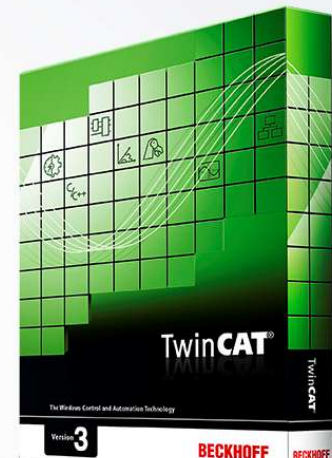
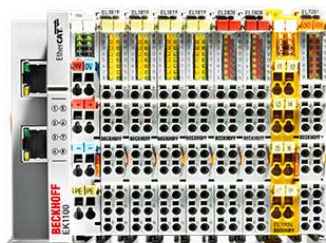


Connecting to a Target System: TwinCAT 3

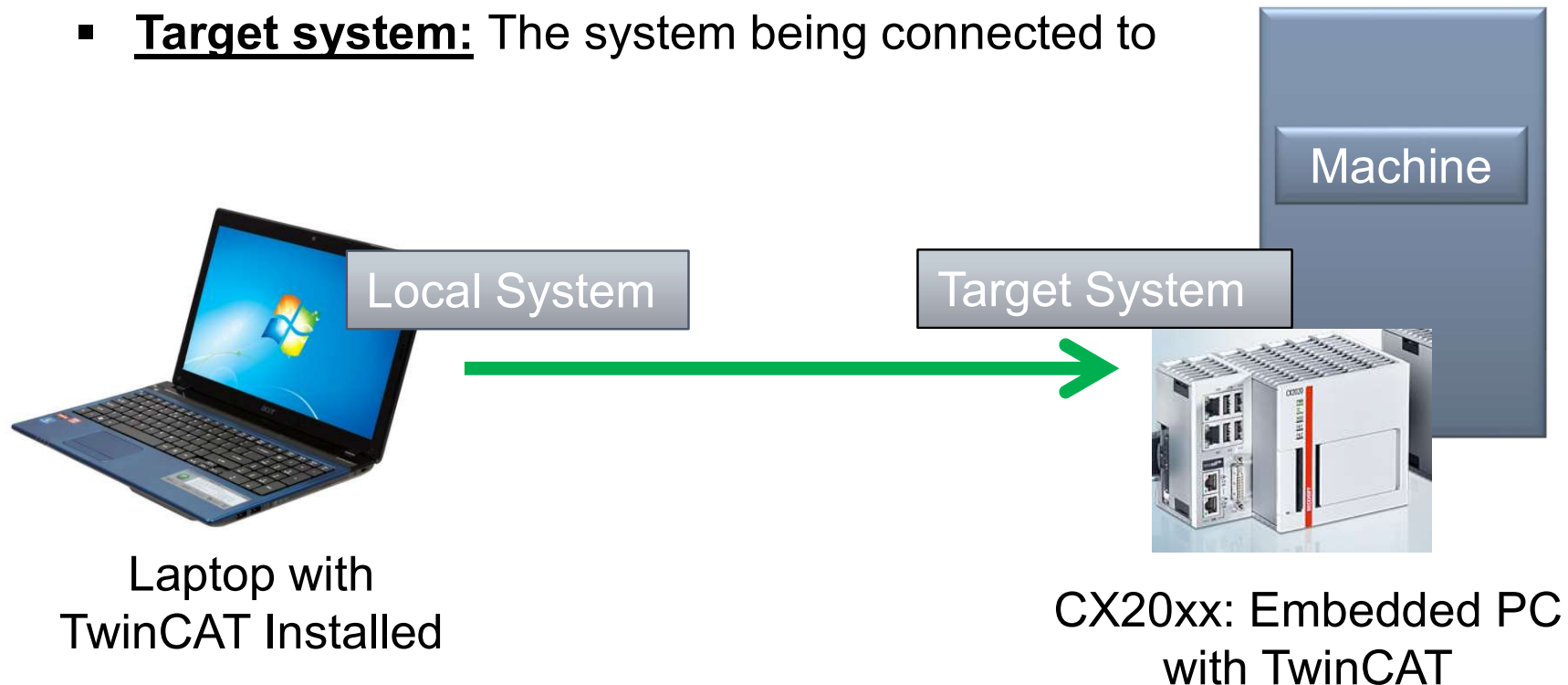
BECKHOFF



- 1. Basic Principles**
2. Connection Prerequisites
3. How to Connect
4. Details and Troubleshooting

Connect to Target Defined

- **TwinCAT System**: an installation of the TwinCAT Software
- **Connect to Target**: when one TwinCAT System is used develop or troubleshoot another TwinCAT System
 - **Local system**: The system “reaching out”
 - **Target system**: The system being connected to

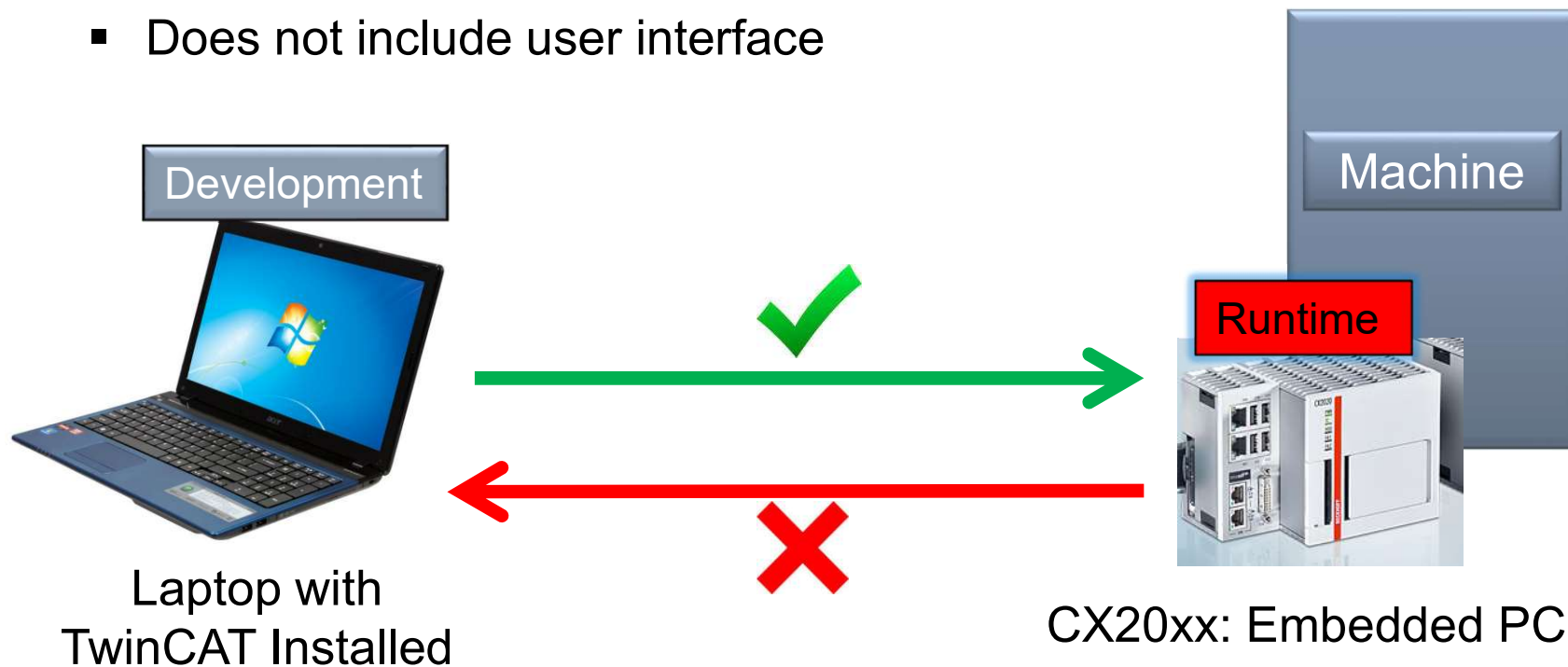


- **Development:**

- TwinCAT System for configuration, troubleshooting, and control
- Includes user interface for TwinCAT

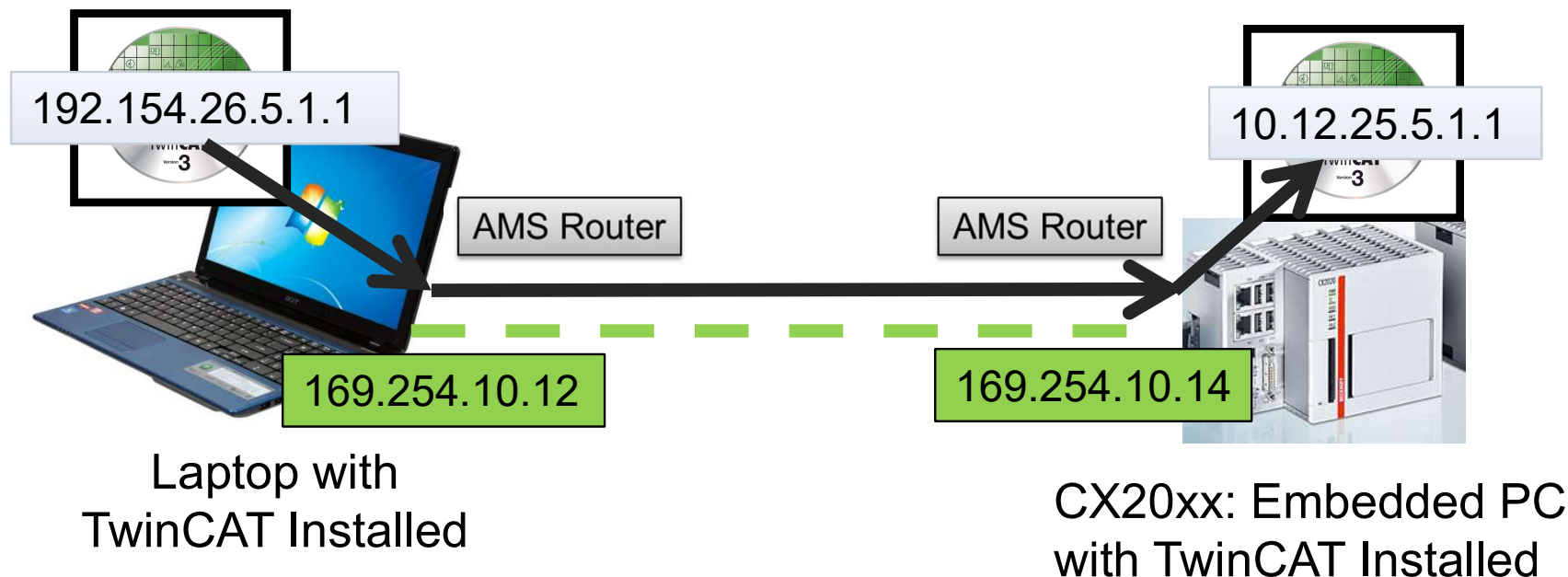
- **Runtime:**

- Lean version of TwinCAT System used only for control
- Does not include user interface

