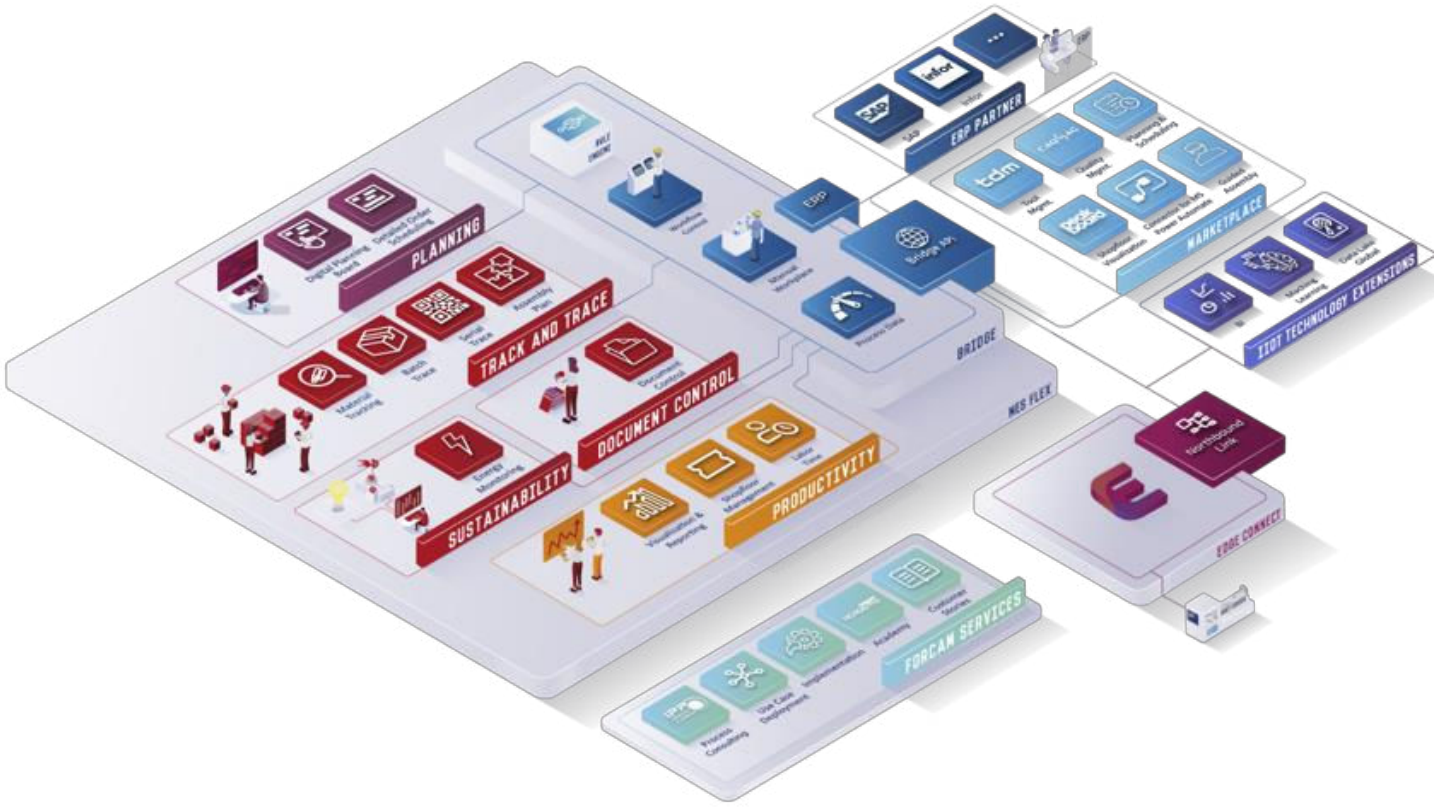
ENISCO FORCAM
smart factory experts

FORCE MES FLEX



FORCE MES FLEX

System requirements

Version 5.12

Document:	FORCE MES FLEX System requirements
Release date:	12.07.2023
Document version:	2
Author:	FORCAM GmbH

