

TAC Xenta[®]

Network Guide

Preface

Welcome to the manual of the product TAC Xenta® Network Guide.

This manual describes how the TAC Xenta® devices and other TAC devices can be used to build different kinds of networks using LONWORKS® technology.

The purpose of this guide is to give an overview of the possibilities that this network concept gives, with the TAC Xenta® products and TAC Vista®. It is not to be seen as a specification of the devices and networks that are mentioned.

It also contains a number of typical configurations, which may serve as a starting point for real applications.

If you should discover errors and/or unclear descriptions in this manual, please contact your TAC representative. You may also send e-mail to **helpdesk@tac.se**.

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TAC Xenta® Network Guide

Subject to modification.

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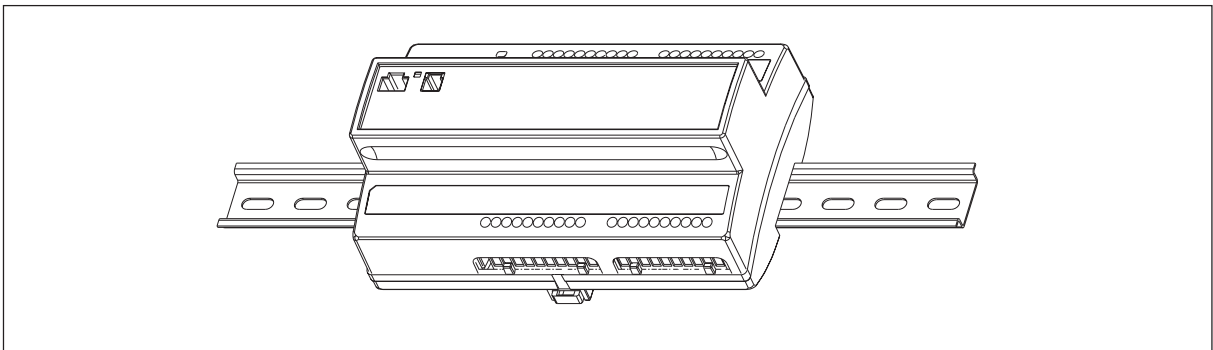
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1 TAC Xenta® and LonWORKS® Devices

1.1 The TAC Xenta Devices

TAC Xenta® is a family of freely programmable devices, with communication features, designed for small and medium sized heating and air handling systems. Members include, among others, TAC Xenta 301/302/401/901 and I/O modules from the TAC Xenta 400 series.



A TAC Xenta 300 controller

In for instance small office buildings, typically with a number of air handling devices and heating plants, a number of TAC Xenta devices can be connected to form a local network over which they exchange data.

The TAC Xenta devices communicate with each other using the LonWORKS® 78 kbps network platform. The FTT-10A Transceiver, integrated with each device supports polarity insensitive, free or bus topology wiring, simplifying network expansion.

The TAC Xenta Operator panel (OP) is also connected to the LonWORKS network and acts as an operator panel for any device on the network.

A TAC Xenta 301/302/401 has an RS232 port used for modem connection at dial-up systems, or for downloading application software from the programming tool TAC Menta®.

A supervisory system, like TAC Vista®, can be connected to the LonWORKS network, with comprehensive facilities for overviews, data display, statistics, etc.

1.2 LONWORKS Fundamentals

LONWORKS® is a technology for intelligent distributed control developed by the company **Echelon®** in USA. LONWORKS technology is a complete networking solution which offers a powerful means for implementing a wide range of distributed systems for monitoring and control.

The network used in LONWORKS is called **LON®** which is short for Local Operating Network. On a LON network, intelligent devices called **nodes** communicate using the **LonTalk®** protocol. LonTalk is an open protocol allowing products from different vendors to communicate.

An integrated circuit in every node called **Neuron®** ensures interoperable communication on LON. Each Neuron has a unique **Neuron ID** which, like a serial number, makes each Neuron chip unique.

A **transceiver** is a device that connects the Neuron to the communications medium. Available transceivers, eg. twisted pair, radio, power line and optical fibre. Products operating on different media can coexist on LON with the use of a **router**. These are intelligent devices that connect networks and manage traffic between them. A **repeater** is used for interconnecting network **segments** in order to extend the network in distance and number of nodes.

To support openness and compatibility among products from different vendors, an association called “The **LONMARK™** Interoperability Association” has been founded. LONMARK certified products carry the LONMARK logo, which is a warrant for compatibility.



LONMARK certified devices on a LON network communicate by using **network variables**. A set of Standardized Network Variable Types, **SNVT** (pronounced ‘snivet’), is provided by LONMARK in order to promote interoperability. There are SNVTs defined for temperature, power, time, flow etc.

Every node has a **network address** assigned by a network management tool such as LonMaker Integration Tool, a PC program run under Windows. The tool is also used for **binding** i.e. connecting source and destination SNVTs between nodes. (SNVTs are not necessarily used for communication between TAC Xenta devices. Binding is only required between TAC Xenta devices and third party products.) The network address and binding information for a node is stored in the non-volatile memory of the Neuron.

TAC Xenta and LonWORKS

The TAC Xenta control system is based on LONWORKS technology using 78 kbps and FTT-10A transceiver. Although TAC Xenta will make use of many network features such as installation flexibility and interoperability there are a few significant characteristics which may differentiate it from other LONWORKS based systems.

All TAC Xenta devices are equipped with an FTT-10A Transceiver allowing them to communicate on an TP/FT-10 channel.

The communication between TAC Xenta devices is based on LonTalk explicit messages (not SNVTs). All communication between TAC Xenta and third party products, however, is done using SNVTs.

A TAC Xenta I/O module is logically connected to a TAC Xenta 301/302/401 which operates as a “host” for its I/O modules. I/O points on TAC Xenta I/O devices are available to third party products via the TAC Xenta 301/302/401 using SNVTs.

TAC Xenta is LONMARK certified as a system, i.e. TAC Xenta OP and TAC Xenta I/O devices are designed for operating with the TAC Xenta 301/302/401.

The LONWORKS technology is described in a number of documents from the Echelon Corporation, for example in The LONWORKS Engineering Bulletins.

Another source of information is the LONMARK Organization site on the Internet:

<http://www.lonmark.org/>

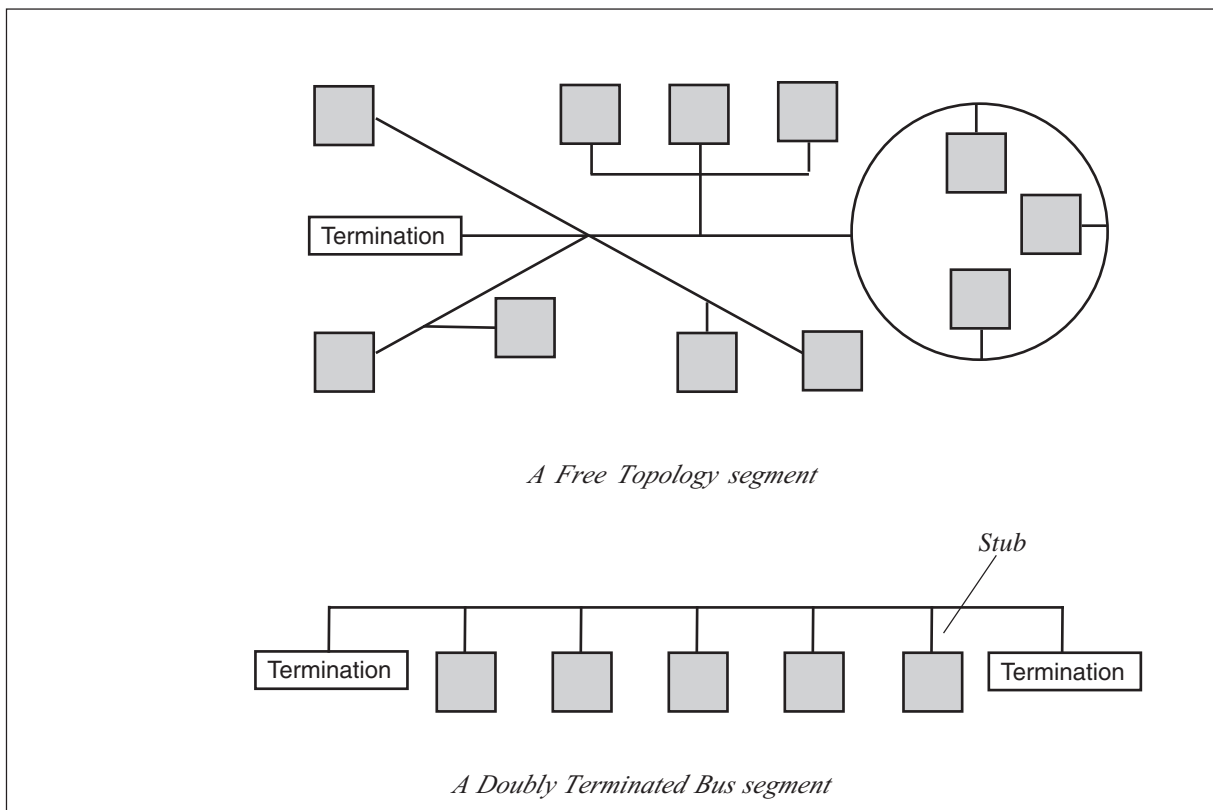
1.3 Network Main Principles

Topology

Topology is a way to describe the design principles of a network.

For LONWORKS applications a network segment is built according to one of the following topology principles.

- Free Topology, single termination
- Bus Topology, double termination



The two principal wiring topologies supported by the LONWORKS technology

As shown in the figure, the *Free Topology* segment has virtually no restrictions in the ways the devices can be connected. The total wire length, however, is 500 m under optimal conditions (see the cable information further on in this chapter).

The *Doubly Terminated Bus* segment, on the other hand, allows a segment that is up to 2700 m under optimal conditions, but imposes limits on the node stub (connection length). Depending on the communication speed the stub must not exceed 3 m (78 kbps) or 30 cm (1.25 Mbps).

Addressing

The addressing of the nodes on a network can be made in several different ways. The addresses are hierarchically structured, with two or three components per address, as shown below. The purpose decides which method is used.

Domain, Subnet, Node	Logical addressing
Neuron ID	Physical addressing
Domain, Group	Group addressing (LONTALK or TAC)
Domain or Subnet	Broadcast

The *Domain* address component defines the larger structures of the network.

In LONWORKS networks with TAC products the domain ID is 11_{16} by default, i.e. it has the hexadecimal value 11 (decimal value 17) for all TAC devices. (If required, the domain ID may be changed, using a Network Management Tool.) The highest subnet/node address is 255/127. All communicating nodes must have the same domain ID.

1.4 Terminology

The following words appear frequently in the text that follows.

Backbone A segment of a network (often a higher speed than the rest of the network) that connects all the other channels.

Channel A channel uses a certain medium (for instance twisted-pair wire) with a certain communication speed (for instance 78 kbps). Adding a router creates a new channel. On a TP/FT-10 channel you can connect both FTT-10A and LPT-10 transceivers. A channel is separated from another channel by a router.

Domain A domain is a large-scale, logical part of the network. In LONWORKS networks with TAC products it has the hexadecimal value of 11₁₆ by default. Using different Domain IDs on the same network makes it possible to split a physical network into several, logically separated parts.

TAC Xenta was originally designed to work using two *domains*, the application domain and the zero-length domain. Using the network configuration tool of TAC Menta, NCT, you can configure the TAC Xenta 301/302/401 devices, assigning the TAC Xenta a subnet/node address, the same in both domains.

An LNS network uses only one domain, the application domain. Additionally, the management tool of LM3 assigns its own address values to the respective devices; these assignments are completely beyond the influence of the operator.

Nodes on different domains cannot communicate with each other. *Subnets* are logical subdivisions of a domain.

When a TAC Xenta 301/302/401 device will be used in an LNS network, you check-mark the NCT box *Using network management software*, and uncheck the *Download group address* box under *Preferences - Configuration*. NCT will then no longer set the address for the TAC Xenta devices; instead, this will be handled by LM3.

As, for example, the Service pin message from an I/O module is always sent on the zero-length domain, a TAC Xenta installed with LM3 cannot receive this message. Instead, you must use the TAC Menta program for network configuration (NCT) at the installation, enter the Neuron ID of the I/O module manually.

Group Bindings Three or more nodes in a domain, connected with network variables of SNVT type. The individual nodes may belong to different *subnets*. *Note!* Group bindings are not synonymous with LONWORKS groups.

LM3 LONMAKER Integration Tool, Release 3

LONMAKER Integration Tool is a software package for designing, installing, operating, and maintaining open, interoperable LONWORKS networks. The LONMAKER tool can be used to design and commission a distributed control network

LTA Abbreviated LonTalk Adaptor; a PC interface to the LONWORKS network.

LONWORKS Group (LWG) The term LONWORKS groups designates a group of LONWORKS devices used in TAC Vista, and networks with TAC products, to structure the LONWORKS devices in the TAC Vista database. *Note!* LONWORKS groups are not synonymous with Group bindings.

NCT TAC Menta Network Configuration Tool, (also known as LonTool). The NCT is used for configuring network nodes, i.e. set subnet/node addresses and other properties of the TAC Xenta 301/302/401 and its I/O modules

Network A network consists of at least two nodes, connected by one or several *channels* in such a way that each *node* has a unique address, allowing the nodes to communicate with each other. TAC Xenta networks use LONWORKS technology.

In some contexts the term “LONWORKS network” is used to stress that reference is made to a network of this type, as opposed to, for example, a network of PCs.

Network Management Tool A general binding tool for devices in LONWORKS networks.

Network Variables: *nvi*, *nvo* (*Network Variable Input and Output*) Values that are sent to (*nvi*) or from (*nvo*) a device. An example could be the outdoor temperature.

Node A node is a device, connected to the network, which can

- communicate with other nodes, using a common *protocol*
- be addressed, having a unique identification (*network address*)
- perform calculations and/or exchange data with other nodes

A node is often a TAC Xenta 301/302/401 or an I/O module. It may even be a single switch or a sensor, if it uses the LonTalk protocol. If a TAC Xenta OP is connected, the OP is also a node.

Protocol A protocol is a standardized procedure, covering both physical and logical aspects, which allows nodes in a *network* to exchange information.

Repeater A device which amplifies the signal on the channel, but does not affect the traffic in any other way. By connecting two or more *segments* with repeaters the physical range of the channel can be increased. There must not be more than one repeater in a path between two connecting nodes on a network. Repeaters shall not be interconnected in such a way as to create a loop.

Router A device that connects *channels*, often with different traffic capacities. It logically divides the network and separates messages destined for different parts of the network. Routers acts as borders for *subnets*. Routers can be set up in four different modes: configured, learning, bridge or repeater. Factory setting is repeater mode.

SCPT/UCPT Standard Configuration Parameter Types and User Configuration Parameter Types. A great number of SNVTs contain configuration properties. These SNVTs are called SCPTs or UCPTs.
Note: This applies for instance to the TAC Xenta 100 devices.

- Segment** A physical part of the network, containing one or several nodes which can exchange data without intervention from any other device. There can be up to 64 nodes in a segment under optimal conditions (FTT-10A and TP/XF-1250) or 128 (LPT-10). Two segments can be connected by the use of a *repeater*, but are still one channel.
- Selector** An ID number for a SNVT binding. The Network Management Tool is responsible for defining these ID numbers.
- SNVT** A set of Standardized Network Variable Types, defined and updated by the LONMARK organization in order to promote interoperability between products from different vendors.
- Subnet** Subnets are logical groupings of the network. Each node can be addressed by its *Domain*, *Subnet* and *Node* number. There can be more than one subnet on the same channel but the same subnet cannot exist on more than one channel.
- TAC Group** All TAC Xenta 301/302/401/901 devices must belong to the *TAC group* in order for TAC Vista to be able to communicate with them. TAC Vista, however, does not belong to the TAC group. The group is created by a group binding on tag_0 in LonMaker Integration Tool.
- TACNV** TAC specific Network Variables.
- Termination** A termination is a piece of equipment that removes wave reflections originating from the end of the cable. Different terminations are used. Terminations can be positioned anywhere on a free topology network, but must be positioned at both ends of a bus topology network.
- TAC Xenta Group** The TAC Xenta Group is a *logical group*, used to build a simple hierarchy of the TAC Xenta devices, for example when a presentation system like TAC Vista is connected to a TAC Xenta network. The *TAC Xenta Group Master* belongs to the TAC Xenta Group. The TAC Xenta groups are also used in TAC Xenta OP. The group is created by a group binding on tag-1 in LonMaker Integration Tool.
Note! Avoid creating groups that span *routers*. If a group exists on both sides of a router (span), the network load increases.
- TAC Xenta Group Master** The *TAC Xenta Group Master* is a TAC Xenta 301/302/401/901 (in the TAC Xenta Group) that monitors the on-line and off-line status of the TAC Group and its members. In the NCT the device is appointed Group Master, for the on-line/off-line information exchange in TAC Vista. The Group Master forwards the on-line and off-line information to the presentation system.
- XIF-file** eXternal Interface File, a file that in short describes which SNVTs the device can handle.
- XFB-file/XFO-file** When the XIF-file is imported to LONMAKER Integration Tool it is compiled into two files: the XFB-file and the XFO-file.

1.5 Cables and Terminators

1.5.1 General

The choice of cables and terminators is governed by, among other things, the transmission speed the channel can handle.

Common applications with twisted pair cables often use one or both of the following channel types.

- TP/FT-10 78 kbps May be designed with free topology or bus topology, and 2700 m distances under optimal conditions.
- TP/XF-1250 1,25 Mbps High speed channel, used as backbone, and 130 m distances under optimal conditions.