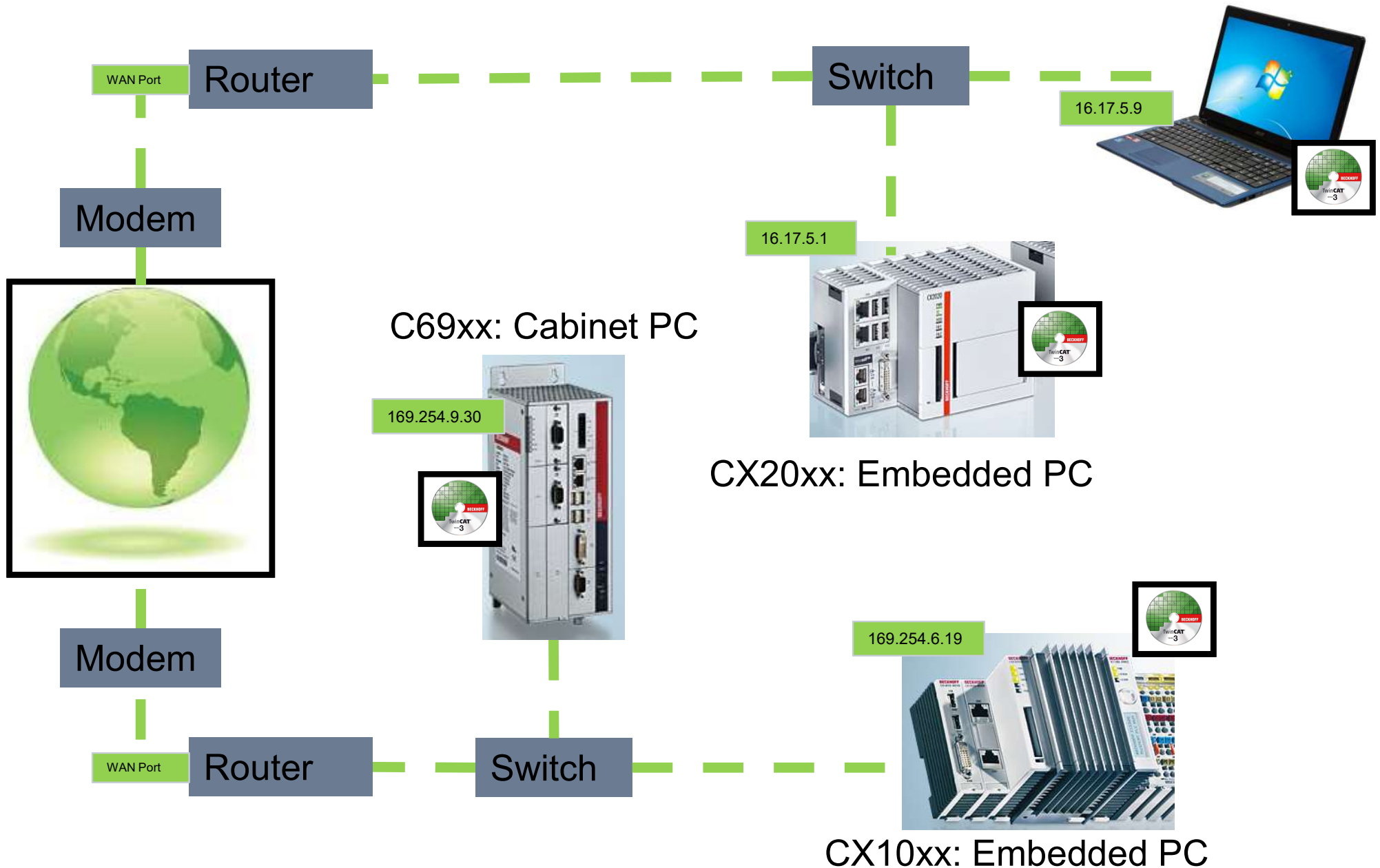


TwinCAT Connections use an AMS Router

- Each TwinCAT System has an AMS* NetID
- AMS NetID: Identifies the message router for a TwinCAT System on a machine
 - Ends in '.1.1' by default
 - Often derived from a MAC Address or first IP address used on a machine
 - Does not need to match IP Address of installed computer
- AMS Router: Part of TwinCAT that routes messages between TwinCAT systems



TwinCAT Connections May Be Global

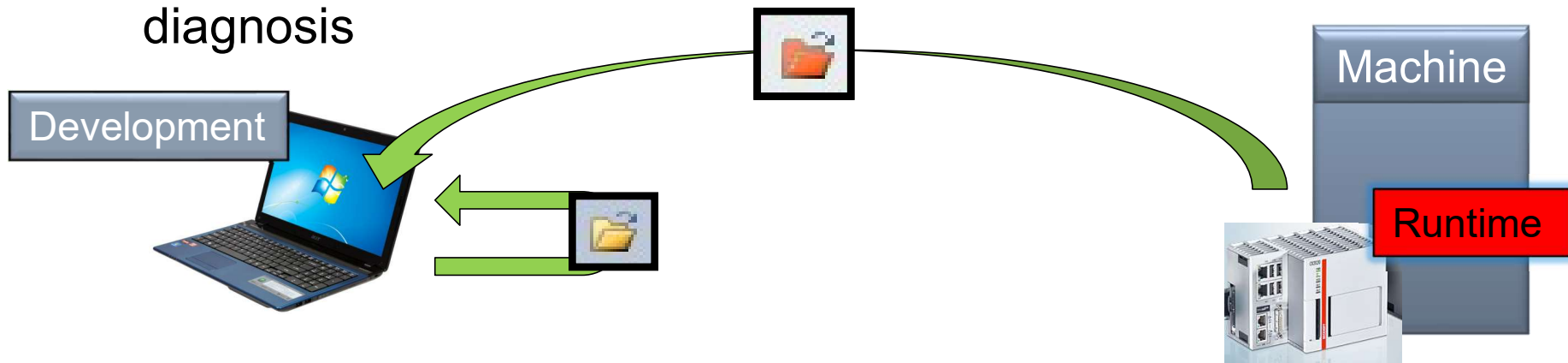


Two Main Actions Occur with a Connection

BECKHOFF

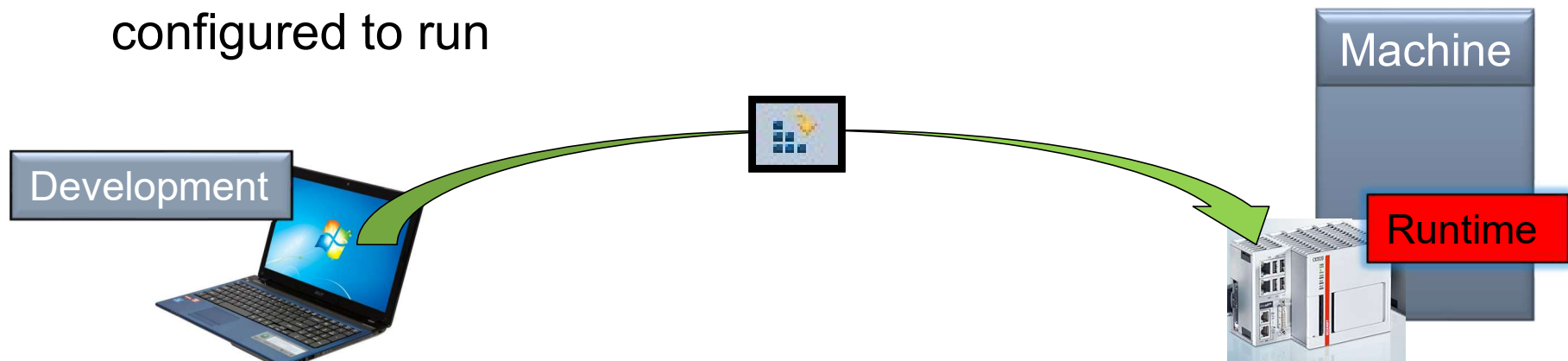
■ Troubleshooting the Machine:

- The development software can monitor a running machine for diagnosis



■ Deploying Changes to the Machine:

- The development software can be used to change how a machine is configured to run



