

VARAN FAQs

VARAN-BUS-NUTZERORGANISATION
Version 6.0

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VARAN-BUS-NUTZERORGANISATION

The VARAN-BUS-NUTZERORGANISATION (VNO) was founded in July 2006. The independent organization supports members with implementing VARAN and is continuously involved with research, development and the implementation of new technologies.

Who can become a VNO member?

Basically, any company, organization or individual who is interested in the VARAN bus can become a member.

Where can one apply for membership?

The application form can be found on the VARAN bus website or you can contact the VNO.

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From what advantages do VNO members profit?

- Receipt of the VARAN design specifications to implement
- Receipt of a VARAN bus vendor ID
- Expanded support in implementing the VARAN bus
- Inexpensive evaluation kits
- Participation in VARAN bus events
- Voting rights on decisions for VARAN bus
- Listing on the VARAN bus homepage
- Free use of the VARAN bus logo

Which information is available without a membership?

- VARAN product overview (VNO homepage)
- Data sheets for VARAN products
- Product manuals

What are the costs for a VNO membership?

According to § 3 of the statutes the VNO requires a membership fee of €500 annually to support the function of the organization. The first membership fee is due immediately after confirmation of membership, prorated over the months remaining to the end of the year.

Licensing Model

All devices with a VARAN connection have an obligatory electronic type label, which contains the device-specific data and unique license number. Each VNO member can acquire a license number from the VNO and license their devices. Devices with invalid license numbers are deactivated.

What licensing costs are incurred for members?

The costs incurred are unit-based license costs, which are essentially intended to cover the costs of the VNO. Intermediate quantities of an order are adjusted linearly.

Licenses per year	Price per license in EUR
1-500	1.016
1,000	0.376
10,000	0.139
50,000	0.052
100,000	0.019

Implementing VARAN in a Peripheral Device

The VARAN bus can be implemented in different ways. Each VNO member receives the VARAN bus design specifications and therewith, the possibility to implement the VARAN bus in their periphery. Roadmaps for component suppliers and machine manufactures can be found on the VNO website www.varan-bus.net in the download section.

Is membership required for implementing the VARAN Bus?

Yes, implementing the VARAN bus in peripheral devices requires a VNO membership.

Can a finished implementation of the VARAN Bus be acquired?

Implementation as VHDL code or as a hardware circuit board from different manufacturers is not allowed.

Implementing the VARAN Bus using Hardware

When implementing the VARAN bus via hardware, a so-called manager or client board is integrated into the peripheral device. The core of the circuit board is an FPGA component with an integrated VARAN bus. The data exchange for the periphery can be configured in different modes.

Where are the manager and client boards available?

The boards are available at:

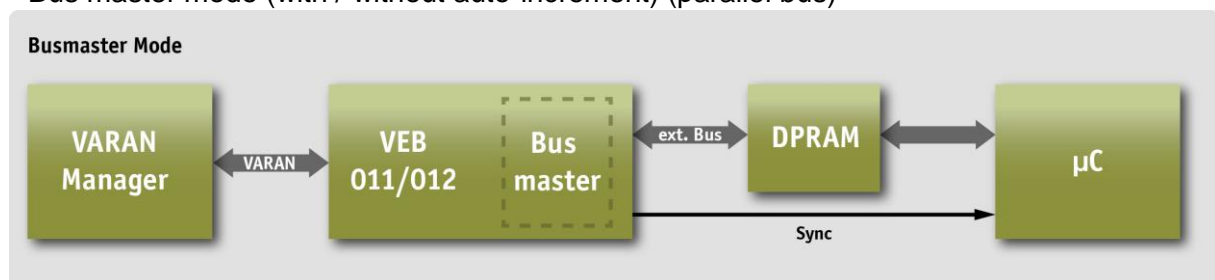
- SIGMATEK GmbH & Co KG Series VEB 0xx
- Hilscher LLC for System Automation Series netX, comX

Which modes are available for the SIGMATEK VEB boards?

- Bus Master Mode
- DPRAM Mode
- I/O Mode
- CANopen
- SPI

How is data exchanged?

