

Trainingmodule
WinCC OA
Distributed Systems

Slides
Exercises
Comments



Requirements / Goals

Training module based on:

- WinCC OA Basic Training (5 days)

Goals to achieve:

- Introduction into the basics of distributed systems
- Implementation of a distributed system

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Distributed Systems

Motivation:

- Geographically distributed systems (i.e.: Intelligent Traffic systems, Factory plant automation, Master Control Centers, ...)
- Distributed systems as the solution to reach:
 - Increased performance (parallel processing, load sharing)
 - Increased availability of the whole system
 - Better flexibility and scalability

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Distributed systems in WinCC OA allow to connect two or more autonomous WinCC OA systems via a network. Each system can process and display data (values and alerts) of other systems. You can also access online values, alerts and history of each system by using distributed systems in WinCC OA ("distributed database"). When you access remote DPEs the datapoints of the sub systems are not copied to the local system. This means that the datapoints are not multiplied and you can only access the system when a connection to this specific system exists.

A WinCC OA system in this connection is a server on which an Event manager is running on (this means not necessarily a complete project). In a redundant system both redundant running servers are considered as one system.



Distributed Systems

Approach:

- Each system will on the one hand keep its process data in its local database. On the other hand each system may access process data from other connected systems via a distribution manager (read and write).

Used interfaces:

- TCP/IP, UDP

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Advantages of distributed systems

Flexibility

- A distributed system may be powered up or down step by step, also software updates to new releases could be done step by step, without shutting down the whole system

Cost efficiency

- Some affordable „normal“ systems instead of one very expensive „Super“ system (server hardware)

Increased performance

- Parallel processing, load sharing

Fault tolerance

- Increased availability of the whole system, reduced downtime



Required Components

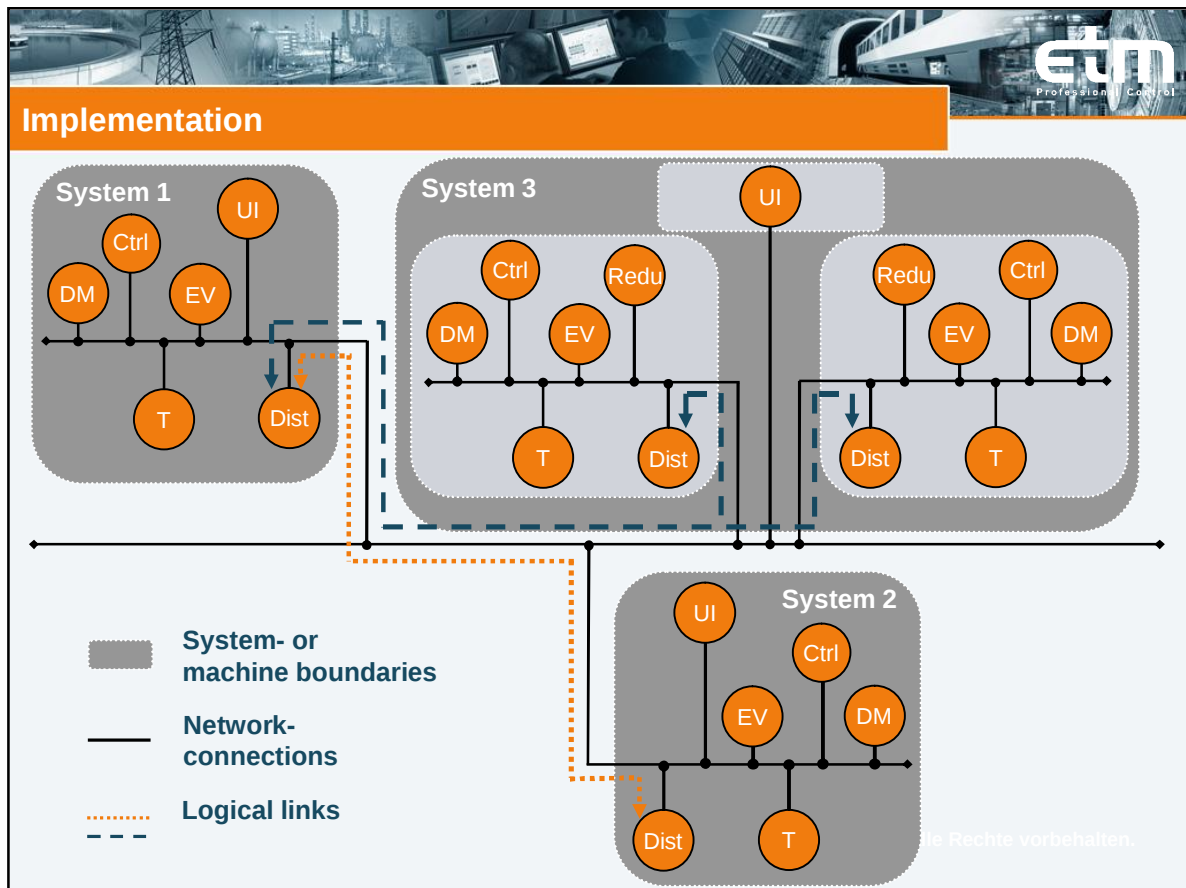
WinCC OA:

- Starting with version 3.0
- Suitable license (shield-file)

Other:

- TCP/IP network
- Correct working DNS resolution

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Note:

As a „network“ in the connection of distributed systems we understand a **static definition of one or several point to point connections** between **two or more WinCC OA systems**. The definition of these **logical connections** is done in the **config file** of each system. There is however no specific entry which particular network protocol will be used nor the kind of topology that is used for building up the network.