1. Basic Principles
- 2. Connection Prerequisites**
3. How to Connect
4. Details and Troubleshooting

Before Connecting to Target, these Must be True*

BECKHOFF

- **Check These Beforehand to Ensure a Target Can be Connected to:**

- Local System has the correct TwinCAT Development build, version, and level



- Network Communication is occurring between systems

```
C:\Documents and Settings\Administrator>ping 10.11.12.13
Pinging 10.11.12.13 with 32 bytes of data:
Reply from 10.11.12.13: bytes=32 time<1ms TTL=128
Reply from 10.11.12.13: bytes=32 time<1ms TTL=128
Reply from 10.11.12.13: bytes=32 time<1ms TTL=128
Reply from 10.11.12.13: bytes=32 time<1ms TTL=128

Ping statistics for 10.11.12.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

- TwinCAT Communication must occur, be unblocked

- **If you have connected in the past, these checks may not be necessary**

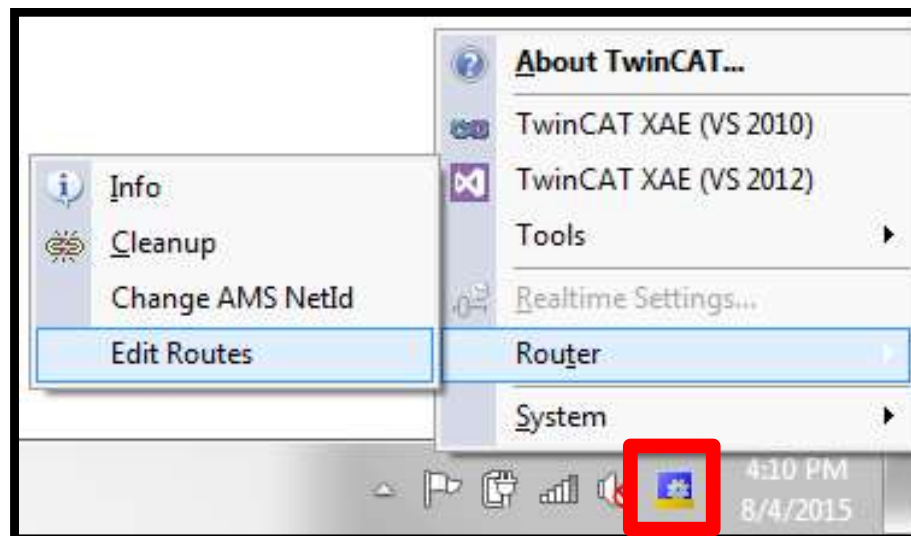


*More information is provided in the details and troubleshooting section.

1. Basic Principles
2. Connection Prerequisites
- 3. How to Connect**
4. Details and Troubleshooting

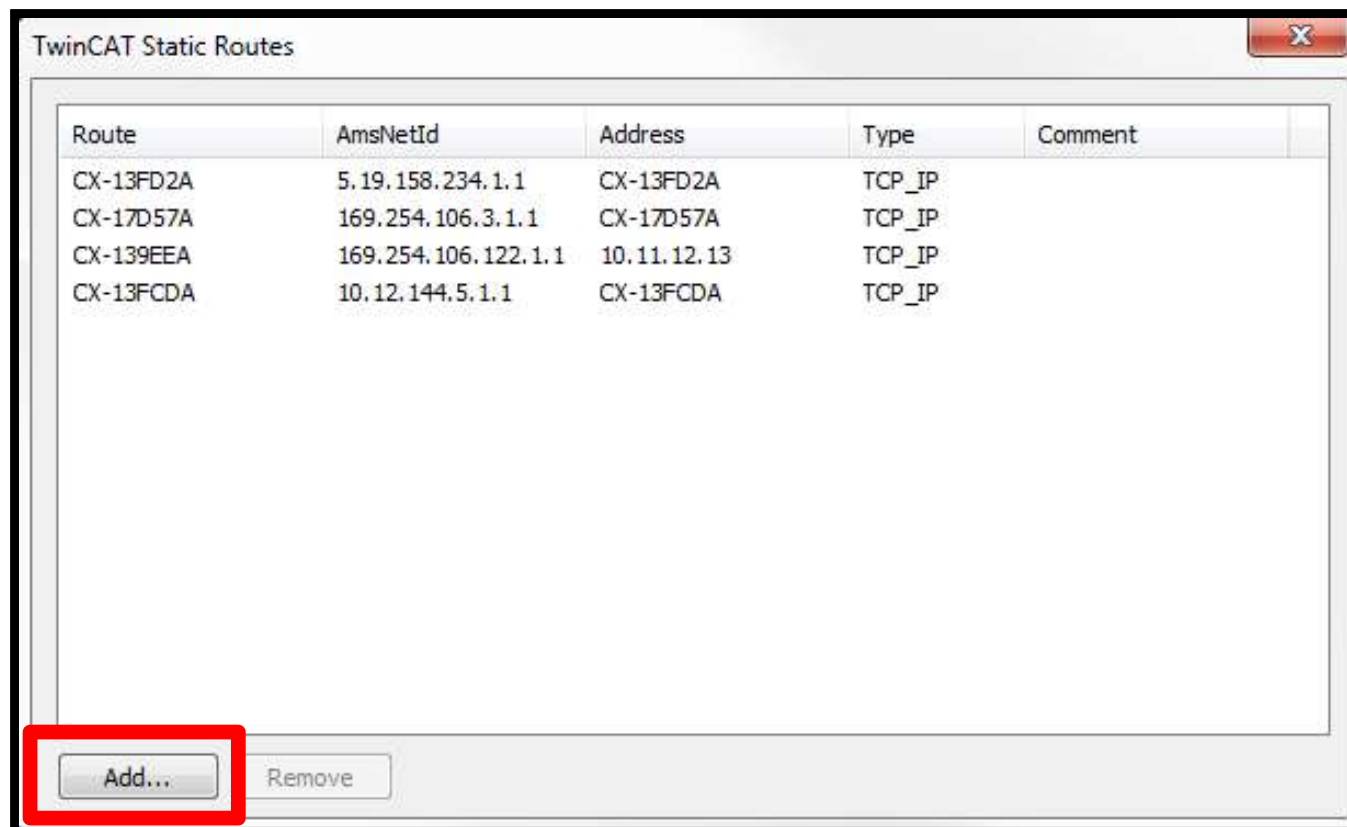
BECKHOFF

- For one TwinCAT system to connect to another a route must be present on both the local and target system to each other.
 - Routes contain information which allow one system to find another on a network.
- To create a route or see existing routes, go the TwinCAT icon and select edit routes:



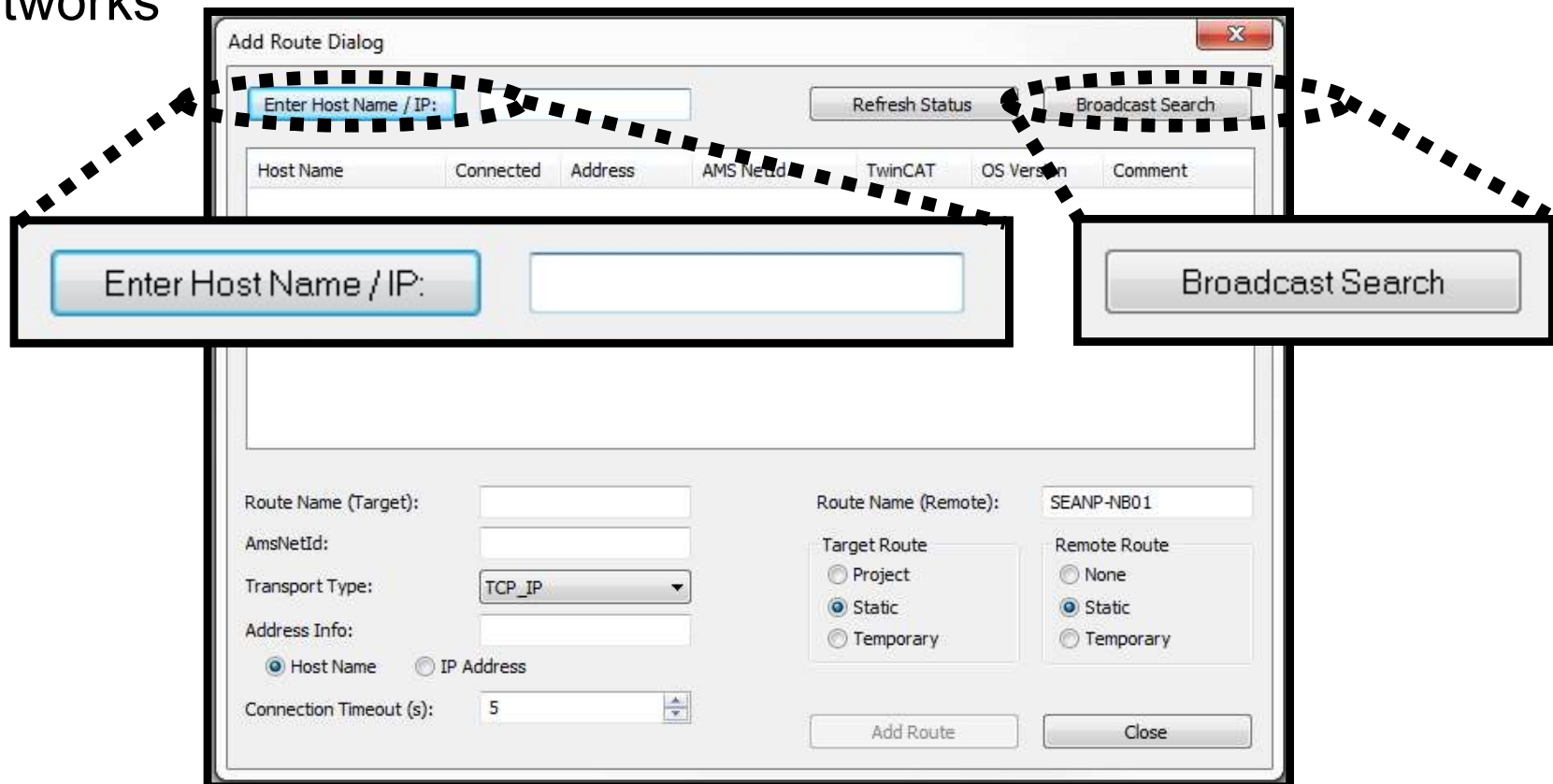
Step 1: See if Route Present

- The Static Routes dialog box contains all existing routes.
- If the desired route is present, no route needs to be added.
- If it is not present, select the add button.



Step 2: Search for Other TwinCAT Systems

- **Two Search Options Exist to Find and Add New Routes:**
 - Click '**Broadcast Search**' to search all **local area network** computers
 - Click '**Enter Host Name / IP:**' after entering computer name or IP address to search *for a specific computer* on both local and wide area networks



Step 3: Select the Desired System

- **Select the computer from the list**
 - If desired system is not present, see the Details and Troubleshooting Section

The 'Add Route Dialog' window displays a table of discovered systems and configuration options for adding a route.

Host Name	Connected	Address	AMS NetId	TwinCAT	OS Version	Comment
CX-14DA1E		10.12.144.6	10.12.144.6.1.1	3.1.4018	Windows 7	
SeanP-nb01		10.12.144.2	10.12.160.11.1.1	3.1.4018	Windows 7	

Below the table, the configuration options are as follows:

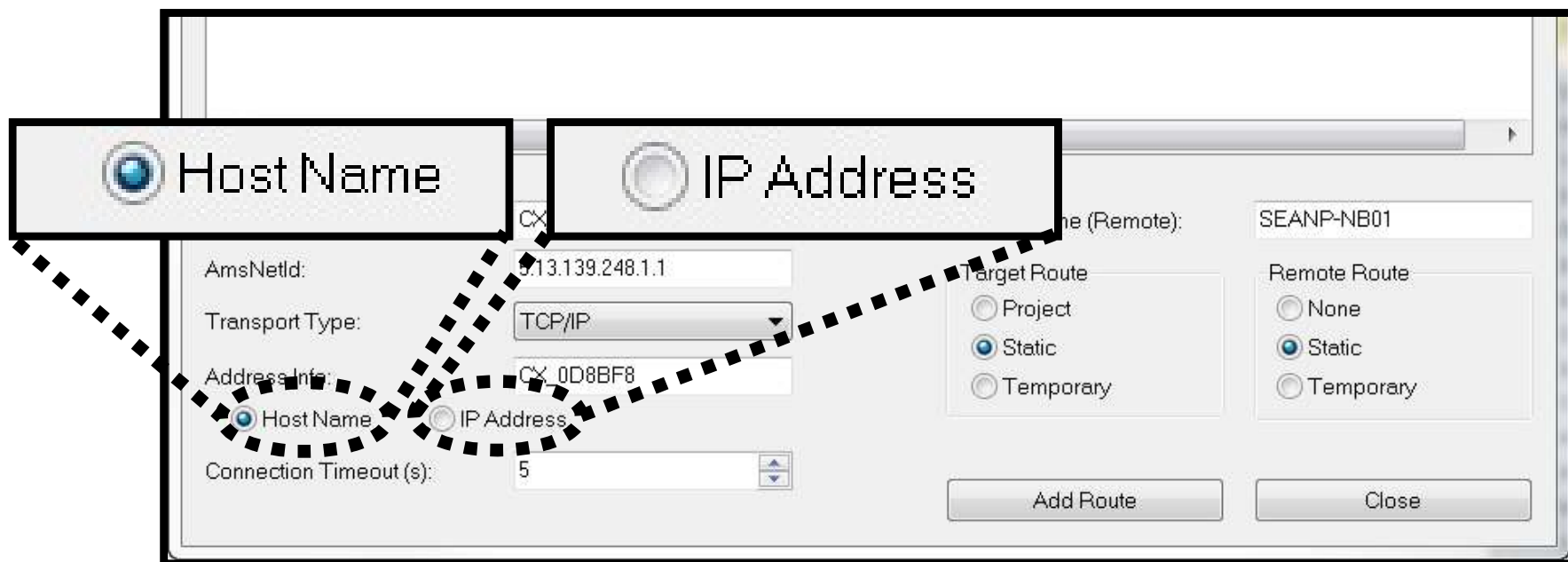
- Route Name (Target): CX-14DA1E
- AmsNetId: 10.12.144.6.1.1
- Transport Type: TCP_IP
- Address Info: CX-14DA1E
- ☒ Host Name ☐ IP Address
- Connection Timeout (s): 5
- Route Name (Remote): SEANP-NB01
- Target Route: ☐ Project ☒ Static ☐ Temporary
- Remote Route: ☐ None ☒ Static ☐ Temporary

Buttons: Add Route, Close

Step 4: Select the Method of System Identification

BECKHOFF

- Select **Host Name** to Identify the TwinCAT System by the name of the computer on which it is installed
 - Use for computers with dynamic IP addresses acquired from a DHCP server
- Select **IP Address** to Identify the TwinCAT System by the specific IP address being used for network communication
 - Use for computers with static IP addresses



Step 5: Add the Route

- Click the add route button to save the route for future connections

Add Route Dialog

Enter Host Name / IP: Refresh Status Broadcast Search

Host Name	Connected	Address	AMS NetId	TwinCAT	OS Version	Comment
CX-14DA1E		10.12.144.6	10.12.144.6.1.1	3.1.4018	Windows 7	
SeanP-nb01		10.12.144.2	10.12.160.11.1.1	3.1.4018	Windows 7	

Route Name (Target):

AmsNetId:

Transport Type:

Address Info:

☒ Host Name ☐ IP Address

Connection Timeout (s):

Route Name (Remote):

Target Route

☐ Project

☒ Static

☐ Temporary

Remote Route

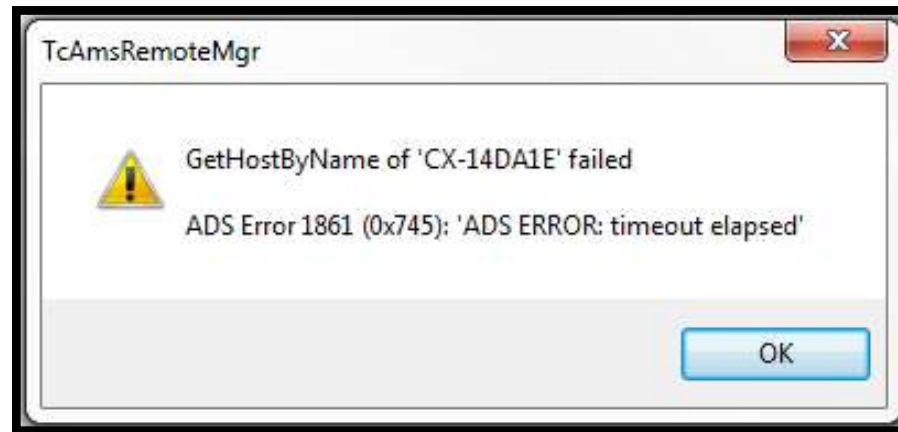
☐ None

☒ Static

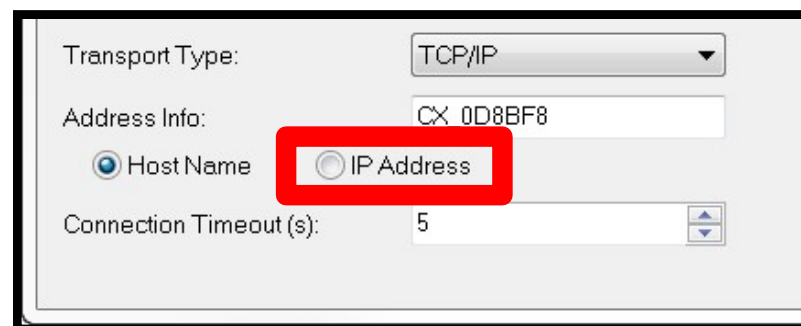
☐ Temporary

Add Route Close

Step 5: Add the Route



- If an error message is obtained, this most commonly means that the AMS Remote Manager was unable to add the target by host name to its Router Table.
- Switch Address info to IP Address and Add Route again



Step 6: Enter Correct Username and Password

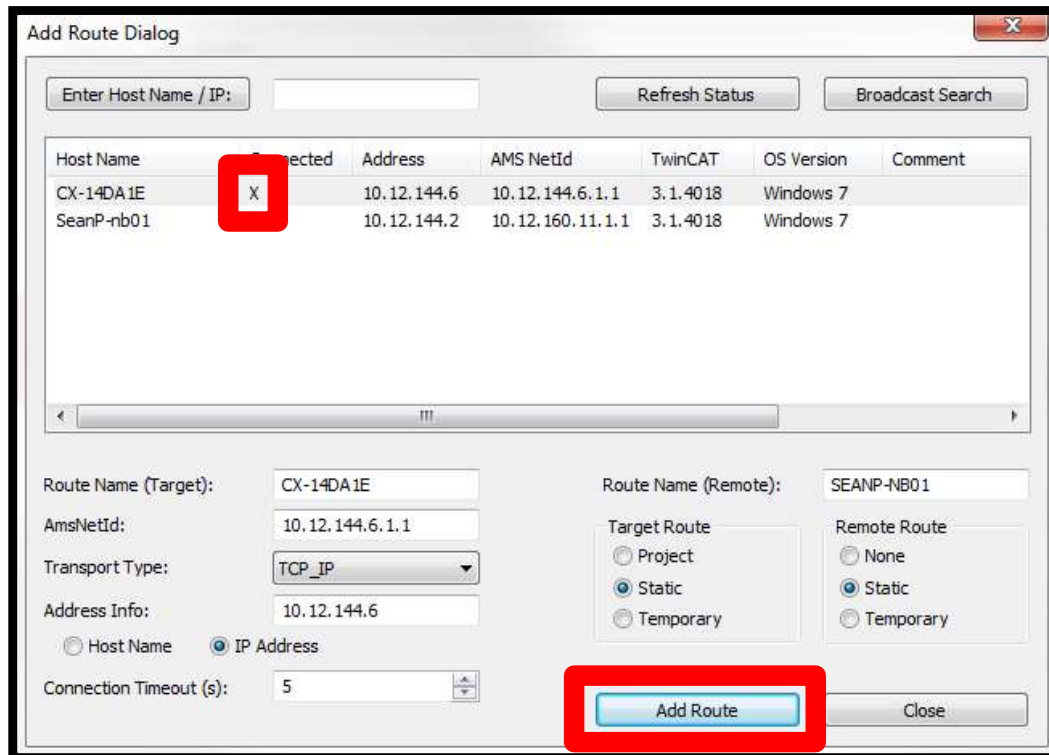
BECKHOFF

- A security window should pop-up before the route can be added.
- Enter an **administrator level username and password** *for the target machine* and hit OK
- Beckhoff PC Default Password:
 - Username: Administrator
 - *Password: 1
- If Password Unknown:
 - There is **no way** to automatically add a new route
 - Beckhoff personnel cannot retrieve an unknown password
- Encryption is available to prevent unauthorized acquisition of username and password by network traffic monitoring



Step 7: Verify Connection and Close Window

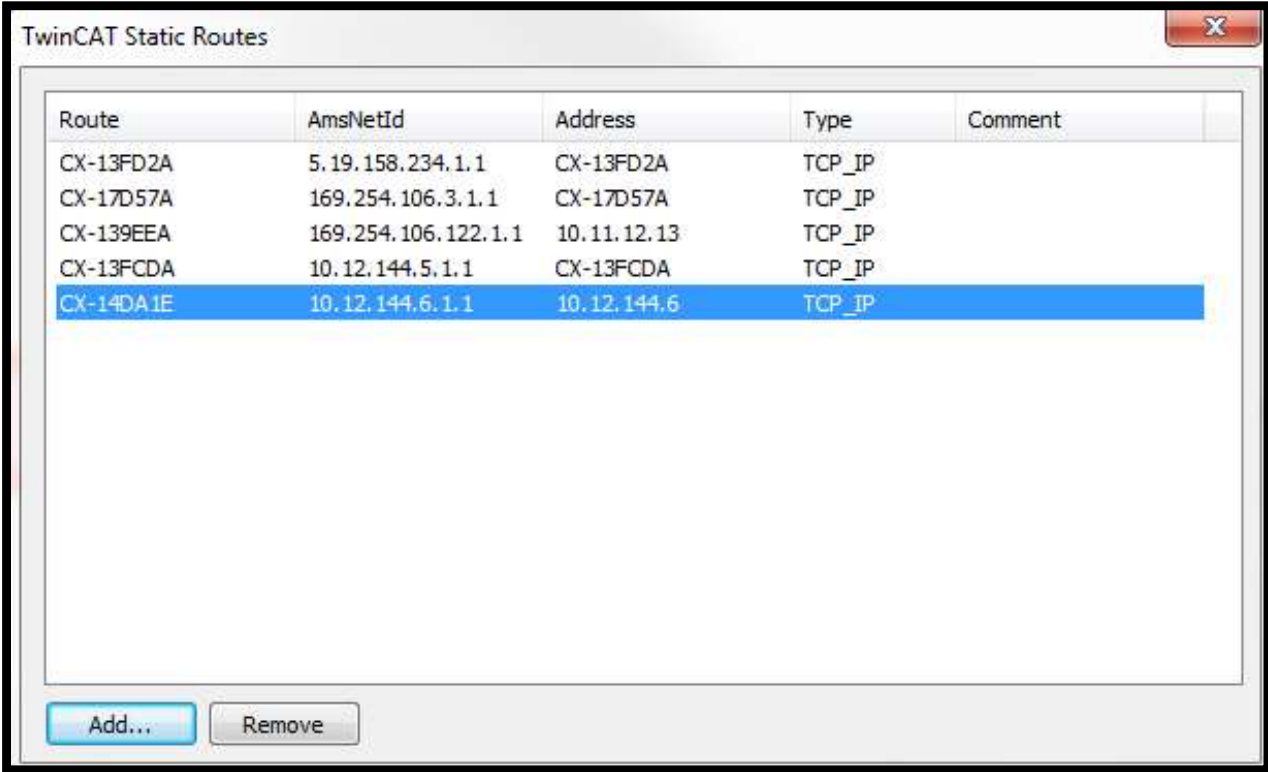
- A new route should now exist on the local machines
- The local route should show an X under the connected column



- If no 'X' is shown, hit the refresh status button
- If one still does not appear, a connection may still be possible