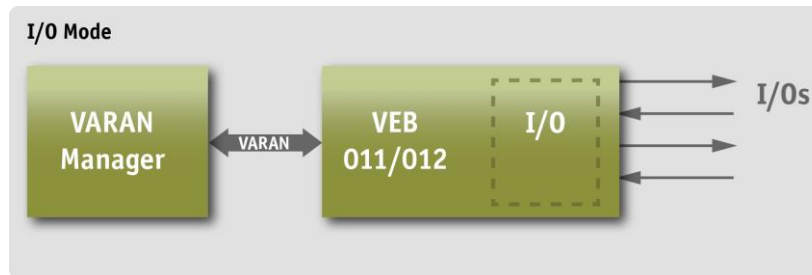
- Bus master mode (with / without auto-increment) (parallel bus)



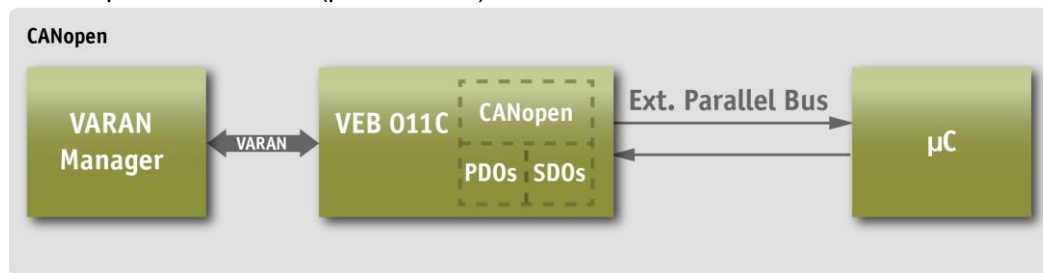
- DPRAM mode (with / without auto-increment) (parallel bus)



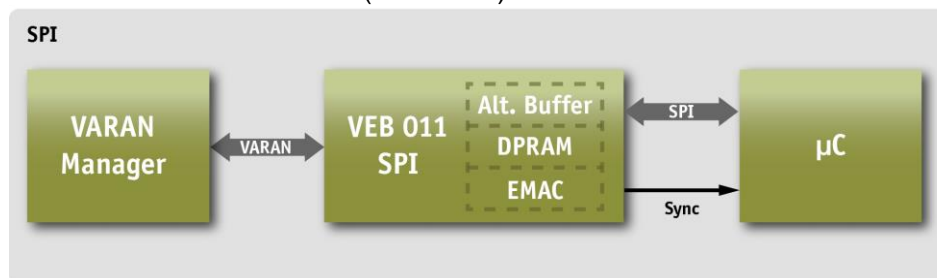
- IO Mode



- CANopen VEB 011-C (parallel bus)



- SPI Mode VEB 011-SPI (serial bus)



Implementation of the VARAN Bus using VHDL Code

By implementing the VARAN bus using VHDL code, it can be obtained by SIGMATEK GmbH & Co KG and integrated into the FPGA of the individual periphery device. The VHDL code is available for the VARAN Manager, as well as the VARAN Client.

Is know-how required for implementing the VHDL codes?

SIGMATEK provides support for implementation, one should have FPGA experience in order to keep the development time as low as possible.

What is contained in the VHDL code from SIGMATEK?

The VHDL code from SIGMATEK contains all required components and functions needed to expand third party VHDL code with an implementation of VARAN.

Key points for orientation:

Media Independent Interface (MII)

> The MII forms the interface between the physical layer and the safety layer in the OSI model

Bus Splitter

> Distribution of VARAN packets and third party packets in the VARAN client.

Media Access Control (MAC) Wishbone Master

> Management and organization of transmission medium (Wishbone Master)
 > Management of VARAN client, SPI master, PLL

Client control Wishbone Slaves

> VARAN client
 > SPI master
 > Synchronization of the Phase-Locked Loop (PLL)

Foreign Port/Package

> Management of third party packets (Ethernet)

How much space does the implementation require in the FPGA?

With the simple structure, little space in the FPGA is needed? This simplifies integration and saves costs.

participants	LUTs	Example FPGA
Master	circa 6500	Xilinx Spartan6
Client incl. splitter	circa 2800	Xilinx Spartan6
Splitter	circa 1800	Xilinx Spartan6

Which FPGA can be used for implementing the VARAN Bus?

In principle, any FPGA can be used

Which FPGAs does SIGMATEK use for the VARAN Bus?