The coupling between the WinCC OA-Systems is done via a distinct **distribution-manager (Dist)**. A Distribution manager may exchange data between WinCC OA systems by using individual logical connections to other distribution managers. In the above illustrated showcase the System 1 may exchange messages with both System 2 and System 3. However the System 2 may not exchange data with System 3 because there is no logical connection built up between their two dist managers.

The dist manager will establish the connection to other systems transparent to any other manager. By doing so a UI connected to System 1 may directly retrieve data from System 2, without the need of knowing where the system is or how the connection should be established

Furthermore the dist manager is responsible for the exchange of the DP-identification tables and the monitoring of the established connections to other dist managers.

Hints:

WinCC OA-systems, that wants to exchange data with other systems must have a direct connection to each other. That means there is no routing spanning over system boundaries to indirectly connected systems.

That is the reason why in the above showcase there is no way of retrieving system 3 - data from within system 2 (or also the other way round) because they are only connected indirectly over the System 1 but the messages will not be routed.

Each WinCC OA system must have a unique system name and a unique system number.

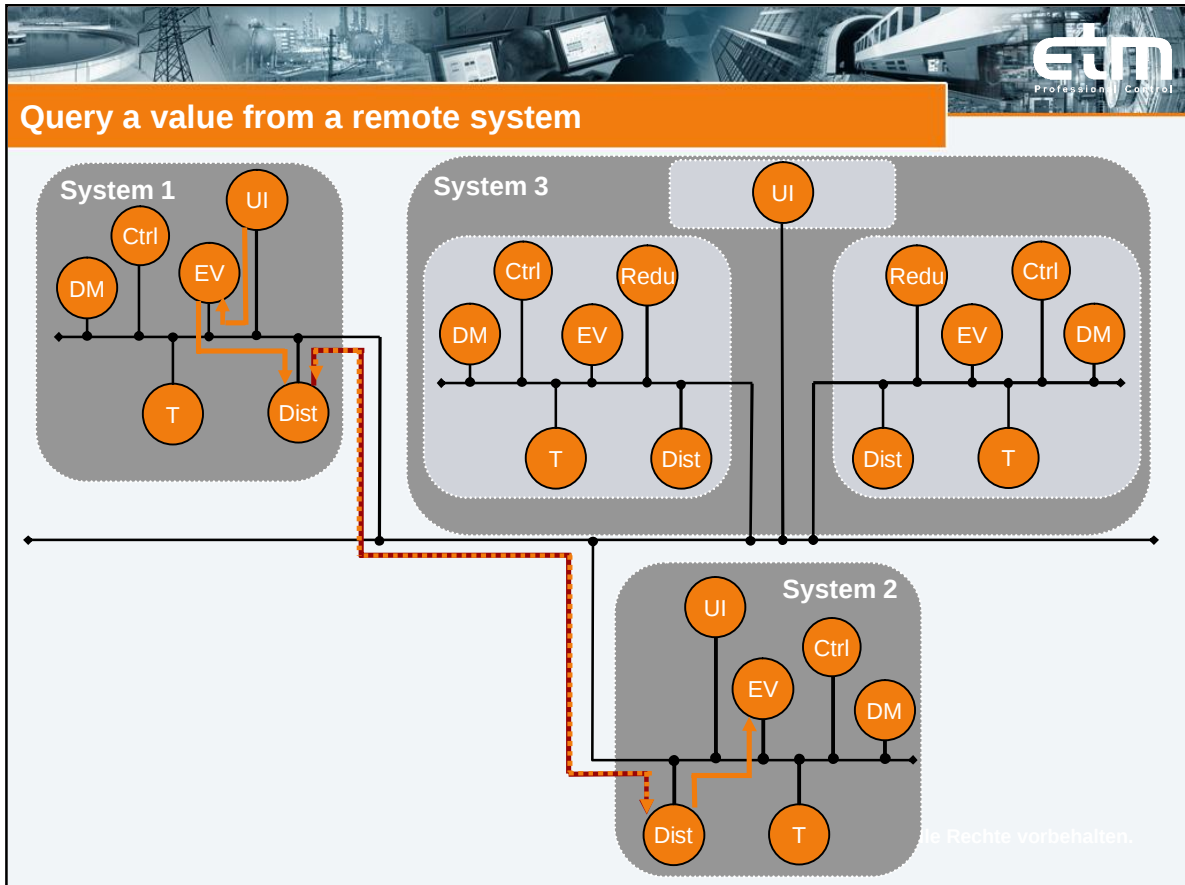
The numbers of languages has to be equal on all connected systems.

However it is possible to connect systems with different releases of WinCC OA.

The creation or deletion of datapoints with the PARA module is by default only allowed for the local system. Also all attributes of the _common config (i.e. alias, unit, etc.) may only be changed for the local system.

Group-alerts may only contain alerts of one system (local or remote systems).

An SQL-query is also restricted to only one system (local or remote).



Note:

In WinCC OA each manager can be identified throughout its manager type, the manager number and the system number on that the manager is running (in case of a redundant project there will be an additional replica-name). By using this identification method each manager can be addressed easily in a distributed WinCC OA system.