- Click the Close button to exit the window

Step 8: Verify Route Has Been Added

- The route just added should be in the Static Routes Table.



Route	AmsNetId	Address	Type	Comment
CX-13FD2A	5.19.158.234.1.1	CX-13FD2A	TCP_IP	
CX-17D57A	169.254.106.3.1.1	CX-17D57A	TCP_IP	
CX-139EEA	169.254.106.122.1.1	10.11.12.13	TCP_IP	
CX-13FCDA	10.12.144.5.1.1	CX-13FCDA	TCP_IP	
CX-14DA1E	10.12.144.6.1.1	10.12.144.6	TCP_IP	

Add... Remove

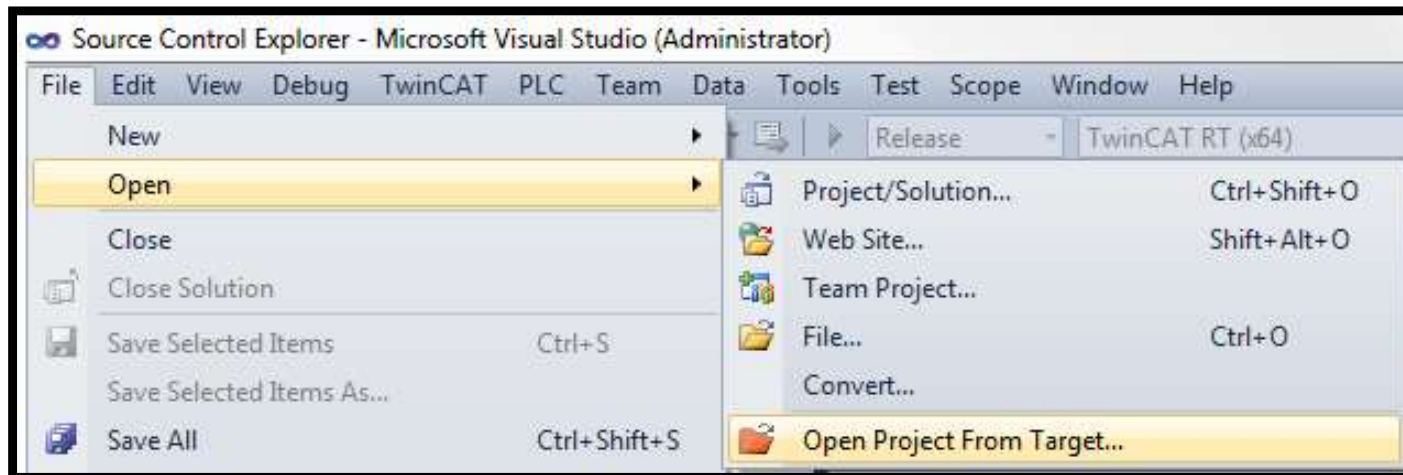
- If so, a route will also have been added to the target machine, which corresponds to the local machine
- If not, see Details and Troubleshooting section

Step 9: Connect to the Target System

- With a route added, TwinCAT can connect to the target system
- Connections are typically used for two reasons:
 - To pull out the running machine files from the target
 - To work on the target machine using local files

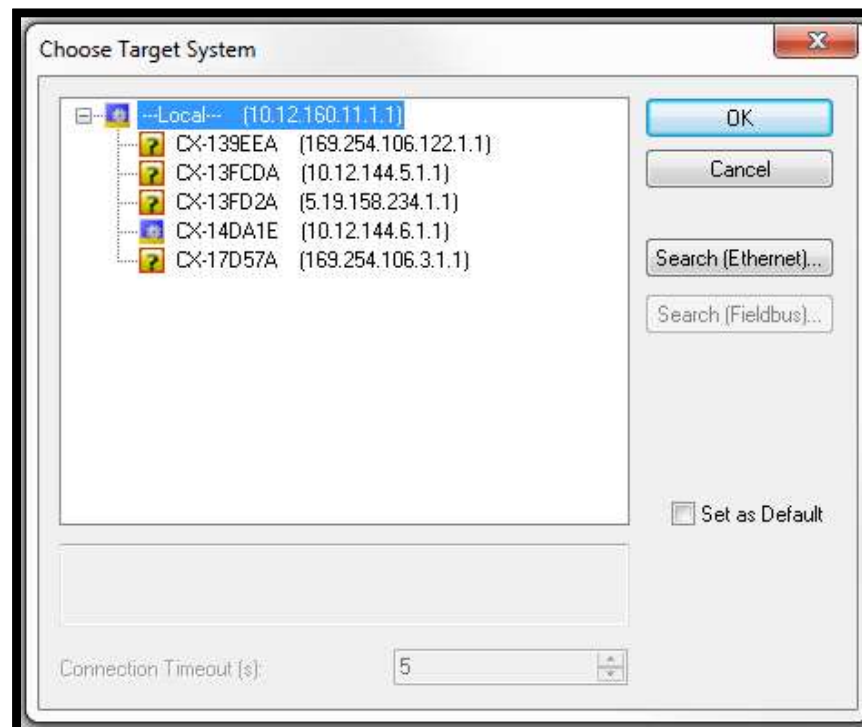
Step 9a: Connecting to Extract Files

- To extract files from the running machine the local machine must have visual studio open without any solutions loaded
- If a solution is loaded, close it under the file menu
- Select Open Project From Target



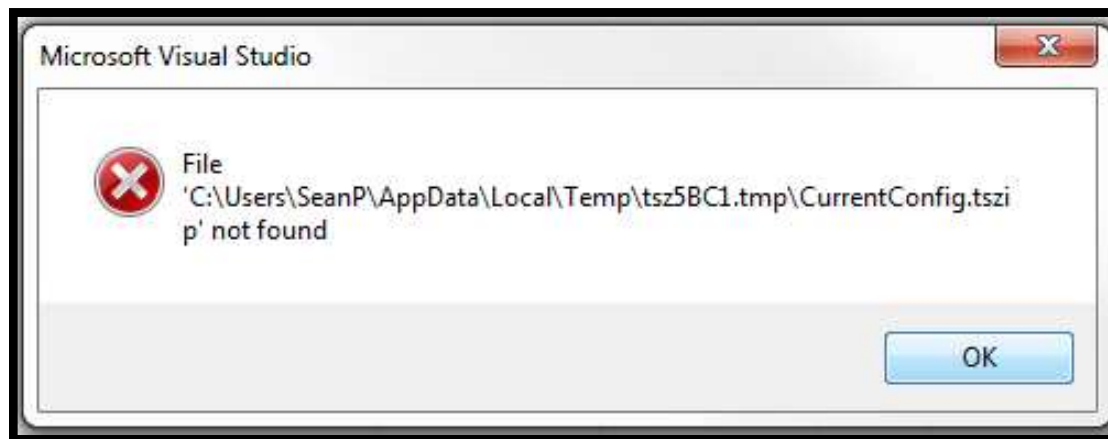
Step 9a: Connecting to Extract Files

- Select the desired Target Route and hit OK.
- The local system will now search the target for user machine files (CurrentConfig.tszip) in **C:\TwinCAT\3.1\Boot**
- All routes with question marks are not communicating with the local machine and cannot be accessed. See Details and Troubleshooting to rectify the problem.



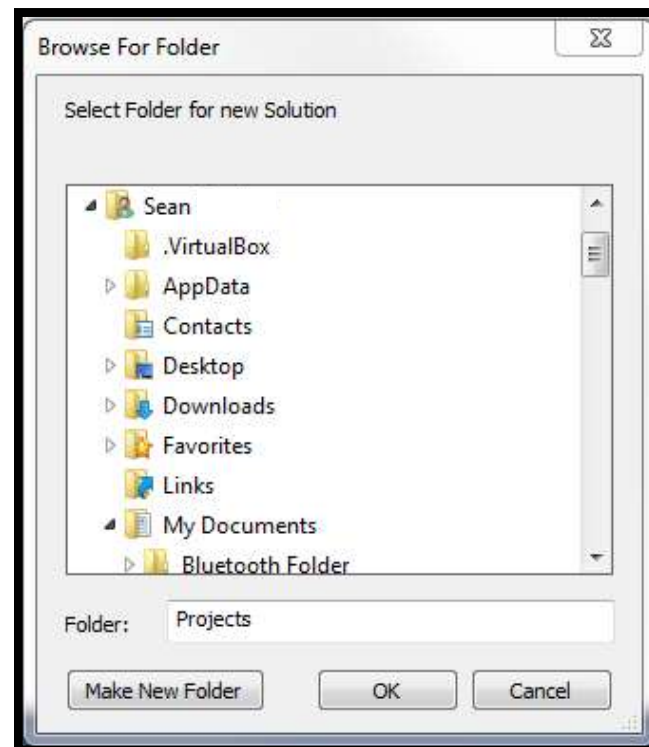
Step 9a: Connecting to Target to Extract Files

- If no CurrentConfig.tszip exists in **C:\TwinCAT\3.1\Boot** of the target, an error similar to the one below will emerge.



Step 9a: Connecting to Target to Extract Files

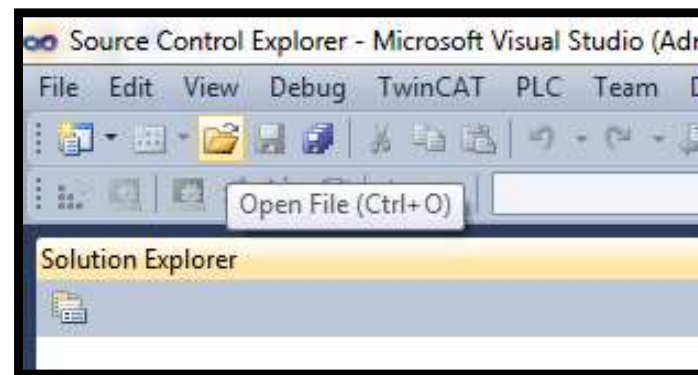
- If CurrentConfig.tszip does exist on the target, the files will need to be saved locally before they can be used.
- A dialog will prompt the user for a desired location.



- Once the files are transferred, the solution will open and automatically point to the target machine.

Step 9b: Connecting to Target with Local Files

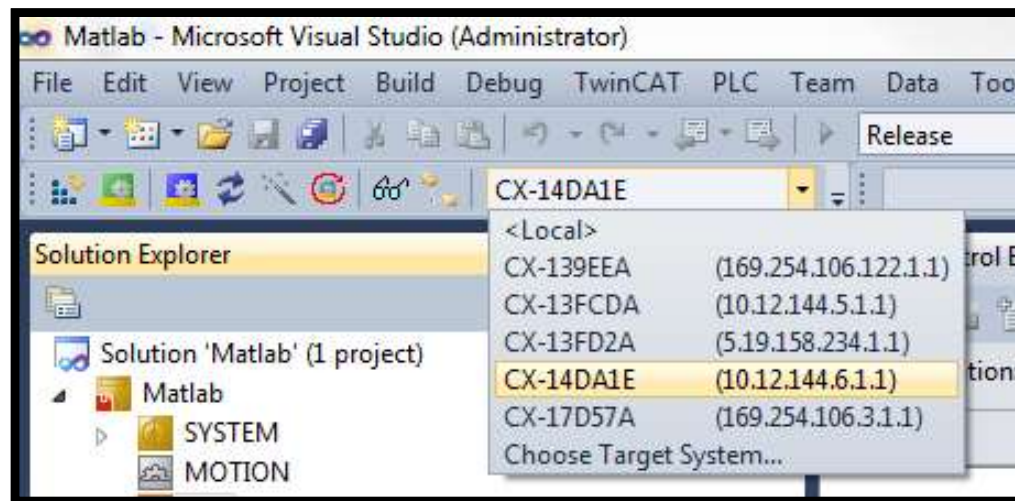
- If TwinCAT project files exist locally for the target machine open them with the yellow folder.



- Note:
 - For proper troubleshooting of a target, the local TwinCAT system must have machine files which exactly match what the target machine is running.