In addition there are further restrictions as shown below

Further information regarding suitable cables, and other considerations that need to be made, is available on the Internet:

www.echelon.com - Part no. 005-0023-01, "Junction Box and Wiring Guidelines For Twisted Pair LONWORKS networks" and

www.lonmark.org - "LONMARK® Layers 1-6 Interoperability Guidelines".

1.5.2 Cables

Adhere to the rules given by the wire manufacturer:

- diameter
- twisted-pair
- shield
- environmental demands

Use the correct type of cable in all parts of the installation, even within cabinets and between screw terminals.

The number of nodes per segment, as for TP/FT-10, is at the most 64, but this number is significantly reduced at extreme temperatures (outside the range 0–70 °C).

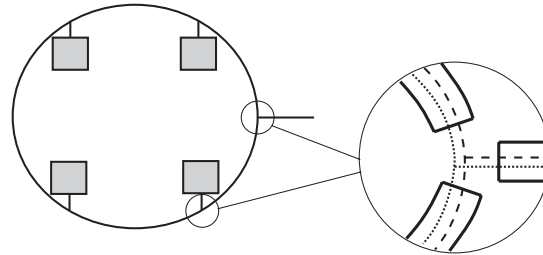
TP/FT-10 Free Topology & Bus Topology Segments

Five cable types have been validated for the TP/FT-10 channel (for use with the FTT-10A Free Topology Transceiver and LPT-10 Link Power Transceiver). These cable types are:

Cable Type	AWG	Diameter (mm)	Bus Topology		Free Topology	
			Length (m)	Stub (m)	Length (m)	Stub (m)
Belden 8471 (PVC Jacket) or equivalent	16AWG	1.3	2700	3	500	400
Belden 85102 (PVC Jacket) or equivalent	16AWG	1.3	2700	3	500	500
Category 5	24WAWG	0.5	900	3	450	250
Level IV cable	22AWG	0.65	1400	3	500	400
JY (st) Y 2X2X0.8	20.4AWG	0.8	900	3	500	320

If a Loop is used, the bus polarity must be observed:

Bus polarity within a loop



TP/XF-1250 Bus Topology Segment

Two cable types have been validated for the TP/XF-1250 channel (for use with the TPT/XF-1250 Bus Topology Transceiver). These cable types are:

Cable Type	AWG	Diameter	Bus	
TIA 568A Category 5 Cable	24WAWG	0,5mm	130m	0,3m
Level IV Cable	22AWG	0,65mm	130m	0,3m

For the TP/FX-1250 Channel operating in a *bus* topology, the maximum bus length of TIA 568A Category 5 cabling is 130 meters, with a maximum stub length of 0.3 meters. There are topology restrictions associated with the use of this channel - refer to www.echelon.com, Chapter 5 of the *TPT Twisted Pair Transceiver Module Users' Guide* (at www.echelon.com) before installing any cabling for this channel.

For further information please refer to the LonWORKS TPT Twisted Pair Transceiver Module User's Guide, part no. 078-0025-01C, available on the LonMark web site:
www.echelon.com

Note! If a shielded cable is used in TP/FT-10 the shield shall be connected to link power source ground with a 470k Ω , 1/4Watt, $\geq 10\%$, metal film resistor to prevent static charge build up.

A gas discharge tube can be connected in parallel with the resistor for lightning protection.

A restriction for TP/XF-1250 is the **8-in-16 rule**, which says that the number of nodes in an arbitrary 16-meter part of the cable must not exceed eight.

If circumstances require that more nodes must be gathered at a certain part, this can be done in two ways, while still observing the rule.

1. Add more cable between suitable nodes; remember though that the maximum length of the bus is still 130 m.
2. Split the channel in two by inserting a router in such a way that the rule is observed for each part.

1.5.3 Terminations

Each network segment **requires** a termination for proper data transmission performance. The terminations are connected differently, depending on the network topology. Terminations are sometimes built into a node, eg. link power supply.

Free Topology Segment

In a Free Topology segment only *one* termination is required and can be placed anywhere on the segment.

If there is a router or a repeater it is convenient to put the termination near it, generally on the “downstream” side.

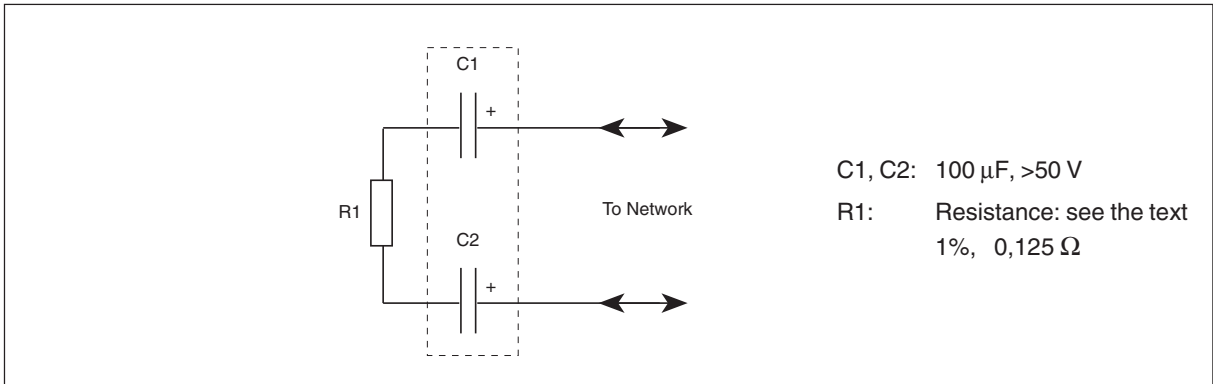
If there is a supervisory PC in the segment, equipped with a PCLTA board, a termination on the board can be connected for this segment.

Doubly Terminated Bus Topology Segment

In a doubly terminated bus topology exactly *two* terminations are required, one at each end of the segment, at the true *endpoints*.

TP/FT-10

The termination is built from the following components, where a total termination impedance of approximately 53 Ω is required.



Network Terminator for a TP/FT-10 connection

Observe polarity shown for C1 and C2. These capacitors are recommended.

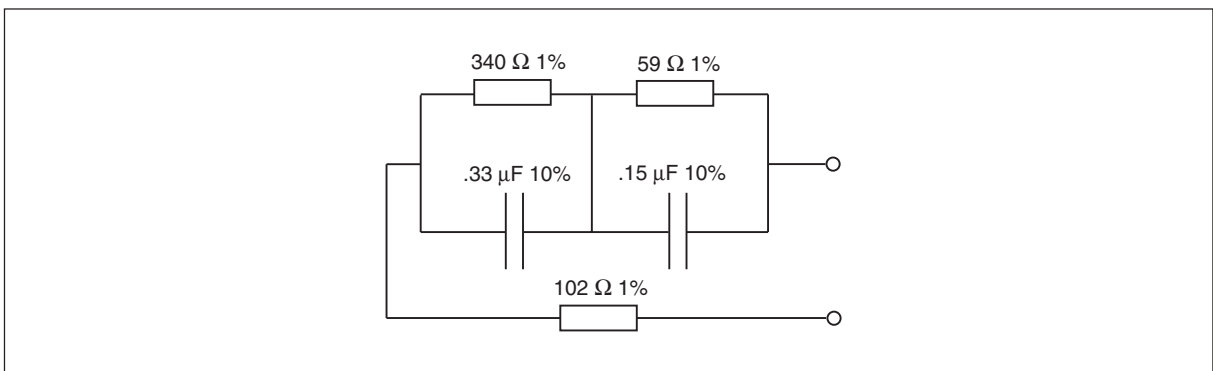
Free topology: one termination with R1 = 52,3 Ω

Doubly terminated bus topology: two terminations, one on each end of the segment, each with R1 = 105 Ω

A LonWORKS termination device (single/double) is available from TAC, part no. 0-073-0905.

TP/XF-1250

Doubly terminated bus topology. The termination has a different circuit diagram from that of TP/FT-10.



Network Terminator for a TPT/XF-1250 connection

1.5.4 PC Interface (LTA)

A LonTalk adapter of some kind is required to connect a PC to a LONWORKS network. The interface is required, for instance when TAC Vista is connected to the network. There are several options:

PCLTA-20 (PCI bus)
PCLTA-10 (ISA bus)
PCC-10 (PCMCIA)
Router LE, i.LON, SLTA
TAC Xenta 511 and others

1.6 Repeaters and Routers

General

As the number of nodes and the physical distances of the network increase, supporting devices must be added to the network.

This section covers two device types:

- Repeaters (amplifier)
- Routers (traffic separator, media switch)

Repeaters connect two segments and in principle amplifies the signals. No traffic separation is performed.

A router separates channels and filters the traffic between them, according to certain rules.

Repeaters

As described in a previous section, the length of a free topology wire segment can be 500 meters under optimal conditions. At greater distances the segments must be connected by repeaters. (Refer to www.lonmark.org - "LONMARK® Layers 1-6 Interoperability Guidelines")

As the number of nodes per segment is limited to 64 (FTT-10A) or 128 (LPT-10) installing a repeater will also double the number of available nodes.

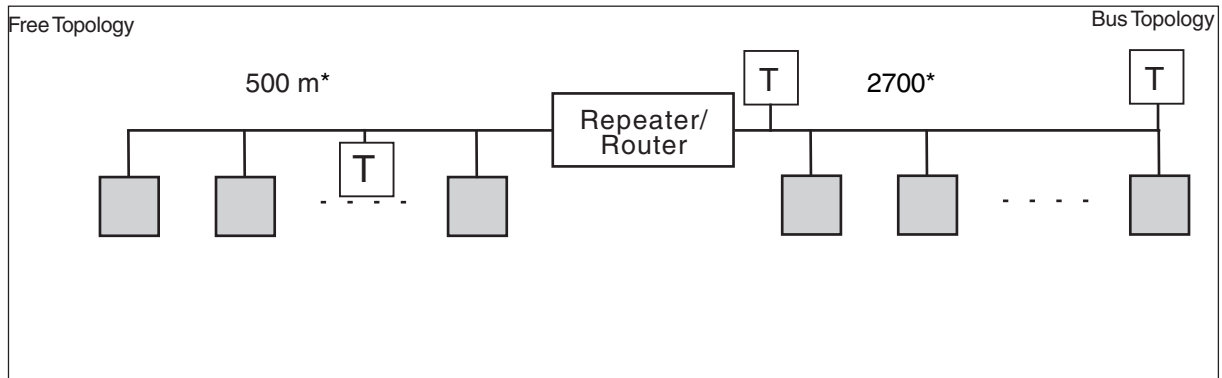
Only one repeater is allowed between any two nodes. Segments must not be connected in such a way that the repeater is included in a loop.

The communication properties of the repeater are determined by the type of channel (for example TP/FT-10) that is expanded by the repeater.

These properties are specified when the repeater is ordered.

Installation The connection of the TAC Xenta Network Repeater FTT-10A, part no. 0-073-0912, is described in 0FL-3872-001.

Example:



Two network segments (one Free Topology segment and one Bus Topology segment) connected by a Repeater or two network channels connected by a Router.

Routers

A *router* connects two communication channels (possibly using different media) and forwards LonTalk messages between them. In general, this may be arranged with a number of options. In TAC Xenta networks, however, the following properties are emphasized:

- A router connects channels and logically separates subnets.
- A router can selectively forward messages, based on the destination subnet address and group address, thus reducing the overall network traffic.

There are four router modes: learning, configured, bridge and repeater.

A router in learning mode

At power on a learning router successively “learns” on which side the different destination subnet addresses reside, and uses this information to determine if messages are to be forwarded or not. Always learning, forwards all messages, does not filter group addressing. It has a volatile memory which means that all information is lost at power off.

A router in configured mode

stores and remembers the information during the system configuration, which gives a more effective traffic separation. Filters group addressing and subnet addressing. Configured by a Network Management Tool.

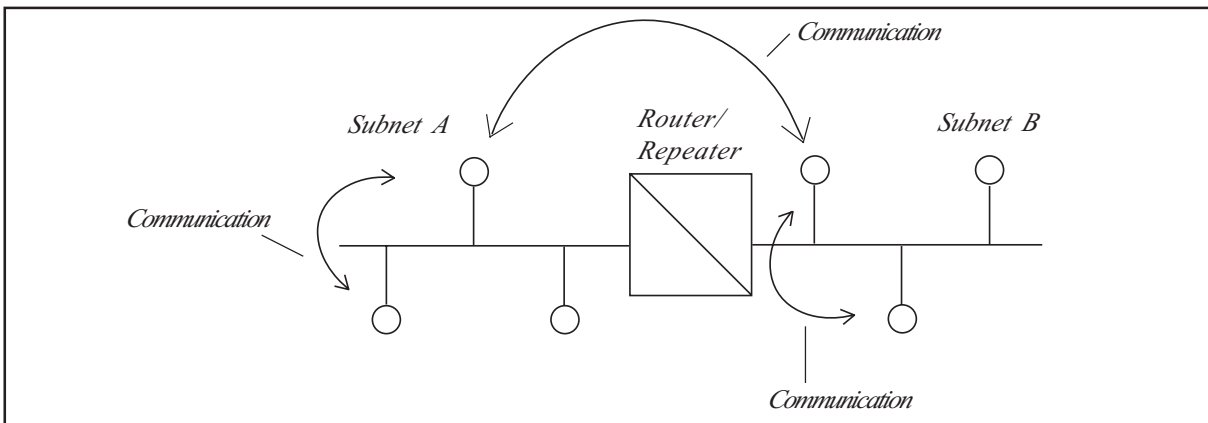
A router in bridge mode

forwards all packets that match its domain(s).

A router in repeater mode

amplifies the signals and forwards all *valid* packets. The router is delivered in repeater mode.

A message sent from a node in Subnet B, with a destination address also in Subnet B, would not be forwarded to Subnet A by the router.



A message with destination address in Subnet A would pass through, though with a slight delay (about 4–10 ms).

The communication properties of the router are determined by the two types of channels which are connected to the router.

For example, it may be required for a TP/XF-1250 Backbone channel to communicate with a TP/FT-10 channel, via a suitable router.

These properties are specified when the router is ordered.

Installation

In general a router requires a power supply and two network connectors. There may be restrictions on media type and on the cable length depending on the communication speed.

For further information regarding LONWORKS Routers please refer to the LONWORKS Router User's Guide on the Internet:
www.echelon.com

2 *LONWORKS Networks with TAC Products*

2.1 *General*

When you design and build a TAC Xenta network you must determine what category it belongs to, as the required configuration procedures and tools will depend on this.

TAC Xenta networks can be divided into the following main categories.

TAC Network Case TAC Xenta 301/302/401 devices with I/O modules and any repeaters; but no routers, no use of SNVTs and no other LONWORKS products on the network.

TAC/Router Network Case As category 1, but the network also includes routers.

Integrated Network Case Routed TAC Xenta networks that use SNVTs and possibly contain other LONWORKS products, for instance TAC Xenta 100. Involves 'System integration'.

Integrated/Intranet Network Case 100% open, routed LONWORKS networks that use all SNVTs, web pages (Internet Explorer 5), and TCP/IP network.

The reason for this classification is the degree of complexity of the configuration procedures.

TAC Network Case

For a simple TAC Xenta network the configuration of the Subnet/Node addresses can be performed with the Network Configuration Tool (NCT) that is delivered with TAC Menta. The binding of the TACNV Network Variables, defined in TAC Menta Network Configuration Tool, is automatic.

TAC/Router Network Case

When a TAC Xenta network is expanded with configured mode *routers*, the configuration procedure also requires the use of a Network Management Tool, for instance LonMaker Integration Tool. This tool is used to define the network objects (including the *routers*) and the different channels that the use of *routers* implies, among other things.

Integrated Network Case

In addition to what is mentioned for the TAC/Router Network Case, the use of SNVTs and other LONWORKS products require further use of procedures provided by the Network Management Tool, mainly to perform the SNVT bindings between the different nodes.

Common Features of TAC Xenta Networks

The TAC/Router Network Case and the Integrated Network Case will be discussed in separate sections, but first we will discuss some of the common features of TAC Xenta networks.

With the 'free' topology, connections may be made anywhere on the segment and only one terminator is required.

The total length of all wires of the segment, can be up to 500 m under optimal conditions. Stub length 3 m.

With the 'bus' topology two terminations - one at each end - are required.

When a TP/FT-10A channel is used, the total length of all wires of the segment can be up to 2700 m, under optimal conditions. If a TP/XF-1250 channel is used, the total length of all wires of the segment can be up to 130 m, under optimal conditions. Stub length 0.3 m.

The TAC Xenta OP is connected directly to the segment, either using the screw terminals on the rear, or the modular jack on the front of any device.

An I/O module is associated with a specific device (TAC Xenta 301/302/401) and normally has an address "close" to the device.

For this simple network we must consider

- the Subnet/Node addresses of all nodes
- TACNV
- TAC Xenta Groups, when relevant
- a possible connection to TAC Vista

and we use TAC Menta and its Network Configuration Tool (NCT).

2.2 TAC Menta Network Configuration Tool (NCT)

TAC Menta Network Configuration Tool (NCT) is a software tool which defines and distributes the configuration information to the nodes of a simple network.

The configuration process is sometimes referred to as the ABC's of installation, as it can be divided into three parts:

A–Address assignment

B–Binding

C–Configuration of the nodes

A–Address assignment

Each node is given a subnet/node *address*.

B–Binding

TAC Xenta nodes may communicate with each other using network variables.

Binding is the process of connecting network variables between the source and destination nodes. This is done automatically in the TAC devices, as long as we do not use the standard types (SNVTs).

