Ethernet Interface

Application Note 123

This application note describes using the Ethernet interface of Triamec drives. Ethernet is an alternative to the USB interface and allows configuration and diagnosis of a drive using the *TAM System Explorer* or other applications based upon the *TAM API*.

Table of Contents

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1 Introduction

The main advantage of Ethernet versus USB is the higher immunity level. USB shares a common ground between the PC and the drive. Bad shielding and large electromagnetic interference of motor currents can degrade the noise immunity of USB connections. Ethernet's isolated interface is from its principle better in noise rejection.

As another improvement over other interfaces, several applications can connect to the drive at the same time. This makes it possible to use the *TAM System Explorer* in parallel with a browser application, both accessing drive resources.

2 Connections

Drives can be connected to a PC using their auxiliary Ethernet connector (X7). This chapter describes how this may be accomplished. After successful connection, the drives may either be accessed by the Triamec *TAM System Explorer* (chapter 4, as if connected by USB or the PCIe board) or by their internal website.

The following use cases assume the drive is in the same subnet as the attaching PC.

2.1 Using a dedicated Router

We propose attaching all drives of a machine to a general purpose Ethernet router that will assign the IP addresses (DHCP). Most routers will work in their factory configuration. This router can be connected to the PC:

- either using a free *Network Interface Card (NIC)* of the PC, or
- using a USB to Ethernet adapter.

In both cases the *TAM System Explorer* will find all adapters and show the drives attached to each adapter independently. Therefore, one machine will be shown under its dedicated router.
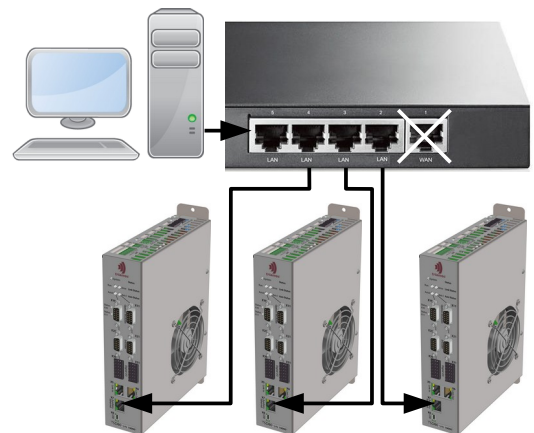
Figure 1: Typical connection of the drives of a machine to a PC through a router.

> **Note** A PC can only resolve domain names of one network, usually the principal *NIC* used for the company network. If a second *NIC* is attached, the PC cannot find drives by their domain names (chapter 3) through this card.
> This is usually not a problem. If the router assigns a dedicated subnet other than the company subnet, the PC can access drives over this card using their IP address and the *TAM System Explorer* broadcast will find the drives.

2.2 Direct connection to a PC

A drive may also be directly connected to a PC. Leave the IP configuration of the drive on the default values (DHCP). If DHCP is missing, the device will enter AUTO-IP mode and assign an IP address auto-matically (see chapter 3).

> **Note:** If direct connection is not successful check the availability of AUTO-IP (APIPA) of the con-necting PC: Type "ipconfig /all" (without the quotation marks) in a MS-DOS command line window. If the 'Autoconfiguration Enabled' line says "Yes", and the 'Autoconfiguration IP Address' is 169.254.x.y (where x.y is the client's unique identifier), then the computer is us-ing APIPA. If the 'Autoconfiguration Enabled' line says "No", then the computer is not cur-rently using APIPA and using the drive in AUTO-IP mode is not possible with this PC-

> **Note:** If the drive is to be used in a non-standard network without DHCP, use static mode as de-scribed in chapter 3. This special situation must be reviewed by your Network specialist to prevent IP conflicts.

2.3 Company Intranet

Since the drive searches for a DHCP server in the standard settings, it can be connected to a standard Intranet without modification. A *TAM System Explorer* that is located in the same intranet should find the drive in its standard settings.

Direct connection to a company network is possible but not considered a typical use case. There are se-curity considerations and if attaching multiple machines to a flat intranet, a network discovery will re-veal all Triamec drives of all machines located in this intranet, which might not be desired.

2.4 Attaching Multiple Drives

Attaching multiple drives using a router (chapter 2.1) or a company intranet (chapter 2.3) is possible without additional measures.

For direct connection to a PC (chapter 2.2) there is a restriction, because two drives attached directly to the same PC without DHCP (for example using USB to Ethernet adapters or a switch) will fall back into AUTO IP mode, using the same address, and therefore can not be distinguished correctly. This is solved by setting one or both drives to fixed IP mode as described in chapter 3 and assign different addresses.

2.5 Bridge Mode

A drive with bus-type *Tria-Link* can be used as a bridge between Ethernet and *Tria-Link*. A *TAM System Explorer* connected over Ethernet will then see all members of the *Tria-Link*. The mode may be activated on one drive only in a *Tria-Link* ring, using General.Parameters.Bridge set to Ethernet.

