

Technical Information

TI 30A10A10-01E

Vnet/IP
Network Construction Guide
(Legacy Edition)



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Introduction

This manual aims to have customers who use a Vnet/IP control bus understand Vnet/IP system configuration, the precautions to be taken to construct the system, and the set items required to construct a control bus system, determining a Vnet/IP system construction.

Chapters 1 and 2 of this manual describe what Vnet/IP will be. Chapters 3 and 4 provide more concrete information necessary to consider the Vnet/IP system construction. Users who wish to have an overview of the Vnet/IP should read Chapters 1 and 2 first.

Chapter 1 gives an overview of the system construction of Vnet/IP as a control bus. It also addresses the equipment required for system construction.

Chapter 2 focuses on detailed specifications of the Vnet/IP system configuration.

Chapter 3 describes the setting of a Vnet/IP network from an example of system configuration. To understand Chapter 3, users need to understand Chapter 1 and 2 first. Chapter 3 takes basic construction and also multiple domains construction to describe devices and settings necessary for each example as well as points to keep in mind from the viewpoint of network construction. For most systems, it is recommended to take system configuration following the examples shown in this chapter.

Chapter 4 describes the functionality requirements of network-related devices used for Vnet/IP. This chapter also describes what functions are included in the equipment shown in the system configuration in Chapter 3. In addition, the setting requirements where these network devices are used in a Vnet/IP network are described.

Chapter 5 describes a glossary of network terms, the system of time synchronization in the Vnet/IP system, and the precautions when installing network devices. The Network description uses many technical terms. Refer to this section if necessary while reading the manual. A mechanism of time synchronization is important for FDA (Food and Drug Administration) : 21 CFR Part 11 (Electronic Records; Electronic Signatures) compliant system or SOE (Sequence of Event) system.

This manual addresses Vnet/IP network configuration as a control network. When Vnet/IP is connected to an external network, it is necessary to take security issues into consideration. Therefore, this manual does not sufficiently cover the Network configuration required or the items to be set for network equipment. If connecting to an external network, consult the network administrator to determine the network configuration.

SEE ALSO

With the release of CENTUM VP R5 and ProSafe-RS R3, the guidelines are changed so that Vnet/IP is used as a network for control communications, and information communications are performed on a network independent from Vnet/IP. Refer to TI 30A10A05-01E Vnet/IP Network Construction Guide for the new guide.

Related Document

- TI 30A10A05-01E Vnet/IP Network Construction Guide
- TI 30A10A20-01E Vnet/IP Built-In security Features

Glossary

The terms used in this document are as follows.

Table Terms related to Yokogawa system products in this guide (1/2)

Term	Description
APCS	Abbreviation of Advanced Process Control Station. An APCS implements control functions with a general-purpose PC, aimed at improving advanced control and plant efficiency.
BCV	A generic name for Bus Converter. It connects stations on a V net to stations on a V net or a HF bus in other domain.
BCV-H	Bus Converter for HF Bus. It connects stations on a V net to stations on a HF bus in other domain.
BCV-V	Bus Converter for V net. It connects stations on a V net to stations on a V net in other domain.
Boundary router	A device having router functions allowing the connection of Vnet/IP and a remote network, such as intranet, for open communications.
CENTUM	A generic name for Integrated Production Control System CENTUM VP and CENTUM CS 3000.
Control bus TCP/IP communications	TCP/IP protocol communications on the control bus V net.
Control communications	Communications to exchange control data in a Vnet/IP network.
ENG	A general-purpose PC with engineering functions used to perform CENTUM system generation and maintenance management. It can be the same PC as the HIS.
Exaopc	A general-purpose PC on which Exaopc OPC Interface Package is installed.
Exapilot	A general-purpose PC on which Exapilot Operation Efficiency Improvement Package is installed.
Exaquantum	A general-purpose PC on which Exaquantum Plant Information Management System is installed.
FCS	Abbreviation of Field Control Station. An FCS is a component of CENTUM system and performs process control and manages communications with subsystems, such as PLCs.
GSGW	Abbreviation of Generic Subsystem Gateway Station. A GSGW can collect and set data of various types of subsystems through OPC DA servers. A GSGW is a general-purpose PC with Generic Subsystem Gateway Package.
HIS	Abbreviation of Human Interface Station. An HIS serves as a human machine interface of CENTUM system for operation, monitoring, and engineering. Software packages are installed in a general-purpose PC.
Interflow switch	A L2SW used to restrict the bandwidth for open communications entering Vnet/IP.
Open-based communications device	A generic name for a device using only Ethernet based standard protocols in a Vnet/IP network.
Open communications	Communications with Ethernet based standard protocols in a Vnet/IP network.
PRM	A general-purpose PC on which PRM Plant Resource Manager is installed.
ProSafe-RS	A generic name for Safety Instrumented System ProSafe-RS R2 and ProSafe-RS R1.
Remote router	A router or L2SW to connect a remote Vnet/IP using a dedicated line.
SCS	Abbreviation of Safety Control Station. An SCS is a safety controller of ProSafe-RS which performs logics such as interlock, emergency shutdown and fire and gas protection.
SENG	A general-purpose PC with engineering functions for ProSafe-RS such as editing, downloading and testing applications as well as carrying out maintenance tasks on SCSs. The SENG functions can be installed in a PC that has HIS or ENG functions.

Table Terms related to Yokogawa system products in this guide (2/2)

Term	Description
SIOS	Abbreviation of System Integration OPC Station. An SIOS integrates process control systems (PCSs) from other vendors into the CENTUM system. The SIOS is a general-purpose PC.
Vnet/IP domain	A region in which devices are connected without using a router, L3SW, or V net router in a Vnet/IP network.
Vnet/IP station	A generic name for a Vnet/IP protocol-enabled device.
V net router	A device to connect a Vnet/IP domain and a V net domain or a VL net domain for relaying control communications.