C–Configuration of nodes

Configuration as defined here, is the process of tuning a node for a particular network. This includes setting both network-related and application-related parameters.

The TAC Xenta devices can be assembled into Groups and in every TAC Xenta group, each member must know who the other members of the group are, and which device functions as Group master. This information is created and downloaded into every TAC Xenta device with the NCT from a PC.

***Note!* If a TAC Xenta group must be re-configured, each member must be updated with the new information about that group.**

If a new group is added *all* nodes must be updated with this information!

These procedures are performed using the NCT, which is described in the "TAC Menta User's manual". Also refer to the manual "TAC Xenta and LONMAKER Release 3", no. 0-004-7775-1 (GB)

2.3 Network Variables

Reference to public signals in other TAC Xenta devices can be made via *Network Variables*. Addressing a network variable is made through the signal name according to the following principle:

|Device|Module|Signal

where

Device is the name of the TAC Xenta 301/302/401, e.g. TAC_1

Module is the name of the current module, e.g. Ahu2

Signal is the name of the public variable, e.g. T1

The Device name and the Signal name may each contain up to 20 characters. The Module name may contain up to 12 characters. The first character must be an alphabetic character (the character ”_” is also allowed, as are the national characters ”å ä ö ç”). Special characters, like ”\ , ; - . \$ ” or space are not allowed¹.

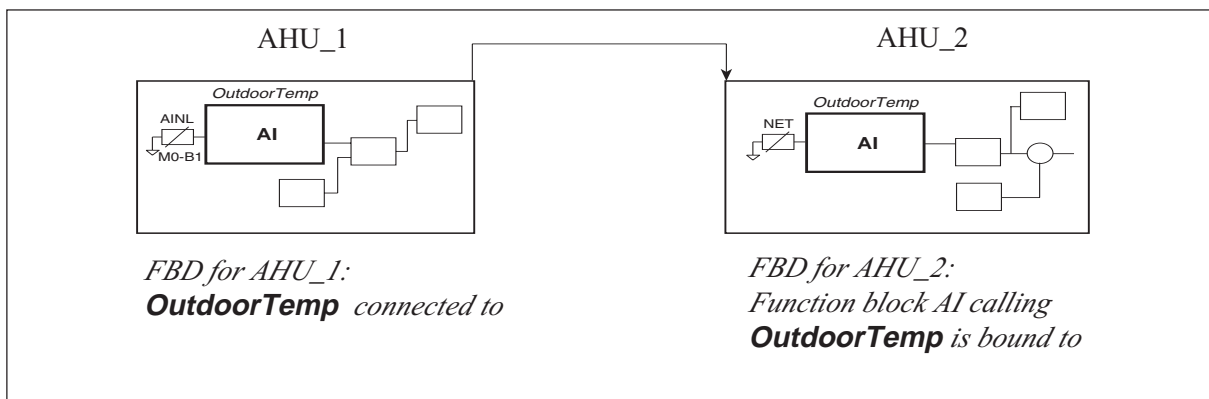
Note! Long names must be considered when setting buffer sizes in routers

The *Module* can be left out, if not applicable, allowing an address like

|Device||Signal

This is a type of binding which automatically connects variables in different devices, sometimes referred to as TACNV

This type of binding is specified in the Function Block Diagram (FBD) and is described in section 2.6 ”External I/O signals” of the TAC Menta User’s manual.



Binding two TACNV Xenta Network variables

¹ For further information regarding the naming convention, please refer to the TAC Menta User’s Manual, chapter 2 sections 2.2.2 and 2.7 and chapter 8, section 8.1.1.

The maximum number of TACNV of any TAC Xenta device is limited.

For instance, in TAC Xenta 301/302 the maximum number is 45, of which

30 are sent *from* the device and
15 are fetched *to* the device.

This means, for example, that two different temperatures can be distributed to at the most 15 ($30 \div 2$) other devices, from one specific device.

The corresponding figures for TAC Xenta 401 are 125 out and 125 in. The total number of TACNV transmissions per second must be limited by the use of suitable *Delta* and *Period* values (see the Network Traffic Calculations chapter).

2.4 TAC Xenta Groups

The TAC Xenta Group is a *logical group*, used to build a simple hierarchy of the TAC Xenta devices, for example when a presentation system like TAC Vista is connected to a TAC Xenta network. The *TAC Xenta Group Master* belongs to the TAC Xenta Group. The TAC Xenta groups are also used in TAC Xenta OP. The group is created by a group binding on tag-1 in LonMaker Integration Tool.

Note! Avoid creating groups that span *routers*. If groups span routers the network load increases.

The use of TAC Xenta groups has two main purposes:

- to simplify the exchange of information between the LONWORKS network and TAC Vista.
- to introduce a hierarchy in large networks, making the information in the TAC OP easier to find and use.

Below some information about the system design and the use of groups will follow.

TAC Vista must be kept up to date on which devices are on-line on the LONWORKS network. To avoid having each device communicate with TAC Vista about this, the Group master will periodically collect on-line status for all members of the group and send it to TAC Vista. Only devices that send a periodic “heartbeat” to the Group master are considered “on-line”.

To let each member (including the Group master) know who the other members of the group are, the current group list must be downloaded to each device with the NCT (TAC Menta Network Configuration Tool).

If the Group master goes off-line, the whole group will be considered off-line by TAC Vista. The separate on-line group members, however, can send alarms and other information directly to TAC Vista as usual.

If there was no group concept, an operator panel connected to a TAC Xenta device would list the names of each and every node on the network. Even with only a dozen devices the handling would become cumbersome. With the group concept the names of the TAC Xenta groups are listed instead. (This is not true when there is only *one* TAC Xenta group; in this case the group member names are listed directly.) The names of the members are not shown on the OP display until a group has been selected,.

2.5 **Connecting to TAC Vista®**

An operator station in the supervisory system TAC Vista can be connected directly to the TAC Xenta network. This is done by using a LonTalk adapter (e.g. SLTA or PCLTA) and TAC Vista represents a node on the network.

TAC Vista communicates with the Group master of each TAC Xenta Group. From the Group master TAC Vista gets information about on-line/off-line status for the TAC Xenta devices which belong to the group.

Please refer to the manual “TAC Vista, Communication TAC Xenta, direct” for details on the installation procedure.

TAC Vista can also connect to single TAC Xenta devices or a TAC Xenta network using TAC Xenta 901 via modem and the public telecom network. This is useful if the device or the network is situated at a great distance from the TAC Vista operator station.

The connection and the modem parameters are defined in TAC Vista, but once the connection has been made, it is possible to initiate test dials from the TAC Xenta device, using the TAC OP operator panel.

Please refer to the manual “TAC Vista, Communication TAC Xenta, dial-up” for details on the installation procedure.

The details on the dial-up procedure, as seen from the TAC Xenta device, are explained in a succeeding chapter.

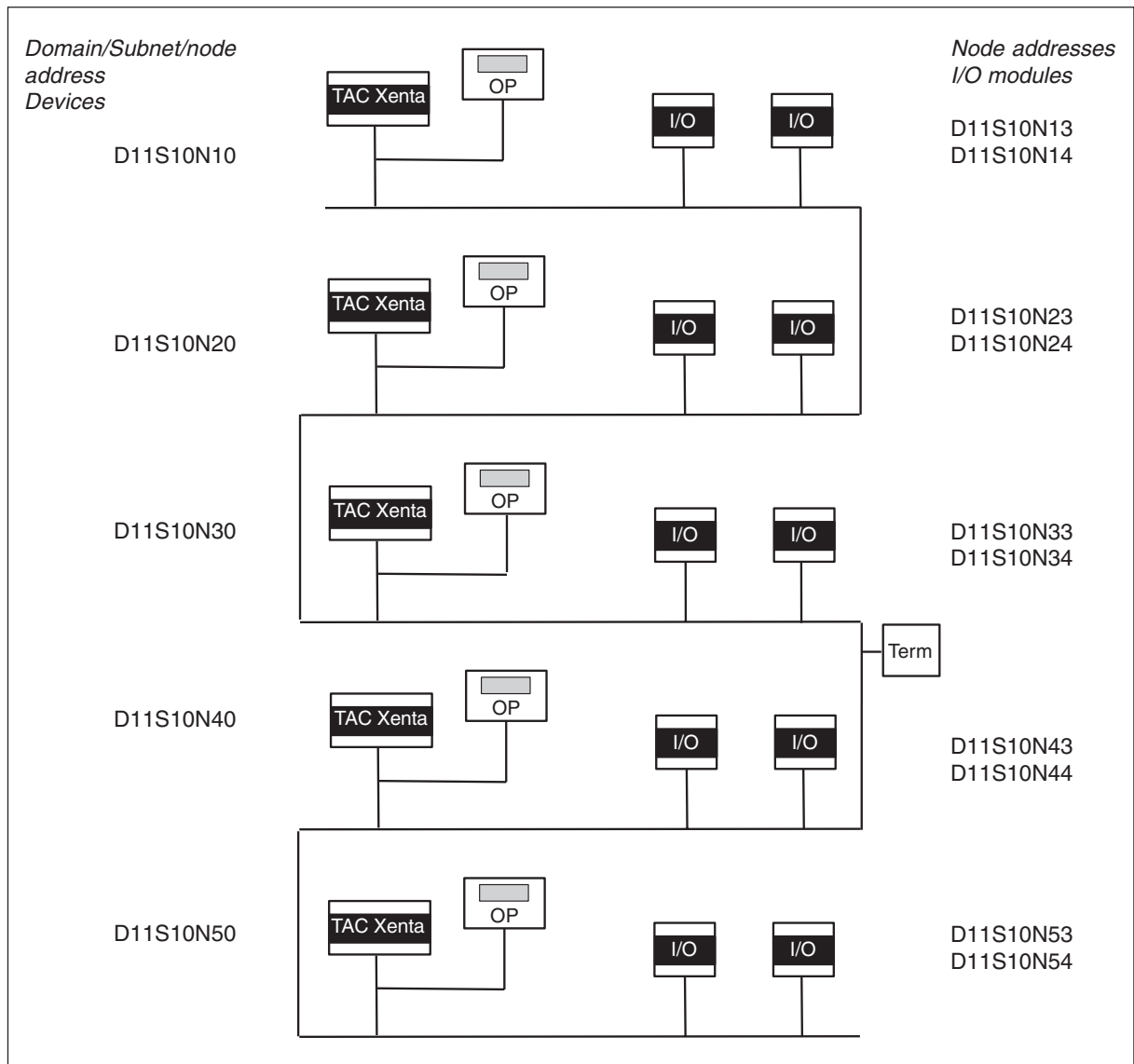
2.6 Model Cases

Network Case 1: I/O modules

This case contains the maximum number of I/O modules, two for each TAC Xenta 301/302 device. TAC Menta is required for the commissioning of the network.

No. of TAC Xenta devices: 5
 No. of I/O modules: 10
 No. of Operator Panels: 5 (not commissioned)
 Total no. of nodes: 20
 Terminators: 1
 Wire length: 500 m*
 Free Topology

Domain 11₁₆



Network Case 1: I/O modules. Note! Two addresses have been reserved for the OperatorPanels

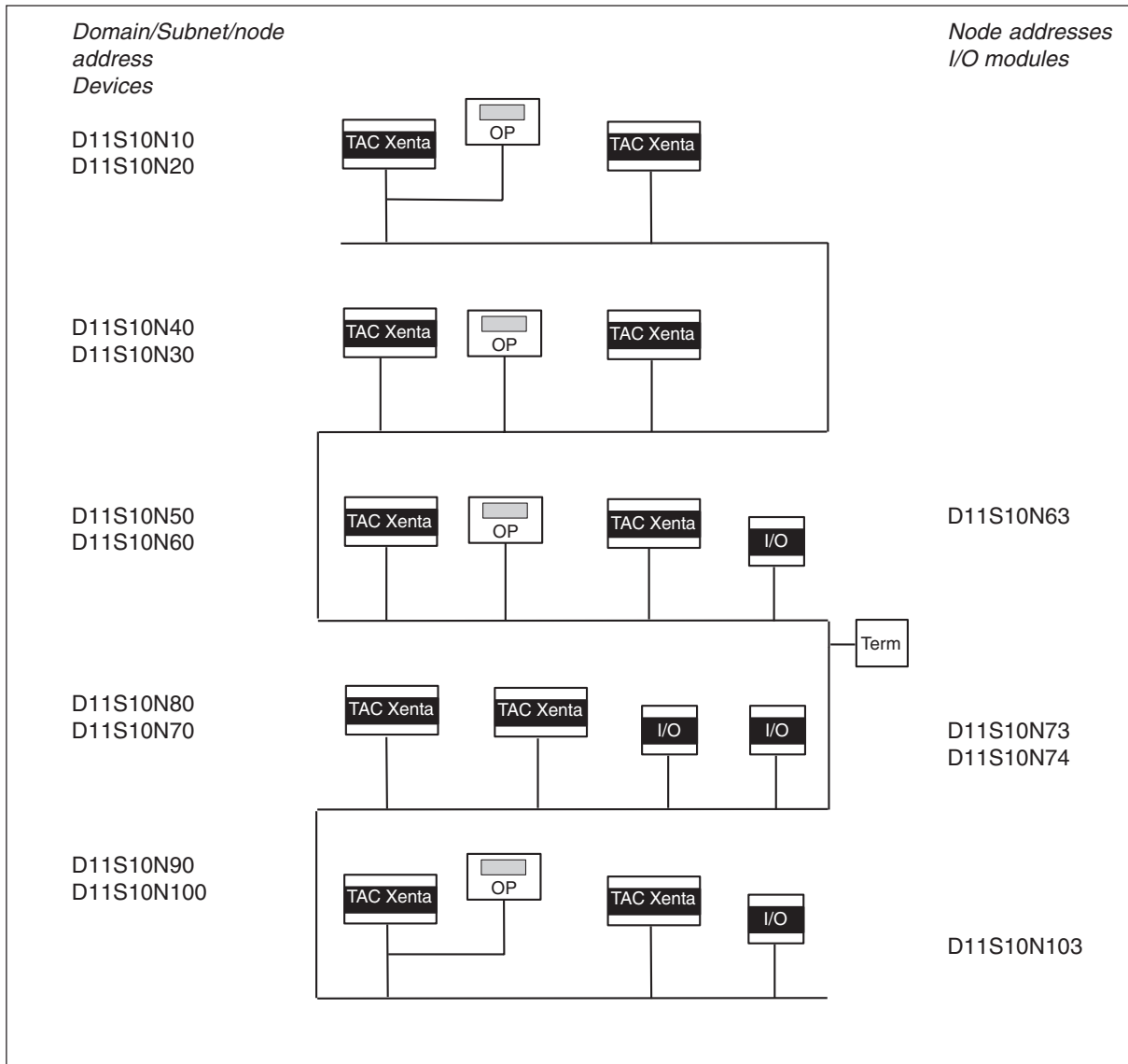
* Under optimal conditions

Network Case 2: Mixed configuration

This case is a mixture, with more devices than I/O modules. TAC Menta is required for the commissioning of the network.

- No. of TAC Xenta devices: 10
- No. of I/O modules: 4
- No. of Operator Panels: 4 (not commissioned)
- Total no. of nodes: 18
- Terminators: 1
- Wire length: 500 m*
- Free Topology

Domain 11



Network Case 2: Mixed configuration

* Under optimal conditions

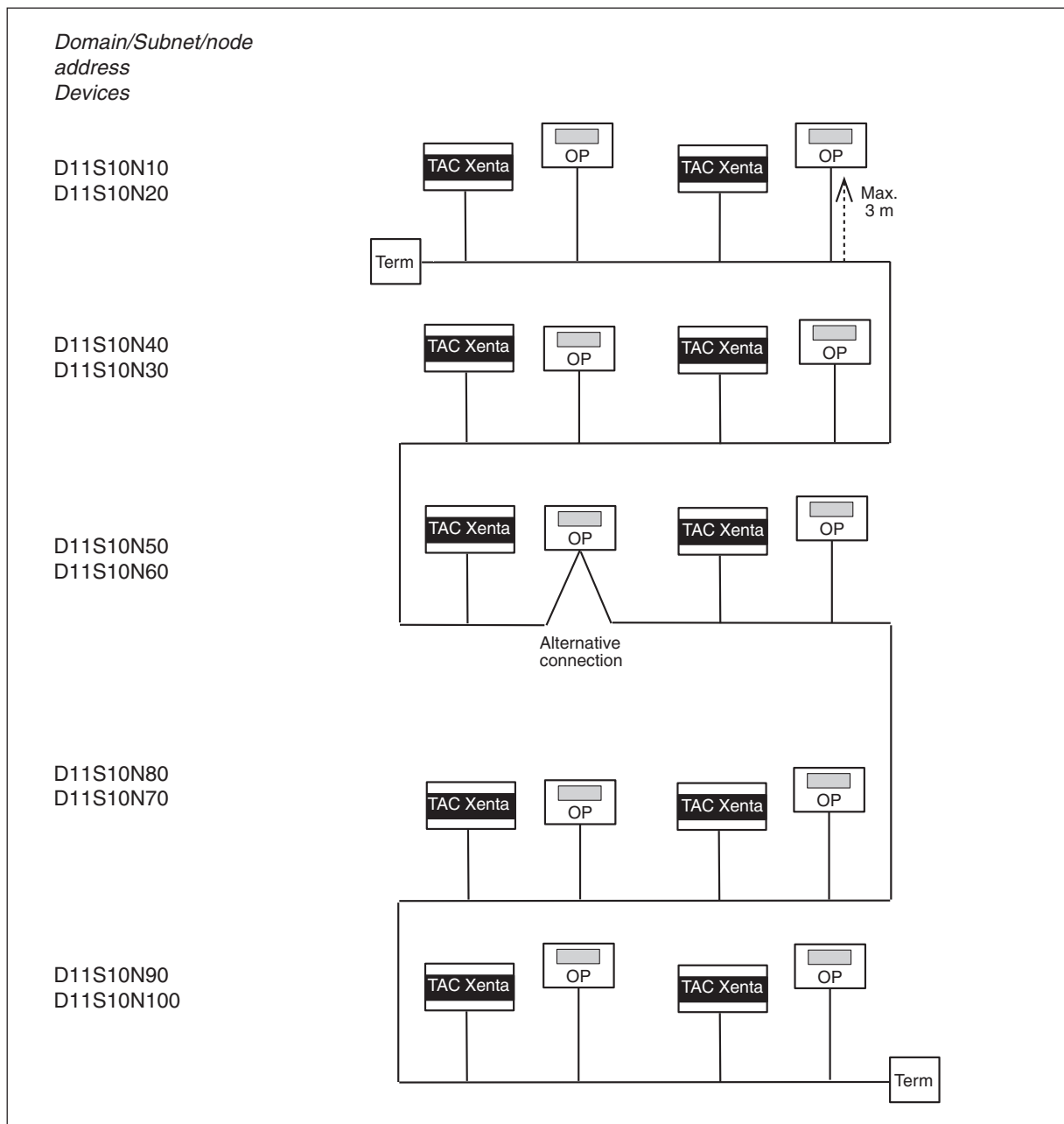
Network Case 3: TAC Xenta devices

The third case consists only of TAC devices and OPs, connected to a doubly terminated bus. This allows a greater distance between the ends, but each stub must not exceed 3 m. TAC Menta, TAC Vista is required for the commissioning of the network.