Xilinx Spartan-family and Zynq

What information does SIGMATEK require in order to support the implementation?

Is FPGA experience available?

Which FPGA should be used?

What periphery should be used?

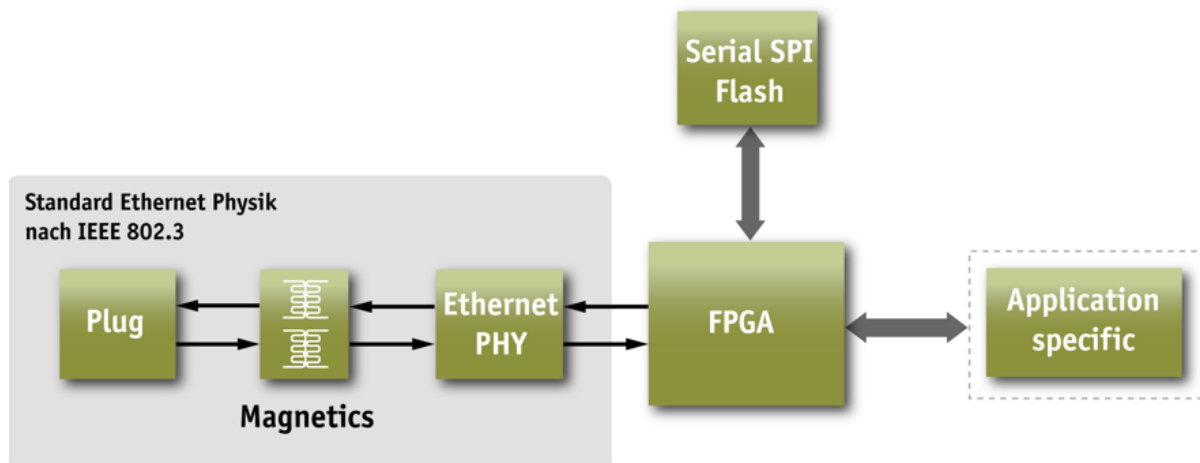
Block diagram of the periphery with FPGA!

General Information on the VARAN Bus

General information on the VARAN bus can be found on the VNO website in the download section.

- Technology folder
- Product overview
- Power Point Presentation

Of which components does the VARAN interface consist?



Plug

The physical connection to the VARAN bus. VNO verified connector plugs are:

- > HARTING RJ Industrial RJ45
- > Industrial Mini IO / TE connectivity
- > PHOENIX Contact M12
- > TYCO 8+4 Power Ethernet

Magnetics

- > Standard Ethernet component for transmitting information
- > Galvanic separation of the periphery from the bus system

Ethernet PHY

- > Coding and decoding the data between the modulated analog signals and the digital signals.

FPGA

- > Displays the functionality of VARAN bus in the hardware.
- > FPGA programming is stored in the external SPI Flash

SPI Flash

- > External memory, which contains the FPGA programming and VARAN header
- > While booting the FPGA, the program is loaded from the SPI flash and run.

How high is the maximum transfer rate?

VARAN uses the IEEE 802.3 100TX standard Ethernet technology, which allows a maximum transfer rate of 100 Mbit.

Which cables are verified by the VNO?

CAT5e, 4-wire, maximum length 100 m

Which connectors are verified by the VNO?

HARTING RJ45 Industrial
 PHOENIX Contact M12 connector plug
 TE connectivity Industrial Mini I/O
 TE connectivity Industrial 4+8 hybrid connector plug

Which VARAN Bus splitter modules are available?

The VARAN bus splitter modules allow the configuration of star, tree, linear and combined topologies. The following splitter modules with various functions are available.

Manufacturer	Description	Function
SIGMATEK	VSV 041/-043/-046, SV 141/-142	Configuration of the VARAN topology
SIGMATEK	VSP 042/-044/-045	Integrated VARAN Profinet gateway
SIGMATEK	VBC 021	Coupling of two VARAN networks
SIGMATEK	VBC 121	Coupling of VARAN - EtherCAT

What other field busses can be integrated?

Depending on the requirement, interfaces to various bus systems and networks are available; such as: Profinet, EtherCAT, CAN-Bus, DIAS, C-DIAS, S-DIAS, RS232, RS422, RS485

VSK VARAN Starter Kit

SIGMATEK provides a starter kit to familiarize with VARAN technology. Through the combination of the Evaluation Board and various client boards, the first manager/client connections can be implemented and tested.

