Industrial Ethernet Training 10

Configuring static routes with a Weidmueller router

Abstract:
Routing is the primary action that happens in a computer network that transfers data from source to destination, going from one node to another to reach the destination as quick as possible. In this Application Note, a common way of routing in an industrial environment is documented using the WAN interface and Network Address Translation (NAT).

Hardware reference

No.	Component name	Article No.	Hardware / Firmware version
1	IE-Training Kit-01	2881730000	1.1.2 (Build 125086)
2			
3			

IE-Training Kit Content

No.	Component name	Article No.	Hardware / Firmware version
1	IE-SR-4TX	2751270000	1.4.7
2	IE-SW-AL08M-8TX	2682280000	1.08
3	IE-SW-AL05M-5TX	2682250000	1.14
4	IE-CS-MBGW-2TX-1COM	2682600000	3.11

Software reference

No.	Software name	Article No.	Software version
1			
2			
3			

File reference

No.	Name	Description	Version
1			
2			

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Content

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2 Prerequisites for doing

You need to have the following hardware and documentation

- Industrial Ethernet Training Kit
- Application Note Industrial Ethernet Training 01 "Setting up default configuration of IE Training Kit" for applying default IP address configuration

3 Why is routing important?

In order to connect different networks, such as an office network with a network from the production line, we can define a static route to find the foreign network. Of course, this does only work, when a router is connected to both networks for example by using its WAN and LAN ports. You can imagine the idea of a static route like a default gateway.

A computer, which is located inside a WAN network, has a defined network range in which it is able to send packets to other network devices. If a receiver IP address is outside of this network, the computer cannot send any data to this device as it is unknown for the computer. This changes when we have a defined gateway where the packets can get sent to. Or in this case a static route. Example: A computer placed in a WAN network "*10.10.10.x*" is only able to communicate with network devices placed in the same network "*10.10.10.x*". A router, connected to the WAN network and also a local network "*192.168.1.x*" through its LAN interface would in theory make it possible for the computer to communicate with any network devices inside the "*192.168.1.x*" network. However, because the computer has no knowledge of the network "*192.168.1.x*" and does not know how to communicate with the devices in it, the packets destined for it get lost.

Implementing a static route here means, that we configure a specific direction for the packet to travel to. In this case, we would configure that the network "*192.168.1.x*" can be found through the IP address "*10.10.10.10*", which is the router's WAN IP.

In comparison to a default gateway, only packets with the destination "*192.168.1.x*" are sent to the configured address, whereas a default gateway means that every unknown destination IP address gets sent to the configured gateway IP address.

4 Why do we need a WAN connection?

In the next steps, we will connect our PC over WAN to the router instead of LAN to simulate two different company networks. The other devices on the Training Kit remain connected to the router via LAN. The computer is connected to the router via its WAN port. A possible application for such a setup would be a moving production station, such as an automated guiding vehicle (AGV). Such an AGV would be connected to the network via WAN to ensure a wide range for the computer to operate in and to stay connected when moving around.

5 Establishing a WAN connection

As of now, the switches, the Modbus gateway and the computer are connected via LAN to one another on the Training Kit. In the next steps we are going to connect the computer to the WAN network port of the router to demonstrate the use of a static route.

1. First, we are going to change the IP address of the computer's Ethernet interface to an IP address inside of the router's WAN IP range. Open the Windows settings and go to "*Network & Internet*". Select "*Change adapter options*" under "*Advanced network settings*".
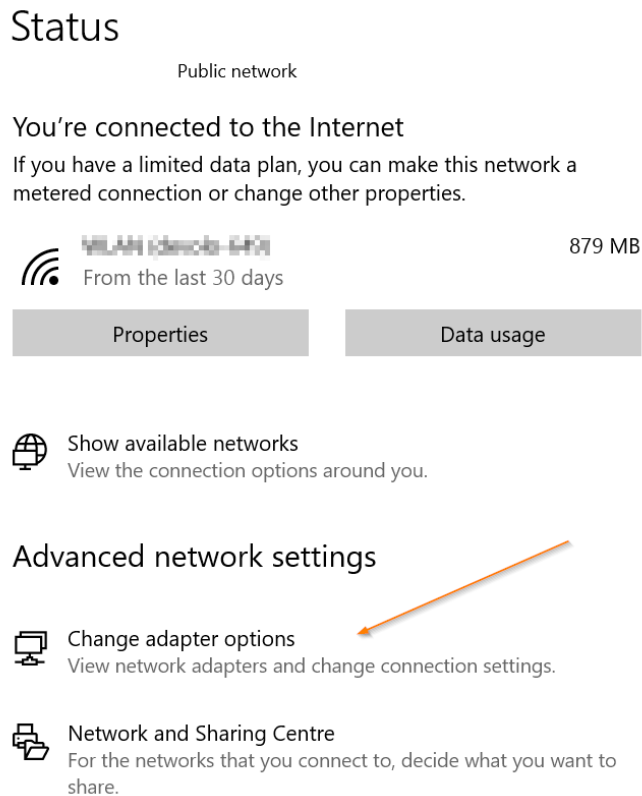
Figure 1: Changing adapter options