Content

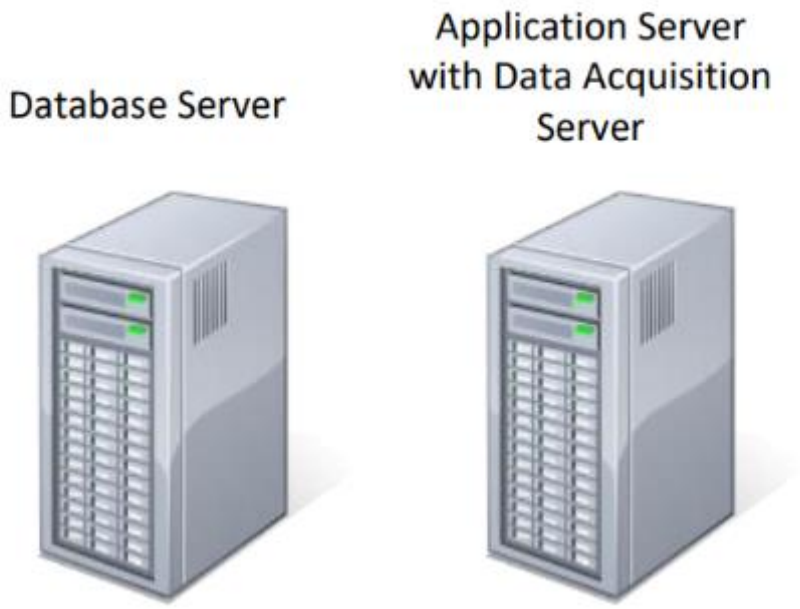
1 Updates and discontinuation

FORCE MES FLEX	5.11	5.12	Note
Operating System	Windows Server 2012 (R2) Windows Server 2016 Windows Server 2019	Windows Server 2012 (R2) Windows Server 2016 Windows Server 2019 **Windows Server 2022**	Not supported anymore (Restricted)
Database	MS SQL Server 2016 MS SQL Server 2019 Oracle 12.2 Oracle 19c (Enterprise Edition)	MS SQL Server 2016 MS SQL Server 2019 Oracle 12.2 (Enterprise Edition) Oracle 19c (Enterprise Edition)	 Recommended Recommended
Java	Java 11 (OpenJDK)	Java 11 (OpenJDK)	Long Term Version
MongoDB	MongoDB 4.0	MongoDB 4.0 MongoDB 4.2 **MongoDB 5.0**	Not supported anymore Supported from 5.12.20
Browser	Google Chrome MS Edge Chromium	Google Chrome MS Edge Chromium	Recommended – current versions

2 Infrastructure

2.1 Multi-tier architecture

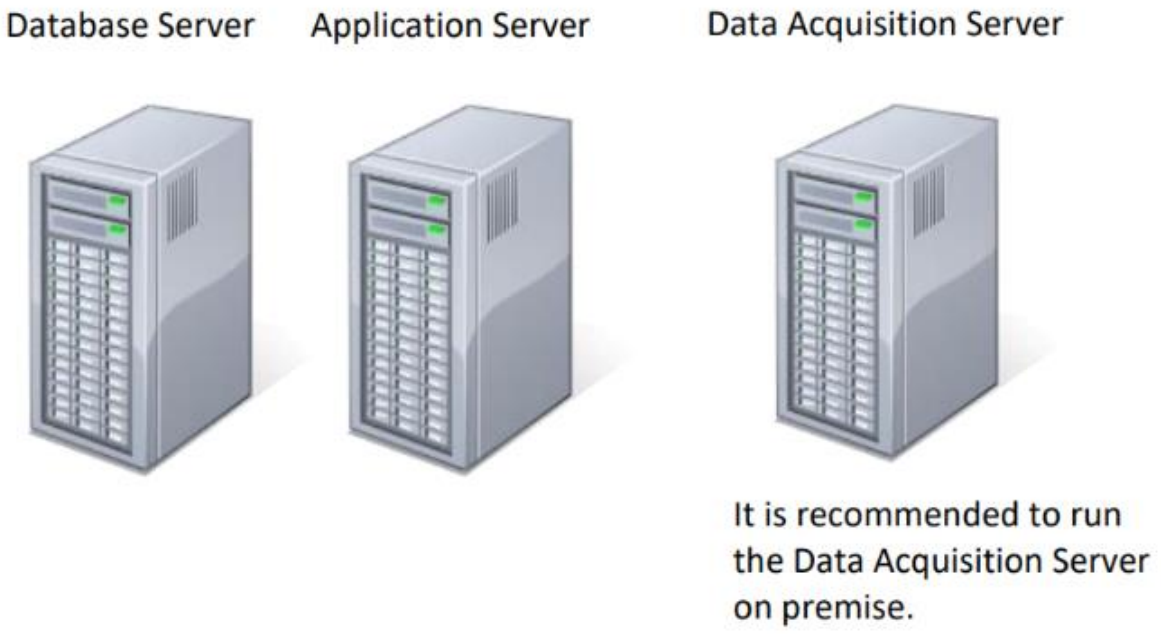
Minimum: Two-tier architecture



Picture 1: Two-tier architecture (minimum requirement)

Recommended: Three-tier-architecture

We recommend using a three-tier architecture. i.e., separating database, application, and data acquisition:



Picture 2: Three-tier architecture (recommended)