Of which components does the Starter Kit consist?

The VEB 021 Starter Kit consists of:

- Evaluation Board
- VEB 011 VARAN Client Board
- **VARAN Service Tool...**
- Standard network cable
- 24 V DC supply voltage

What can one actually do with the VARAN Starter Kit?

The VARAN VEB 011 Client Board is mounted onto the Evaluation Board and connected to the VARAN Manager CPU-module with the network cable provided. After installation of the VARAN Service Tool, the PC can access the VEB memory via the CPU-module.

How the different VEB Client Board modes can be used?

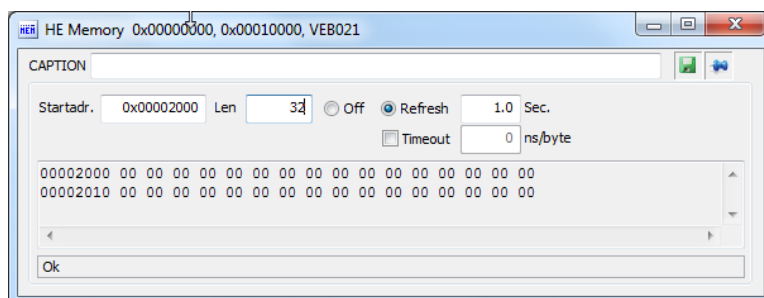
The various Client Board modes can be selected via external wiring of the pins. On the VEB021 Evaluation Board, the modes can be selected by changing the jumper resistance. In delivery condition, the IO mode is active.

Is a password required for expanded functions?

Yes, the password can be requested from the VNO.

In there a simple option for accessing the VEB memory?

Yes, the Hex editor can be called with a right-click on the device in the VARAN Service Tool. With the editor, write and read access is possible.



VARAN Analyzer

What is the VARAN Analyzer?

The VARAN Analyzer is a module that provides the analysis of the VARAN communication of the real-time network. All packets of the network communication are recorded as analysis data.

How is the VARAN Analyzer integrated into the VARAN network?

The VARAN Analyzer can be connected at any location in the VARAN system. Either over a free VARAN port in the system or by disconnecting the system. The analyzer is integrated into the VARAN network without changing the configuration.

Where is the analysis data displayed?

SIGMATEK offers various products which can be used for analysis:

With the ETVA 0501 product, the data can be displayed and processed on the integrated touch display or in the VARAN Service Tool. With the VA 062 (extension card for C-IPC) and the VA 011, the data get analyzed in the VARAN Service Tool.

The VA 011 also enables the use of Wireshark, which can be used to log the packets with the streaming mode via the Gbit Ethernet interface. A plug-in for Wireshark is provided for this purpose.

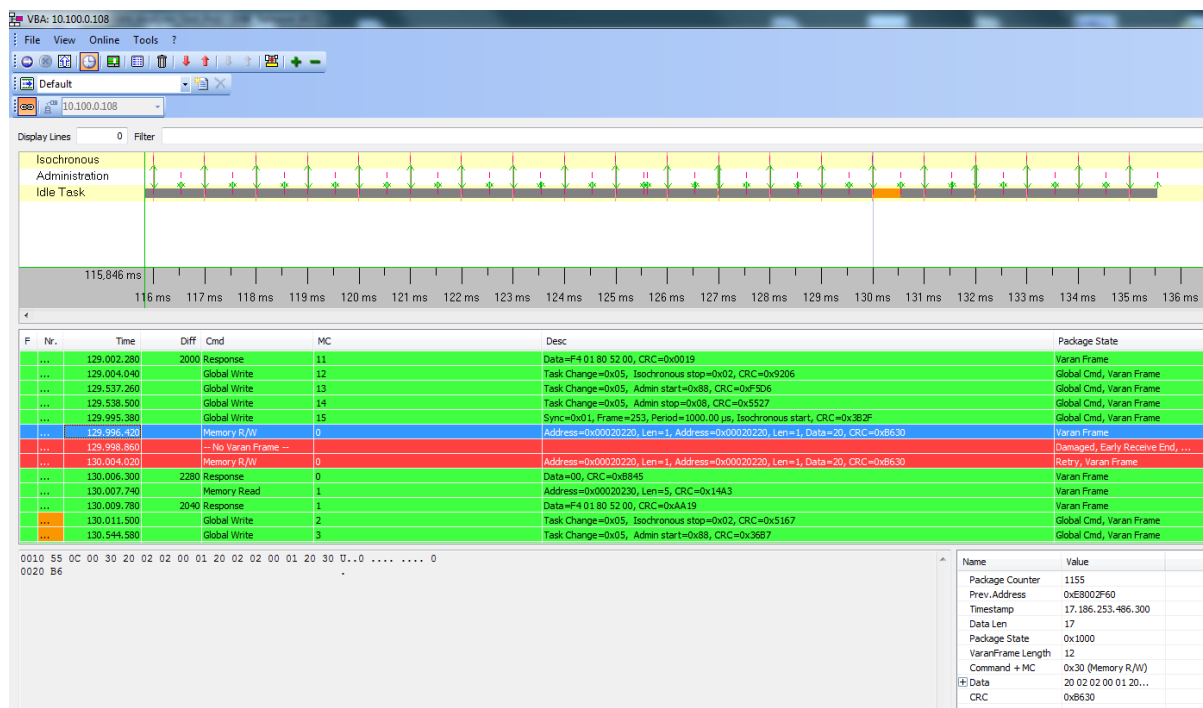
Which network data can be viewed with the VARAN Analyzer?