 - To reconfigure a target machine, any files can be opened locally and then deployed to the target assuming the new configuration files make sense.

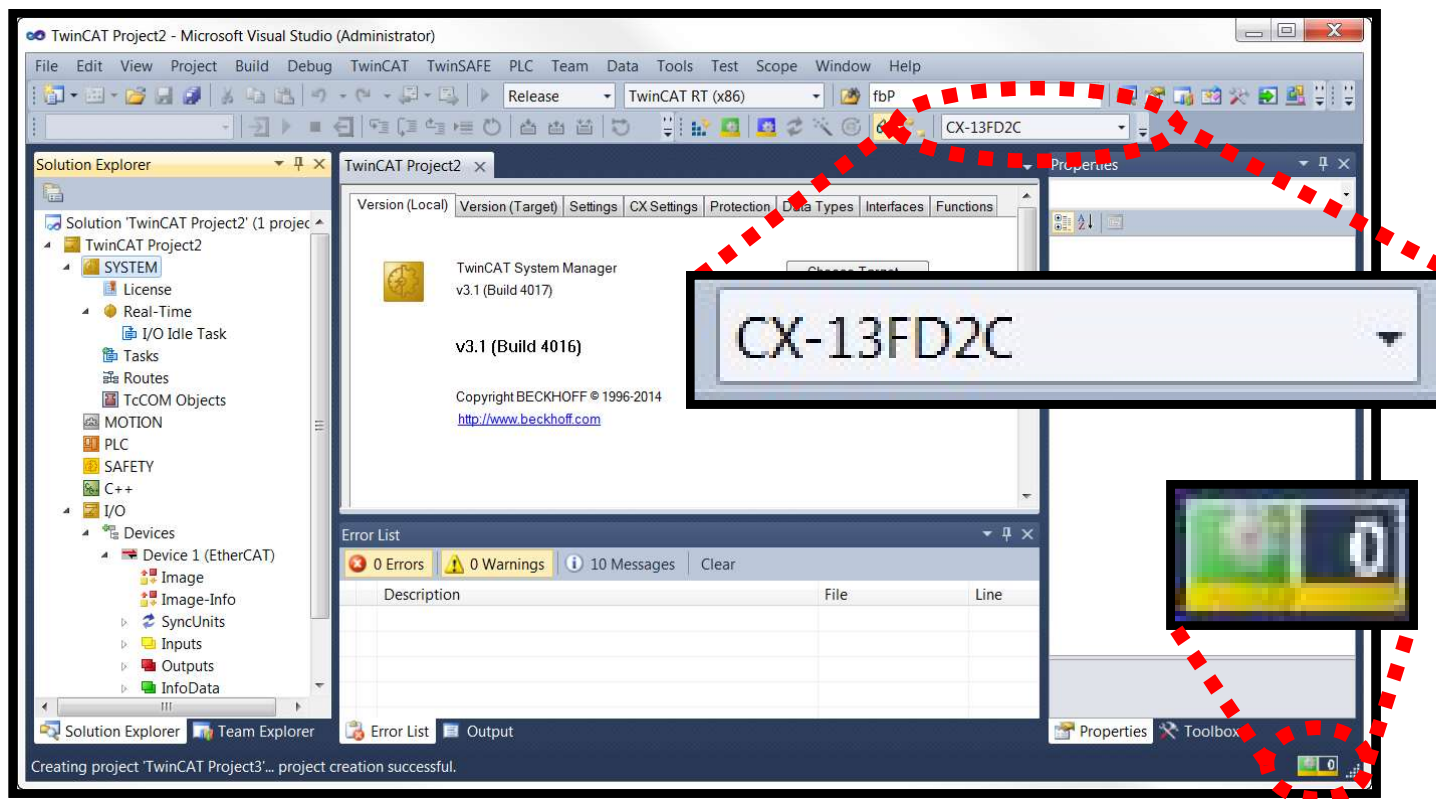
Step 9b: Connecting to Target with Local Files

- **Select the Route** of the target machine using the **Choose Target** drop down menu once the desired files are loaded.



- If drop down menu not present, right click anywhere in the toolbar and Select 'TwinCAT XAE Base'

- The local TwinCAT development software now points to a Target
- The **Target Name** should still show at the top of the window
- The State of the TwinCAT system is shown in the lower right



Other Options:

- Timed Out



- Config Mode



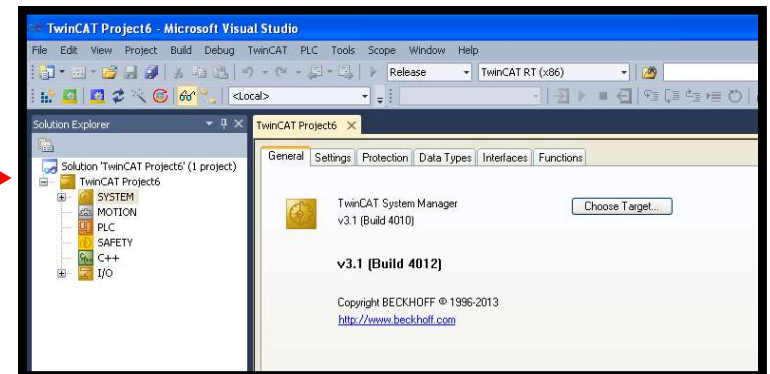
1. Basic Principles
2. Connection Prerequisites
3. How to Connect
- 4. Details and Troubleshooting**

- Without checking **Connection Prerequisites** the Connection Process may not work
- See following slides to:
 - A** Ensure the **correct development** is installed on local machine
 - B** Ensure Ethernet **communication** between computers **over the network**
 - C** Ensure **TwinCAT communication** is possible
 - Check for other potential causes for connect to target failures

Local System Needs TwinCAT Development

BECKHOFF

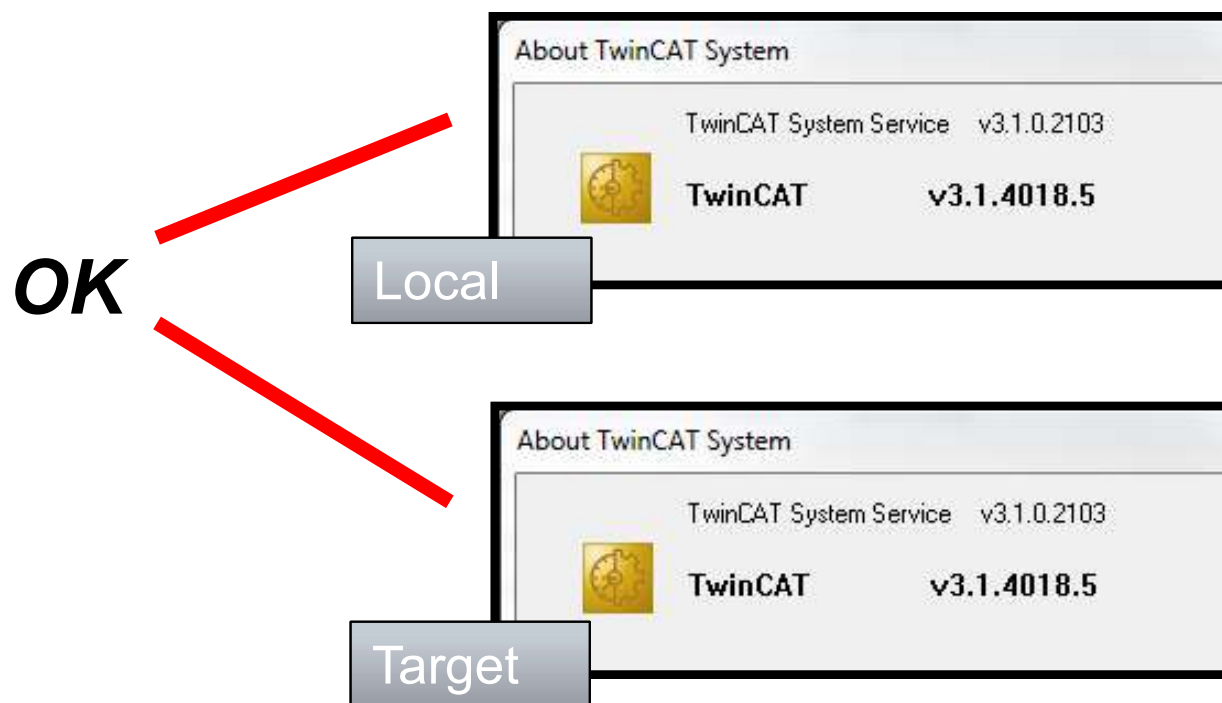
- Development is needed to gain access to the choose target button
- How do I know if I have development?
 - If you can open TwinCAT XAE



Local System Specifications

- Version and build should be the **same as the target***
 - If not, update your local TwinCAT installation.

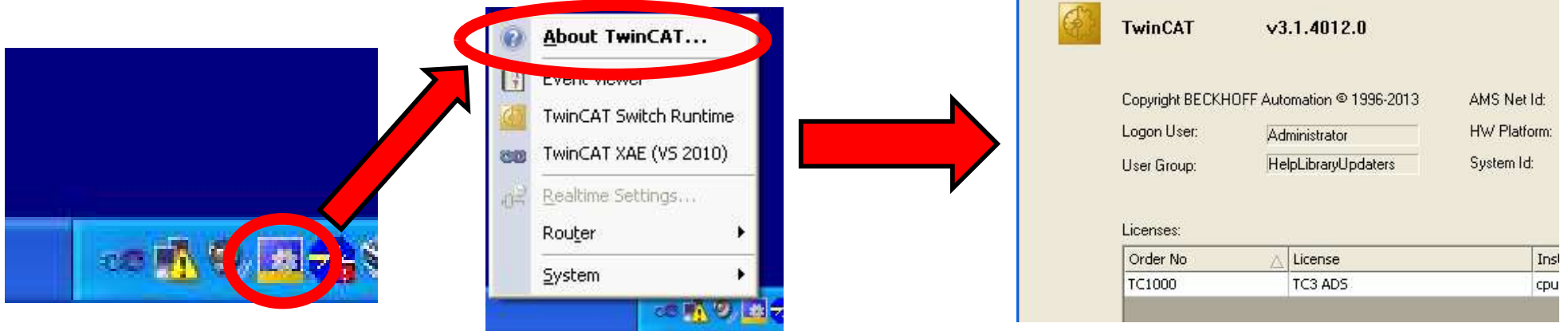
Note: TwinCAT 3 cannot be used to connect to TwinCAT2



**Connection may still be possible if this doesn't hold true, but problems may arise.*

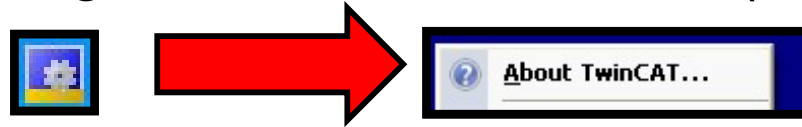
Local System Specifications

To Obtain Information on Local System:



Target System Specifications

- To Obtain this Information on **Target System** gain access to target machine and go to “About TwinCAT” (see previous slide)



- **Can Access Machine by:**

- Physically going to machine equipped with monitor and mouse
OR
- Logging into the Target Machine Using:
 - ‘Remote Display Control for Windows CE’ (Windows CE)
 - ‘Remote Desktop Connection’ (Other Windows OS)

**These programs require the IP Address of the target system and user login credentials*

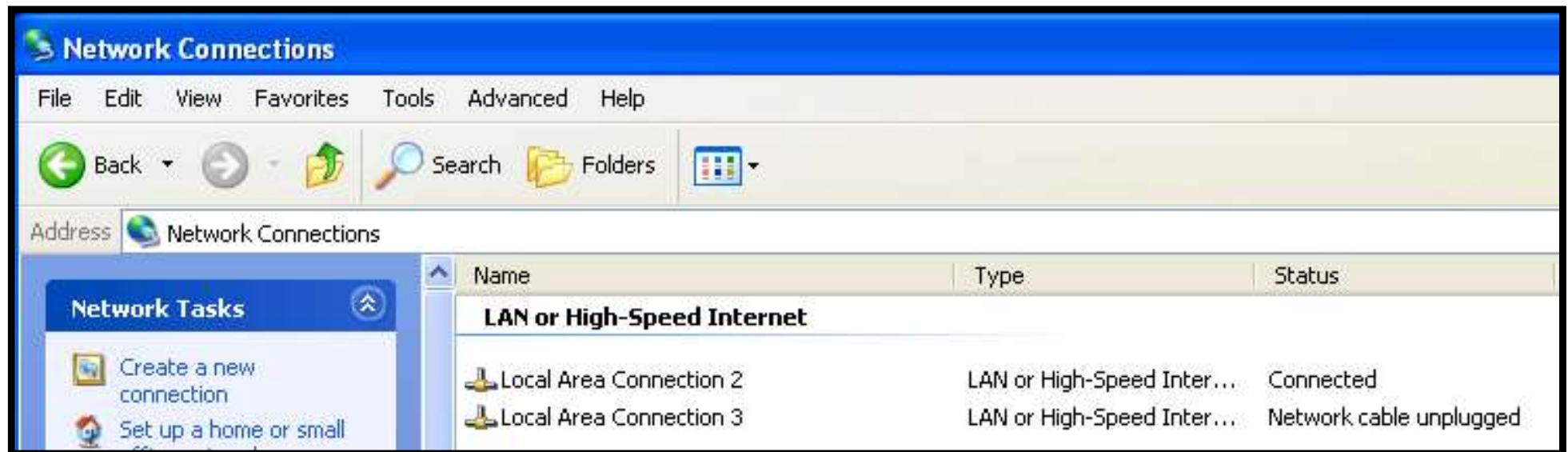
Disclaimer:

- Always talk to your IT professional/machine specialist before altering any network

Network Communication