Background information: two-tier vs. three-tier architecture

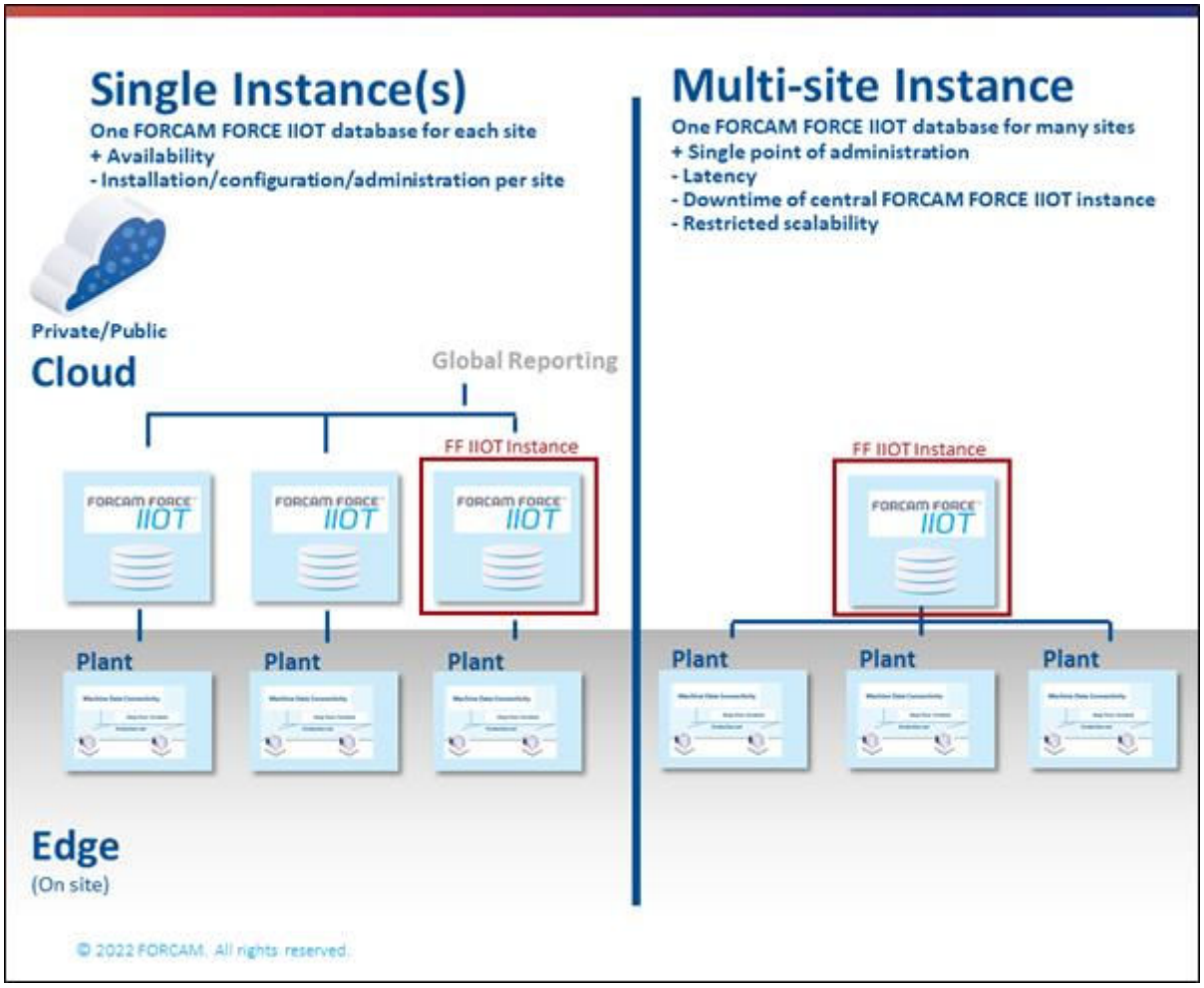
When taking architectural decisions, take the following differences into account:

Two-tier Architecture	Three-tier architecture
– Sufficient for test systems or early pilot phases for projects – Lower performance because DCU server runs in parallel on the application server – Upgrade to three-tier setup recommended after test/pilot	– Required for productive systems – Recommended for use with the FORCAM FORCE EDGE server – Provides high performance for timely signal processing – Physical proximity to the machine parks can be an advantage, depending on the number and frequency of signals – Maintains network security (integrity) for machine parks in case of separated LAN networks (VLAN)

2.2 Limitations for one instance (single/multi-site)

To ensure a performant operation, the following system limits should not be exceeded.

⚠ The recommendations are based on empirical values from various FORCAM FORCE installations and should therefore be adhered to, if possible.