- No. of TAC Xenta devices: 10
- No. of I/O modules: -
- No. of Operator Panels: 10
- Total no. of nodes: 20
- Terminators: 2
- Wire length: 2700 m*

Domain 11

Bus Topology



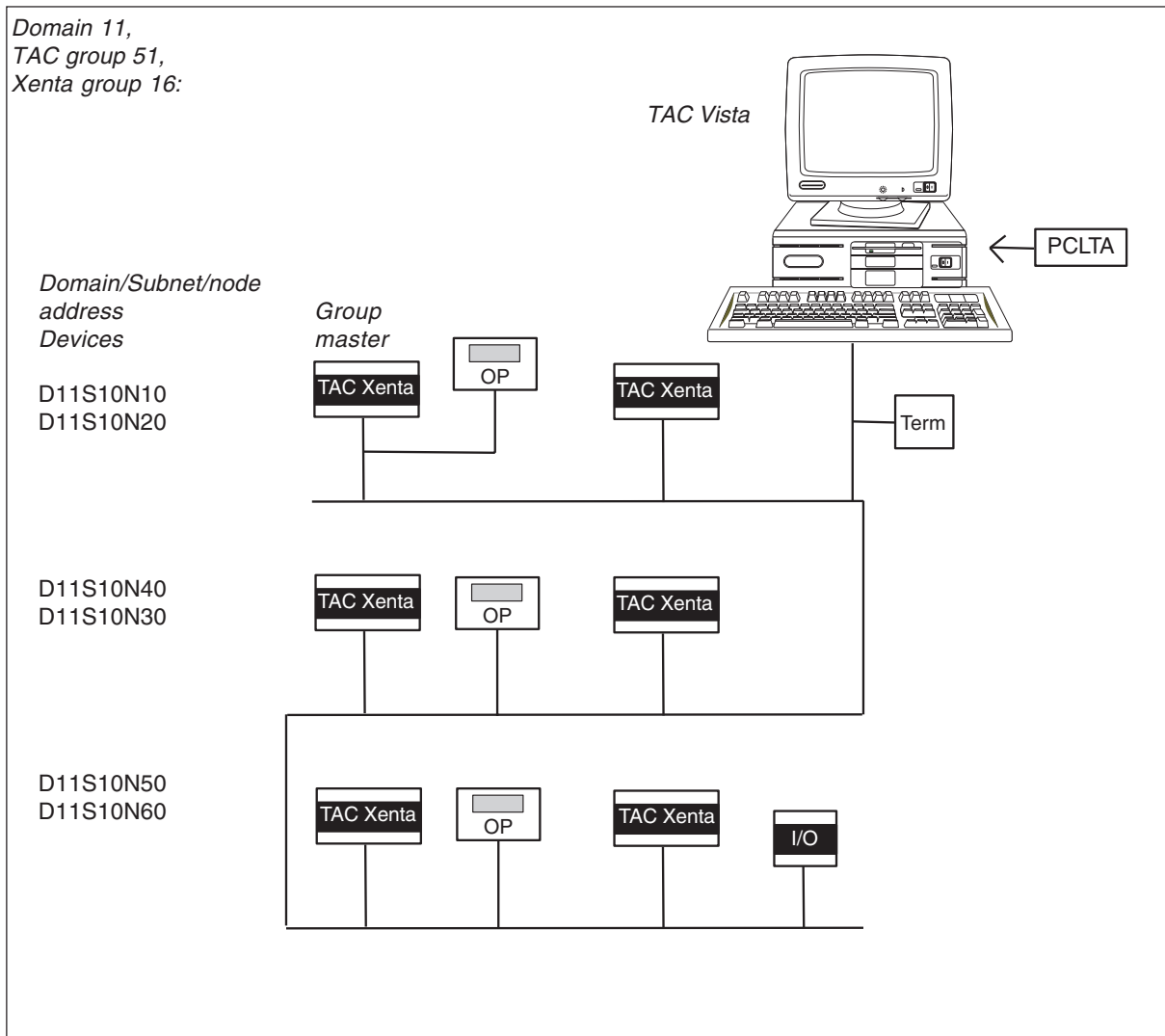
Network Case 3: Xenta devices

* Under optimal conditions

Network Case 4: Mixed configuration with TAC Vista

This case is a mixture, with a couple of devices and I/O modules (cf. case 2). TAC Vista is connected as a presentation system. TAC Menta and TAC Vista are required for the commissioning of the network.

Domain address for TAC equipment:	11	(default value)
TAC group:	51	(default value)
TAC Xenta group:	16	(default value)
TAC Xenta group members:	(all)	
Group master (subnet/node):	10/10	
TAC Vista connection:		PC Network Card, such as: PCLTA 20 (PCI) PCLTA 10 (ISA)
Terminators:	1	
Wire length:	500 m*	



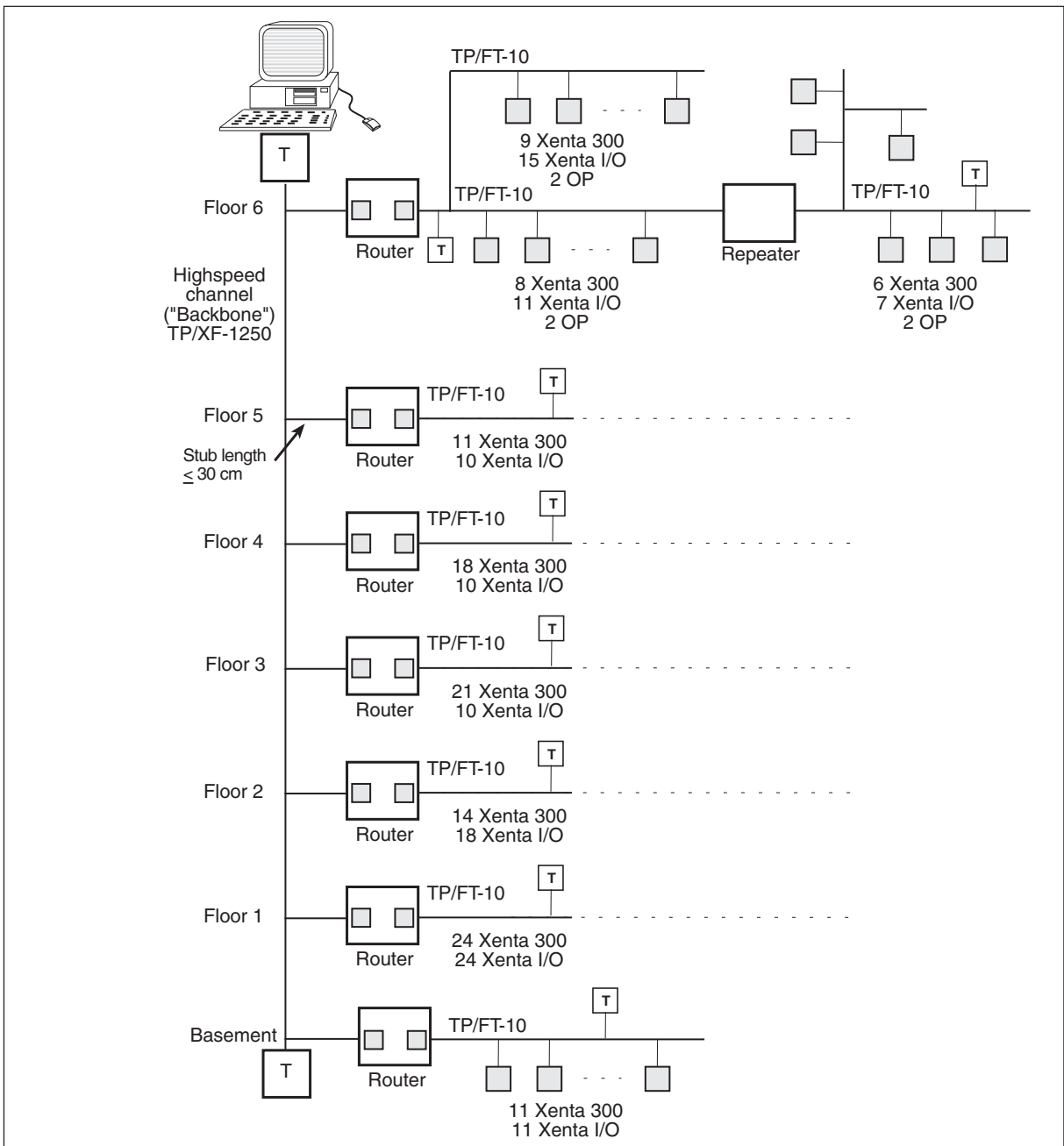
Network Case 4: Configuration with TAC Vista

* Under optimal conditions

Network Case 5: A medium-sized network

This case shows a network where a number of devices and I/O modules are connected via *routers* and *repeaters*, to increase the physical and logical extension of the network. Commissioning requires a Network Management Tool.

No. of TAC Xenta devices:	122	
No. of I/O modules:	116	
No. of Operator Panels:	6	
Total no. of nodes (Incl. routers):	256	
Terminators:	2 (backbone)	+ 1 per segment
Wire length:	130 m (backbone)*	500* m per segment



Network Case 5: A medium-sized network with routers and repeaters

* Under optimal conditions

The terminators are situated at the true ends of the backbone and for the remaining channels one per channel (free topology), near the router or repeater.

The total distance per channel for Free Topology and Bus Topology.

Distance	Channel	Topology
\leq 500 m	TP/FT-10	Free
\leq 130 m	TP/XF-1250	Bus

The routers isolate the traffic between the slower TP/FT-10 channels and the backbone.

The supervisory TAC Vista system is connected to the backbone.

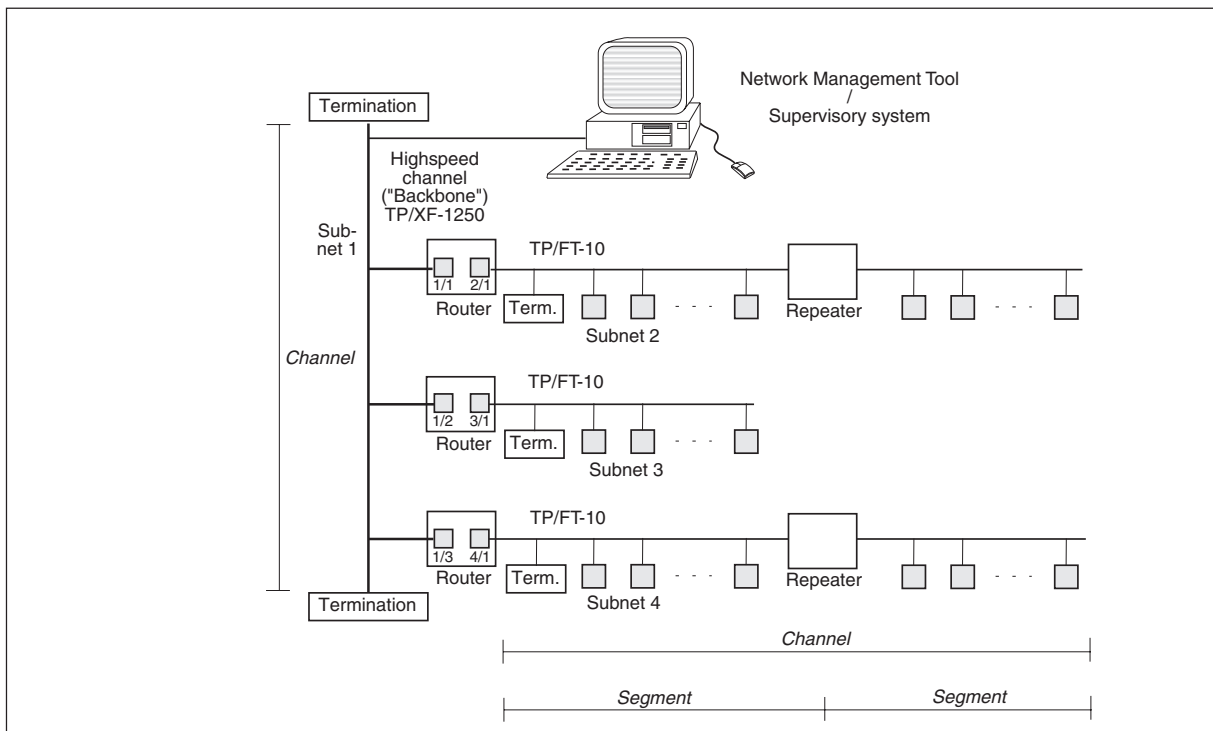
3 Networks with Routers

3.1 General

As the network grows, it may be necessary to introduce some kind of hierarchy and/or some logical partitioning of the network.

This is accomplished with the *router*, a device that connects channels with different media. It also separates messages destined for different parts of the network.

A typical example:



Network with **routers** which connect channels of different types; Subnet/Node numbers indicated

As routers are added the configuration procedure also requires the use of a *Network Management Tool*, such as LONMAKER Integration Tool. This tool is, among other things, used to define the network objects (including the routers) and the different channels that the use of routers implies.

3.2 Router Properties

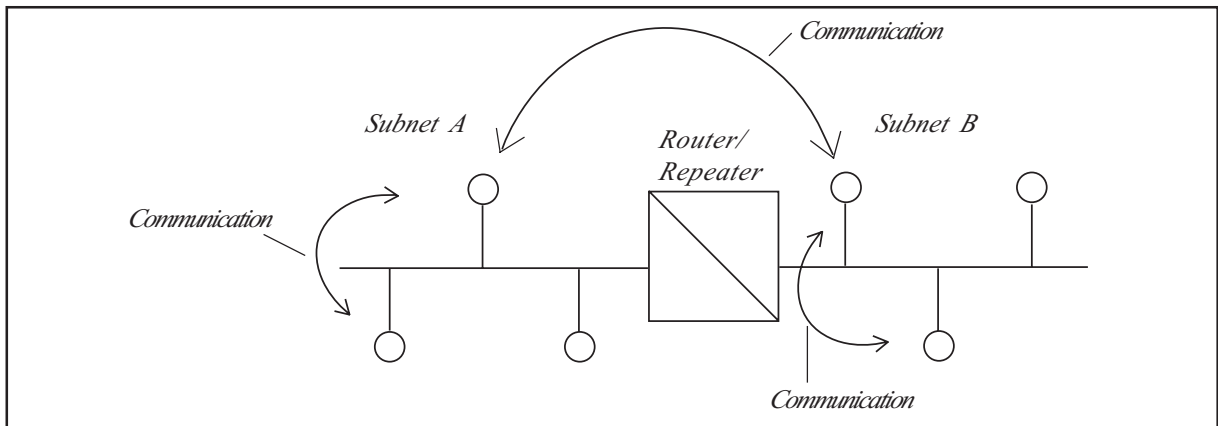
When routers are used the following should be noted.

- The router has two sides which connect to its respective channel. Large networks may require a high-speed backbone channel to carry traffic between low-speed channels.
- Nodes that communicate with each other should not have to pass more than two routers (make two 'hops'), otherwise timing problems may occur.
- Routers can selectively forward information between two channels. This can be utilized to isolate subsystems and to improve the network performance. It is recommended to put nodes that regularly exchange information on the same channel.
- The router is a device, with two nodes (one on each side of the router) that connect channels.
- Routers can be set up in four different modes: *configured*, *learning*, *bridge* or *repeater*. Configured and learning routers are classified as intelligent routers, which use routing intelligence to selectively forward messages based on destination address. A bridge forwards all packets that match its domain(s). A repeater forwards all valid packets. The router is delivered in repeater mode.
- When the Subnets are specified for a router in the Network Management Tool this is done only for the Application Domain. In this domain the same subnet number must not appear on both sides; all numbers have to be unique.
- Routers have *buffers* to be able to handle the forwarding of messages between channels that have different communication capacities. These buffers can be optimized if the maximum message length and the total buffer areas are known. (Long TACNV names, and the use of TAC Xenta OP up to and including v 3.0, requires such a buffer modification.)