Ensure Systems are on the Same Subnet:

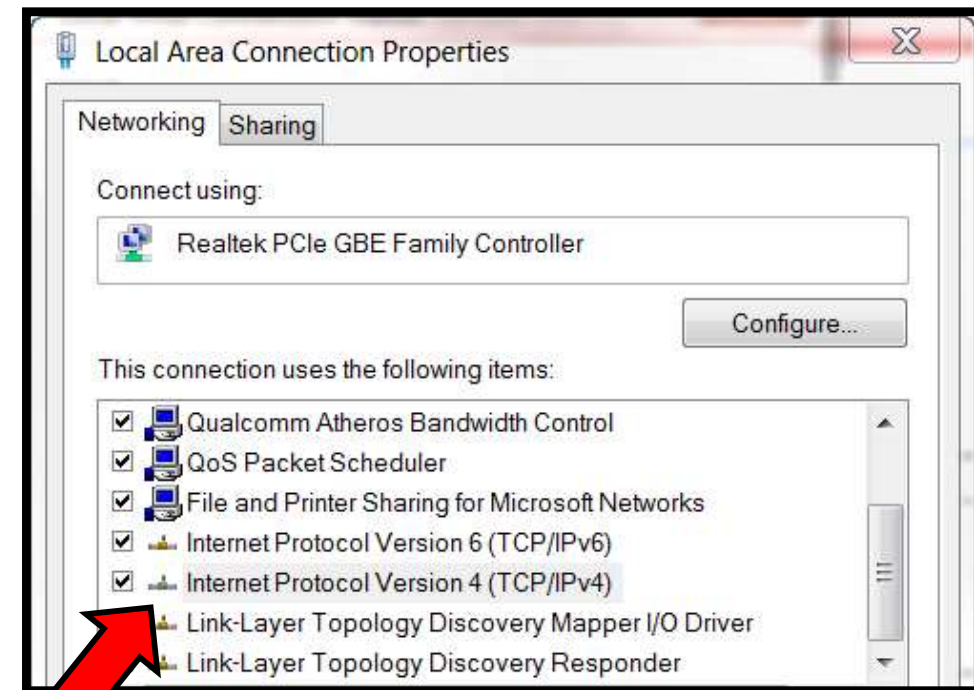
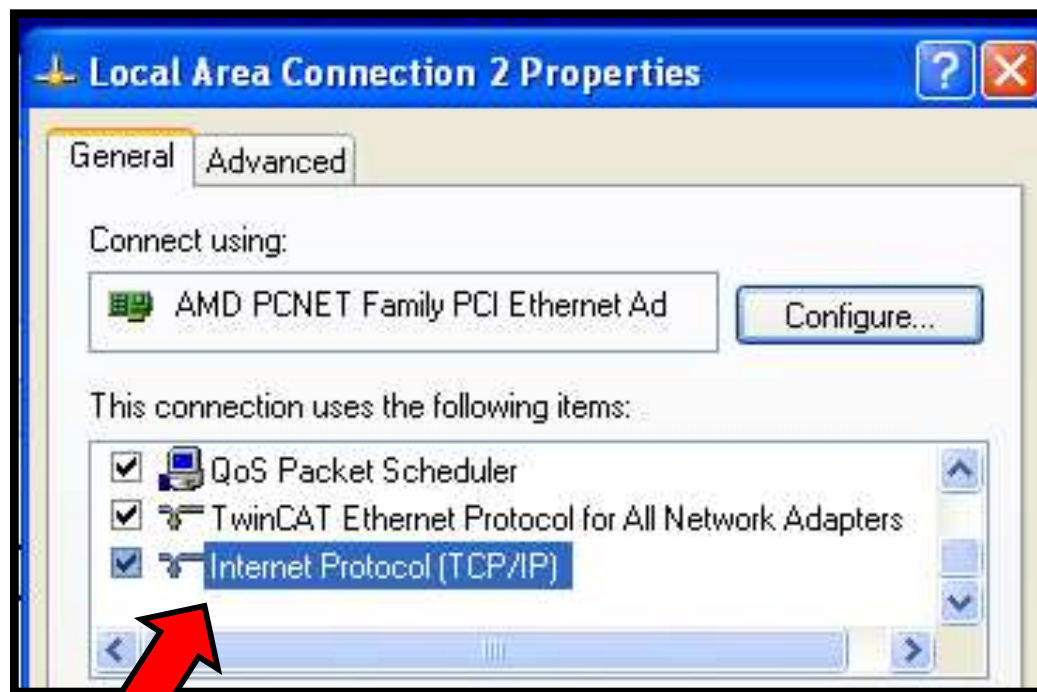
- For each system:
 - Identify the port used for network communication
 - One solution is to unplug the cable and watch the connection change state in the network settings area of Windows*
 - Go to the properties of that port



*Unplugging cables may interfere with machine performance. Ensure beforehand that this operation will not cause unauthorized downtime

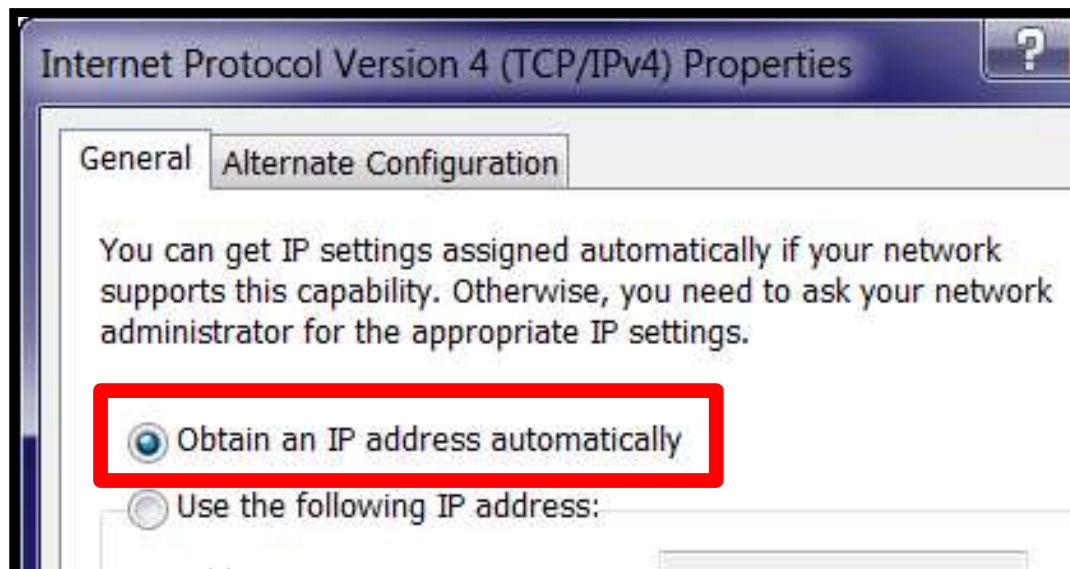
Ensure Systems are on the Same Subnet

- Double click on the Internet Protocol(v4) item in the list.
- Identify the IP Address and Subnet mask of that connection



Ensure Systems are on the Same Subnet*

- Using the top radio button(DHCP) will automatically address the network card (see next slide to check address)
- If two computers are set to automatically address without a DHCP server involved(if the ethernet cable is connected direct from one machine to another) wait until the two auto negotiate an address.
 - Once completed, the TwinCAT route must be added by IP Address, not Host Name



*Always talk to your IT professional before changing network settings

Ensure Systems are on the Same Subnet*

- If a static IP address is used**:
 - The subnet masks should match each other.
 - Each number of the ip address located in the same position as a 255 in the subnet mask should match between local and target systems.

	Local	Target
	☒ Use the following IP address:	☒ Use the following IP address:
IP address:	169 . 254 . 150 . 9	169 . 254 . 12 . 13
Subnet mask:	255 . 255 . 0 . 0	255 . 255 . 0 . 0

A red rectangular box highlights the second and third octets of the IP addresses (254 and 150 for Local, 254 and 12 for Target) and the corresponding octets of the subnet masks (255 and 0 for both). This visualizes the requirement that these values must match for systems to be on the same subnet.

*Always talk to your IT professional before changing network settings

**These rules do not have to be followed but are given here to avoid explaining the binary math involved with the IP address and subnet

Network Communication

BECKHOFF

- Verify network communication
 - Open a [command window](#)
 - Ping the IP Address of the Target from the Local Machine
 - If using automatic addressing, type ipconfig on each machine to identify its address

Reply means network communication ok

No Reply means no communication

- Check cabling and network devices
- Double check network settings
- Turn off firewall on both local and target