Table General terms in this guide

Term	Description
1000BASE-LX	One of Gigabit Ethernet standards specified in IEEE 802.3.
1000BASE-T	One of Gigabit Ethernet standards specified in IEEE 802.3.
100BASE-TX	One of Fast Ethernet standards specified in IEEE 802.3.
Autonegotiation	A function which allows automatically setting of the transmission rate and full-duplex or half-duplex transmission between switches and terminal equipment.
DCOM	Microsoft-defined specification of the distributed object technology. It enables software components referred to as COM objects to communicate over a network and exchange data and processing requests.
DVMRP	Abbreviation of Distance Vector Multicast Routing Protocol.
Fiber-optic cable	A cable made of glass or plastic for optical communications.
Firewall	A generic name to prevent devices or functions from being affected by illegal access from a remote network.
Gigabit Ethernet	An Ethernet standard for 1 Gbps transmission rate, as defined by IEEE802.3.
IGMP	Abbreviation of Internet Group Management Protocol.
Intelligent switch	Other than the simple transmission function, this is a switch that enables configuration of different settings such as VLAN, QoS, and the transmission rate for ports. It also enables management and configuration of SNMP through the network.
L2SW	Abbreviation of Layer 2 Switch.
L3SW	Abbreviation of Layer 3 Switch.
Multicast routing	A routing process for multicast communications.
Non-intelligent switch	A switch that has only the simple transmission function.
OPC	Abbreviation of OLE for Process Control.
PIM-DM	Abbreviation of Protocol Independent Multicast-Dense Mode.
RIP	Abbreviation of Routing Information Protocol.
Router	A network device that transmits packets between networks based on information in the network layers.
SNMP	Abbreviation of Simple Network Management Protocol.
SNTP server	Abbreviation of Simple Network Time Protocol server.
Switching capacity	One of numeric values indicating the processing capacity of switches. The amount of data processed per second by switches is indicated.
Switching hub	A hub with a bridge function.
Unicast routing	A routing process for communicating to a single host.
UTP cable	Abbreviation of Unshielded Twisted Pair cable.
VLAN	Abbreviation of Virtual Local Area Network.

Symbol Marks of this Technical Information

Throughout this Technical Information, you will find several different types of symbols are used to identify different sections of text. This section describes these icons.



CAUTION

Identifies instructions that must be observed in order to avoid physical injury and electric shock or death to the operator.



IMPORTANT

Identifies important information required to understand operations or functions.

TIP

Identifies additional information.

SEE ALSO

Identifies a source to be referred to.

Trademark

Trademark

- CENTUM, ProSafe, Vnet/IP, Exaopc, Exapilot and Exaquantum are registered trademarks of Yokogawa Electric Corporation.
- PRM is a registered trademark of Yokogawa Electric Corporation in the United States and Japan.
- Microsoft and Windows are either registered trademarks or trademarks of Microsoft Corporation in United States and/or other countries.
- Ethernet is a registered trademark of Xerox Corporation.
- Other product and company names may be registered trademarks of their respective companies (the TM or ® mark is not displayed).

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Vnet/IP Network Construction Guide (Legacy Edition)

TI 30A10A10-01E 2nd Edition

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1. Overview of Vnet/IP

Vnet/IP is a control network with high reliability and quick response. Yokogawa has developed Vnet/IP. The following sections briefly describe Vnet/IP features and specifications to provide a comprehensive view of Vnet/IP.

1.1 Vnet/IP Features

Vnet/IP is a process automation control network based on Gigabit Ethernet. It has the qualities essential for stable plant operations, namely reliability, real-time response, and Ethernet openness. In addition, it provides security against external threats such as cyber attacks. Vnet/IP is approved by international standards (IEC 61784-2 Ed.2.0).

Vnet/IP is a control bus that conforms to IEEE 802.3 and UDP/IP. It connects the devices that make up the CENTUM and ProSafe-RS systems. Control data is then exchanged between the devices. Even though Vnet/IP is a control network, communication with Ethernet-based standard protocols is possible as long as the signals lie within the predefined bandwidth. TCP/IP protocol-based communication, such as accessing data from the Exaopc OPC interface, can be performed. Moreover, by using V net router, Vnet/IP can also connect to other systems that use V net or VL net as a control bus.

You can use general-purpose Ethernet communication devices such as commercially available transmission media (Ethernet cable), layer 2 switch (L2SW), layer 3 switch (L3SW), and routers to build a Vnet/IP network.

■ High Reliability

Vnet/IP is a control network that has a dual-redundant configuration. A dual-redundant bus consists of independent subnets, bus 1 and bus 2. When both buses are operating normally, bus 1 is used in control communications for control data transmission, while bus 2 is used in open communications for Ethernet-based standard protocols. Bus 2 is also used as a backup for bus 1. When a problem occurs in bus 1, the path will be instantly and automatically switched so that control communications is performed using bus 2. At this moment, control communications and open communications coexist in bus 2. However, since the bandwidth for open communications is controlled to secure bandwidth for control communications, heavy traffic in open communications will not interfere with control communications.

■ Real-time Response

Vnet/IP implements a highly reliable dedicated protocol on UDP, which has a fast transmission speed, instead of implementing it on TCP, which is commonly used by Ethernet. Communication stations perform transmission at a fixed time slot. The transmission-scheduling function prevents transmission delays and packet loss by prohibiting the accumulation of packets. Real-time response is achieved by having a priority scheme for the different communication types.

■ Openness

Vnet/IP is a control network based on 1 Gbps Gigabit Ethernet. Control networks and information open networks, which were built separately, can now be integrated. Therefore, it is now possible to connect control devices and general-purpose information devices to the same network. Network integration also contributes to reduction in wiring costs.

■ Security

Vnet/IP has also taken security into account. In order to counter cyber attacks such as data eavesdropping, falsification, and spoofing, it performs authentication by using a shared secret key, which is periodically updated.

**SEE
ALSO** About Vnet/IP security features, refer to the following.
TI 30A10A20-01E Vnet/IP Built-In Security Features

1.2 Vnet/IP Main Specifications

Vnet/IP main specifications are described below.

■ Communications Specifications

- **Control Communications**

Control communications are achieved through the bus-1 side usually. If a problem occurs in bus1, bus2 will be used.

Communication method: Read/write communications, message communications and link transmission (*1)

Link transmission period: 100 msec (*1)

*1: CENTUM VP, CENTUM CS 3000 and Prosafe-RS only.

- **Open Communications**

Open communications are achieved through the bus-2 side. Ethernet-based communications devices are connected to CENTUM and ProSafe-RS system components. Devices through an external network cannot directly be connected to the Vnet/IP from the viewpoint of security. Be sure to connect through a firewall.