2. Locate the corresponding Ethernet interface and click on it. To find out which adapter is the right one we can simply disconnect and reconnect the Ethernet cable to the router and choose the adapter that reappears.
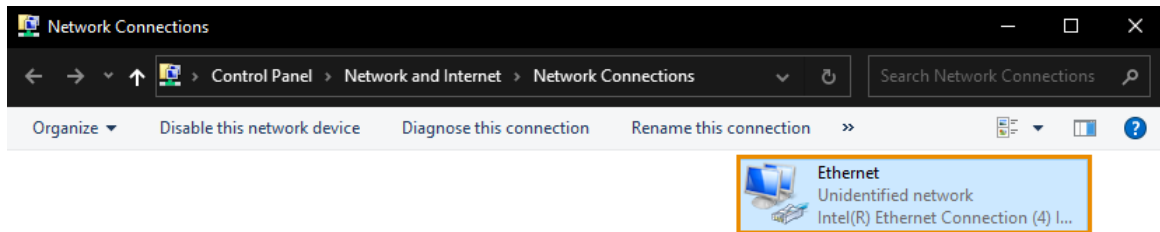
Figure 2: Locating the network interface

3. Open the "*Properties"* and then click on "*Internet Protocol Version 4 (TCP/IPv4)*".
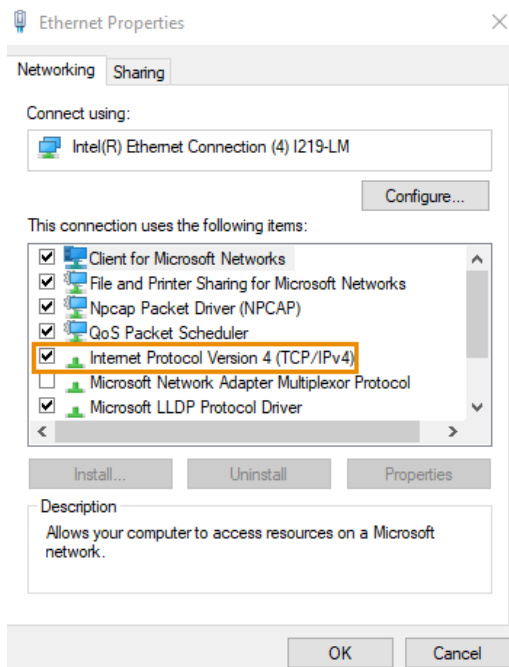

Figure 3: Navigating to IPv4 Settings

4. A new window opens where we can change the IP address of the computer. Change the IP address as depicted below to "*10.10.10.20*" and the subnet mask to "*255.255.255.0*".
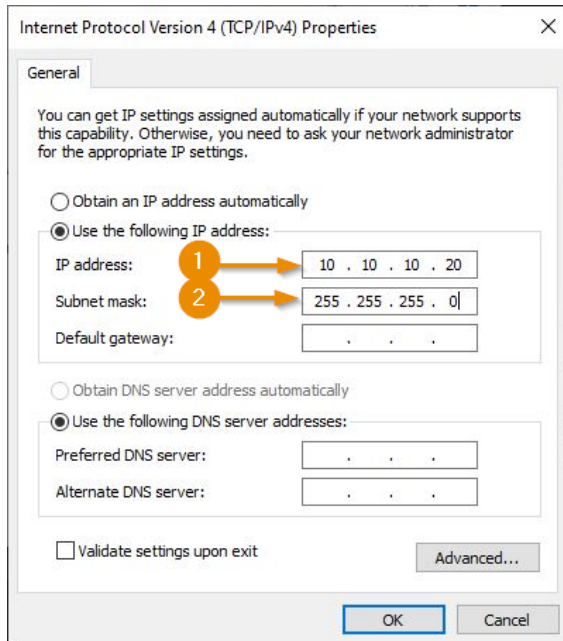
Figure 4: Changing the IP address