The only requirement existing, for sending messages from a source-manager to a destination-manager, is the direct logical connection between the two systems (keep in mind: no routing that spans over system boundaries)

In our case the query of a certain value from system 1 to system 2 will cause the following message telegrams:

- 1) The UI on System 1 sends a query to its Event manager (EV) "give me the value of a datapointelement xyz from System 2"
- 2) The EV from System 1 has no knowledge about this datapoint (because of the local holding of the process-data) and will forward this query to its Dist manager.
- 3) The Dist manager from System 1 will now check whether there is an established connection to the Dist of system 2. If this was configured by the user (as an entry in the config file) the message will be forwarded to the dist of System 2.
- 4) The Dist from System 2 takes this query and forwards it directly to its local EV.
- 5) The EV on System 2 is aware of the data and the answer will be sent back to the UI on System 1 using the same methods only in the other direction.

When you are using a `dpConnet()` instead of a one-time-query (`dpGet`), there is the possibility that the network connection between the two systems may be lost. However the once established `dpConnet` will not be discarded but the value of the connected remote systems datapointelement will be marked as invalid during the downtime of the network connection.

SIMATIC WinCC Open Architecture



Exercise

Configuration of a distributed system

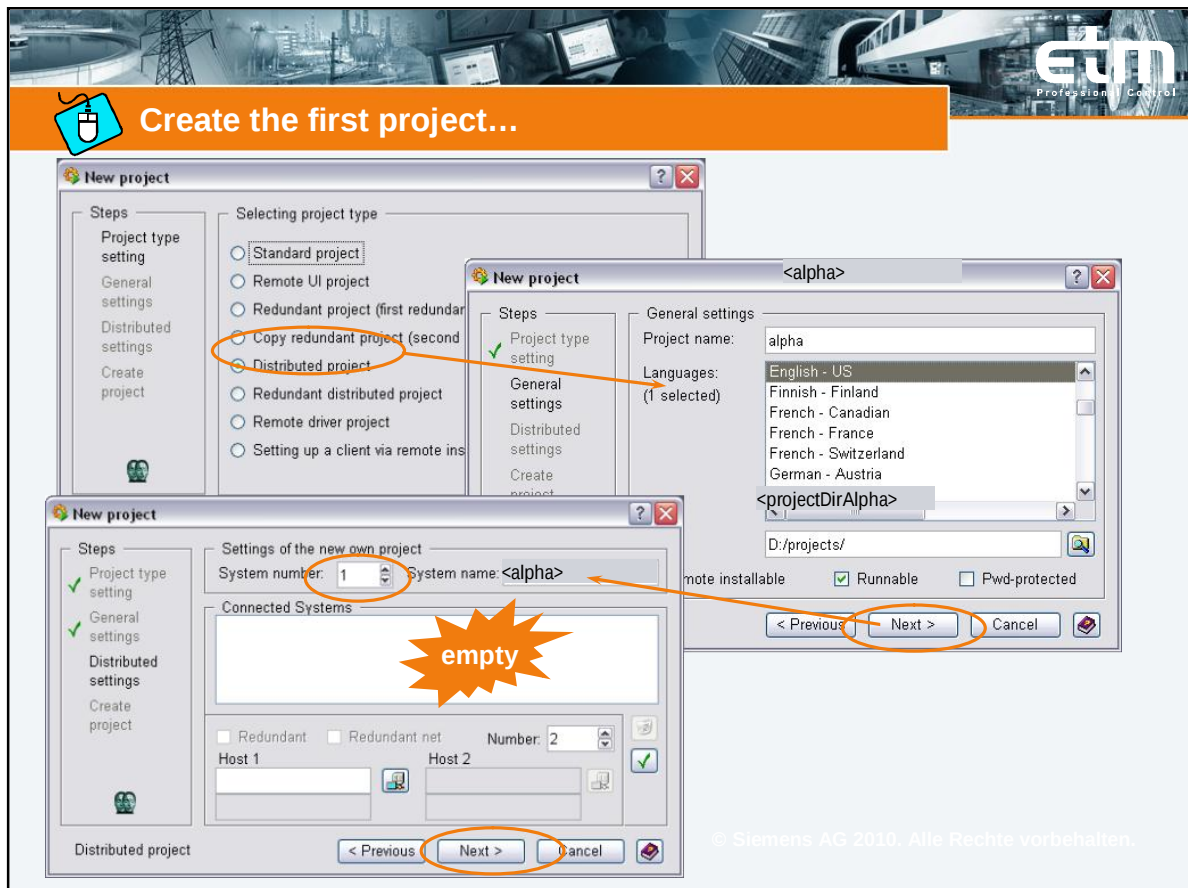
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 **Exercise**

- Configuration of a distributed system consisting out of three hosts
- System 1 <alpha> shall have permission to access all the data points of the other two systems
- System 2 <beta> and System 3 <gamma> are not allowed to access each others data points