- **Transmission Path Specifications**

Network topology: Tree formation

Transmission path redundancy: Dual redundant paths (control communications only)

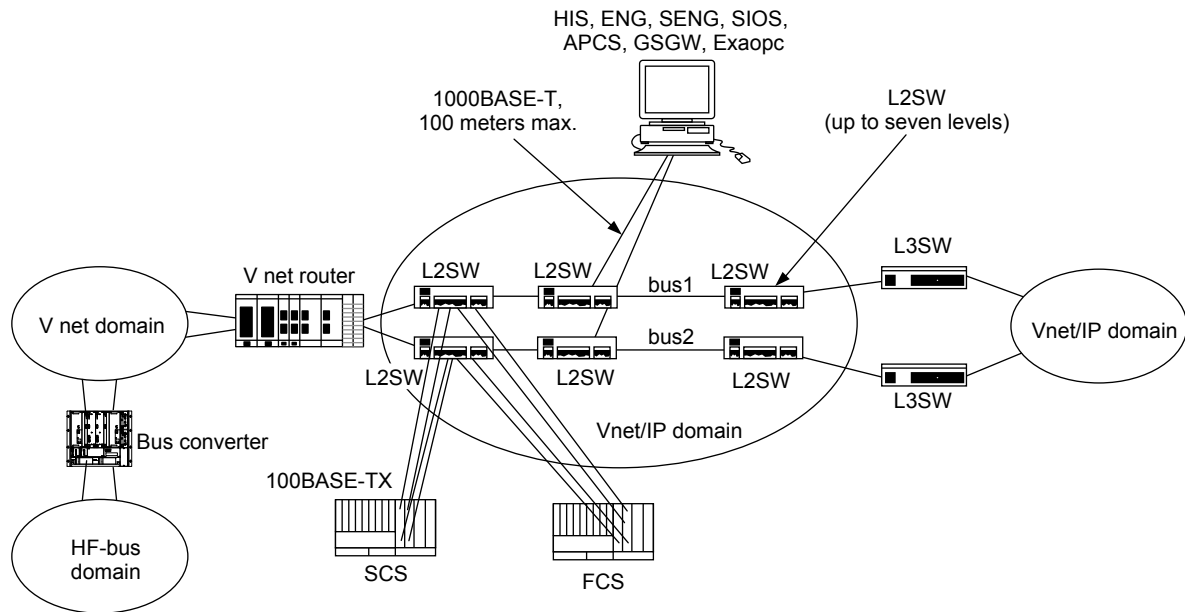
Transmission rate: 1 Gbps

■ Connection Topology

Vnet/IP connection topology takes tree formation. Devices within Vnet/IP domains are connected using L2SWs. In a dual-redundant Vnet/IP, buses 1 and 2 are independent subnets. Two independent communications routes, buses 1 and 2, exist.

The system's connection topology using Vnet/IP as a control bus is briefly described in the following. Vnet/IP can use network devices that are commercially available for network connections. Devices on a Vnet/IP are connected using commercially available cables, switches, and the like.

In a Vnet/IP network, a region in which devices are connected without using a router, L3SW or V net router is called a Vnet/IP domain. Vnet/IP constructs a network for each domain.



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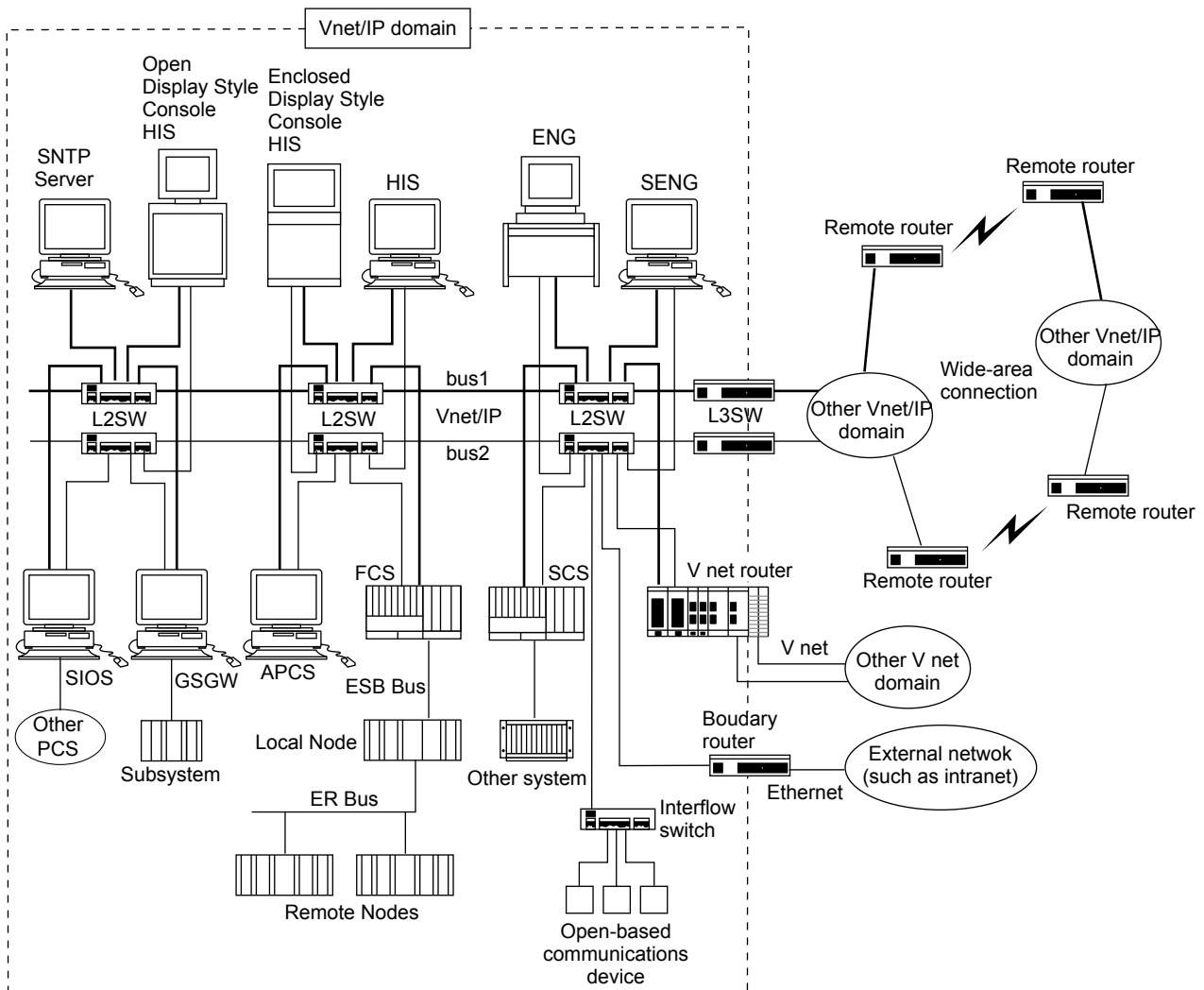
Figure Overview of Network Construction

TIP

The connection of multiple domains is supported in the CENTUM system and in the CENTUM integration structure of ProSafe-RS. A system with ProSafe-RS only does not support the connection of multiple domains.