5. Furthermore, we should check if there are multiple IP addresses configured in the advanced settings. If this is the case, it may lead to network issues. To check if more than one IP address is configured, click on the button "*Advanced…*".
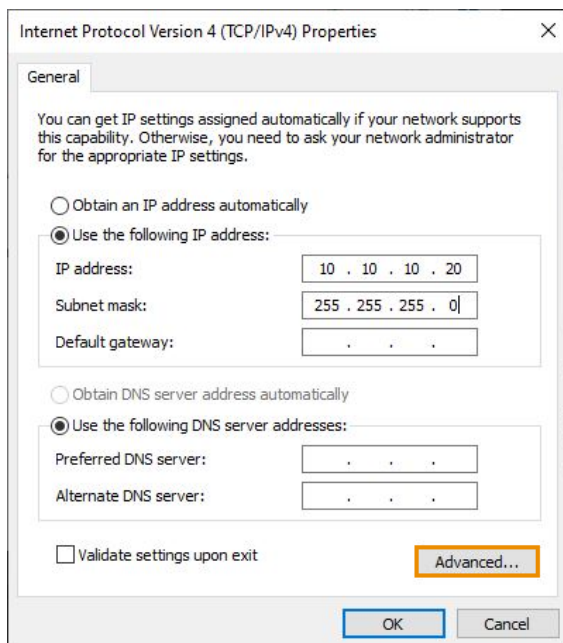

Figure 5: Opening advanced IP settings

6. The advanced IP settings should look like the following picture. In case there are any additional IP addresses configured on this interface, simply remove them by selecting the additional IP address and then clicking on *"Remove"*.
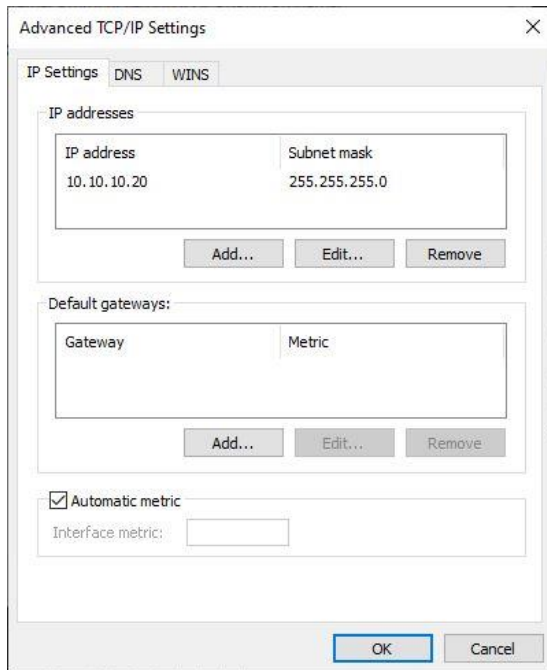

Figure 6: Checking advanced IP settings

7. After applying the newly configured settings, make sure that your Ethernet cable is connected to the WAN port since we can only reach the router with the WAN IP address now.
    To do so, type "*10.10.10.10*" into the browser's URL field and log in with the user credentials.
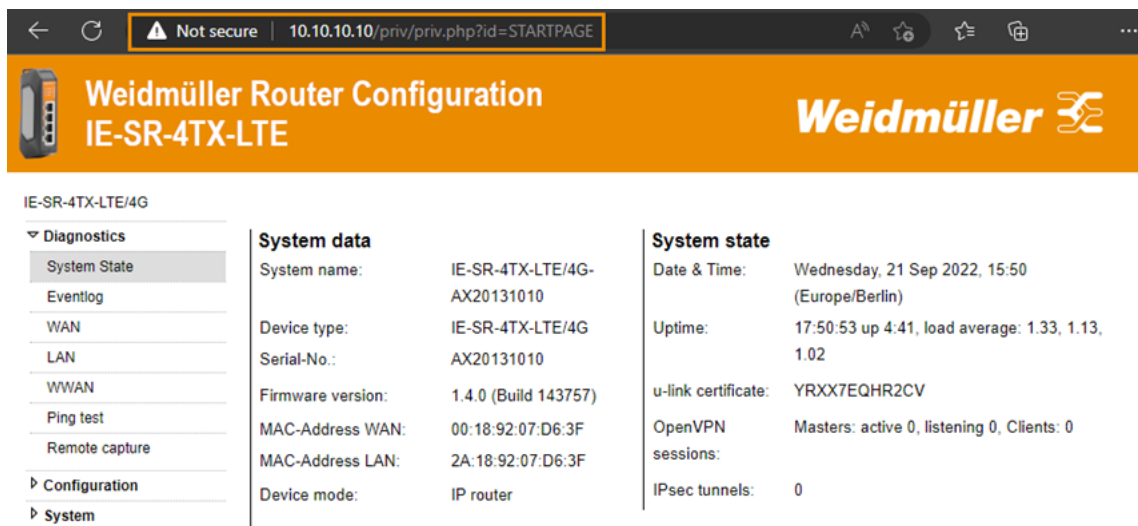