Further information on the use of properties:

Router Configuration

The figure below describes a router that connects a high-speed channel (Subnet A) with a TAC application channel (Subnet B).



A message sent from a node in Subnet B, with a destination address also in Subnet B, would not be forwarded to Subnet A by the router.

4 Network Variables of SNVT Type

4.1 General

In TAC networks the nodes exchange information in different ways. One goal is to use standard protocols, but in order to simplify the handling of the TAC Xenta OP, as well as permitting efficient communication with TAC Vista and the I/O modules, TAC specific methods have been used as well.

For explanations to the terms used in this chapter please refer to chapter 1, section 4, Network Devices - Terminology

SNVTs and XIF-files

Standard Network Variable Types, SNVTs, is a standard for Network Variables created by LONMARK Association to facilitate communication between products from different vendors. As soon as SNVTs are used some kind of Network Management Tool is required to bind SNVTs in different nodes.

Information about SNVTs can be obtained in “The SNVT Master List and Programmer’s Guide” from Echelon Corporation, Internet home page www.echelon.com.

Delivered with the product, there is usually a XIF-file (eXternal Interface) which describes which SNVTs the device supports. The XIF-files are read by the Network Management Tool in order to determine which SNVTs are available for the respective nodes. The first time the XIF-file is imported to LonMaker Integration Tool it is compiled in to an XFB-file and an XFO-file.

An important thing to remember is that it is only possible to bind SNVTs of the same type!

TACNV

TAC Network Variables (TACNV) are used to exchange certain application data between the TAC Xenta 301/302/401 nodes of a network. The use of these is described in chapter 2. TACNVs by themselves do not require any Network Management Tool.

Configuration and Binding Tools

The NCT (TAC Menta Network Configuration Tool) and the general Network Management Tools, such as LONMAKER Integration Tool, affect partly the same data areas of the node, sometimes in direct conflict with each other.

In many cases, for different reasons, both must still be used. In order to do this in a correct way, you must know about the conflicts that may arise and how to avoid them.

This chapter points out the most common problems. Chapter 6 also contains information that may be of interest.

4.2 SNVTs in TAC Products

The TAC Xenta 100 devices are certified LONMARK products and use only SNVTs for the external communication. The SNVTs are defined in a XIF-file which can be ordered with the product.

Please refer to the TAC Xenta 100 manuals for a detailed list of available SNVTs and their use in the application programs.

TAC Xenta 301/302/401 devices communicate with explicit messages. The application, however, may be designed to use SNVTs and in this case the SNVTs can be bound with the Network Management Tool.

A XIF-file is always created automatically by TAC Menta when the application is generated.

4.3 Binding SNVTs in TAC Xenta 301/302/401

4.3.1 Different Ways to Transfer SNVT Data

SNVT data can be transferred by binding Network Variables (SNVTs), which have been defined in two or more nodes. The binding is accomplished with a Network Management Tool (not via TAC Menta that is).

In TAC Menta Configuration Tool you specify which application (node) has the “*responsibility*” to arrange for data to be transferred. Transfer may be initiated in two ways:

Send SNVTs The *sending* node has the responsibility for the current NV value to be transmitted, when the value has changed or when the time interval *Period* has elapsed since the last update. This you indicate in TAC Menta by checking the corresponding box, when that *output* is configured. If the *Period* is set to 0 the external variable will only be updated on status changes.

Input

The screenshot shows the 'Bind Digital Output' dialog box. It has a 'Name' field at the top. Below it is the 'Bind to:' section with three radio buttons: 'Physical output', 'Not connected', and 'SNVT' (which is selected). To the right of these buttons are several dropdown menus: 'switch', 'Member: state', and 'Name: status'. Below these is a checked 'Send' checkbox (circled in red), a 'Period' field with the value '180', and 'Initial value' radio buttons for 'On' and 'Off' (with 'Off' selected). 'OK' and 'Cancel' buttons are at the bottom.

Polled SNVT 'Polled' or read means that the *receiving* node has the responsibility to fetch the value to the current NV, for example each 180:th second (3:rd minute). This you indicate in TAC Menta by checking the corresponding box, when that *input* is configured.

Output

The screenshot shows the 'Bind Digital Input' dialog box. It has a 'Name' field at the top. Below it is the 'Bind to:' section with five radio buttons: 'Network variable', 'Physical input', 'On-line device', 'SNVT' (which is selected), and 'Constant value'. To the right of these buttons are several dropdown menus: 'switch', 'Member: state', and 'Name: Start status'. Below these is a checked 'Poll' checkbox (circled in red), a 'Period' field with the value '180', and 'Initial value' radio buttons for 'On' and 'Off' (with 'Off' selected). 'OK' and 'Cancel' buttons are at the bottom.

If the same NV value (for example the outdoor temperature) is to be transmitted to two or several nodes, sending and receiving nodes are collected in a *group binding* (not the same as a TAC Xenta group; please refer to explanation further on in this chapter) by the Network Management Tool, thereby saving space in the address table.

4.3.2 SNVT Binding Limits

As mentioned above, there is an address table in each LONWORKS device, where the Network Management Tool stores address information about SNVT bindings.

The available number of address positions in the address tables is limited to 13 in TAC Xenta 301/302/401

Each position can hold one *node address* or one *group address*. A group holds several nodes, which all have the same set of NVs bound to them from one and the same, sending node. The nodes can be TAC Xenta devices or third party nodes.

Note! Several SNVTs and TACNVs can be bound to the same node, without requiring additional positions in the address table. On the other hand, the amount of *traffic* may increase. This is the reason why there is a limit for the number of TACNVs in/out for the TAC Xenta devices.

Send SNVT

In a sending node the S/N addresses are put in the address table, one position for each node that is going to receive one or several SNVT values from the sending node.

The receiving node requires no information in its address table.

If the same SNVT values are sent to several devices, a group is formed by the Network Management Tool and the group number is put in the address table of the sending node.

In the receiving nodes one position of the address table is used to store that same group number.

The receiving TAC Xenta cannot tell which group member who sent the value. A more recent value overwrites the previous one.

Polled SNVT

If a node uses polled inputs to read SNVT values, one position (S/N-address) is needed in the address table of the receiving device for each device to call.

The address table of the polled device is not affected.

TAC Xenta 301/302/401 do not support polling of a group, as the receiving TAC Xenta cannot tell from which group member the polled message originated.

4.3.3 TAC Xenta Group and TAC Group

To arrange SNVT bindings, the Network Management Tool puts group numbers or S/N addresses in the address table of a TAC Xenta 301/302/401.

The two first positions in the address table, address index 0 and 1, are occupied by the TAC Group (by default 51) and the TAC Xenta group (by default 16 for the first TAC Xenta group) that the device belongs to.

These group numbers may get different values, depending on which Network Management Tool is used for the configuration:

- A)** If the *NCT* is used for the configuration, the default value for TAC Group is 51 and TAC Xenta Group 16 (for the first group) These values will also be the default values for TAC Vista.



This dialog in the NCT appears when you choose **Edit - Edit LonWorks Network name.**

- B)** If instead a *Network Management Tool* (such as LONMAKER Integration Tool) is used - which is recommended - to form the TAC Group and the TAC Xenta Group, using Message Tags, the tool will use the first available group numbers and go on from there. However the Tag bindings must be made manually. Compare to the example above where, in the address table, tag 0=Index0 (51) and tag 1=Index1 (16) for the first group.

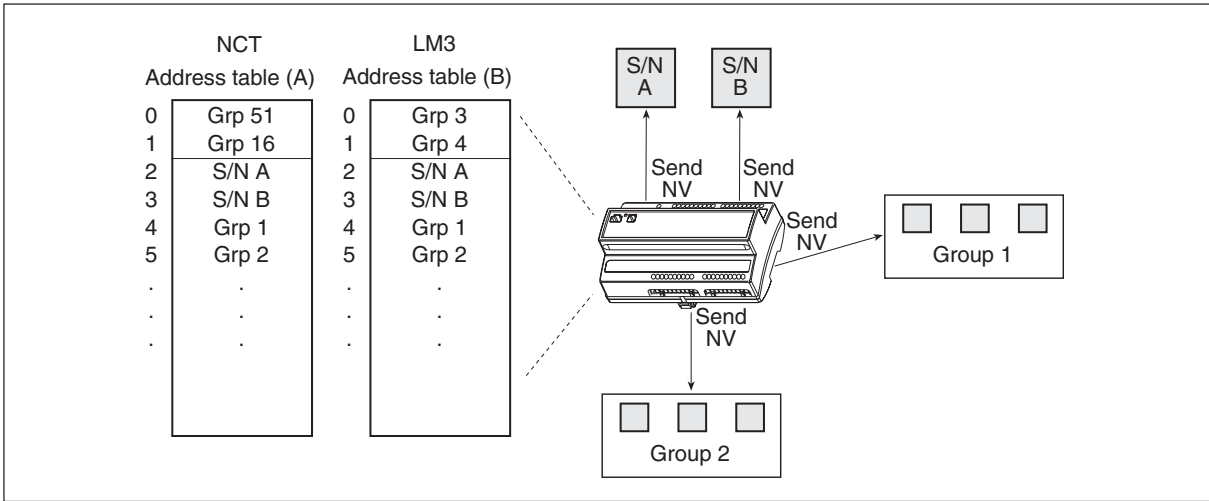
If the Network Management Tool is capable of binding 'Message Tags' this method is preferable, as the tool then will control all group numbers. Please note that the TAC groups must be created with exactly the same members as those specified in the NCT, but remember not to download the group number. Remove the checkmark in the box **Download group address.**

The remaining positions (from address table index 2) are used by the Network Management Tool to store Subnet/Node addresses or group numbers for receiving or polled devices with SNVT bindings.

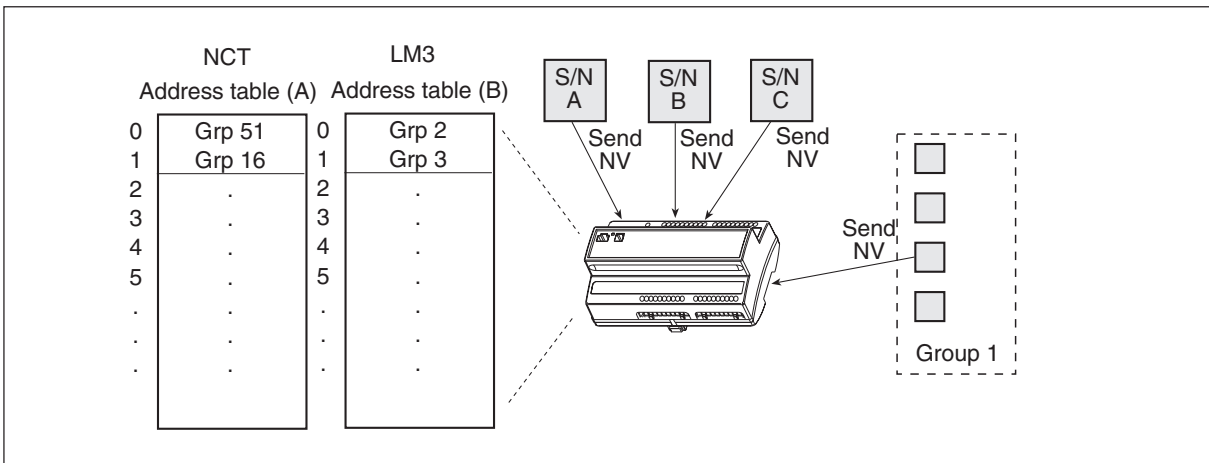
In the succeeding diagrams we show examples on how the address table of a TAC Xenta 301/302/401 is affected by different types of SNVT bindings. The two table alternatives (A) and (B) show the result, depending on how the configuration was made, according to the description above.

For further information please refer to the manual *TAC Xenta and LonMaker Release 3, 0-004-7751-X (GB).*

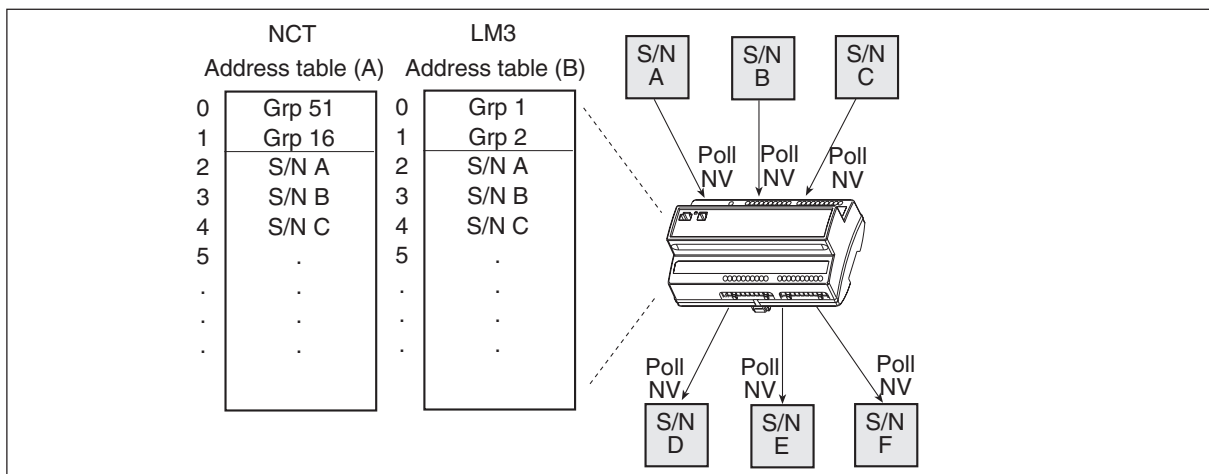
4.3.4 SNVT Binding Examples



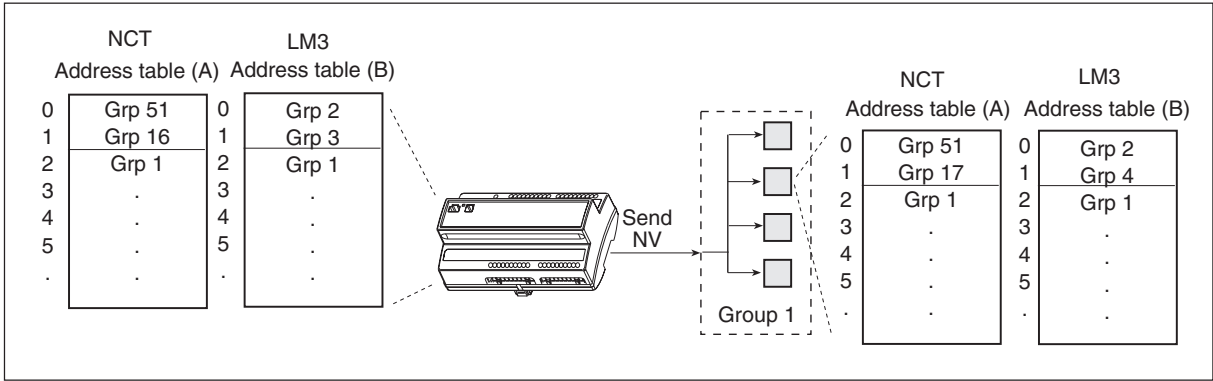
The address table (A and B, see the previous pages, or NCT and LM3) of the current TAC Xenta device is affected by "own Send NV"



The address table (A and B, see the text) of the current TAC Xenta device is not affected by "foreign Send NV" (it is assumed that only one node sends from Group 1)



The address table (A and B, see the text) of the current TAC Xenta device is affected by "own Polled NV"

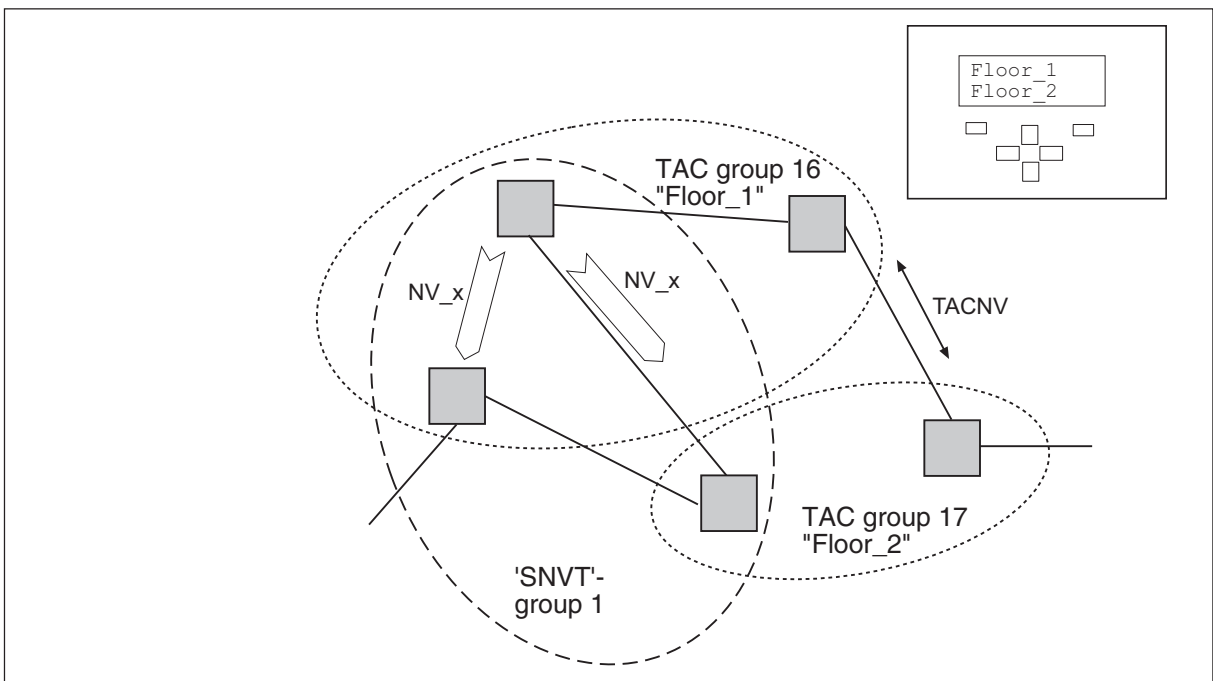


The address tables (A and B, see the text) both in the current TAC Xenta device and the receiving devices, are affected by "Send NV to Group"

If we consider the last example and assume that we have configured the TAC groups with the NCT (method A), we can graphically describe the configuration as shown below. Group 1 is a 'SNVT' group, while the TAC groups were created to appear in a hierarchy on the TAC Xenta OP.