1.3 System Components

A Vnet/IP system configuration example is illustrated as follows:



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Figure System configuration example

A Vnet/IP system can use commercially available network devices. System components include Vnet/IP protocol-enabled devices and general-purpose devices unrelated to Vnet/IP protocol.

Vnet/IP protocol-enabled devices include a general-purpose PC with Vnet/IP interface card, FCS for Vnet/IP, SCS for Vnet/IP and V net router. These devices enable Vnet/IP control communications. Our specific Vnet/IP-enabled devices include:

- HIS
- FCS
- GSGW
- Exaopc
- SENG
- V net router
- ENG
- APCS
- SIOS
- PRM (Field communications Server)
- SCS

In this manual, a Vnet/IP protocol-enabled device is referred to as a Vnet/IP station. In addition, a device using an Ethernet standard protocol is also referred to as an open-based communications device.

1.3.1 Vnet/IP Stations

■ HIS

An HIS serves as a human machine interface of CENTUM system for operation, monitoring, and engineering. Software packages installed in a general-purpose PC (an IBM PC/AT compatible computer) or in a console HIS, consisting of a general-purpose PC and Open Display Console Assembly, implement operation and monitoring functions as well as engineering functions. Users can install and run operation and monitoring functions and/or engineering functions in an HIS as necessary.

For connections to the Vnet/IP, a Vnet/IP interface card is required.

■ ENG

An ENG is a general-purpose PC with engineering functions used to perform CENTUM system generation and maintenance management. It can be the same type as the general purpose PC for the HIS, and can even be the same PC as the HIS.

For connections to the Vnet/IP, a Vnet/IP interface card is required.

■ FCS

An FCS performs process control and manages communications with subsystems, such as PLCs.

Two types of field control stations for Vnet/IP and FIO are available:

AFV10S: Field Control Unit (for Vnet/IP, FIO, rack-mounted)

AFV10D: Duplexed Field Control Unit (for Vnet/IP, FIO, rack-mounted)

■ APCS

An APCS implements control functions with a general-purpose PC, aimed at improving advanced control and plant efficiency. The APCS requires "LFS1200 APCS Control Functions" to be installed.

For connections to the Vnet/IP, a Vnet/IP interface card is required.

■ GSGW

A GSGW can collect and set data of various types of subsystems through OPC DA servers. The GSGW is a general-purpose PC with LFS1250 Generic Subsystem Gateway Package.

For connections to the Vnet/IP, a Vnet/IP interface card is required.

■ SIOS

An SIOS integrates process control systems (PCSs) from other vendors into the CENTUM system. The SIOS is a general-purpose PC with LBC2100 System Integration OPC Client Package.

For connections to the Vnet/IP, a Vnet/IP interface card is required.

■ Exaopc

Exaopc provides an open OPC (OLE for Process Control) interface bridge between the control room and the outside world. The Exaopc is a general-purpose PC with NTPF100 Exaopc OPC Interface Package.

For connections to the Vnet/IP, a Vnet/IP interface card is required.

■ PRM (Field Communications Server)

A Field Communications Server acts as the gateway between PRM and the apparatus to which field devices are connected. The Field Communications Server acquires field device information upon request of a PRM Client or PRM Server. The Field Communications Server is a general-purpose PC with SSS7720 Field Communications Server.

For connections to the Vnet/IP, a Vnet/IP interface card is required.

■ SENG

An SENG is a general-purpose PC with engineering functions for ProSafe-RS such as editing, downloading and testing applications as well as carrying out maintenance tasks on SCSs. The SENG functions can be installed in a PC that has HIS or ENG functions.

For connections to the Vnet/IP, a Vnet/IP interface card is required.

■ SCS

An SCS is a safety controller of ProSafe-RS which performs logics such as interlock, emergency shutdown and fire and gas protection.

We provide the following four SCSs for Vnet/IP:

SSC60S: Safety Control Unit (for Vnet/IP, rack mountable)

SSC50S: Safety Control Unit (for Vnet/IP, rack mountable)

SSC60D: Duplexed Safety Control Unit (for Vnet/IP, rack mountable)

SSC50D: Duplexed Safety Control Unit (for Vnet/IP, rack mountable)

■ V net Router

A V net router is a device to connect a Vnet/IP domain and a V net domain or a VL net domain for relaying control communications. Bidirectional data exchanges are possible between the system on a Vnet/IP side connected by a V net router and the system on a V net side or a VL net side. This router realizes operation and monitoring of a control station in one domain from another domain.

The following product is available:

AVR10D: Duplexed V net Router (redundant use of communications modules and power supply modules)

SEE ALSO

A Vnet/IP station is connected to a Vnet/IP network by installing a Vnet/IP interface card if a Vnet/IP station uses a general-purpose PC as its platform. The Vnet/IP interface card contains two ports of connectors to connect Vnet/IP communication cables to support duplexed Vnet/IP buses (bus 1, bus 2).

1.3.2 Open-based Communications Devices

These devices exchange information with CENTUM and ProSafe-RS systems using Vnet/IP open communications. These are devices that have until now been connected to Ethernet separately from a control bus. Network printers, general-purpose PCs and PLCs are categorized into these devices.

■ Peripherals (commercially available)

Since an HIS, ENG, and SENG support Microsoft Windows, Windows-compatible peripherals, such as printers can be used. Consult Yokogawa for more details on peripherals that can be used with an HIS, ENG, and SENG.

1.3.3 Network Devices

■ L2SW (commercially available)

This is a device to connect equipment within the Vnet/IP domain. The transmission speed for Vnet/IP has to be 1Gbps. The switch, unlike a HUB, incorporates bridge functions to send data to the destination terminal equipment only; it can, therefore, reduce traffic within its domain. (Vnet/IP uses full-duplex communication systems, so no collision occurs.)

■ L3SW (commercially available)

This switch is used to connect Vnet/IP domains. If the Vnet/IP network is separated into multiple domains, the domains are connected via this switch. The switch has routing functions, allowing a communications frame to be relayed to another domain.

The L3SW also has a function the L2SW has. Therefore, it allows direct connections between Vnet/IP stations and open-based communications devices.

■ Boundary Router (commercially available)

In this guide, a device having router functions allowing the connection of Vnet/IP and a remote network is called a boundary router. It is connected to the bus-2 side only.

■ Interflow Switch (commercially available)

In this guide, a L2SW used to restrict the bandwidth for open communications entering Vnet/IP is called an "interflow" switch.

■ Remote Router (commercially available)

In this guide, a router or a L2SW to connect a remote Vnet/IP using a dedicated line is called a remote router. If a wide-area connection is being used, consult Yokogawa.