Figure 7: Connecting to router web interface with WAN

8. As explained before, by default packets can only be sent to devices in the known network range.

   Of course, this does also apply to switches and Modbus Gateways. When, for example, the computer is trying to send a packet to the 8-port managed switch after implementing a static route (next paragraph), it does reach the destination since this network can be found via the router. The switch on the other hand, does not know the IP address of the computer.

   This means, that even though the network is reachable by the computer, the switch is not able to respond since the sender's IP address is outside of the switch's network range.

   To manage this problem, we must activate the Network Address Translation (NAT) option in the router. This option overwrites the sender's IP address with the router's IP address, meaning that the switch can simply reply back to the router, which then redirects the packet back to the computer.

   To do this, navigate to "*Configuration*" then "*IP Configuration*" and enable the "*NAT (Masquerading)*" checkbox for both the LAN and WAN interfaces.
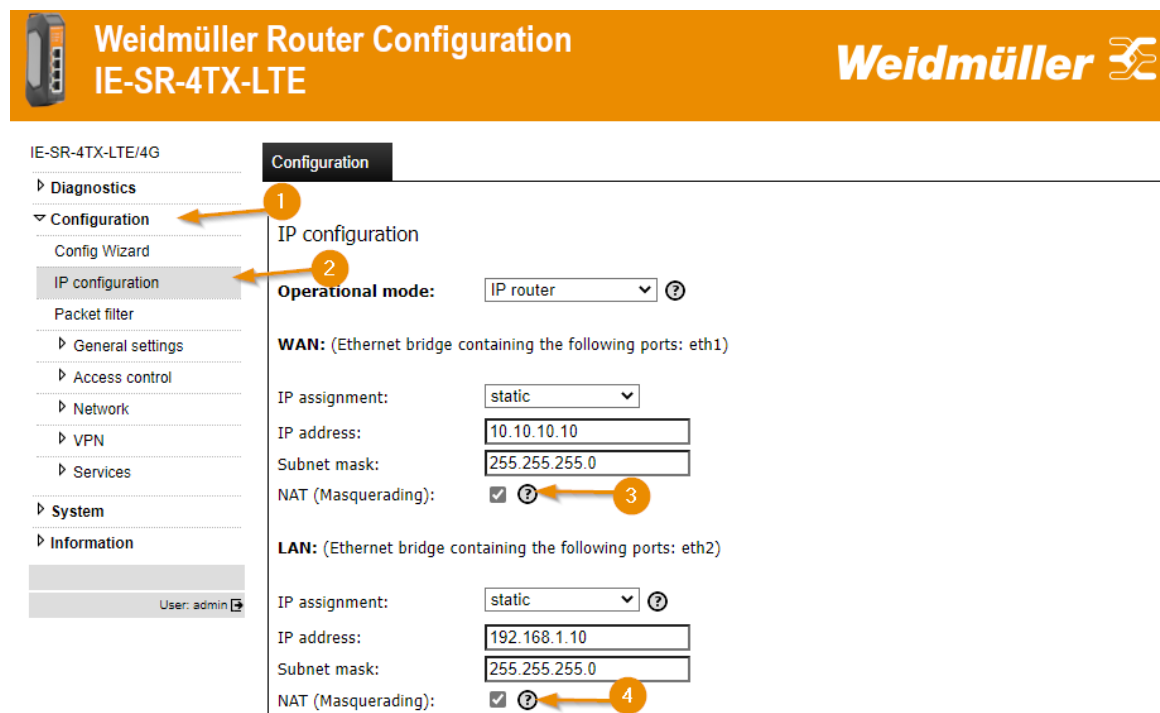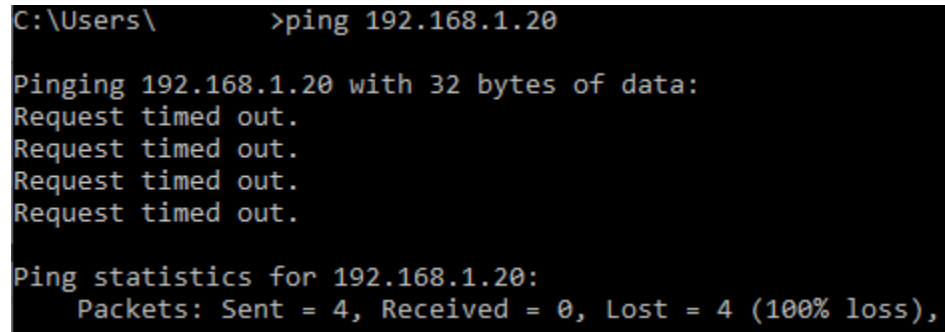