Note! If the number of 'SNVT' groups exceeds 15, the following number will collide with the group number already assigned to "Floor_1", without the Network Management Tool noticing this.

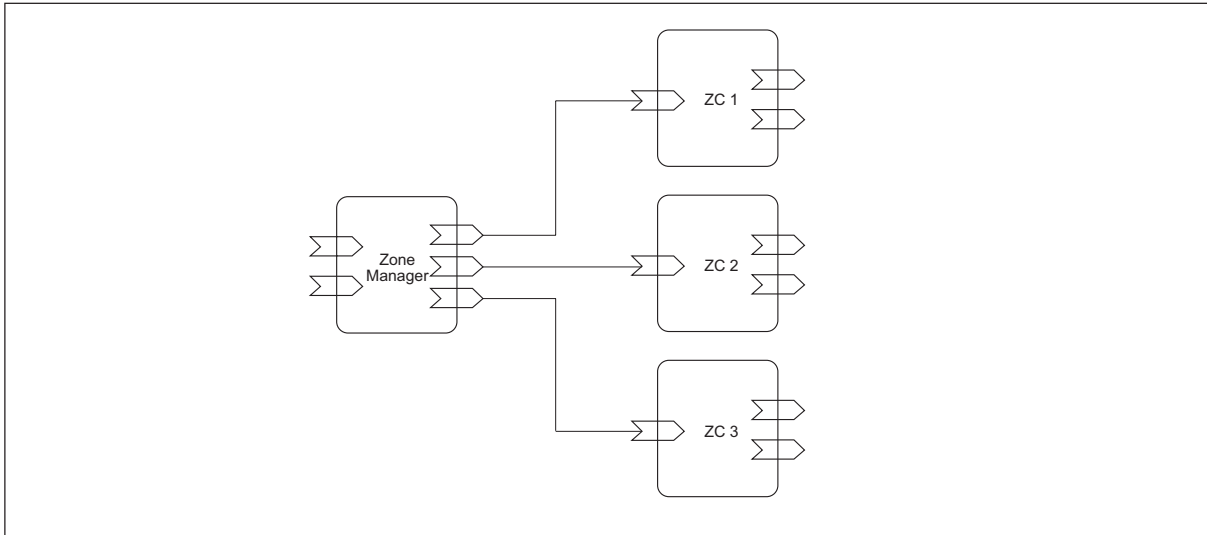
Such a collision would not happen if the TAC groups were created with the Network Management Tool as well (method B).



An example of groups formed during configuration and SNVT binding

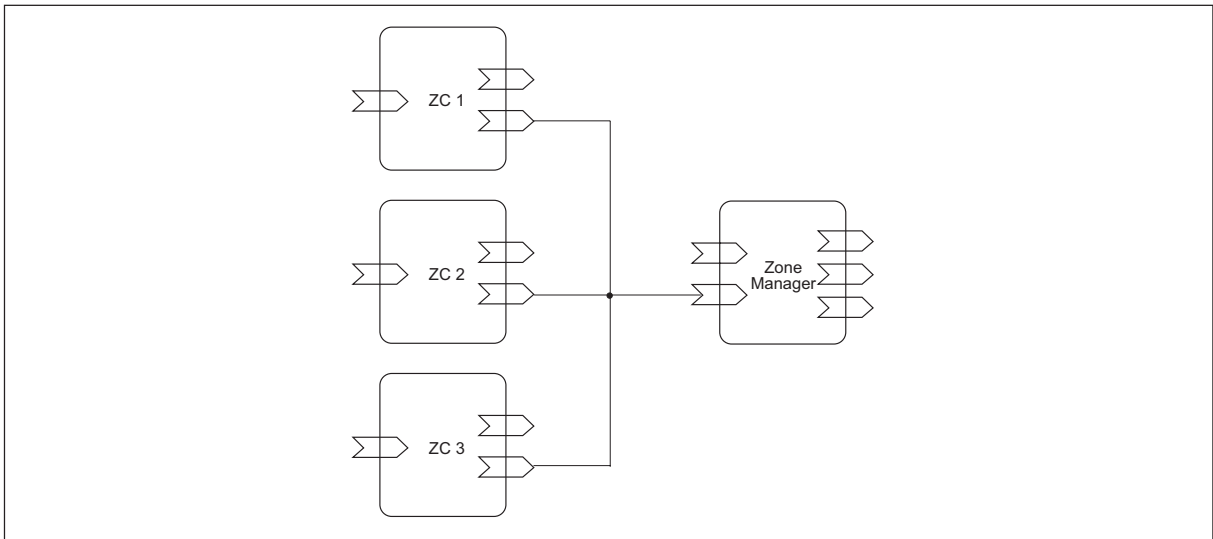
Below we show some other examples of how the address tables are filled by different address types when the network variables of *SNVT type* are bound.

Binding: One – One



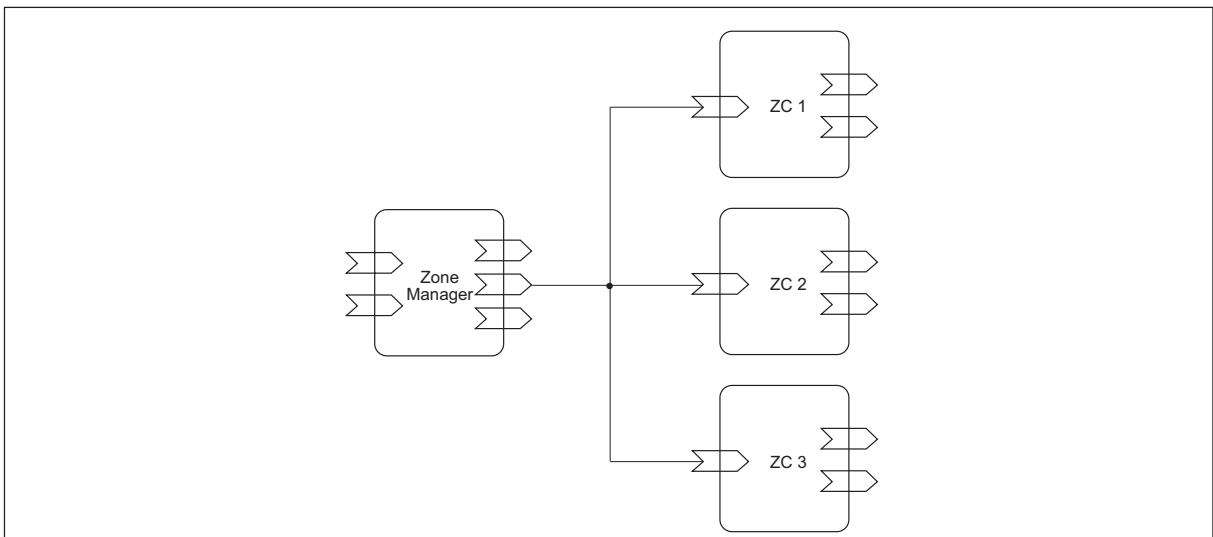
Binding type	ZM (send)	ZC 1 (poll)	ZC 2 (poll)	ZC 3 (poll)
single address:	3	-	-	-
group address:	-	-	-	-
poll address:	-	1	1	1
Total no. of addresses	3	1	1	1

Binding: Several – One



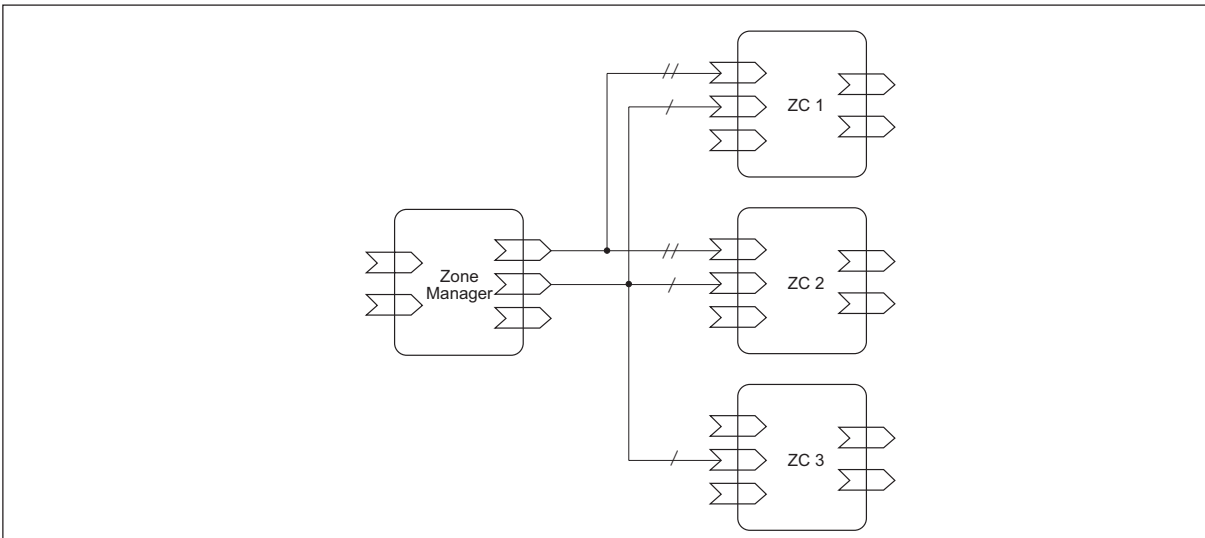
Binding type	ZC 1 (send)	ZC 2 (send)	ZC 3 (send)	ZM (no poll)
single address:	-	-	-	-
group address:	1	1	1	1
poll address:	-	-	-	-
Total no. of addresses	1	1	1	1

Binding: One – Several



Binding type	ZM (send)	ZC 1 (poll)	ZC 2 (poll)	ZC 3 (poll)
single address:	-	-	-	-
group address:	1	1	1	1
poll address:	-	1	1	1
Total no. of addresses	1	2	2	2

Binding: Several – Several (Different)



Binding type	ZM (send)	ZC 1 (poll)	ZC 2 (poll)	ZC 3 (poll)
single address:	-	-	-	-
group address:	2	2	2	1
poll address:	-	1	1	1
Total no. of addresses	2	3	3	2

In the last case one group address is created for the '/' bindings and one group address for the '//' bindings.

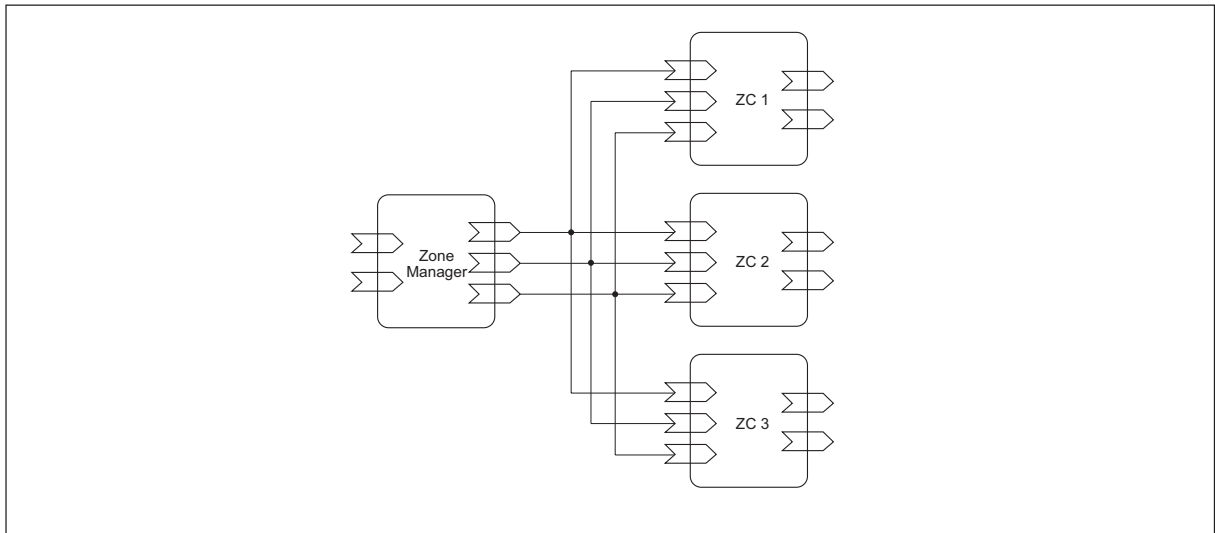
The Zone Manager below may be a TAC Xenta 401. The inputs of this device may be set either as *poll* or *no poll*.

The ZCs are TAC Xenta 100 Zone Controllers.

Settings:

- inputs: always *poll*
- outputs: always *send*

Binding: Several – Several (Identical)



Binding type	ZM (send)	ZC 1 (poll)	ZC 2 (poll)	ZC 3 (poll)
single address:	-	-	-	-
group address:	1	1	1	1
poll address:	-	1	1	1
Total no. of addresses	1	2	2	2

4.3.5 Summary of SNVT Bindings in TAC Xenta Devices

To optimize the use of the limited TAC Xenta address tables, please note the following.

- TACNV does not use address tables, however SNVTs do. To save addresses it is recommended to use TACNV between TAC Xenta 301/302/401 devices.
- If the same value is to be transferred from one TAC Xenta to many nodes (TAC Xenta or third party devices) the Network Management Tool will assign all nodes concerned to one group when 'Send SNVT' is used. This way only one position is used in the address tables of the sending and receiving devices.
- Values that are to be transferred from third party devices to a TAC Xenta, should *not* be defined in TAC Xenta (via TAC Menta) as 'Polled SNVT'. Instead the value should be defined as 'Send SNVT' in the third party device.
- If the application allows, SNVTs from TAC Xenta can be read by TAC Vista and then transferred on from there. This way there is no need to use the address table.

5 Network Traffic

5.1 General Network Considerations

There are different types of systems: with TAC Xenta only, integrated and routed. When designing a system, the following items should be considered.

- 1 How many nodes will be used in each network segment?
- 2 Try to estimate the data traffic (see below). Ask yourself if the traffic can be reduced in the whole or parts of the network?
- 3 Which TAC Xenta groups are to be used and which device should be appointed Group master (please refer to chapter 2)?
- 4 Where should the terminations be put? Future extensions may be facilitated by a wise positioning, where they are easy to find.
- 5 Plan for a bandwidth spare capacity of at least 20%.

To ensure that the network will be able to handle the data traffic, a number of conditions must be met.

The continuous traffic between the TAC devices is an important factor of system design. Two different calculations are made, both are described in section 5.3.

There are other factors, more difficult to calculate, which also may affect the performance:

- Alarms: frequency and permissible delay time
- Start-up conditions after a manual restart or a power failure
- Other third party equipment, if present

5.2 *Limitations in Number of Devices*

When calculating the number of devices in a TAC Xenta network, you have to consider the following limitations.

- A general limitation in the number of TAC Xenta devices
- A limitation in the updating frequency per device
- Limitations in each local segment of the network
- Other factors that affect the network load
- Available bandwidth for the medium being used

We will take a look at each one of the limitations.

General limitations in the number of TAC Xenta devices

The following limitations apply for the total number of TAC Xenta devices:

No. of TAC Xenta 301/302/401:	400
No. of TAC Xenta 901 devices:	240 ¹
No. of TAC groups:	30
No. of devices per TAC group:	30
No. of I/O modules: (400 x 10)	4000 ²
No. of TAC Xenta OP:	100 ²

There can be a total of 3200 LONWORKS devices in a single LONWORKS network.

For further information please refer to the documentation of TAC Vista version 3, for example “Communication TAC Xenta, direct” and “Communication TAC Xenta, dial-up”.

¹ TAC Vista can dial up 240 different phone numbers where one TAC Xenta 901 device can handle up to 30 TAC Xenta 301/302/401 with I/O-modules, and up to 120 other LONWORKS devices

² These values are recommended. The limitation is set by the amount of bytes in relation to the available bandwidth. If more LONWORKS devices are needed please contact TAC helpdesk.

Recommended Bandwidth

When all the traffic has been summed up it is time to compare the figures with the bandwidth available for the corresponding channels.

Bandwidth figures for different media:

Media	Recommended bandwidth (bytes/sec.)
TP/FT-10	3 000*
TP/XF-1250 (copper)	10 000
FO-10 (fiber optics)	10 000
PL (PowerLine)	250*
Radio and other slow media	250*
±30%	

When using radio communication, or other slow media, you must study the details of the traffic, as it may work out differently from a cable network.

Limitations in the updating frequency per device

See section 5.3.

Limitations on each local channel of the network

For each channel you can add a number of products according to the diagram below. The total sum, which describes the average traffic on the channel, is compared to the bandwidth (traffic capacity) that the current channel provides.

The right column shows the sum of the products, if you have values near the maximum number according to the general limitations. See table!