■ Cables

The interface cable standards and maximum cable distances are listed in the table below. Use a CAT5e (enhanced category 5) or higher UTP cable for 1000BASE-T. It is required that the number of L2SWs is increased or the maximum distances be expanded by fiber cabling (1000BASE-LX) according to the system configuration or equipment installation location.

Tabel Cables

Connection	Cable standard	Speed	Maximum distance
Between station and L2SW	100BASE-TX (IEEE 802.3u)	100 Mbps (*1)	100m
	1000BASE-T (IEEE 802.3ab)	1 Gbps	
Between L2SWs	1000BASE-T (IEEE 802.3ab)	1 Gbps	100m
	1000BASE-LX (IEEE 802.3z)	1 Gbps	5 km
Between L2SW and L3SW	1000BASE-T (IEEE 802.3ab)	1 Gbps	100m
	1000BASE-LX (IEEE 802.3z)	1 Gbps	5 km

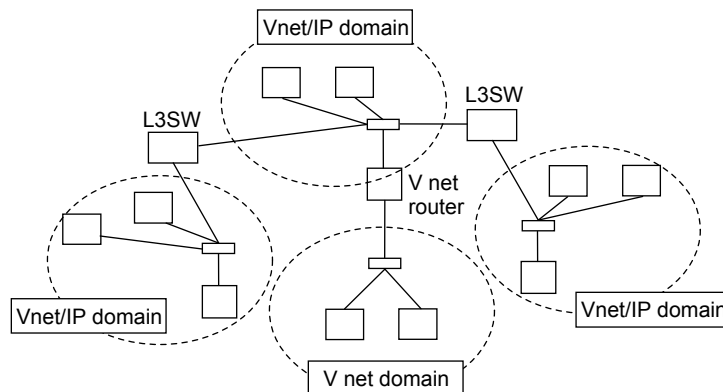
*1: For V net Router, SCS and Open communication network.

1.4 Vnet/IP System Specifications

Vnet/IP network is configured with a domain or multiple domains. When constructing a Vnet/IP network, give attentions to the specifications for each domain as well as the specifications for total domains.

■ Vnet/IP Domain

In a Vnet/IP network, an area connected without communicating through relaying devices in an IP layer, such as a router (boundary or remote router), a L3SW, etc., is called a domain. Up to 64 Vnet/IP stations per Vnet/IP domain can be connected. If more than 64 Vnet/IP stations are connected, domains can be separated to increase the number of stations connected. In a CENTUM and ProSafe-RS system, up to 16 domains can be defined in combinations of Vnet/IP domains, V net domains and VL net domains (CENTUM only).



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Figure Structure of Multiple Domains

Use a Class C private address for the IP address for Vnet/IP. Duplexed FCS, duplexd SCS and V net router use two IP addresses for each subnet per station. Up to 64 Vnet/IP stations in one domain can be connected. In addition, a total of 124 network devices with IP addresses and open-based communications devices per single-sided bus in one domain can be connected. There is no limit on the number of network devices with no IP address.

- Number of Vnet/IP stations in one domain: Up to 64
- The total number of network devices (with IP addresses) and open-based communications devices in a domain: Up to 124 devices per single-sided bus (Unmanaged L2SWs without SNMP functions are not included. If an IP address is set to use SNMP functions for managed L2SWs, they are counted).
- Levels of L2SW connections in one domain: Up to 7
- Number of domains in the system: Up to 16

■ Connection within a Vnet/IP Domain

Each device within a Vnet/IP domain is connected to a L2SW in a star or tree (multiple star) network topology. A dual-redundant Vnet/IP bus consists of independent subnets, bus 1 and bus 2; therefore, a L2SW is installed in each line.

Up to seven levels of L2SW connections can be connected in a Vnet/IP domain. Use 1 Gbps port of L2SW for connections between L2SWs and connections between L2SW and Vnet/IP station.

Note that the transmission rate is 100 Mbps for SCS and V net router. You can connect SCS and V net router to a port that allows 100 Mbps transmission.

When only SCS and V net router are connected, the L2SW with 100 Mbps downlink and 1 Gbps uplink port can also be used.

Distance between L2SWs and that of L2SW and L3SW can be extended to 5 km, using a fiber-optic cable.

There is no problem if number of L2SW steps or distances is different in bus 1 and bus 2 between Vnet/IP stations.