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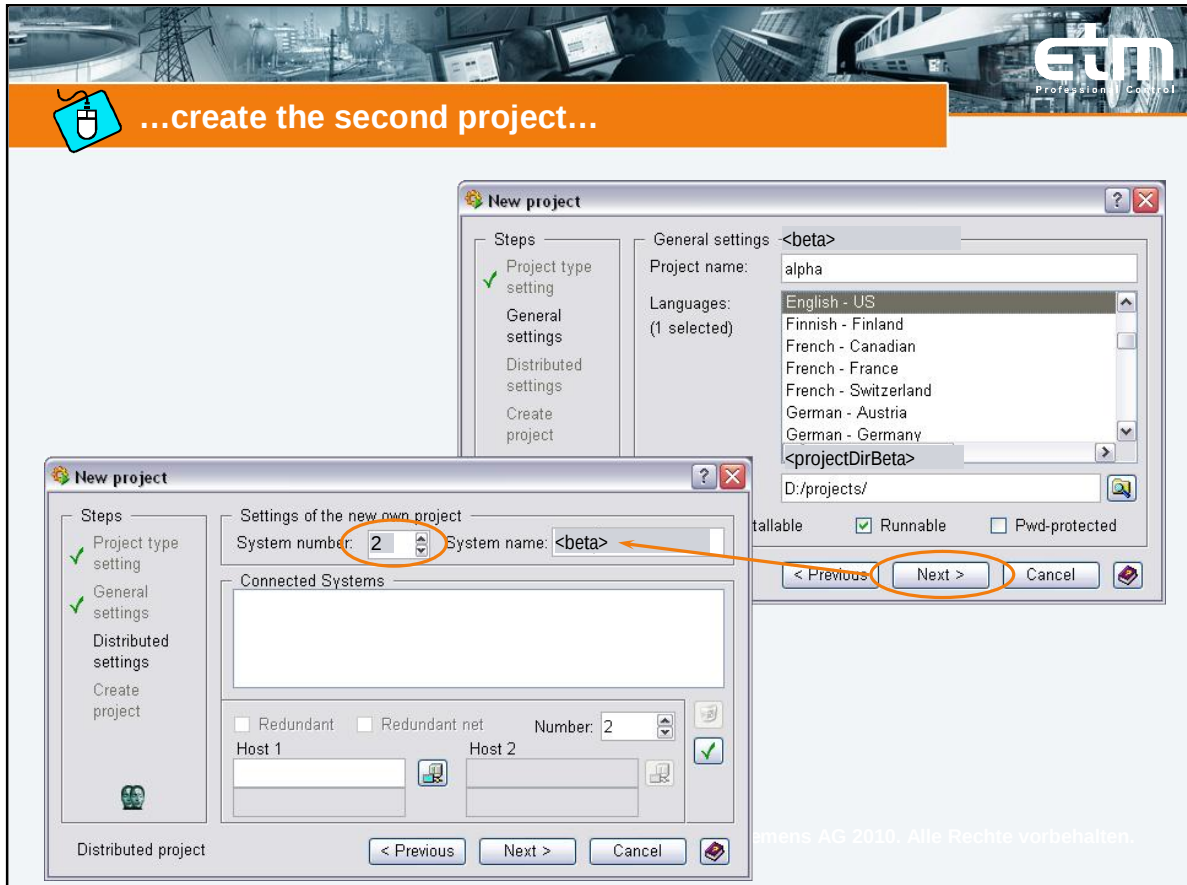


Note:

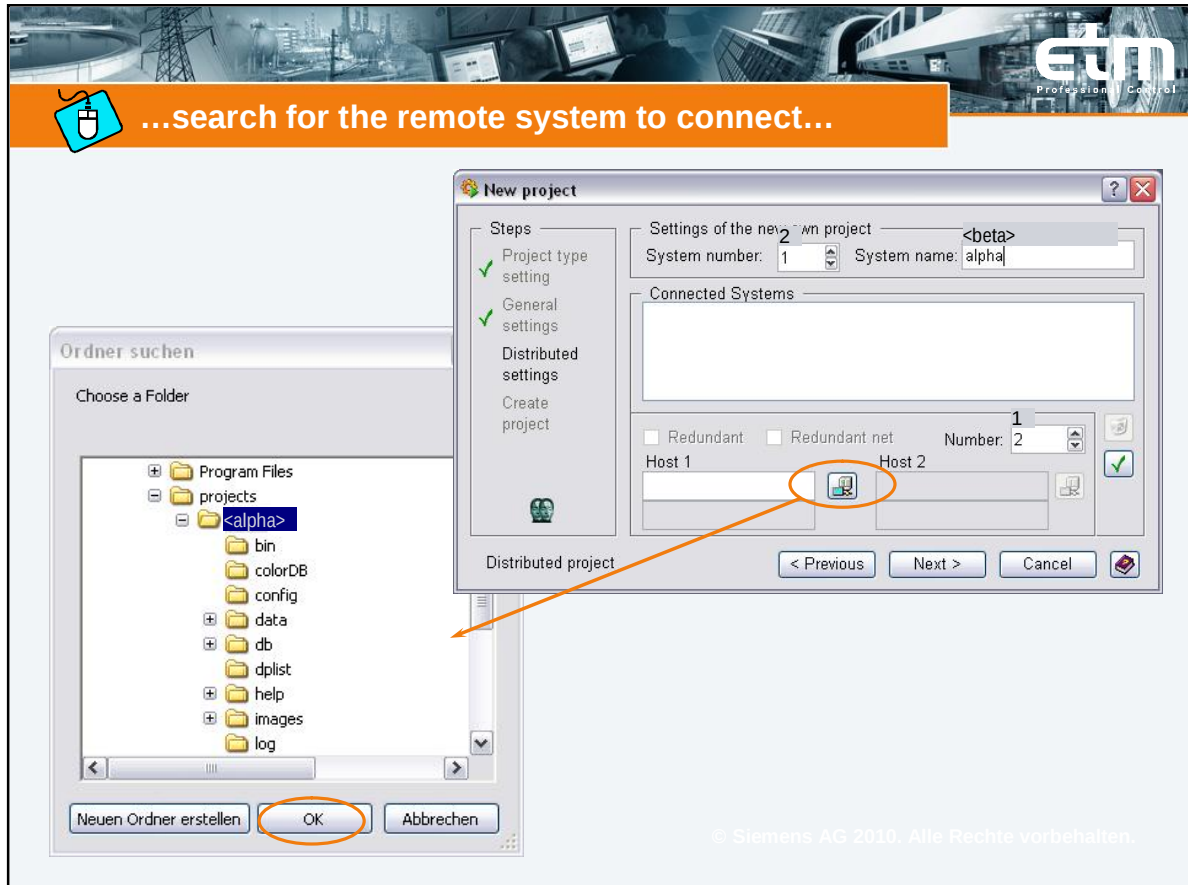
Keep in mind that each system has to have an unique name and number.