Module	No.	Multiply with	Product, bytes/sec.	Near max no. acc. to General limitations (bytes/sec):
TAC Xenta 301/302/401 (whole network if not separated with configured router)		2		400 TAC Xenta 301/302/401 gives 800
TACNV (changes/sec.) in channel and SNVT		18		10/channel gives 180
TAC Groups (whole network)		2		30 TAC Groups give 60
TAC Xenta OP in channel		14		30 OP give 420
I/O modules in channel		7		60 I/Os give 420
TAC Vista		6		1 TAC Vista gives 6
TAC Xenta 100 (calculated as TACNV)		no change/sec.		
Other LONWORKS units		*		
Spurious Traffic adds...	-	-	-	35
Sum of products	-	-		1921

* Calculated as
no. of messages per second x message length in byte

Note! This calculation assumes that the exchange of variables do not exceed the limits that are shown in section 5.3.

Limitations in a common Backbone, if present

If the channels are connected to a high-speed channel (a ‘Backbone’), a corresponding calculation must be done for this.

Module	No.	Multiply with	Product, bytes/sec.	Example: Near max no. acc. to General limitations: bytes/sec
TAC Xenta 301/302/401(whole network if not separated with configured or learning router; if used: 0)		2		400 TAC Xenta 301/302/401 800
TACNV (changes/sec.) passing and SNVT		18		100 in channel: 1800
TAC Groups (whole network)		2		30 TAC Groups give 60
TAC Vista		6		1 TAC Vista gives 6
Sum of products	-	-		2666

Other factors that affect the network load

In addition to the calculated traffic on each segment, you should allow for the following standard figures.

- + Calculated traffic from any TAC Xenta 100 and other devices
- + Spare capacity 20%
- + Safety margin 10%

5.3 Updating Frequency and Network Load

When TACNV or SNVTs are defined in TAC Menta or SNVTs in the Network Management Tool, updating conditions are specified. These conditions have great influence on the updating frequency and consequently affect the network load.

Delta This is the smallest change in an *analog* value that will initiate an update via the network. The default value is 0.5.

(A negative value inhibits change detection and only periodic updates will occur, see below)

A change in a *digital* value will always be detected, and trigger an update that will be performed during the succeeding TAC Xenta program cycle.

Period This is the interval in seconds for cyclic updating via the network. The default value is 60 s. It should not be lower than 10 s and cannot be set to a value lower than 1 s.

The interval is timed from the previous cyclic update or, if more recent, from the previous Delta update.

For out-SNVTs a *Period* value of **0** means that only the *Delta* is to be used.

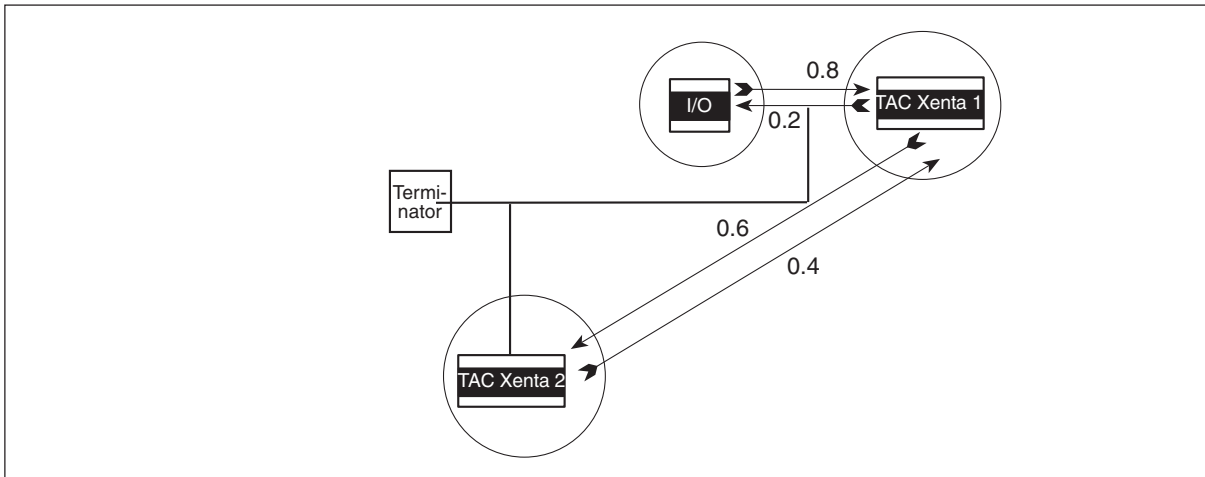
For an in-SNVT you specify *polling* if the corresponding out-SNVT has not been marked with *Send*. See “TAC Menta version 3 Reference manual”.

To get an idea about the network load in steady-state you make an estimation of the number of messages exchanged per second between the different devices. The values are summed up per device. These values must not exceed certain limits.

The following two conditions apply to TAC Xenta 301/302/401.

- 1 The number of transfers (to *and* from) one device must not exceed **two per second** for any device.
- 2 The total number of transfers calculated according to rule 1 above and then divided by 2 (as every transfer is counted twice) should not exceed **50 per second**.

Let us take a look at an example and assume that the transfers per second are shown in the illustration below are correct.



Example of transfers per second between three devices

For the I/O module we have assumed that the most frequent input supplies data 0.8 times per second, and that the most frequent output will get output values 0.2 times per second (that is one value for every 5 seconds). These values are added and give a characteristic value of 1.0 for the I/O module.

The TAC Xenta OP is not considered as it will only temporarily use the network.

- 1 The number of transfers for each of the devices:

$$\text{Xenta 1: } 0.8 + 0.2 + 0.6 + 0.4 = 2.0$$

$$\text{Xenta 2: } 0.6 + 0.4 = 1.0$$

$$\text{Xenta I/O: } 0.8 + 0.2 = 1.0$$

that is, condition 1 is met for all devices.

- 2 Half the value of the summed up no. of transfers within the Subnet:

$$\frac{1}{2} (2.0 + 1.0 + 1.0) = 2.0$$

Thus, also condition 2 is met.

Should the conditions not be met you will have to limit the number of TACNV or decrease the updating frequency to an acceptable level.

5.4 I/O module - minimum send time

The setting *minimum send time* defines how often the I/O module is allowed to communicate with the TAC Xenta 301/302/401. Default and minimum value is 500 ms, but the value can be increased to reduce the network load. This may be useful for instance when an I/O-module with constantly changing values, e.g a pressure transmitter, is connected.

6 Network Management

6.1 General

This chapter is intended to give an overview of the data and methods involved when the NCT and the Network Management Tools are used to configure and install TAC Xenta devices on a LONWORKS network.

6.2 Network Data and Databases

In order to build, operate and maintain a network, configuration data is needed both 'in the network' during its operation and in the databases of the software tools that are used to design and maintain the network.

The TAC Xenta 301/302/401, with the TAC Xenta OP operator panel, have facilities that are not normally available in LONWORKS networks and so they need the NCT with its database.

However, as were described in chapters 3 and 4, a general Network Management Tool may also be needed.

Note! *If more than one tool is used, it is extremely important that the different databases contain matching and updated information. Keep database information together in a safe place for future use.*

The main data items, their origin and contents are listed below.

NCT (TAC Menta Network Configuration Tool)

The NCT is a limited network management software with two main functions:

1. To name the TAC Xenta 301/302/401 and group them in TAC Xenta groups. This is done mainly to simplify the use of TAC Xenta OP, but can also be seen in TAC Vistas.
2. To set the network address for TAC Xenta 301/302/401 and I/O-modules, when no other network management tool is present.
3. To bind an I/O module to a specific TAC Xenta 301/302/401.

.NDB During the design the network configuration data is saved in a file with the extension .NDB, which contains:

- Network name
- TAC Group information
- Subnet/Node addresses, Device type, Neuron ID
- The I/O-module connections to the Xenta 301/302/401 devices
- TAC Xenta Group

When you perform a download the contents of the NDB-file is condensed and put into a file, **.BPR**, which is loaded to each node. This 'blueprint' file contains information about the environment of each node, that is

- The network name (used in TAC Vista, when connected)
- The names of all TAC Groups in the network
- The names of all devices in 'this' TAC Xenta Group
- I/O modules belonging to this TAC Xenta 301/302/401

The .NDB-information is also used when the database of TAC Vista is updated.

If a download of the application, not the network configuration, is ordered from TAC Menta NCT, the .BPR-content is automatically uploaded from the node, to be appended to the application before the actual download.

If a download of the network configuration is ordered from TAC Menta NCT, the application is, due to flash memory handling, automatically uploaded from the node to be appended to the network configuration before the actual download.

Network Management Tools

These tools (such as LONMAKER Integration Tool) create and maintain data for different levels of the network.

Information on *each node*

- Subnet/Node address
- Domain and address table information
- .XIF and SNVT information
- Configuration data (channels, routers, etc.)
- Profiles (configuration status, functions), etc.

On a *system level* the following information is available

- Types of node connections
- Current bindings, and so on...

The TAC Xenta 301/302/401

The TAC Xenta 301/302/401 are loaded with information that, for the network designer, can be divided into four parts:

- Subnet/Node address information
- TAC-specific configuration data, eg. TAC Groups, I/O modules and TAC Xenta OP information
- LONWORKS-specific information, eg. SNVTs and network parameters
- SNVT bindings

These pieces of information must always be matched against the corresponding information in the data files mentioned above.

In addition there is the application itself for TAC Xenta 301/302/401.

6.3 TAC Xenta 301/302/401 Data Handling

Let us take a look at how the different program- and data areas are affected during the application download and network configuration.

We use the following designations for the software contents of a TAC Xenta node:

<i>S/N address</i>	The assigned Subnet/Node addresses of the application (TAC) domain and the default (Zero length) domain
<i>Application</i>	The application program, TAC Menta, with any SNVTs
<i>TAC conf. data</i>	TAC-specific configuration data from the NCT, like I/O modules and TAC groups with their names for presentation on TAC Xenta OP and TAC Vista.
<i>LonWorks conf. data; SNVT</i>	LONWORKS-specific configuration data, for example Configured - Unconfigured and channel timing characteristics.
<i>SNVT bind</i>	SNVT bindings, when applicable.

These items are generated and/or handled by the following programs:

<i>TAC Menta</i>	Generates and down/uploads the application program. Used for defining TACNV.
<i>NCT</i>	(TAC Menta Network Configuration Tool) A tool which generates and down/uploads TAC configuration data.

Network Management Tool

or “Binding tool”. For instance: LONMAKER Integration Tool. Assigns S/N addresses, binds SNVTs and generates LONWORKS configuration data.

A general uploaded and configured TAC Xenta node would look like this:

S/N address
Application
TAC conf. data
LONWORKS conf. data
SNVT-bind.

When we have made the overall planning of the network and start to build the separate nodes, we first use TAC Menta to download the application. (This may contain references to SNVTs and TACNV, when applicable):

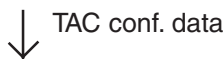
TAC Menta:



Application

After that, we use the NCT to download the TAC configuration data. The data is needed as soon as TAC Xenta OP, I/O modules, TACNV or TAC Vista are used in the network.

NCT:



Application
(TAC conf. data)

The TAC configuration data is not complete, as this area also must contain the real names of the remaining members of the TAC group.

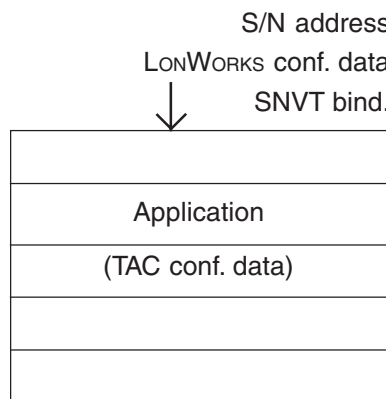
With the other tool, *the Network Management Tool*, we design the network configuration, specify the network objects, configure the nodes and perform the SNVT bindings. During this phase the Network Management Tool assigns Subnet/Node addresses in an incremental fashion as nodes are added to the project.

When the Network Management Tool is used to install the nodes, the LONWORKS configuration data and the assigned S/N address are loaded into each node.

(Unfortunately it may happen that certain binding tools overwrite areas in the TAC configuration data, which contain Message Tags in the Address table.

The specific node is identified by its Neuron ID or can be retained by the use of the Service Pin.

Network Management Tool:



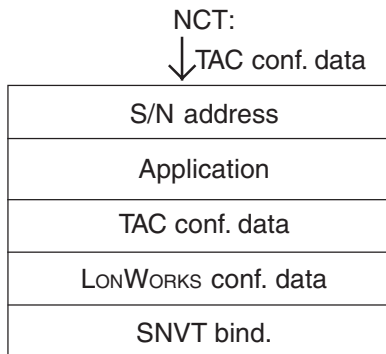
After this installation the node will contain the following.

S/N address
Application
((TAC conf. data))
LONWORKS conf. data
SNVT bind.

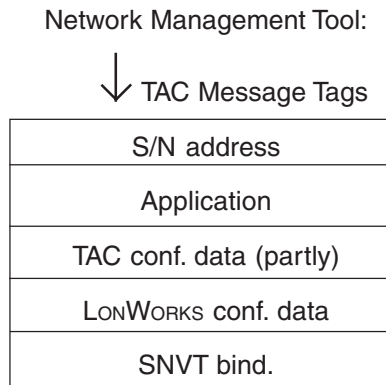
This can be done in two different ways, depending on how the box “Download Group information” has been marked in the TAC Menta NCT.

- A The box has *not* been checked (recommended): Information about the general TAC groups (16 and 51) can be set by the Network Management Tool using Message Tags, as mentioned above. (These are reserved in the XIF-file of TAC Xenta.) *The remaining TAC group information require that the TAC Menta Network Configuration Tool is used.*
- (B) The box is checked: The Network Configuration Tool *uploads* the S/N address, saves it in the database for the appropriate TAC Xenta and uses the information when compiling and downloading the TAC config.data.
- A When the TAC config. data are *downloaded* with the TAC Menta Network Configuration Tool, each TAC Xenta node will get the correct TAC Group and Xenta OP information. Unfortunately the Network Management Tool will not get access to this information. Instead you yourself must make sure that there will be no conflict with the creation of other groups in the network.

The Message Tags areas that may have been overwritten are restored after this download.



- (B) If instead we choose to create the general TAC groups with the *Network Management Tool* using the Message Tags, the tool will have all necessary information to create further groups with other third party device.



Finally, you should use the Self Documentation feature of the Network Management Tool in order to save all relevant details of the network structure.

6.4 Changes That Affect the Data Areas

Let us take another look at the general TAC Xenta 301/302/401 node, communicating with TAC Xenta 100 or third party products:

S/N address
Application
TAC conf. data
LONWORKS conf. data
SNVT-bind.

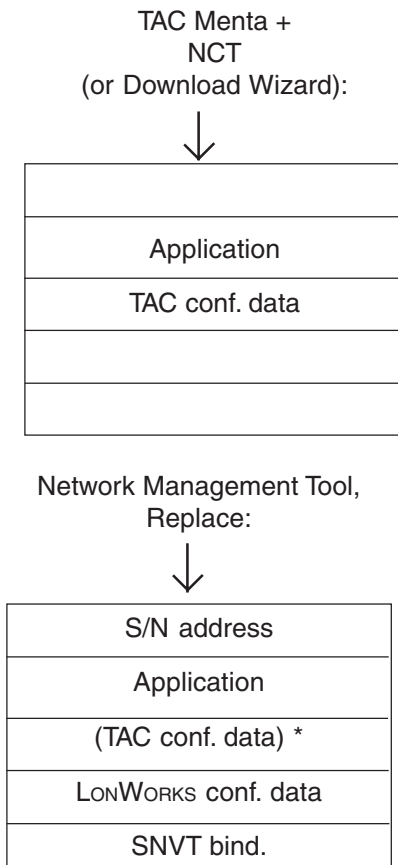
A change that concerns any of these areas will affect one or more of the databases that we have discussed in the previous sections.

Change of TAC Xenta Device

If only the faulty hardware of a device is to be replaced, no database will be affected. The change is performed in two steps.

Normally you use TAC Menta and the NCT to perform the download of the application and the TAC configuration data into TAC Xenta. This should be done in “the office” *before* the device is connected to the network.

(If you have to do the download at the site, it may be simpler to use TAC Vista, or the software tool “Download Wizard”, delivered with TAC Menta, instead).



Change of TAC Xenta Application

A change of the application program is treated differently if the SNVTs have been affected or not.

When there is no change in the use of SNVTs only a TAC Menta download is required.

TAC Menta:



S/N address
Application
TAC conf. data
LONWORKS conf. data
SNVT bind.

For further information please refer to the manual *TAC Xenta and LonMaker Release 3, 0-004-7751-X (GB)*.

Changes in the TAC Xenta groups

If the number of groups or their composition has been changed, most likely only the TAC conf. data will be affected.

If the change only applies within one group, only the TAC Xenta devices of that group have to be updated.

If the change concerns the number of groups, or group names, all TAC Xenta devices have to be updated with this information.

NCT:

↓ TAC conf. data

S/N address
Application
TAC conf. data
LONWORKS conf. data
SNVT bind.