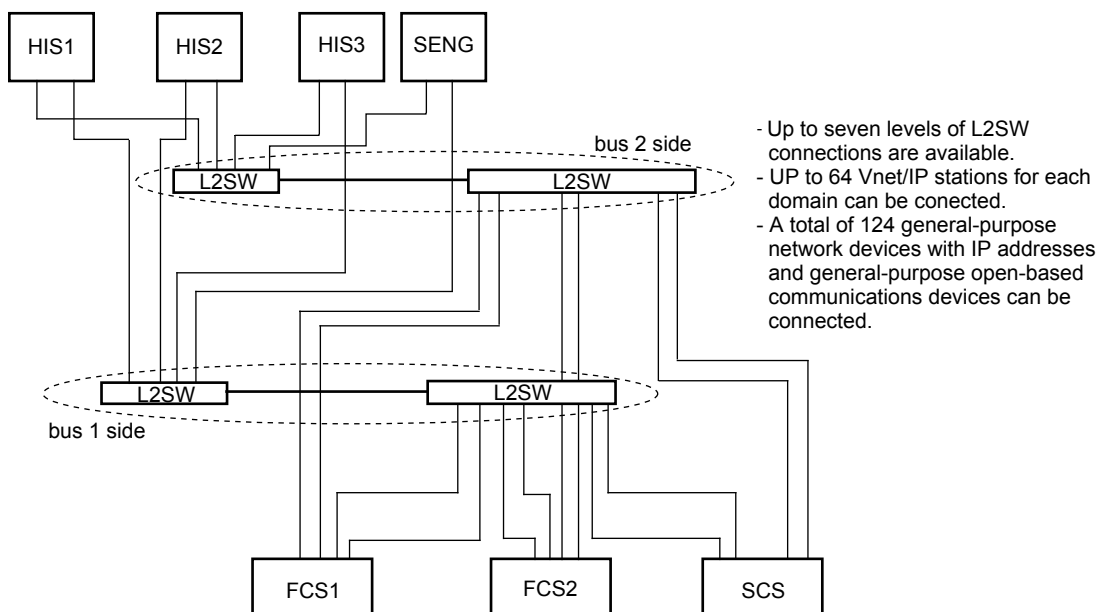


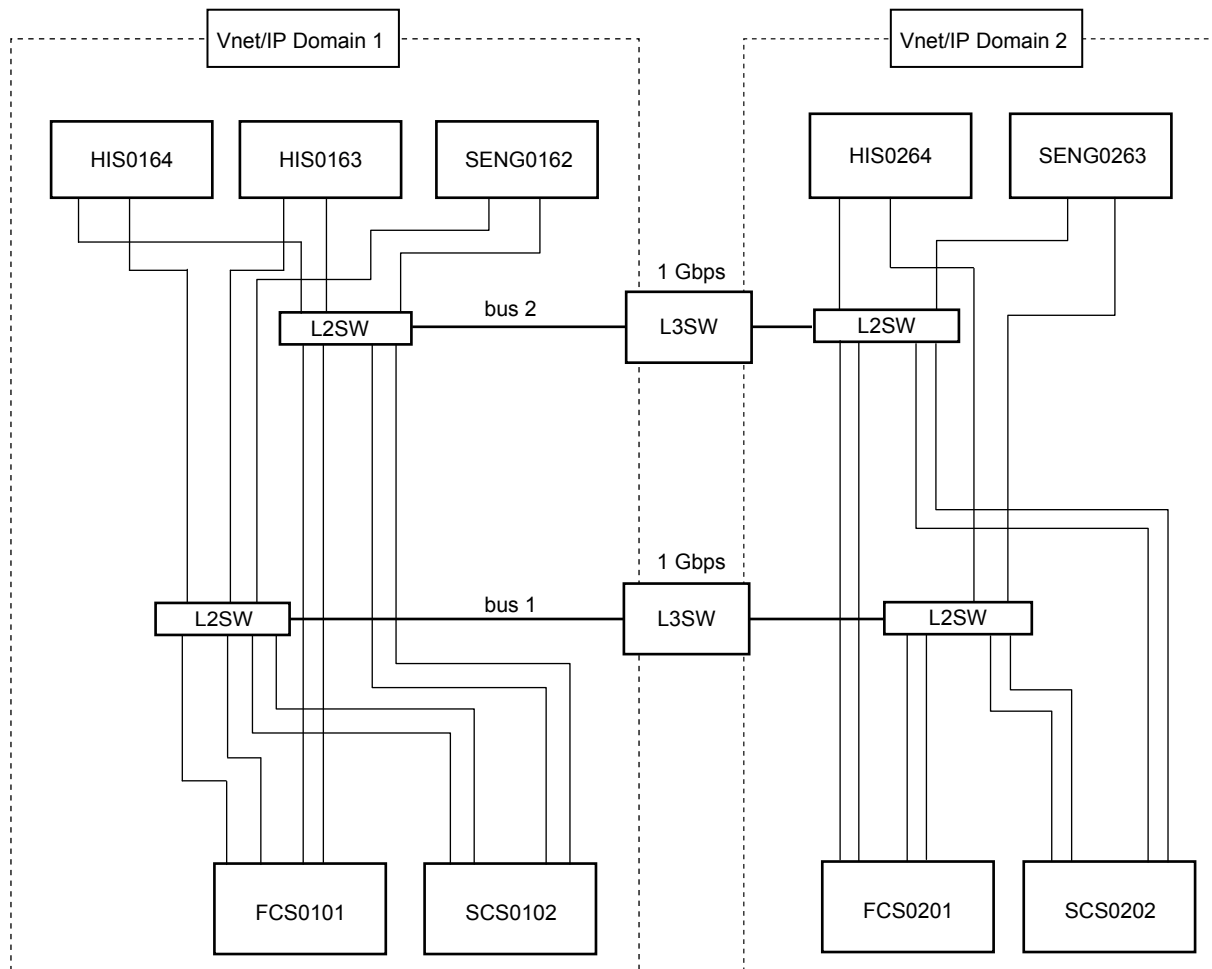
Figure Connections within a Vnet/IP Domain

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■ Inter-domain Connections

● Connection Topology

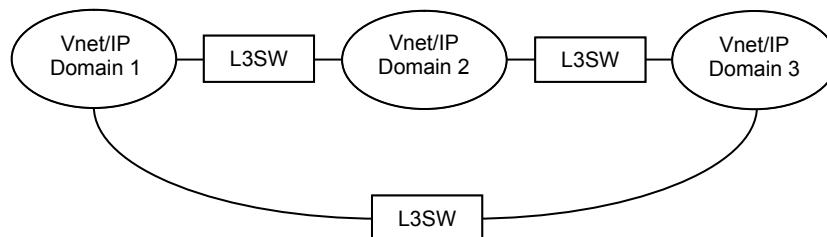
Vnet/IP domain interconnections are made using commercially available L3SWs. Up to 16 domains can be connected. The transmission rate for connections between domains is above 1 Gbps. If a connection of less than 1 Gbps such as a wide area connection is used, consult Yokogawa. The following figure is a brief example of connecting two domains. In the figure, buses 1 and 2 use L3SWs to connect two Vnet/IP domains.



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Figure Example of Connecting Vnet/IP Domains

Do not connect in such a way that multiple communication paths exist between any two Vnet/IP domains. For example, refrain from creating the following connection where two paths exist between domains 1 and 3:



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Figure Example of Multiple Paths

The Vnet/IP domains interconnection topology includes bi-directional, hierarchical and bridge connections. Bi-directional connections allow HISs in both domains to operate and monitor other domains.

- **Bi-Directional Connection**

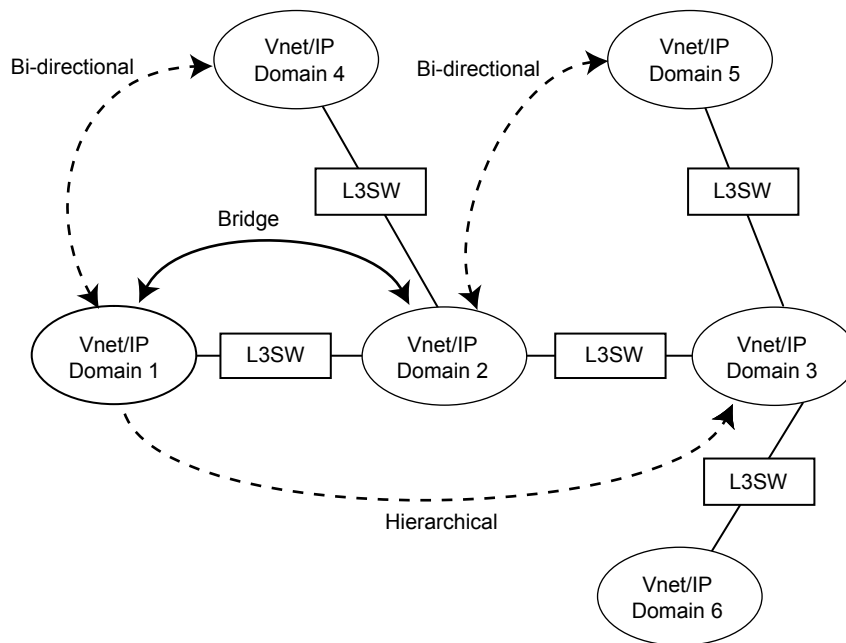
This connection does not use a hierarchical structure. HISs in both domains can operate and monitor other domain statuses. Both domain stations can accept FCS, SCS and HIS messages.