In the above exercise the system-name is alpha and the system-number is 1.

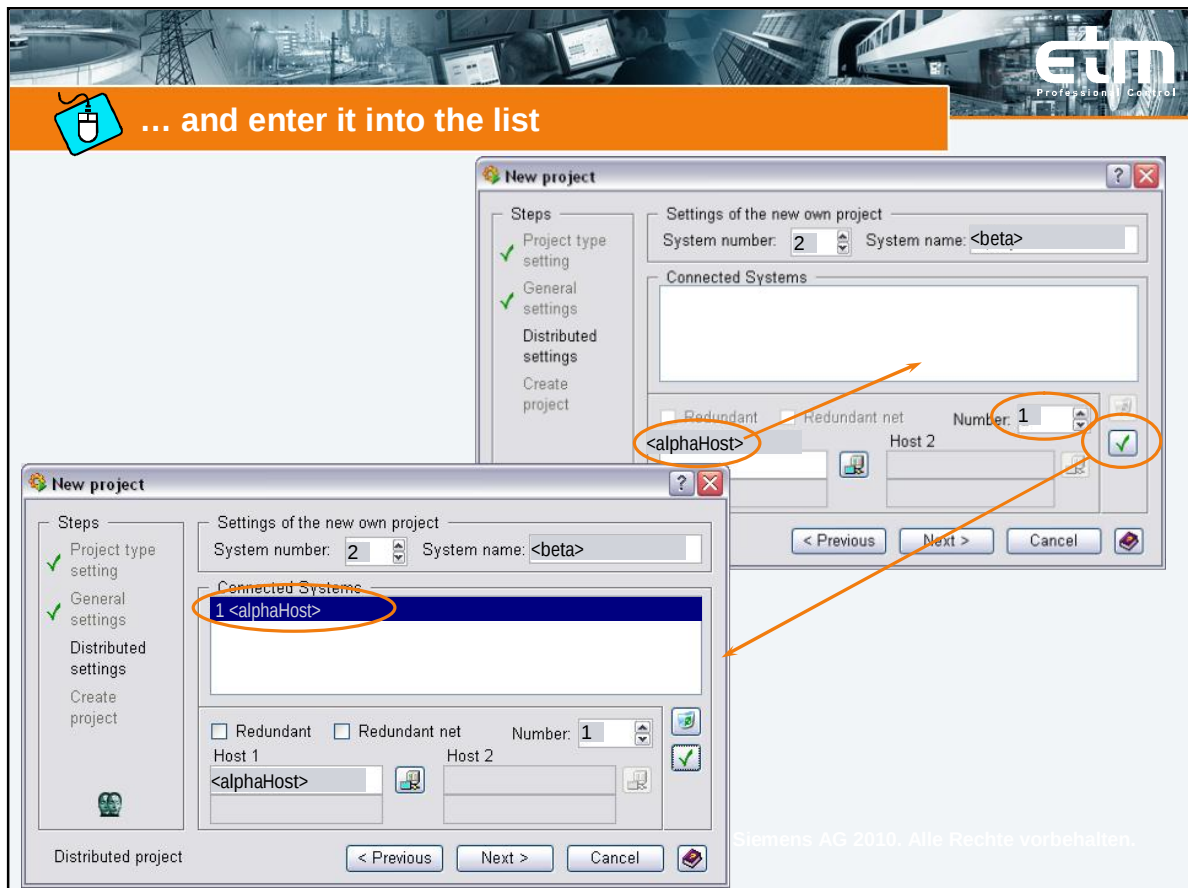
Because this is our first system the list of connected systems will stay empty (the other systems will establish the connection to the alpha system).

**Note:**

The second system is also getting an unique name and number (the system-name is now beta and the system-number is 2).