The VARAN bus can be displayed and analyzed in the smallest detail.

Graphic display of the bus times

Each packet is displayed with content (address, data, type).

Defective packets and their repetition are marked in red. Packet repetition in the same bus cycle → see graphic.



VARAN Design Specifications

The VARAN design specifications describe the function of the VARAN bus, including the protocol structure and all information required to integrate the VARAN bus into a system.

VARAN Manager

The VARAN Manager interprets the data objects from the DPRAM of the FPGA. All access is initialized by the manager.

What are data objects (DO)?

Data objects are linked lists stored in the FPGA RAM. The lists contain all commands and data for the manager. Each task has its own data object list consisting of at least one data object. Processing the data objects is defined by their pointer structure.

What data objects are used in the VARAN Bus?

Service Data Objects (SDO) for setting the parameters of object directory items
Process Data Objects (PDO) for transporting real-time data

VARAN Bus Design

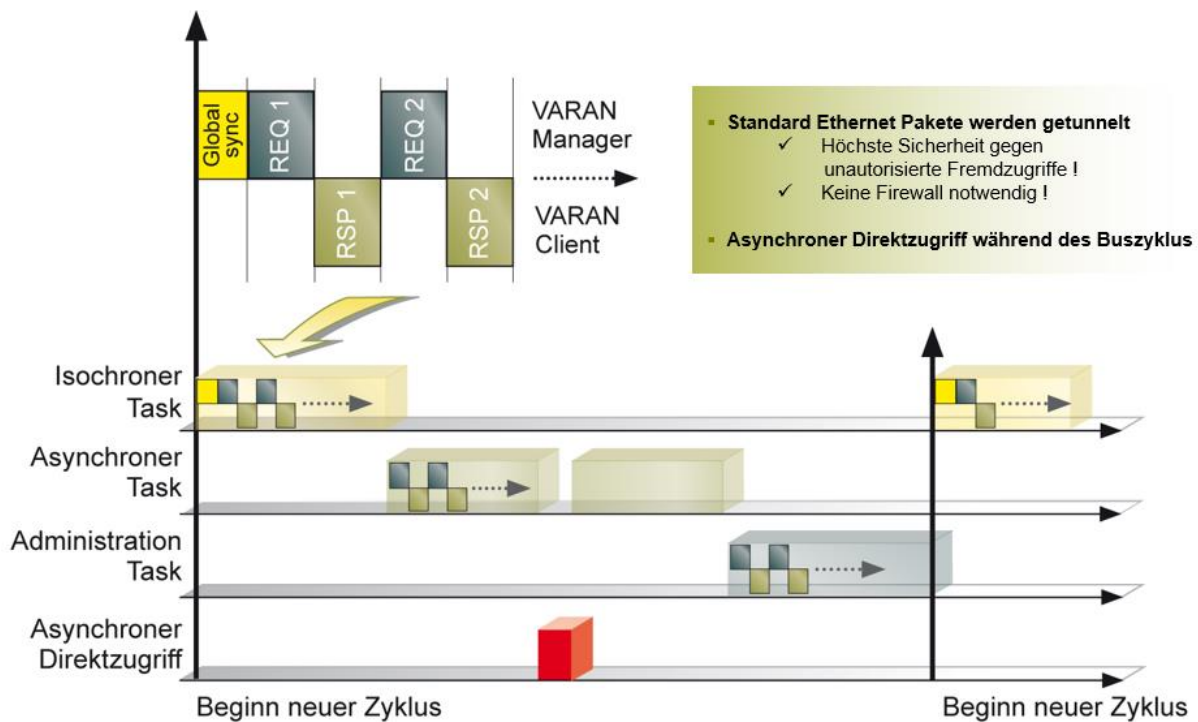
Are there tasks with different priorities?