> **Note** To use Bridge Mode, all drives in the *Tria-Link* ring must have a firmware version >= 4.6.0.

For more information on Bridge Mode, see chapter 2.3.3 of [2].

3   Configuration

For typical Ethernet access as described in the last chapter, the standard configurations may be used. If the user wants to modify the IP settings, use the *TAM System Explorer* (for example using a USB or *Tria-Link* connection) to change the settings in the drive register folder General.Parameters.Ethernet.

IPv4Setting	DHCP	Static
Behavior	The drive boots per default in DHCP mode. If it fails to obtain a configuration from a DHCP server, the drive goes into AUTO-IP mode. Every 60s, a new DHCP search is started.	Use static settings
DomainName	DomainName, also known as network name. An empty string will set this to "Triamec-{SerialNumber}"	Not used
IPv4Address		The static IP address
SubnetMask	Not used (automatically assigned)	The static subnet mask
Gateway		The static gateway address

Note	FW >= 4.23: In AUTO-IP mode, a pseudo-random address, derived from the MAC address is assigned. The last two bytes of the MAC address are the same as the last two bytes of the IP address. For example: MAC = 40-D8-55-1C-**10-0E** → IP = 169.254.**16.14** FW < 4.23: The AUTO-IP address is always 169.254.222.222.

4   TAM System Explorer

This chapter describes the access of the drives with the *TAM System Explorer*. If the drives are connected with a method as described in section 2 it should now be possible to access them with the following steps:

- Start the *TAM System Explorer*.
- The Tree shows the accessible network interface cards (*NIC*s), as in Figure 2, left-hand side.
  If the *NIC*s are not visible, check **File > Preferences > Acquired adapters**.
- When using this *TAM System Explorer* Workspace the first time, all *NIC*s are disabled. Choose the *NIC* that is physically connected to the drive and execute the 🔍 **Scan** command from the context menu of the *NIC*. This step is not necessary when using the *TAM System Explorer* the next time.
- Now the drive(s) should be visible in the tree (Figure 2, right-hand side), if they are powered on and running for at least 10s. An *Auto-Update* feature finds drives even, if they are powered after the *TAM System Explorer* (> 7.20.0).

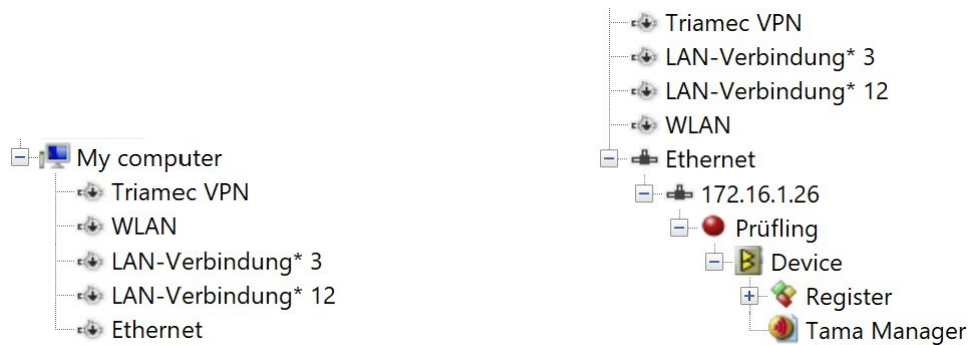See the next sections for further information about accessing the drive with the *TAM System Explorer*.

Figure 2: The appearance of Network interface cards (NICs) in the TAM System Explorer
My computer has 5 NICs. We only enable the last one, Ethernet. On the network side, this drive is represented as
172.16.1.26.

4.1 NIC Enablement

During startup, the *TAM System Explorer* checks for all available *NIC*s and shows them as ⊕ icons in the Topology tree.

> **Note:** A *NIC* must be up (physically connected to some network) to be shown in the application. The *TAM System Explorer* searches for applicable *NIC*s during startup, but doesn't antici-pate changes to *NIC*s during its lifetime.

By default, all *NIC*s are disabled at startup. You must enable a *NIC* to see the drives attached to it. Do this with the 🔍 **Scan** command from the context menu of the desired *NIC*. The *NIC* is enabled, changing its symbol to ⊕ accordingly. The application scans the local network for attached drives, and shows dis-covered drives under the *NIC*. Likewise, *NIC*s can be disabled in the context menu. This state is retained across application lifetime..

NIC enablement in the *TAM System Explorer* is not related to the operating system feature of enabling and disabling network connections. For instance, disabling your primary network connection in the *TAM System Explorer* doesn't disable it for browsing.

Scanning can result in a startup overhead of several seconds. If the Ethernet interface is unused, you may set the **File > Preferences > Acquired adapters** to **All devices w/o Ethernet,** to reduce the startup time.

4.2 Scope data of multiple drives

Scoping data from multiple drives is possible if they are synchronized, i.e. in the same *Tria-Link* or (booted) *EtherCAT* bus.