**Note:**

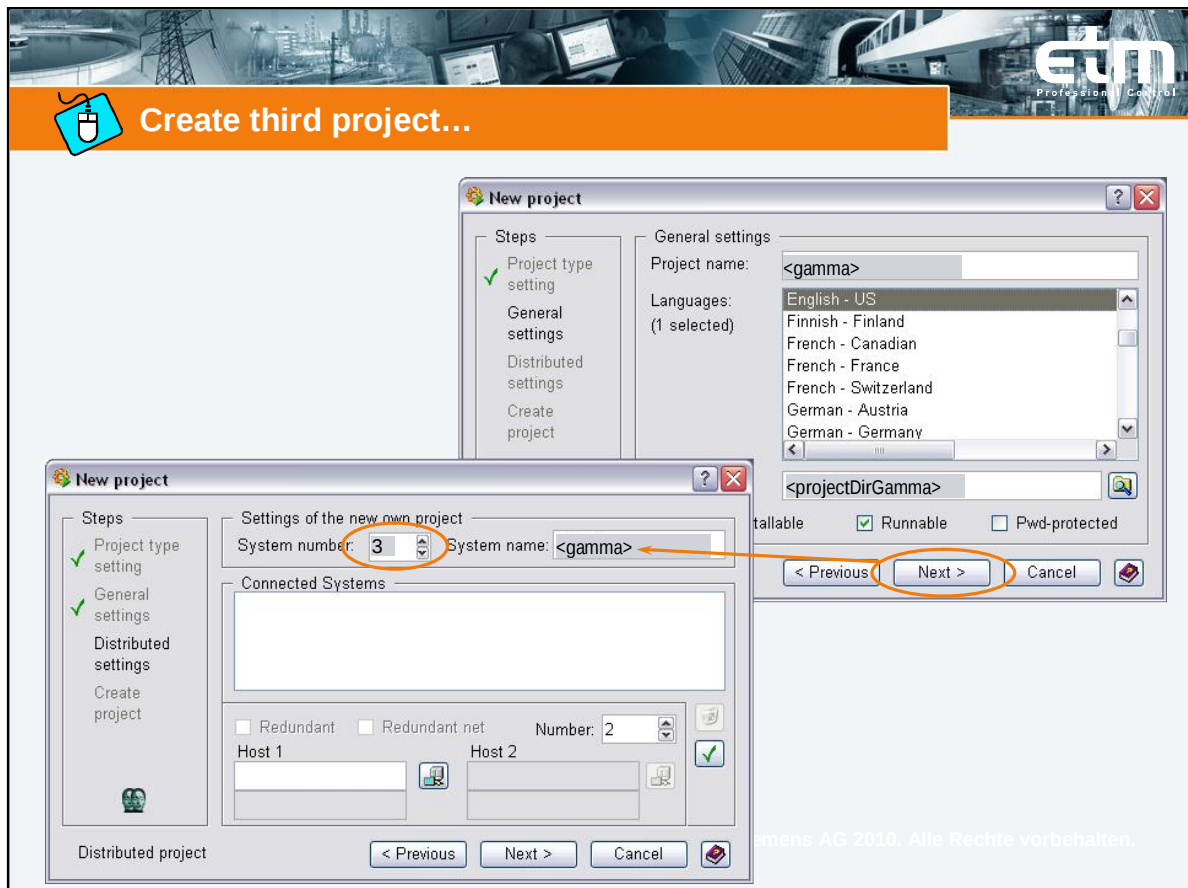
By using the **file-selector** the user may select the project dir of the remote system where the connection should be established to. (The whole path itself is not needed, only the hostname is retrieved – if one already knows the hostname in advance it may be also enter manually into the text field).



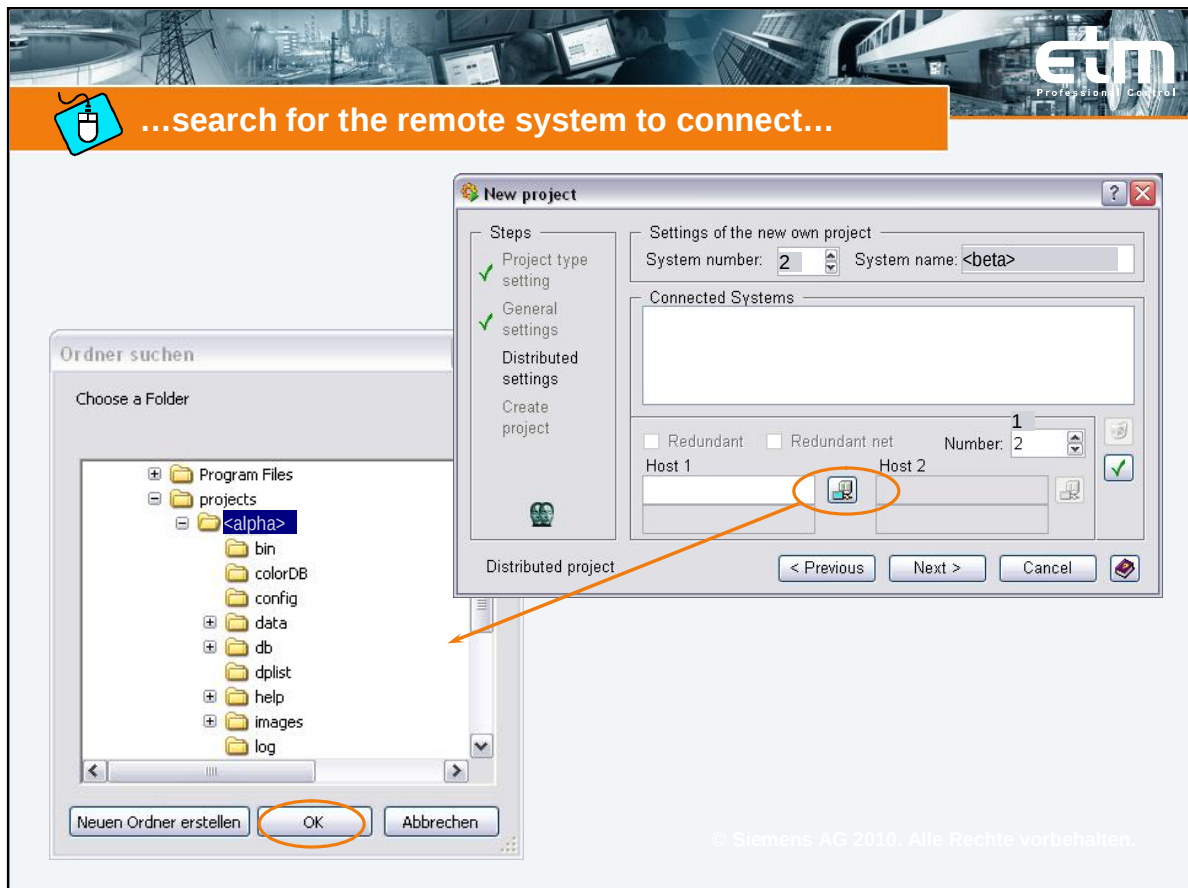
Note:

The remote system is not referenced by the system name, but its unique system number and the hostname, where the system is running on.

However this unique system number will not be retrieved automatically by the use of the file-selector – it has to be known by the user!

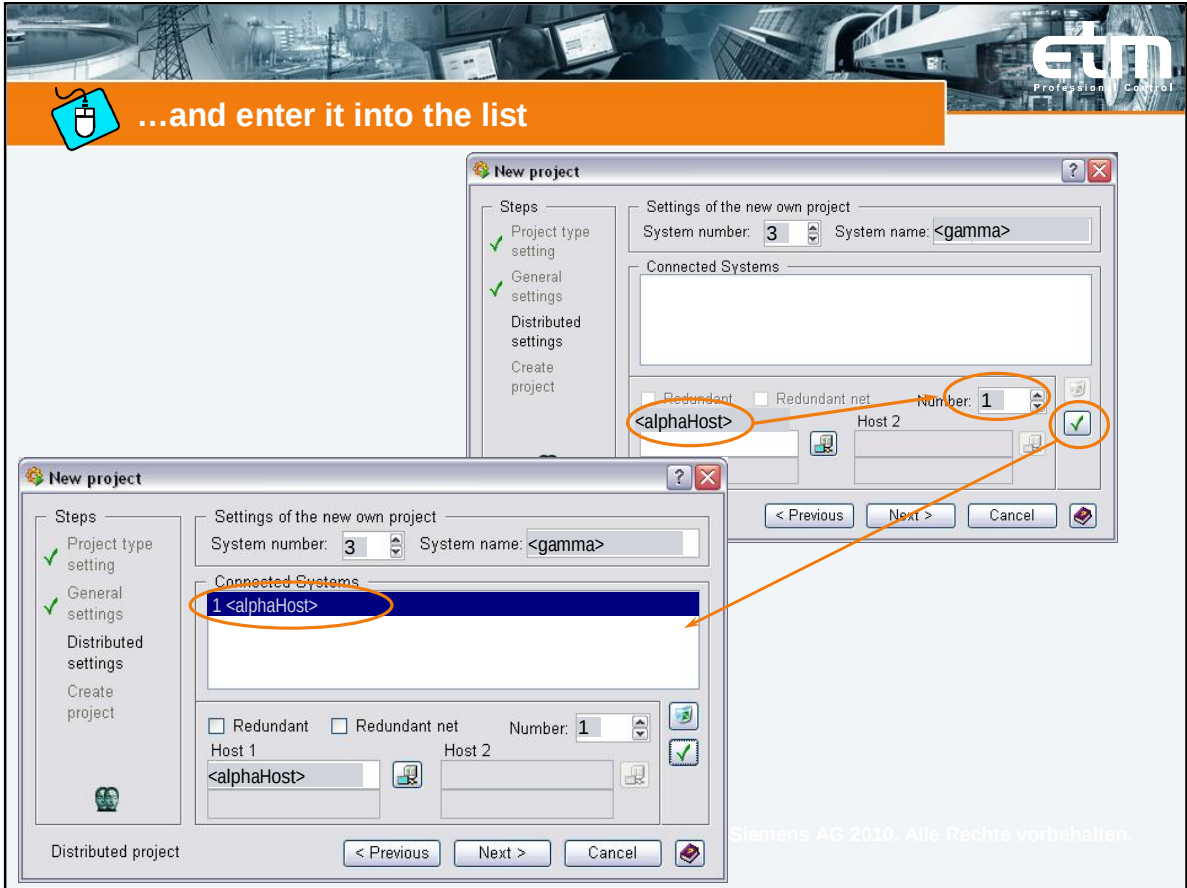
**Note:**

The third system finally is also getting an unique name and number (the system-name is now gamma and the system-number is 3).

**Note:**

By using the **file-selector** the user may select the project dir of the remote system where the connection should be established to. (The whole path itself is not needed, only the hostname is retrieved – if one already knows the hostname in advance it may be also enter manually into the text field).