Picture 3: Single / multi-site instance

Limitation for **each instance:**
(1 Instance = 1 dedicated FORCAM FORCE MES FLEX server + 1 dedicated database server)

500 workplaces and 300.000 events per shift
(regular 8 hour shift)

2.3 TLS/SSL certificate for HTTPS

Customer responsibilities

- **Creation of SSL certificates**
- **Update of expired SSL certificates**

General information on certificates

To create an encrypted connection between a web server and a client, an SSL certificate for the web server is required. An SSL certificate is a file that contains information on the identity of the web server and the organization hosting it. Additionally, it contains cryptographic key material that is used for securing the communication channel between server and client.

How to obtain a certificate

The certificate needs to be obtained by the organization hosting the web server (i.e., the hostname needs to be in a domain owned by the organization) and is digitally signed by a certificate authority (CA). The clients connecting to FORCE MES FLEX need to accept certificates signed by the CA in use as root of trust for successfully creating connections to the server. This is usually achieved by obtaining certificates signed by a CA that is considered trustworthy by the vendor of the web browser in use. The hostname referenced in the certificate needs to be the fully qualified domain name of the server in use. It needs to be possible for client machines to resolve it via the domain name service (DNS). Every instance of FORCE MES FLEX needs to have its own certificate matching its host name.

- ➔ Certificates that are used and valid within the customer's IT infrastructure (as described above) need to be obtained from the customers IT department.

  or
- ➔ If the IT department does not maintain its own CA for internal use, a valid certificate should be obtained from a third-party certificate provider.

Technical requirements for certificates

- The hostname in the certificate needs to match the DNS host name of the FORCE MES FLEX system.
- The expiration date of the certificate needs to be in the future, but not more than one year.
- The certificate should be created for web server use.
- The certificate should use a minimum key length of 2048 bits for RSA or 256 bits for ECDSA.
- The certificate signature algorithm should be SHA-256 or better.
- The certificate and key need to be available in the PKCS #12 file format and file extension "pfx".
- Password of certificate files should be provided to FORCAM.

ⓣ See the FORCE MEX FLEX manual "Secure communication between components" for more information on secure communication and the different types of certificates.

3 Database server

MS SQL server license

For productive system environments, a Microsoft license for “SQL Server Standard Edition” (minimum) is required.
Options:

- License for each core
  or
- License for at least 1 CAL (Client Access License)

Overall server requirements

- 1 Server (physical or virtualized environment), intended for exclusive use with FORCE MES FLEX
- CPU with at least Haswell technology (e.g. Intel Xeon E5) or higher, 4 cores, clocked with > 2 GHz
- 16 GB RAM
- Operating system: Windows Server or Unix, Linux
- Regarding anti-virus software, the recommendations of the OS vendor must be strictly observed, for Microsoft TechNet, observe the anti-virus exclusion list
- Server time zone must be UTC to cover the change to Daylight Saving Time
- Windows-Server user for FORCAM must have extended rights
- User of MS SQL server for FORCAM must also have extended rights (DB owner)

Specific database server requirements

- SQL Server 2016 or SQL Server 2019 or Oracle 12.2/19c
- HDD Raid Level 1, no striping (for physical devices)
- Best practice: 3 physically separated disks with
  - 100 GB + 1 GB per workplace for data,
  - 100 GB for log space,
  - 100 GB for tempdb and backups

3.1 Memory space of the SQL instance (recommendations)

- 1 GB of memory reserved for the operating system
- 1 GB each for every 4 GB of RAM after the initial 4 GB, up to 16 GB of RAM
- 1 GB each for every 8 GB in more than 16 GB of RAM

Example

If a 32 GB RAM database server is used, memory should be assigned to the operating system as follows:

- 1 GB, the minimum allocation
- + 3 GB, since 16 GB – 4 GB = 12 GB; 12 GB divided by 4 GB (each 4 GB gets 1 GB) is 3 GB
- + 2 GB, as 32 GB – 16 GB = 16 GB; 16 divided by 8 (each 8 GB after 16 GB gets 1 GB) is 2 GB

In total, for a server with 32 GB of RAM, 7 GB will be reserved for the operating system.

The maximum memory allocated to the SQL server should be 25 GB.
For a 64 GB server, 10 GB should be reserved for the operating system and 54 GB should be allocated for the SQL server.