- **Hierarchical Connection**

A hierarchical structure is used between domains. The upper domain can operate and monitor the lower domain. The upper domain can accept FCS, SCS or HIS messages occurring in the lower domain.

- **Bridge Connection**

This is a domain-independent connection, where a domain will not receive FCS, SCS, and HIS messages that are triggered on another domain. You can also disable time synchronization between domains.



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Figure Domain Connection Types in Vnet/IP

TIP

The connection of multiple domains is supported in the CENTUM system and in the CENTUM integration structure of ProSafe-RS. A system with ProSafe-RS only does not support the connection of multiple domains.

■ Connection with Existing Systems

A V net router allows the connection of a Vnet/IP domain to a V net domain or a VL net domain. A Vnet/IP domain cannot be connected directly to CENTUM-XL or μ XL systems. When connecting with these systems, provide a BCV (Bus converter) in a V net domain, through which connections to CENTUM VP or CENTUM CS 3000 systems can be made.

Number of domains that can be hierarchically connected: 16

Number of hierarchical connections through a V net router (*1):

Three (two levels of bus converters, three levels of control buses)

Devices connected: V net routers and bus converters

*1: The number of levels of Vnet/IP domains and V net routers are not counted as the allowable number of hierarchical connections.

The following figure shows specifically the hierarchical number where the hierarchical structure applies.

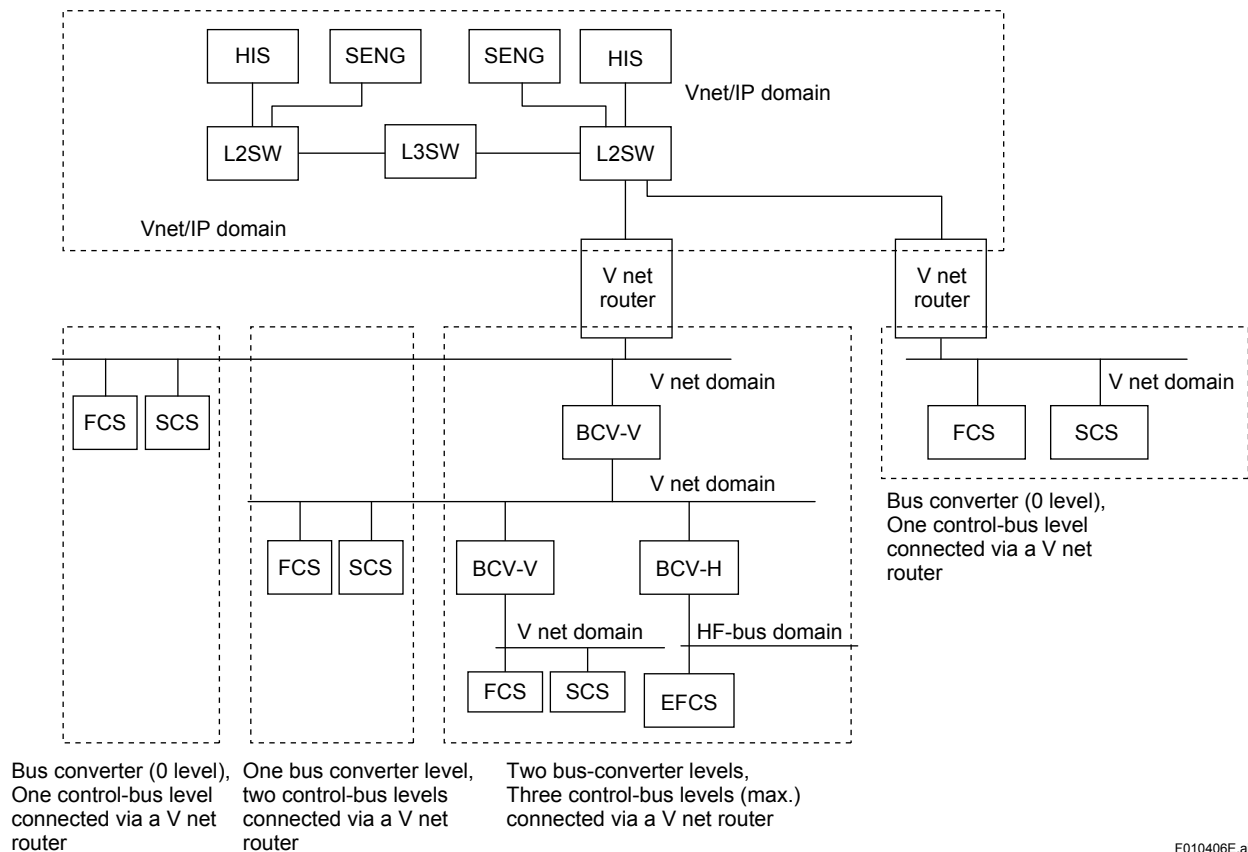
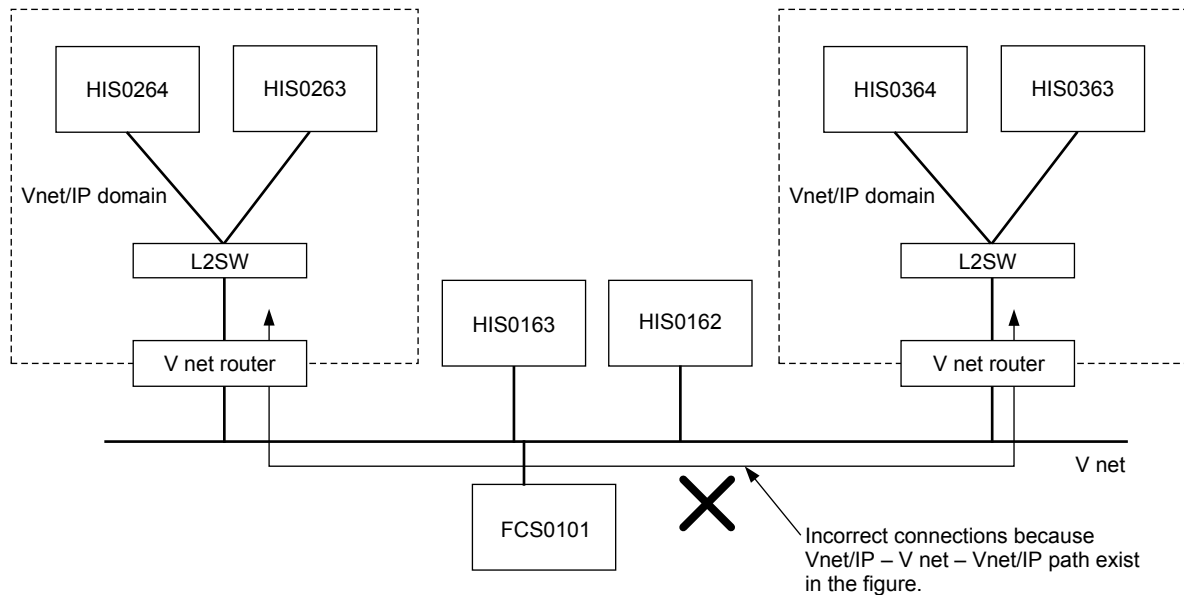