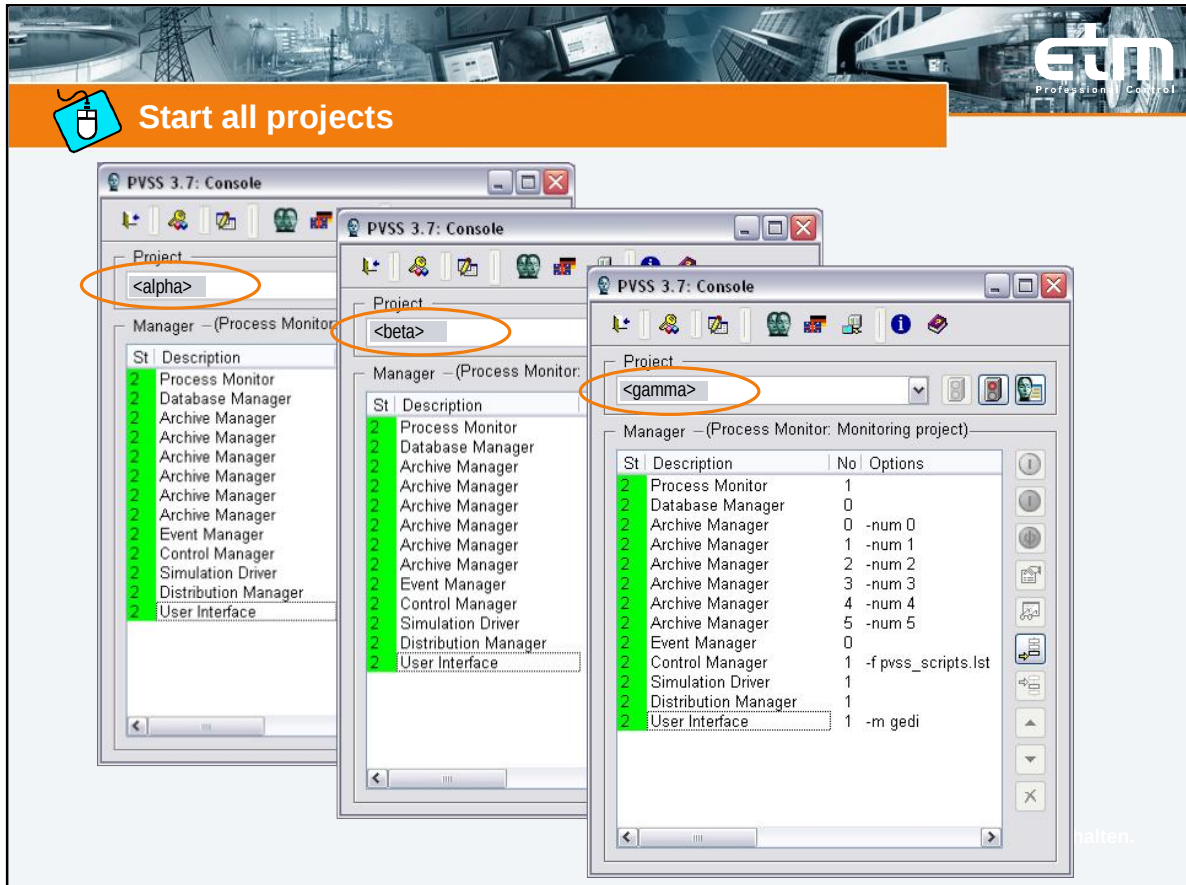

...and enter it into the list



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Note:

The system 3 should only establish connection to the system 1 therefore only the alphaHost (with the corresponding system number) is added to the list and not the hostName of the beta system.

**Note:**

When starting up all projects each dist manager tries to connect to the systems specified at its config file.

With our setup the dist manager of the first system will not actively connect to another system.

The dist manager of the second system however will establish a connection to the system 1.

And the third dist manager will also establish a connection to system 1.

Attention:

If the config files of the different systems will be manipulated later wards, the user has to take care that each established connection between two systems is every time bidirectional (i.e. when system 2 establishing a connection to system 1, make sure that system 1 will not also try to connect to system 2).

Explanations to the LOG-entries on the FIRST distributed systems:

The following lines will give a short explanation about the on goings when starting up the three distributed Systems one by one (below you will find excerpts from the log file of the first system).

```
<time> ... actual timestamp
<projectName_#1> ... first distributed project
<projectName_#2> ... second distributed project
<projectName_#3> ... third distributed project
```

- 1) When the first distribution manager starts up, the only connection it will establish is the one to its own event manager (@ localhost), because there is no other connection parameterized in the config file:

```
WinCC OA00dist (0), <time>, SYS, INFO, 1, Manager Start, PROJ, <projectName_#1>,
  <pvssVersion> linked at <linkDate>
WinCC OA00dist (0), <time>, SYS, INFO, 3, Trying to connect to,
  (SYS: 0 Data -num 0 CONN: 1) @ localhost:4897
WinCC OA00dist (0), <time>, SYS, INFO, 4, Connected to,
  (SYS: 0 Data -num 0 CONN: 1) @ localhost
WinCC OA00data (0), <time>, SYS, INFO, 4, Connected to,
  (SYS: 1 Dist -num 1 CONN: 1) @ localhost
WinCC OA00dist (1), <time>, SYS, INFO, 6, Initialization by Data Manager finished
WinCC OA00dist (1), <time>, SYS, INFO, 3, Trying to connect to,
  (SYS: 1 Event -num 0 CONN: 1) @ localhost:4998
WinCC OA00dist (1), <time>, SYS, INFO, 4, Connected to,
  (SYS: 1 Event -num 0 CONN: 1) @ localhost
WinCC OA00event (0), <time>, SYS, INFO, 4, Connected to,
  (SYS: 1 Dist -num 1 CONN: 1) @ localhost
```



Thank you for your attention!

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