4 Application server

Overall Server Requirements

- 1 Server (physical or virtualized environment) dedicated only for use with FORCE MES FLEX (without preceding load balancer)
- CPU (e.g. Intel Xeon E5) or higher, clocked with > 2 GHz
  - 4 cores for up to 150 workplaces
  - + 2 cores per additional 100 workplaces
- 32 GB RAM + 50 MB per workplace for a basic setup
  - + 4 GB for fftracing-processing (+ 2 GB for fftracing acquisition)
  - + 2 GB for every additional module (ffdnc, ffscheduler, ffwebservices…)
  - Basic setup includes:
    ffruntime-ignite, ffruntime, ffworkbench, ffworker, ffnewoffice (Modeller + Visualisation), ffnewoffice-background, DCU/DACQ, FFauth
- Microsoft .NET-Framework version 3.5 must be installed
- Regarding anti-virus software:
  - The recommendations of the OS vendor must be strictly followed, for Microsoft TechNet Anti-Virus exclusion list (or more up to date)
  - The FORCE directory, its subfolders and FORCE Services must be excluded from the AV scan. If this is not possible for security reasons, the scan of this directory must only be performed sporadically at low-operational times, otherwise the performance of the application will be considerably reduced.
- Server time zone must be UTC to cover the change to Daylight Saving Time
- Windows-Server user for FORCAM must have administration rights
- If a FORCAM online license is used, an internet connection to the FORCAM license system is required.

ⓘ For information regarding required ports, refer to chapter 8 (“Firewall”) in this document.

Specific application server requirements

- Read/Write speed must be > 250 MB/sec.
- RAID system (for physical devices), best practice: RAID Level 1
- 1 partition physically separated from the OS containing 250 GB for exclusive use with FORCE MES FLEX
- OpenJDK 11 (JDK and JRE), 64 Bit. If 2-tier architecture is being used, please install 32 Bit JDK also.

5 Data acquisition server

Overall Server Requirements

- 1 Server (physical or virtualized environment), intended for exclusive use with FORCE MES FLEX
- CPU (e.g. Intel Xeon E5) or higher, 4 cores, clocked with > 2 GHz
- 12 GB RAM + 0,5 GB RAM per additional DCU[1]
- At least 100 GB of available disk space
- Operating system: Windows Server 2016 or Windows Server 2019
- Regarding anti-virus software:
  - The recommendations of the OS vendor must be strictly followed, for Microsoft TechNet Anti-Virus exclusion list (or more up to date)
  - The FORCE directory, its subfolders and FORCE Services must be excluded from the AV scan. If this is not possible for security reasons, the scan of this directory must only be performed sporadically at low-operational times, otherwise the performance of the application will be considerably reduced.
- + 2 GB RAM for fftracing acquisition
- Server time zone must be UTC to cover the change to Daylight Saving Time
- Windows-Server user for FORCAM must have administration rights
- Should be very close to the Shopfloor – No Wireless (WAN) data communication

ⓘ For information regarding required ports, refer to chapter 8 (“Firewall”) in this document.

Specific data acquisition server requirements

- Only required for three-tier architecture
- OpenJDK 11 (JDK), 32 and 64 Bit, latest versions

[1] Depending on the load of this server (which depends on the number of configured machines/signals and the DACQ scripts and whether process data shall be collected), it might be necessary to equip the server also with additional compute cores.

6 Network

Overall network requirements

- 2x 1 Gbit NIC1 per server in failsafe-/load balancing mode
- Database server, application server and data acquisition server connected to Switched LAN (1 Gbit or better)
- Shopfloor network connected with at least 100 Mbit uplink to office network
- Best practice: Use LAN instead of WLAN to avoid problems with electro-magnetic interferences)
- For use in dedicated environments: optical (fibre) connections to reduce latency

7 Clients

Overall client requirements

- Windows 10, Windows 11
- Supported browsers: Google Chrome and Microsoft Edge with Chromium engine
- In general, no Java 11 (JRE) needed due to HTML5 technology

  Exception: Use of PDM/DNC, ffscheduler and client-side programs (e.g. UDP scanner and printers) - In this case, the Client-Side Connector application is needed, which requires an installation of JRE.