Figure 8: Activating NAT (Masquerading)

6 Static routes

We can now use the WAN interface of the router and its network range properly with the configurations done. The LAN network of the router is still not reachable for the computer though, meaning that any devices in the LAN network area, such as the switches and the Modbus Gateway, are unknown for the computer.

You can confirm this by trying to ping any of the devices in the LAN network by typing in "*ping 192.168.1.20*" in the Command Prompt of the computer. The request times out.


```
C:\Users\        >ping 192.168.1.20

Pinging 192.168.1.20 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.1.20:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Figure 9: Pinging switch without static route

This is the point where we implement a static route to give the packets a clear direction where they can find the unknown network.
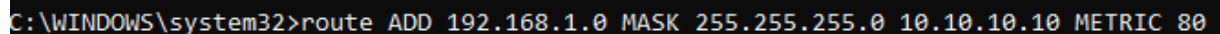
1. To configure a static route on the computer, open the Command Prompt **as an administrator** and type in the following command:
   "*route -p ADD 192.168.1.0 MASK 255.255.255.0 10.10.10.10 METRIC 80*"
   The first IP address states the destination and the mask defines the network's subnet mask. The last IP address stands for the device through which we can find the "*192.168.1.0*" network, the "METRIC" simply gives this route a priority value. Lower metrics are considered faster and are prioritized over higher metrics. Furthermore, *-p* stands for *persistent*, meaning that this route is saved even through a restart of the computer. If you do not want it to be saved, simply leave the "*-p*" out of the command.
   You can imagine this command expressed in words like this:
   The network 192.168.1.0 with the subnet mask 255.255.255.0 can be found through the IP address 10.10.10.10. with the metric 80.


```
C:\WINDOWS\system32>route ADD 192.168.1.0 MASK 255.255.255.0 10.10.10.10 METRIC 80
```

Figure 10: Adding the static route

2. After implementing this route, we can try to ping any device in the LAN network. As we did before, we try to ping the 8-port switch with the IP address "*192.168.1.20*". We can see that we can successfully ping the device in the LAN network.

```
C:\WINDOWS\system32>ping 192.168.1.20

Pinging 192.168.1.20 with 32 bytes of data:
Reply from 192.168.1.20: bytes=32 time=5ms TTL=127
Reply from 192.168.1.20: bytes=32 time=3ms TTL=127
Reply from 192.168.1.20: bytes=32 time=3ms TTL=127
Reply from 192.168.1.20: bytes=32 time=3ms TTL=127

Ping statistics for 192.168.1.20:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 3ms, Maximum = 5ms, Average = 3ms
```

Figure 11: Pinging switch with static route

Note: If the static route already exists or you want to delete the route, you can delete it with the following command:
"route DELETE 192.168.1.0".
As soon as you have done this, you can just add it again as described in chapter 6.

7 Results

After completing this application note we have now achieved the skills to establish a connection to a device via WAN, to properly use the network address translation (NAT) and we can redirect specific packets with a specific destination over a static route. With this skillset, we can now establish a connection between two networks, such as the office network and the production line network.

8 List of figures