7 TAC Xenta Dial-up

7.1 General

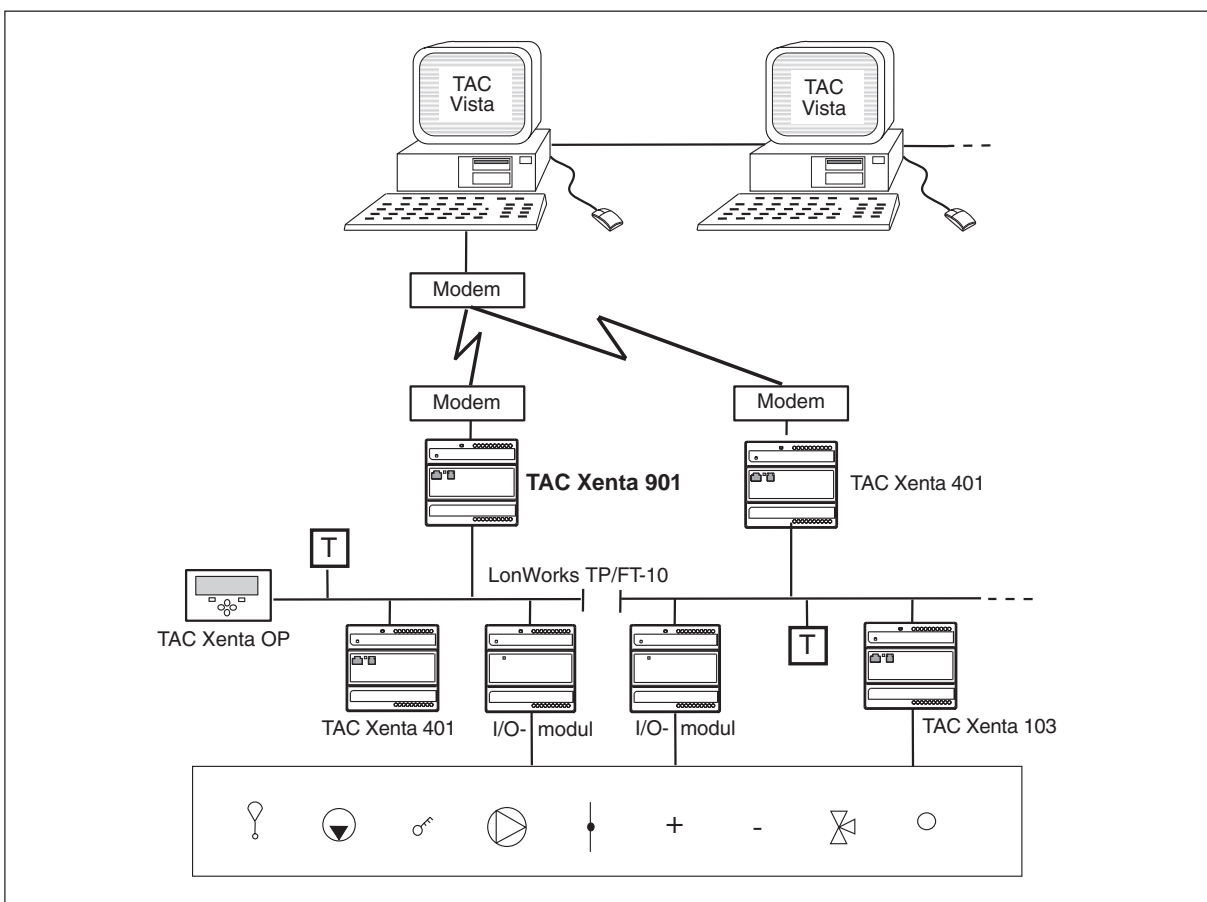
Distant devices connected to a modem can be dialled-up from a supervisory system, like TAC Vista, or download from TAC Menta.

Note! The dialled device should always be TAC Xenta Group master.

Devices connected in this way can exchange most of the data that a directly connected device can. For example it is possible to

- Read/write Public variables
- Exchange alarm information
- Up/Download the Application program and the Network configuration

The device may be part of a TAC Xenta network, but the other nodes are not directly accessible via the modem connection at this stage.



Xenta devices connected to TAC Vista via TAC Xenta 901 and a modem

7.2 *Modem and Dial-up Functions*

Modem

It is strongly recommended that PSTN modems connected to the TAC Xenta are 3Com US Robotics Sportster modems.

Other available dial-up connections are cable TV modems, and TAC Xenta 911 for TCP/IP networks.

TAC Vista contains a set of default modem parameters, which makes it possible to call most standard modems.

Adjusting the modem parameters in the TAC Xenta device is possible from TAC Vista only, but is handled with ModInit32 software. Installation instructions and help for TAC Vista are included in the ModInit32-files (available at TARAI).

The connection of certain modems recommended by TAC, to TAC Vista, are described in installation instructions of the OFL-type.

Dial-up

A TAC Vista connected to a modem can dial-up 240 modems which in turn are connected to different TAC Xenta devices.

From TAC Vista these, and other, parameters can be set:

- Number of attempts for dial-up, frequency and the setting of "Line blocked".
- Telephone numbers to be used by the device to dial-up TAC Vista; one ordinary and one alternative number.

It is also possible to disable "Line blocked".

Disconnect

Normally, disconnect is handled by the TAC Vista part. However, in the following cases, the controller may initiate a disconnect:

- The DCD (Data Carrier Detect) signal is missing.
- No messages received for at least 60 seconds.

Modem statistics

The following items are stored in the device and in TAC Vista. They can be read and reset from TAC Vista only.

Current status: Connected, Line engaged, etc.

Last time for statistics reset

Time for latest successful dial-up from TAC Xenta

No. of dial-up attempts from TAC Xenta

No. of failed dial-up attempts from TAC Xenta

The longest time required to dial-up from TAC Xenta

The longest dial-up time from TAC Xenta

The total dial-up time from TAC Xenta

7.3 Application Functions

Dial-up from TAC Vista to the TAC Xenta

Dial-up will automatically occur when the operator or the supervisory system has to reach the device.

Any waiting alarm acknowledge will be transferred to the device as soon as connection has been established for some other reason.

It is possible to download a new Application program and/or a new Network configuration to a device after a dial-up.

Dial-up from the TAC Xenta device to TAC Vista

The device will automatically dial-up the supervisory system when there is an alarm, when it is time to dial in a trend log or when a test dial from an OP is requested.

It is also possible to define the importance of different message types, so that the dial-up will occur at low-rate periods or at other events instead of one call for each alarm. These conditions are specified in TAC Vista.

The contents of the alarm stack will always be transferred as soon as connection has been established for some reason.

The device can be set to periodically dial-up the supervisory system. The interval is set from TAC Vista.

7.4 Test Functions

It is possible to initiate a test dial-up from either TAC Vista or from the TAC Xenta device.

When a test dial-up from TAC Vista is initiated, the device is supposed to call back immediately. If this procedure is successful, the device will generate a System message, which will be treated like an ordinary alarm and be visible to the operator.

Test dial-up from the device may be initiated from the TAC Xenta OP operator panel. Go to the Service menu, as described in the TAC Xenta 300 Handbook, appendix 1:

```
TAC Service menu
1. Name
2. LON Address
3. Wink
4. Restart
5. IO Module Config
6. Test Dial
7. System info
8. Boot Info
```

Select 6. Test dial and the following menu will appear.

```
Test dial
Dial          0
Status        08
0000 0000 0010 0100
```

Use the Dial value **0** for the normal telephone no. or toggle to the value **1** for the alternative telephone no. and press Enter to initiate a dial-up from the device to a supervisory system.

The Status lines will display codes with information about the procedure.

(Dynamic) Status (**upper** integer value) shows the progress of the dial-up sequence.

<i>Code</i>	<i>Meaning</i>
IDLE 00	This is the state before any dial attempts have been made.
LINE_BLOCKED 01	The line was blocked.
NO_DIAL_STRING 02	No dial string was defined, so no dial attempt was made.
SENDING_DIAL_STR. 03	We are either in the process of sending the dial string to the modem, or waiting for the response.
BUSY 04	The line was busy.
NO_ANSWER 05	No one picked up the phone at the other end.
NO_CARRIER 06	There was no modem at the other end that could answer.
ERROR 07	Something was wrong with the dial string.
NO_DIAL_TONE 08	No normal dial tone.
TIMEOUT 09	The modem did not reply to the dial string at all.
CONNECT 10	We are connected to the remote modem.
NO_LOGIN_REPLY 11	Attempt to log in, but no reply from TAC Vista.
LOGIN_FAIL 12	Our password (and/or network ID) was not accepted by TAC Vista.
LOGIN_OK 13	Connection established!

(Static) Status (lower 16-bit string) pertains to the modem and communication environment, such as availability of modem etc.

Code	Meaning
-----1	DSR is set if TAC Xenta detects that the modem drives the Data Set Ready line. Possible reasons for DSR being low: modem not connected, modem not powered on, DSR line not connected in the cable.
-----1-	AT OK is set when TAC Xenta has sent an AT command to the modem and received an OK reply. Possible reasons for not receiving AT OK: modem configured to not return any response to modem commands.
-----1--	Reset OK is set when AT OK is not set and TAC Xenta sent an AT&F sequence ordering the modem to return to factory defaults, and an OK reply was received. Possible reasons for not receiving Reset OK: RX line not connected in the cable or the modem is configured not to return any response to modem commands.
-----1---	Init string defined is set if the TAC Vista has defined a modem initialization string.
-----1----	Init OK is set when Init string defined is set and TAC Xenta sent the init string and received an OK reply. Possible reasons for not receiving Init OK: the init string contained a command that turned replies off, the init string contained an illegal command.
-----1-----	No contact.
-----1-----	Ready.
-----1-----	Phone number defined is set when TAC Vista has defined a modem dial string.

Appendix 1

I. TAC Xenta Device Subnet/Node Addresses

Note! The following text is only applicable in a stand-alone TAC system where no network management tool is used

The node addressing of a network can be performed in different ways, as mentioned in chapter 1. All nodes need an individual Subnet/Node address, i.e. a logical address.

The Subnet address can be any number between 1 and 255. To facilitate future router connections it is recommended that you start with Subnet no. 10. Normally the I/O modules have the same Subnet address as their TAC Xenta 301/302/401.

The addressing of a TAC Xenta *Node* should follow some simple rules.

- 1 Each TAC Xenta device requires **three** consecutive node addresses; the first for the device itself, *the other two are always reserved* for the handling of one or two operator panels.

Example:

Device 1 Node address 10 (and 11+12 for any OP)

- 2 For each TAC Xenta 301/302 device a maximum of two I/O modules may be added (for TAC Xenta 401 ten I/O modules), each requiring its own node address. The addresses will typically follow the two OP addresses.

Example:

I/O module 1 Node address 13

I/O module 2 Node address 14 and so on.

- 3 The maximum number of Node addresses on one subnet is 127 (125 for the TAC Xenta 301/302/401).

If the number of nodes exceed 125 on a subnet, or if logical grouping is required for other reasons, a new subnet number is used.

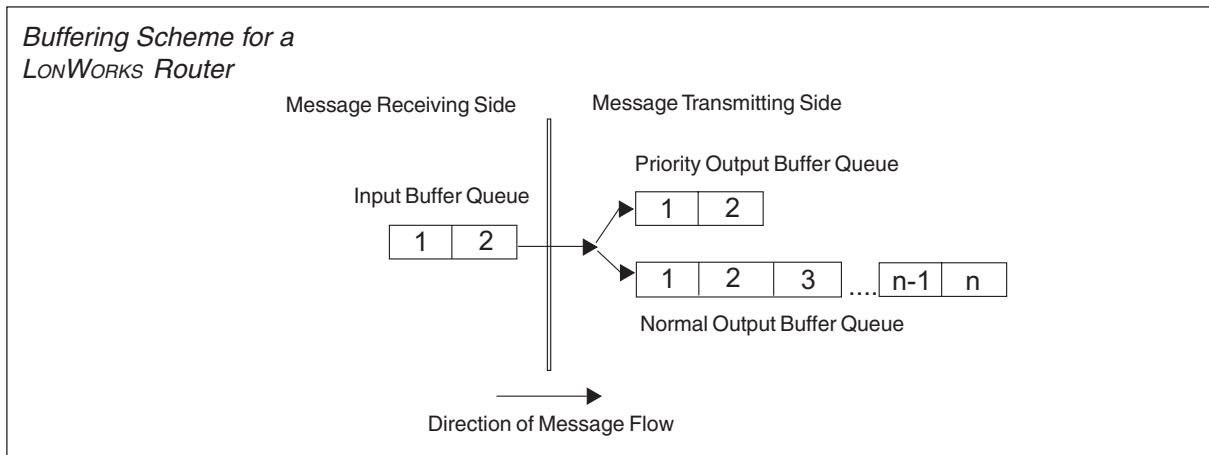
Use the NCT to

- set the device name of each device, for example Xenta_1,
- assign the subnet/node address, for example Subnet 10, Node 10,
- associate the I/O modules with the device, for instance Subnet 1 and its address, Node 13,
- specify the group name of all devices that belong to the same TAC Xenta group, for example Xenta_1, Xenta_2, Xenta_3 and
- appoint one device to work as Group master, for example Xenta_1.

The procedures are described in Chapter 8 “Network Configuration Tool” of the TAC Menta User’s manual.

II. Router Input Buffers

Messages received by a router are placed in an input buffer queue. By default this queue is limited to two message buffers, to ensure that priority messages are never queued behind a non-priority message. Priority messages have their own outgoing buffer queue when forwarded to the transmitting side of the router. This assures priority processing of these outgoing messages since the transmitting side will send messages from the priority output buffer queue before sending messages from the non-priority output buffer queue. The figure below summarizes the message flow through the input and output buffer queues. This message flow is duplicated for messages moving in the opposite direction, i.e. another set of input and output buffer queues exist for messages flowing in the opposite direction.



The size and count of the message buffers is limited by the amount of RAM on the router. Each router side has 1254 bytes of buffer space available. By default this space is allocated as two input buffers, two priority output buffers and 15 non-priority output buffers.

In some cases network traffic can get heavy (many packets appear on the network almost at the same time). In these cases the default configuration can be changed. The size of the input queue can be increased and the size of the output queue decreased. A router with a larger input queue can handle larger bursts of traffic, at the risk of priority messages being queued behind several non-priority messages.

II. Utility Programs

AltoRoute

A general LONWORKS router utility for verifying router settings and manual configuration. Available from Sysmik (www.sysmik.de).

NODEUTIL

A simple DOS-based utility from Echelon Corporation that can be used to diagnose and configure LONWORKS network nodes. It is not a Network Management Tool; it will not assign destination addresses or bind network variables. It is included in the "Connectivity Starter Kit", together with a short description file, NODEUTIL.TXT, explaining all available commands.

NODEUTIL communicates via a LonTalk Adapter.

Start NODEUTIL (you may have to specify which port is used, for example -dlon2) and press the service pin of the device.

Normally, the buffer size is set in the Network Management Tool, but if that does not work, we must use the utility program, NODEUTIL. NODEUTIL is an Echelon RTR-10 standard router module, which normally is included in all routers.

When NODEUTIL has been started, the following commands are available:

```
A -- Node (A)ddress table.
B -- (B)uffer configuration.
C -- Application (C)onfiguration structures.
D -- Node (D)omain table.
E -- (E)xit this menu and return to main menu.
G -- (G)o to another node.
H -- (H)elp with node commands.
M -- Change node (M)ode or state.
O -- Redirect (O)utput to a file.
R -- (R)ead node memory.
S -- Report node (S)tatus and statistics.
T -- (T)ransceiver parameters.
V -- Control (V)erbose modes.
W -- (W)rite node memory.
```

Setting Buffers for old OP (prior to version 3.0)

- 1 Press the service pin on the router. A message will appear with the node no. of the router.
- 2 **(G)**o to node menu
to get a list of the current Node IDs (Node no.s).
- 3 Select the router according to the Node ID and the
*** router near/far side information in the list:
Enter node id for Neuron Chip data structures **:g1**
to get to the near side router (node).

3 To get the current buffer size enter:

```
NODE:1> (B)uffer configuration
Node buffer configuration
```

	Type	Count	Size
Bytes			
Receive transaction	3	13	39
Transmit transaction	2	28	56
App buffer in	2	42	84
App buffer out	1	42	42
Net buffer in	2	66	132
Net buffer out	15	66	990
App buff out priority	0	42	0
Net buff out priority	2	66	132

==> Total bytes = 1475
Do you want to change this configuration? (Y/[N]) :

4 To change the buffer size answer **Y** and then enter the figures to the right:

```
Receive trans count [3] :3
App in buff size [42] :114
App out buff size [42] :114
Net in buff size [66] :114
Net out buff size [66] :114
App out priority count [0] :0
Net out priority count [2] :0
App buff in count [2] :2
App buff out count [1] :1
Net buff in count [2] :2
Net buff out count [15] :5
```

The result should be:

Type	Count	Size	Bytes
Receive transaction	3	13	39
Transmit transaction	1	28	28
App buffer in	2	114	228
App buffer out	1	114	114
Net buffer in	2	114	228
Net buffer out	5	114	570
App buff out priority	0	114	0
Net buff out priority	0	114	0

==> Total bytes = 1207

5 The buffer size must be changed on *both sides* of the router.6 *All* routers have to be modified.

Note! Changing settings with the NODEUTIL program may cause problems.

VI. Available no. of SNVTs

Summary In a LONWORKS network the no. of SNVTs are limited by different factors. For a specific TAC Xenta node the out-SNVTs are mainly limited by the following two parameters:

- No. of entries (for Groups or individual nodes)
The maximum is 13 for TAC Xenta 301/302/401.
- No. of members, that is, the total number of values defining the different SNVT structures.
In TAC Xenta 301/302 the max. no. of SNVTs is 15 *in* and 30 *out*, in TAC Xenta 401 it is 125 *in* and 125 *out*.

To transmit the values of out-SNVTs the device has to store a number of data items; among these are the destination address(es) and the SNVT value(s).

The destination address can be a LONWORKS Group or an individual node. Only one entry of the destination address is needed, even if more than one SNVT is sent to that address.

The total number of destination addresses (Group or individual) may not exceed 13, please refer to text above.

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