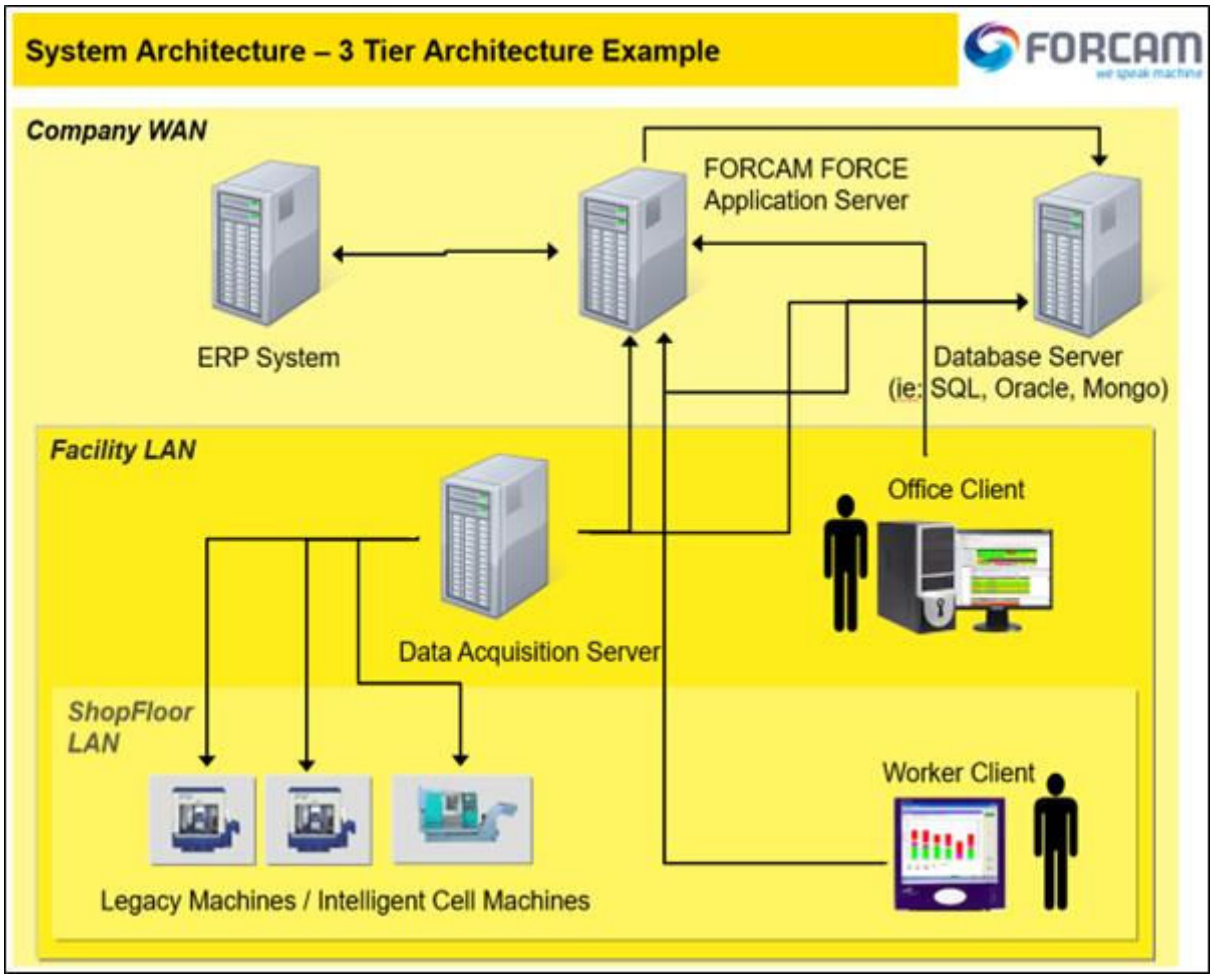
Hardware

- Minimum screen resolution: **1280 x 720 pixels**

8 Firewall

8.1 System architecture and overall recommendations

Note the overall system architecture when setting up the firewall:



Picture 4: System network architecture

ⓘ All ports requested are to allow return traffic.

⚠ For the ports listed in the following chapters, port scan must be disabled, as a scan can drastically reduce the system performance and may cause serious problems.

⚠ To avoid exposing port 1099/TCP to the network, we recommend filtering it in the firewall setup.

8.2 IT infrastructure isolation

Source	Description	Destination	Port	Protocol	Comment
Office PCs	Access to FORCE MES FLEX Office Client	FORCAM Application Server	19080	TCP	Configure in server.xml
	Access to FORCE MES FLEX Workbench	FORCAM Application Server	15080	TCP	Configure in server.xml
	Access to FORCE MES FLEX MDESimulator	FORCAM Application Server	16080	TCP	Configure in server.xml
	Access to FORCE MES FLEX Shopfloor Terminal	FORCAM Application Server	11080	TCP	Configure in server.xml
	Access to FORCE MES FLEX Modeller	FORCAM Application Server	20080	TCP	configure in server.xml
	Access to FORCE MES FLEX Detailed Scheduler	FORCAM Application Server	21080	TCP	Configure in server.xml
	Access to FORCE MES FLEX FFSetup	FORCAM Application Server	22080	TCP	configure in server.xml
	Access to FORCE MES FLEX webservices	FORCAM Application Server	24080	TCP	Configure in server.xml
	Access to FORCE MES FLEX Authorization	FORCAM Application Server	25080	TCP	Configure in server.xml
Office PCs (secured)	Access to FORCE MES FLEX Office Client	FORCAM Application Server	19443	TCP	Configure in server.xml
	Access to FORCE MES FLEX Workbench	FORCAM Application Server	15443	TCP	Configure in server.xml
	Access to FORCE MES FLEX MDESimulator	FORCAM Application Server	16443	TCP	Configure in server.xml
	Access to FORCE MES FLEX Shopfloor Terminal	FORCAM Application Server	11443	TCP	Configure in server.xml
	Access to FORCE MES FLEX Detailed Scheduler	FORCAM Application Server	21443	TCP	Configure in server.xml
	Access to FORCE MES FLEX webservices	FORCAM Application Server	24443	TCP	Configure in server.xml
	Access to FORCAM FORCE MES FLEX Authorization	FORCAM Application Server	25443	TCP	Configure in server.xml