Scoping was tested with eight 100kHz publishers of single precision floating-point registers. The perfor-mance might degrade when publishing scope data over a heavily loaded company intranet. Typical UDP frames are 1440 bytes. This is expected feasible in a controlled subnet. Publishing over firewalls is not considered a typical use case.

5 Diagnostics

The drive provides a number of signals for diagnostics of the Ethernet interface. The following signals in General.Signals.Ethernet may be checked, using the *TAM System Explorer*, to show the state of the adapter.

Register	Description
LocalIp Mask Gateway	IP settings actually assigned to the network interface.
State	*Disconnected*, *WaitForAddress* (wait for DHCP), *AutoIP, Ready*
MACAddress	The MAC address is stored during production.

Since up to four *TAM System Explorer* instances (or other observers) can connect in parallel, the following signals are provided for each connecting server in General.Signals.Ethernet.TriaLinkConnections[]

Register	Description
RemoteIp RemotePort	The IP and port of the remote server that connected
State	1 = Established, 2 = IdleTimeoutCheck, 6 = Disconnecting
CountTcpRx CountTcpTx ErrorTcpRx ErrorTcpTx	TCP connection data (successful counts and error situations)
CountUdpTx ErrorUdpTx	UDP publisher data (successful counts and error situations)

Please check the following on problems with the Ethernet interface. If the *TAM System Explorer* does not find a drive.

1. A newly attached (USB) Ethernet adapter may take a while to be found.
2. Make sure the PC considers the adapter as a private network.
3. Check the PC firewall settings of the adapter to be used.
4. Check if the router found the drive and note its IP address.
5. Try ping to see if it answers: Open a Windows command prompt and enter `ping` followed by the IP address found in the last point.
6. Open the IP address using a browser. It should show the website of the drive (port 80).

If a *TAM System Explorer* is shut down improperly, the drive will close its connection after 60s.

6   TAM API

When referring to the *TAM System Explorer* above, this always includes customer applications written against the *TAM SDK*. This section provides information for programmers about network related *APIs*.

Each *NIC* is represented by a `TamAdapter` instance within the local host `TamSystem` instance. These instances implement neither the `IPeripheryLayoutOwner` nor the `IProduct` interfaces, as typical `TamAdapter` instances do.

You can set up a system specifically accessing *NIC*s only:

```
var nicName = "Ethernet 3"; // The name of a network interface card as shown e.g. by ipconfig
TamAdapter adapter = topology.ScanNetworkInterfaces(nicName)[0];
```

The adapter instance represents the NIC, while the remotely accessed drives appear as `TamLink` nodes within the *NIC*.

Have a look at the *Acquisition* developer sample to see this code fully integrated.

Invoking `TamAdapter.Reset(TriaLinkRole.Untouched)` disables a *NIC*.
Likewise, calling `TamAdapter.Reset(TriaLinkRole.Unknown)` enables a *NIC* again, or scans for newly accessible devices, while removing no longer accessible devices. Unlike other implementations of `Reset`, this will not recreate `TamLink` instances representing accessible remote devices during scan. New devices are added automatically to the adapter, and removed devices are suprise-removed. If needed, this can be tracked using the `NodesChanging` and `NodesChanged` events of the adapter.

7   Facts for Experts

The following features are supported in firmware release 4.1.0 and newer.

- DHCP to receive the IP-address from an attached router, which falls back to AUTO-IP after 10s. Alternatively, static IP can be set.
- UDP port 47203 to answer "scan" discovery broadcasts from the *TAM System Explorer*.
- TCP port 47202 for command exchange to up to 4 *TAM System Explorers*.
- Scope data publishing from drive UDP port 47301 to the *TAM System Explorer* port shared with TCP-opening port.
- ICMP to respond to ping requests.
- TCP port 80 with a WEB server for file system access (AN124).

The drive publishes a network name to a DNS. This name is by default "Triamec-NNN", where NNN is the serial number. The name can be changed using register `General.Parameters.DomainName`. Please note the hint on DNS in chapter 2.1.

During scan, the *TAM System Explorer* broadcasts an UDP message to the subnet of the corresponding card and uses the answers to find all IP addresses of Triamec drives. Then it sets up a connection to all drives of this subnet to display its tree as usual.

References

[1] "Servo Drive Setup Guide", ServoDrive-SetupGuide_EP027.pdf, *Triamec Motion AG,* 2024

[2] "FieldBus", AN155_FieldBus_EP001.pdf, Triamec Motion AG, 2025

Revision History

Version	Date	Editor	Comment
001	2018-12-18	mvx, chm	Initial edit
003	2019-07-01	mvx	Include static IP settings (FW4.6.0) and bridgeMode
004	2021-03-19	dg, mvx, chm	After Review by DG
005	2023-01-13	sm, mvx	Give Bridge Mode a dedicated chapter, add chapter 2.4, update template
006	2023-06-19	chm	The TAM API has been extended
007	2024-08-09	fm	Small review and added reference
008	2024-12-13	es	Updated AUTO-IP behavior (FW 4.23)
009	2025-01-13	fm	Added reference to fieldbus doc AN155

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