	0,40%
Network utilization of terminal bus on OpenPCS7 station	2,00%	3,00%	5,30%

Chanel Diagnosis	Measurement		
	1	2	3
Tags in 1s cycle AS1	9098	14298	14298
cycle overload 1 s AS1	0	0	0
Requests 1 s AS1	85	133	133
Tags in 1s cycle AS2			14300
Cycle Overload 1 s AS2			0
Requests 1 s AS2			133
Read Response AS1, Worst Case	44	40	50
Read Response AS2, Worst Case			45
Request Queue Size AS1	1	5	9
Request Queue Size AS2			9
Own Cycles AS1	53	101	101
Own Cycles AS2			101

NOTE

The first measurement series of the OPC UA tags was made with an automation system in this configuration with 9000 tags, as a queue forms for a time (Request Queue Size) with loads greater than this.

The second measurement series was made with two automation systems in this configuration, each with 14,300 OPC UA tags, as a permanent queue forms above this value.

UaExpert was used as the OPC client.

8 Evaluation of Measuring Results

The measured values obtained are with reference exclusively to the specified PCS 7 configurations under the specified conditions. The results might be completely different under different conditions.

8.1 Basis of the Evaluation

- The statements are valid only for the specified conditions.
- All the tags requested by the OPC server are also updated in the requested cycle on the OPC client computer.
- The configurations are not operated in the limit zone so that there are enough resources available for coping with any events that occur acyclically.
- The values given here are with reference to OPC tags that actually change in the second cycle. More OPC tags can be subscribed to if they do not change correspondingly frequently or if the OPC tags are subscribed to in a slower cycle.

8.2 Configuration 1

- The Matrikon client OPC cannot provide more than 12,800 tags/s from each of AS1 and AS2.
- Above 10,000 OPC tags/s per AS a queue forms (Counter Request Queue Size) in the AS-OS channel.
- If there are more than a total of 80,000 subscribed OPC-DA tags and a group change, it will not be possible to use the Matrikon client at times, however it stabilizes again after a few seconds.

Conclusion

As there are no restrictions due to too high a processor load or OS-operability, in the first configuration 10,000 OPC tags/s per AS can be subscribed and updated by the server.

8.3 Configuration 2

- The Matrikon client OPC cannot provide more than 11,600 tags/s from each of AS1 and AS2.
- Above 7,000 OPC tags/s per AS a queue forms (Counter Request Queue Size) in the AS-OS channel.

Conclusion

As there are no restrictions due to too high a processor load or OS-operability, in the second configuration 7,000 OPC tags/s per AS can be subscribed and updated by the server.

8.4 Configuration 3

8.4.1 OPC DA

- The Matrikon-client OPC cannot provide more than 12,500 DA tags/s from each of AS1, AS2, AS3 and AS4.
- Above 10,800 OPC DA tags/s per AS a queue forms (Counter Request Queue Size) in the AS-OS channel.
- With a cyclic screen change every 5 seconds at maximum OPC load (a total of 80,000 OPC DA tags) the processor utilization of the OSSRV1 does not rise above an average of 22 %. This value is absolutely acceptable, so no individual measurements of the processor have been made at lower loads.

Conclusion:

In the third configuration, 10,800 OPC DA tags/s can be subscribed by each automation system and updated by the server.

8.4.2 OPC UA

- Above 9,000 OPC UA tags/s in each case, a queue forms (Counter Request Queue Size) in the AS-OS channel at times.
- Above 14,000 OPC UA tags/s in each case, a permanent queue forms (Counter Request Queue Size) in the AS-OS channel.
- If an AS is operated with a load of 14,300 OPC UA tags/s and a second AS with the same load is connected, the values of the OSSRV1 total processor utilization, the network utilization of the terminal bus on the OSSRV1 and the network utilization of the OpenPCS7 station act almost proportionally and are added together. From this it is possible to make a prediction for additional connected automation systems.

Conclusion:

In this third configuration, 9,000 OPC UA tags/s can be subscribed by each automation system and updated by the server.

8.4.3 Note

Configuration 3 with the OPC D test is used as an example. 10,800 tags are subscribed by a single AS. These can be updated on the OS-server, the OpenPCS 7 station and the OPC client. Above this value, however, a queue will form in the AS-OS channel. If a second AS, also with 10,800 tags, is now connected to it, the functionalities of all the other participants remain the same. The OS server, the Open PCS 7 station and the OS client can update this total of 21,600 subscribed tags. The automation systems are connected to one another over the system bus and have only a single interface to the OS server. However since the tags for both automation systems are updated on the OPC client, all data must of necessity be provided via the OS server. The same behavior occurs when all four automation systems are activated. With further consideration of the utilization of the OS server and the unrestricted operability, even under full load, it seems obvious to suppose

that the performance limitation is caused by the automation systems and not by the OS server, the OpenPCS7 station or the OPC client.

Put simply, the maximum number of updated tags on the OPC client must presumably be attributed to the performance of the client. This is also noticeable due to the fact that at times the client can no longer be operated under maximum load, while there are no restrictions with the OS server or the OpenPCS7 station.