Source	Description	Destination	Port	Protocol	Comment
Application Server	SQL Server database connections	FORCAM Database Server	1433	TCP	Database configuration
	Mongo connections	FORCAM Mongo Server	27017 or 27024 or 37028	TCP	Configure on Mongo install
	Mongo Apache Drill component	FORCAM Mongo Server	2181, 31010	TCP	configure in tool install
	Emailing reports and alerts (AutoReporting)	Company Mail Server	25	TCP	Configure in context.xml
	Access to ActiveMQ	FORCAM Application Server	61616	TCP	If separated, not likely
	Ignite	FORCAM Application Runtime	48100 to 48500	TCP	Configure in context.xml
	http/remote/runtime/server/port	FORCAM Application Runtime	10080	TCP	Configure in context.xml
	rmi/remote/server/port	FORCAM Application Runtime	1199	TCP	Configure in context.xml
	rmi/exporter/server/port	FORCAM Application Runtime	1299	TCP	Configure in context.xml
	Detailed Scheduler RMI	FORCAM Application Server	1998	TCP	Configure in context.xml

8.3 DNC server isolation (DCU/DACQ Server)

Source	Description	Destination	Port	Protocol	Comment
DNC Server	SQL Server database connections	FORCAM Database Server	1433	TCP	Database configuration
	ActiveMQ	FORCAM Application Server	61616	TCP	ActiveMQ configuration
	Ignite	FORCAM Application Runtime Ignite	48100, 48500	TCP	Configure in context.xml
	http/remote/runtime/server/port	FORCAM Application Runtime	10080	TCP	Configure in context.xml
	rmi/remote/server/port	FORCAM Application Runtime	1199	TCP	Configure in context.xml
	rmi/exporter/server/port	FORCAM Application Runtime	1299	TCP	Configure in context.xml
	ffdnc Workbench General Configuration	FORCAM Application Server	15080-15084	TCP	Configure in workbench
	Machine Access	Machines…	Varies by machine	TCP	See list below
Application Server	ffdnc Java JMX remote access	FORCAM DNC Server	8092	TCP	Configure on install
	ffdnc server.xml access	FORCAM DNC Server	14005, 14009, 14080, 14443	TCP	Configure in server.xml
	ffdnc Workbench General Configuration	FORCAM DNC Server	14080-14084	TCP	Configure in workbench

8.4 Data acquisition server (DCU/DACQ) isolation

Source	Description	Destination	Port	Protocol	Comment
Data Acquisition Server	SQL Server database connections	FORCAM Database Server	1433	TCP	Database configuration
	ActiveMQ	FORCAM Application Server	61616	TCP	ActiveMQ configuration
	http/remote/runtime/server/port	FORCAM Application Runtime	10080	TCP	Configure in server.xml/javis.ini
	rmi/remote/server/port	FORCAM Application Runtime	1199	TCP	Configure in context.xml
	rmi/exporter/server/port	FORCAM Application Runtime	1299	TCP	Configure in context.xml
	Internal DACQ to DCU on server	FORCAM Data Acquisition Server	8765	TCP	Only if separate services
	Remote Restart of DACQ-scripting	FORCAM Data Acquisition Server	8775	TCP	

8.5 Shopfloor isolation

Source	Description	Destination	Port	Protocol	Comment
Shopfloor Terminals	Access to FORCE MES FLEX Shopfloor Terminal	FORCAM Application Server	11080	TCP	Configure in server.xml
	Access to FORCE MES FLEX Shopfloor Terminal	FORCAM Application Server	11443	TCP	Configure in server.xml
Data Acquisition Server	Allen Bradley/Rockwell (EtherNet/IP™, new)	Machines with …	44818	TCP/ UDP	
	Allen Bradley/Rockwell (PLC5E, SLC5/05, old)	Machines with …	2222	TCP/ UDP	
	Allen Bradley/Rockwell (Peer to Peer)	Machines with …	4000	TCP/ UDP	
	Fanuc FOCAS 1&2 / Ethernet	Machines with …	8193	TCP	Configure on controller
	Fanuc CIMPLICITY i CELL	Machines with …	8192	UDP	
	Fanuc FOCAS2/Ethernet	Machines with …	8195	UDP	
	Fanue Unsolicited Message Server	Machines with …	8196	TCP	
	Heidenhain (for newer controls, TNC640 and for older controls, iTNC530)	Machines with …	19000-19034	TCP	
	Heidenhain (NFS)	Machines with …	111	TCP	
	Heidenhain (SMB)	Machines with …	445	TCP	
	Heidenhain (default)	Machines with …	5000	TCP	
	Heidenhain (LSV2, for serial COM)	Machines with …	9000	TCP	
	IBH-Link S5++ (IBHNet, read/write)	Machines with …	2002	TCP	
	IBH-Link S5++ (Programming Unit - PU)	Machines with …	10010	TCP	
	IBH-Link S5/S7 RFC1006	Machines with …	102	TCP	
	IBH-Link S7 Standard	Machines with …	1099	TCP	
	IBH-Link S7++ (Search for IBHLink device)	Machines with …	25383, 25384	UDP	
	Makino MML	Machines with …	8193 or 11212	TCP	
	MCIS-RPC	Machines with …	3010	TCP	Host port
	MCIS-RPC	Machines with …	3011	TCP	Machine (listening) port
	MOXA telnet communication	Machines with …	23	TCP	
	MOXA Web UI	Machines with …	80	TCP	
	MOXA Data port	Machines with …	950-965	TCP	
	MOXA Command port (for transferring data)	Machines with …	966-981	TCP	