```
C:\ Command Prompt
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\Administrator>ping 169.254.12.13

Pinging 169.254.12.13 with 32 bytes of data:

Reply from 169.254.12.13: bytes=32 time<1ms TTL=128
Reply from 169.254.12.13: bytes=32 time<1ms TTL=128
Reply from 169.254.12.13: bytes=32 time<1ms TTL=128
Reply from 169.254.12.13: bytes=32 time<1ms TTL=128

Ping statistics for 169.254.12.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

```
C:\ Command Prompt
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\Administrator>ping 169.254.12.13

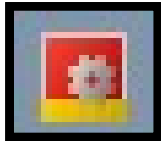
Pinging 169.254.12.13 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

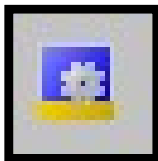
Ping statistics for 169.254.12.13:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

- **TwinCAT must NOT be in Stop Mode**

- In Stop Mode, TwinCAT does not communicate:

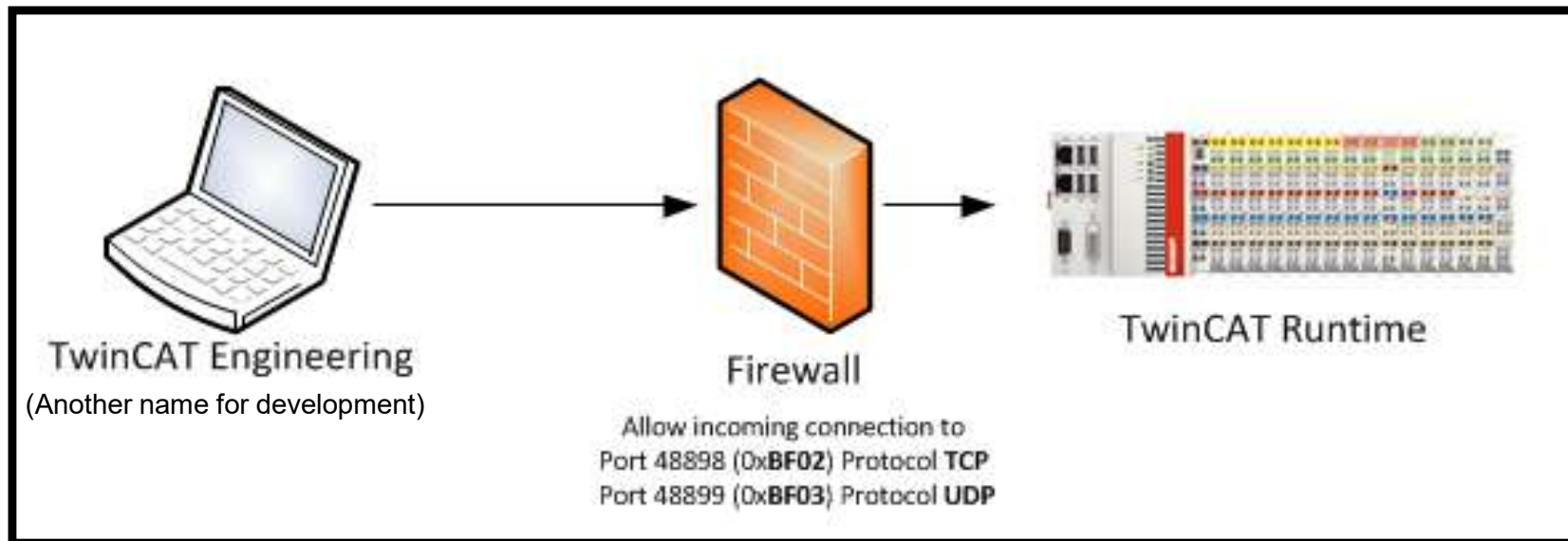


- In Config(blue) or Run(green) Mode, TwinCAT will communicate



...And not be Blocked

- Ensure that **Firewall** ports are open*:
 - Discovery: 48899 / udp (also outgoing)
 - Not secured: 48898 / tcp (also outgoing)
 - Secure ADS: 8016 / tcp (also outgoing)
- **Turn off virus protection** software



*Firewall may be turned off for short term testing per IT approval

Connecting to a Target, Details and Troubleshooting

ADS Firewall port PowerShell commands



BECKHOFF

You can use the following PowerShell commands to add the required ADS ports to your firewall.

Be sure to run PowerShell as Admin

```
New-NetFirewallRule -DisplayName 'TwinCAT-ADS (TCP)' -Profile 'Any' -Direction Inbound -Action Allow -Protocol TCP -LocalPort 48898
New-NetFirewallRule -DisplayName 'TwinCAT-ADS (TCP)' -Profile 'Any' -Direction Outbound -Action Allow -Protocol TCP -LocalPort 48898
New-NetFirewallRule -DisplayName 'TwinCAT-ADS (TCP) Secure' -Profile 'Any' -Direction Inbound -Action Allow -Protocol TCP -LocalPort 8016
New-NetFirewallRule -DisplayName 'TwinCAT-ADS (TCP) Secure' -Profile 'Any' -Direction Outbound -Action Allow -Protocol TCP -LocalPort 8016
New-NetFirewallRule -DisplayName 'TwinCAT-ADS (UDP)' -Profile 'Any' -Direction Inbound -Action Allow -Protocol UDP -LocalPort 48899
New-NetFirewallRule -DisplayName 'TwinCAT-ADS (UDP)' -Profile 'Any' -Direction Outbound -Action Allow -Protocol UDP -LocalPort 48899
```

 Administrator: Windows PowerShell

Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Try the new cross-platform PowerShell <https://aka.ms/pscore6>

```
PS C:\Windows\system32> New-NetFirewallRule -DisplayName 'TwinCAT-ADS (TCP)' -Profile 'Any' -Direction Inbound -Action Allow -Protocol TCP -LocalPort 48898
>> New-NetFirewallRule -DisplayName 'TwinCAT-ADS (TCP)' -Profile 'Any' -Direction Outbound -Action Allow -Protocol TCP -LocalPort 48898
>> New-NetFirewallRule -DisplayName 'TwinCAT-ADS (TCP) Secure' -Profile 'Any' -Direction Inbound -Action Allow -Protocol TCP -LocalPort 8016
>> New-NetFirewallRule -DisplayName 'TwinCAT-ADS (TCP) Secure' -Profile 'Any' -Direction Outbound -Action Allow -Protocol TCP -LocalPort 8016
>> New-NetFirewallRule -DisplayName 'TwinCAT-ADS (UDP)' -Profile 'Any' -Direction Inbound -Action Allow -Protocol UDP -LocalPort 48899
>> New-NetFirewallRule -DisplayName 'TwinCAT-ADS (UDP)' -Profile 'Any' -Direction Outbound -Action Allow -Protocol UDP -LocalPort 48899
```

Troubleshooting Tips: Further Assistance

BECKHOFF

- The following may also prevent a proper connection:
 - Alternate connections on the TwinCAT PC may need to be disabled (stale routes)
 - Wireless connections
 - Wired Connections
 - Virtual Connections from Virtual Machine
 - Windows May Need a Restart from Recent Updates
 - Pending updates may block TwinCAT communication
- See the “Connect to Target Quick Sheet” for a summary of items to check from this document.
- **If all else fails:**
 - Call Beckhoff Support at 1-877-722-6846

Beckhoff Automation Ltd

Canadian Headquarters
4 Schiedel Ct, Unit 1-3
Cambridge
Ontario, N3C 0H1
Canada

Phone: +1 (289) 627-1900
E-Mail: info@beckhoff.ca
Web: www.beckhoff.ca

© Beckhoff Automation 01/2023

All images are protected by copyright. The use and transfer to third parties is not permitted.

Beckhoff®, TwinCAT®, EtherCAT®, Safety over EtherCAT®, TwinSAFE®, XFC® and XTS® are registered trademarks of and licensed by Beckhoff Automation GmbH. Other designations used in this presentation may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

The information provided in this presentation contains merely general descriptions or characteristics of performance which in case of actual application do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of contract.