The **isochronous task** has the second highest priority (real time) and is

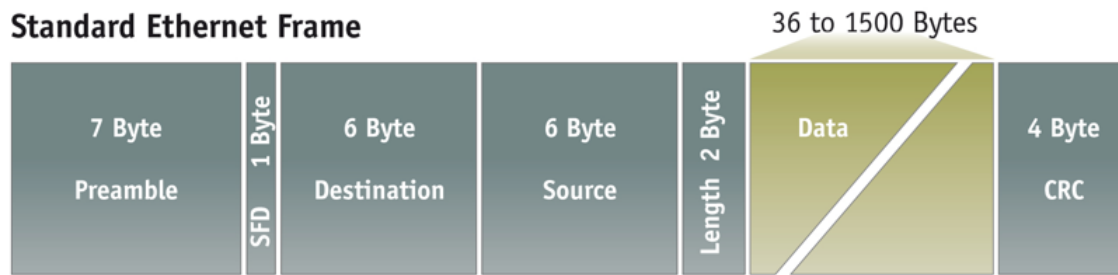
The **asynchronous task** has a lower priority and is sent after the isochronous task.

In the **administration task**, low-priority data are sent. For example, tunneled Ethernet frames.

The **asynchronous direct access** is used for high-priority tasks. For example, drives with high performant axes.



Where does a VARAN frame differ from a standard Ethernet frame?



Can a VARAN frame be sent via standard Ethernet?

Yes, however, real-time transmission is thereby no longer possible.

How is a VARAN data packet detected in standard Ethernet?

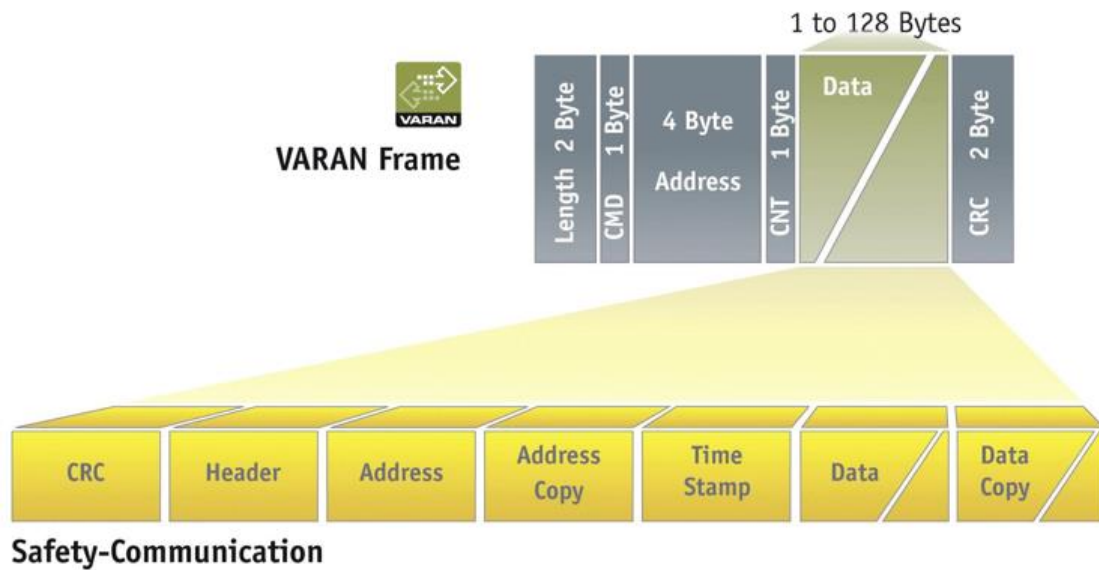
Via the Ether Type 88FA real-time Ethernet VARAN