Source	Description	Destination	Port	Protocol	Comment
	MOXA Data port (for transferring data)	Machines with …	4001	TCP	
	MOXA Broadcast search	Machines with …	4800	UDP	
	MOXA Firmware Upgrade	Machines with …	4900	TCP	
	MQTT.fx server	Machines with …	2783	TCP	
	MQTT (default)	Machines with …	1883, 1885	TCP	
	MQTT (SSL/TLS)	Machines with …	8883	TCP	
	MTConnect Agent	Machines with …	5000, custom	TCP	Configurable
	MTConnect Adapter	Machines with …	7878	TCP	Configurable
	Okuma THINC Listening	Machines with …	8888	TCP	
	Omron (FINS)	Machines with …	9600	UDP	
	OPC DA (Binary/DCOM, read)	Machines with …	5000	TCP	
	OPC DA (Binary/DCOM, write)	Machines with …	6000	TCP	
	OPC DA-XML	Machines with …	80	TCP	
	OPC DA-XML (HTTPS)	Machines with …	443	TCP	
	OPC UA (SOAP-XML)	Machines with …	80	TCP	
	OPC UA (SOAP-XML, HTTPS)	Machines with …	443	TCP	
	OPC UA (Binary)	Machines with …	4840, 4843	TCP	
	OPC UA (Binary, DataFEED OPC)	Machines with …	4980	TCP	
	OPC UA (SOAP-XML, KEPServerEX)	Machines with …	49320	TCP	
	OPC-Server (DCOM, Service Contr. Manager)	Machines with …	135	TCP	
	Siemens Control with CP (IPS7Link/RFC1006)	Machines with …	102	TCP	
	Siemens MCIS-RPC (RPC, Host)	Machines with …	13010	TCP	
	Siemens MCIS-RPC (RPC, Machine)	Machines with …	3011	TCP	
	Simatic S7 IPS7LNK	Machines with …	502, 2000	TCP	
	WAGO http access	Machines with …	80	TCP	WAGO configuration page
	WAGO https access	Machines with …	443	TCP	WAGO configuration page
	WAGO CodeSys Software	Machines with …	2455	TCP	
	WAGO Controller - FORCAM I/O-Box	Machines with …	3002	UDP	
	WAGO (Modbus, polling/send)	Machines with …	502	UDP/ TCP	

8.6 External access

Source	Description	Destination	Port	Protocol	Comment
External access	Access for: 1. Customer system for support 2. Customer access GUIs 3. Cloud environment	FORCAM Application Server	80, 443, 1998, 3389, custom, 10080, 10443, 11080, 11443, 15080, 15443, 16080, 16443, 19080, 19443, 21080, 21443, 24080, 24443, 25080, 25443	TCP	Customer defined Access Runtime Worker Client Workbench MDESimulator Office Client Scheduler Webservices Authentication
		FORCAM Database Server	80, 443, custom	TCP	Customer defined Access
		FORCAM Data Acquisition Server	80, 443, custom	TCP	Customer defined Access
ffERP	ERP "Download" interface	FORCAM Application Server	26080	TCP	
	ERP secured "Download" interface	FORCAM Application Server	26443	TCP	

8.7 Single Sign-on (SSO)

⚠ LDAP naming schema configuration does not support multi-site.

Source	Description	Destination	Port	Protocol	Comment
SSO external access		LDAP Server	Custom	TCP	Configure on LDAP server
FORCAM Application Server		LDAP Server	HTTP=389, HTTPS=636	TCP	Configure on LDAP server
LDAP Server		FORCAM Application Server	15009, 19009	TCP	Configure on LDAP server