Others:

0x8892	Echtzeit-Ethernet PROFINET
0x88A2	ATA over Ethernet Coraid AoE ^[5]
0x88A4	Echtzeit-Ethernet EtherCAT
0x88A8	Provider Bridging
0x88AB	Echtzeit-Ethernet Ethernet POWERLINK
0x88CD	Echtzeit-Ethernet SERCOS III

How are Safety data integrated into the VARAN Bus?

> Safety-relevant data are transmitted using the "Black Channel Principle".

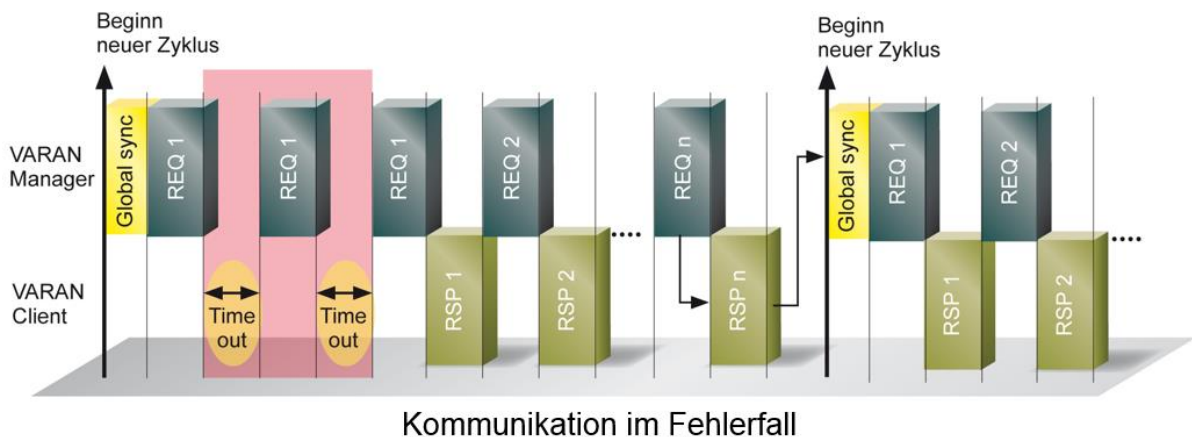


What does the type label contain?

- > With the VARAN type label, each participant can be individually identified.
- > Vendor ID – Each VNO member receives a unique member identification number
- > Device ID – Each devices is assigned a unique device identification number
- > Every bus participant is licensed through a license number.
- > The manufacturer can store device-specific user data directly in the module.



How is the high data security of the VARAN bus explained?

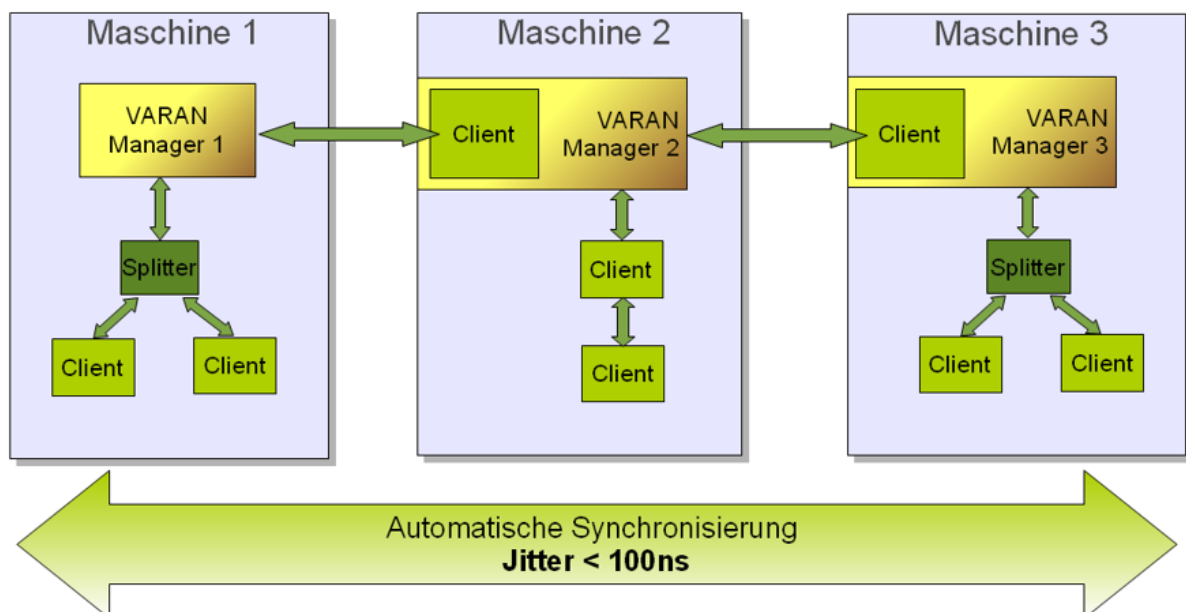


Guaranteed data consistency with reconfirmation of each message

Communication in the VARAN bus system is always initiated by the VARAN Manager. At the start of each bus cycle a synchronization command is sent to all participants and each time the VARAN Manager accesses a client, it sends an answer to confirm.

If the packet is not correctly transmitted due an error, the client does not answer. After the time-out, the packet is sent within the same bus cycle.

How is a multi-manager system formed?



Which topologies are possible?

> Start, tree and linear topologies can be configured and combined as desired.

Are signal and power supply via the bus possible?

Yes, with hybrid connectors
 > PHOENIX Contact M12
 > TYCO 8+4 Power Ethernet

Where is the advantage of PLL in comparison with the distributed clocks?

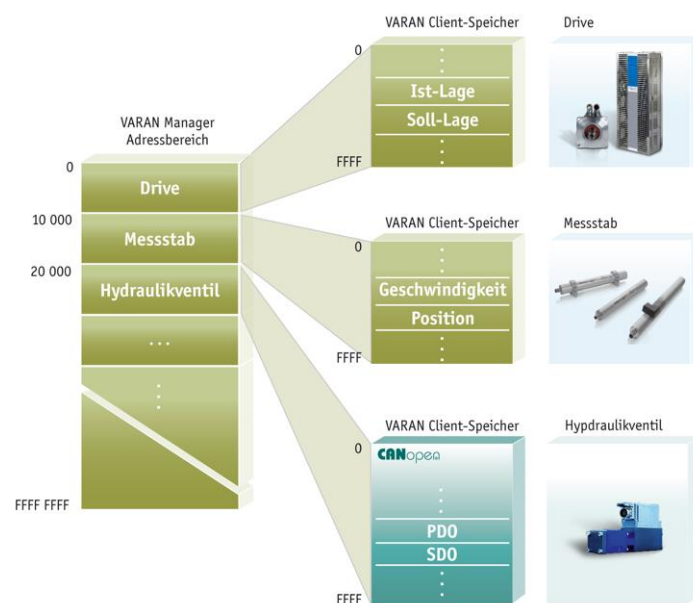
Programming is significantly reduced and the client stays thin.
 Configuring the system is simpler.

Are there VARAN bus connections, which must be cross linked?

No, cross linking when necessary, is automatically performed by the Ethernet PHY.

Function Principle of the VARAN Bus?

The participants are seen as a 4 Gbyte memory space, which can be read and written to.
 Participants in the bus system are addressed automatically.
 The instruction set is very simple and therefore saves space.



How many participants can be connected per manager?

Over 65,000 per manager

What is the shortest cyclic time possible?

The cycles > 100 μ s are possible

How long does data access take?

The isochronous access of 8 IOs (1 byte) is 2.18 μ s.
 The update time of a drive with a 16-byte r/w is 5.05 μ s

What is Multiple Read/Write?

A frame is distributed to multiple nodes, which answer in a predefined sequence. A lower overhead is thereby generated.

How long does direct access take?

The update time of asynchronous direct access is < 25 μ s at 128 bytes

If precisely are the cycle times maintained?

The jitter describes the maximum deviation between synchronized bus participants and with the VARAN bus, is below 100 ns

VARAN Client Block Diagram