Figure Example of Expanded System Configuration

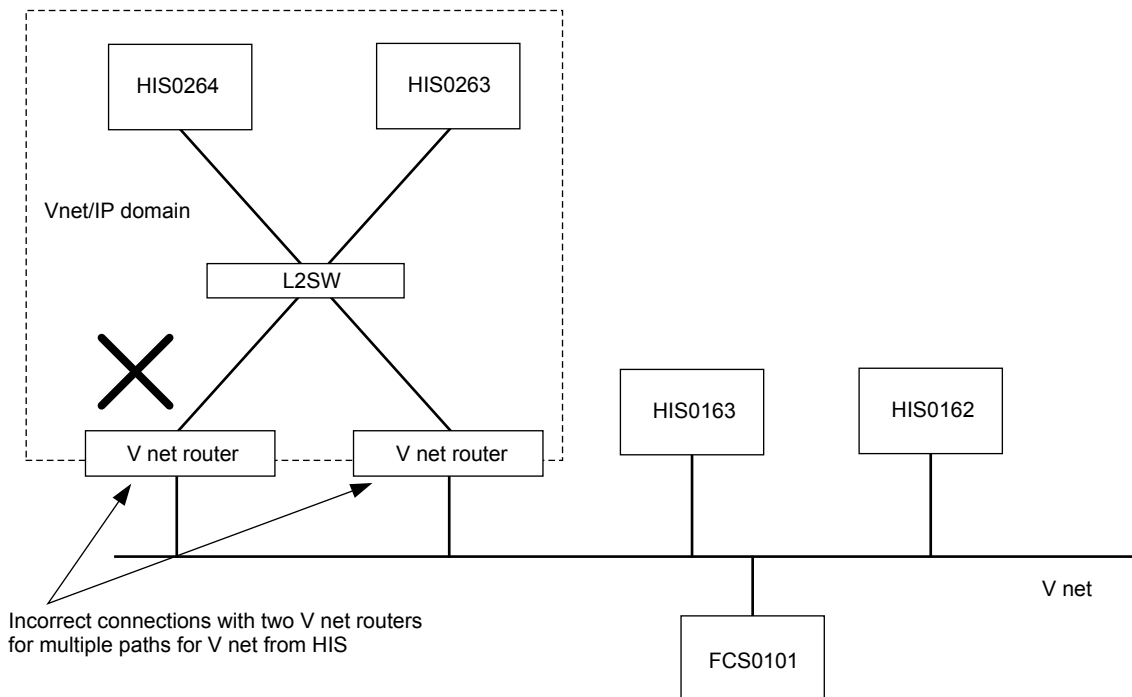
● Example of Incorrect Connection

Note that no connection via V net from Vnet/IP to other Vnet/IP domains can be made. Multiple paths for V net systems from Vnet/IP cannot be configured either.



F010407E.ai

Figure Example of Connection of Vnet/IP Domain via V net



F010408E.ai

Figure Example of where there are multiple paths to V net from Vnet/IP

2. Vnet/IP Communications Specifications

In constructing a Vnet/IP system, it is necessary to take the system configuration into account. The information required to construct Vnet/IP networks is described herein.

2.1 High Reliability of Vnet/IP

Vnet/IP is a control network that has a dual-redundant configuration. Statuses of Vnet/IP stations and the communication paths are constantly monitored. When a problem occurs in bus 1, the path will be instantly and automatically switched so that control communications is performed using bus 2.

■ Statuses of Vnet/IP Stations and the Communication Path

Vnet/IP stations connected to Vnet/IP have features for transmitting the statuses of the station and the communication path with each other. With these features, each Vnet/IP station retains the statuses of the Vnet/IP station on Vnet/IP as well as of communication paths. In addition, the information is updated periodically.

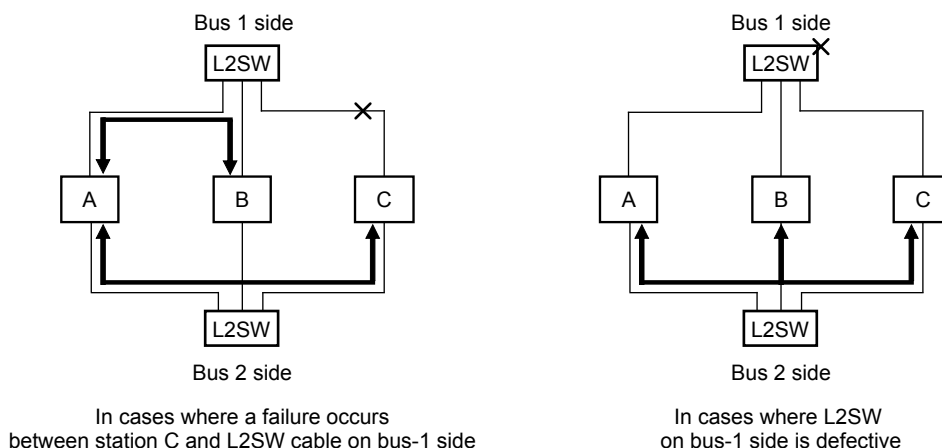
■ Selection of Transmission Path for Control Communications

A Vnet/IP station comprehends the path status for a communication destination from its own communication path information, and chooses a normal bus to transmit the control data required. If the communication paths for the communication destination are normal in both buses, bus 1 is selected.

For control communications, bus 1 is usually prioritized to be used rather than alternately used. If a problem occurs in bus 1, bus 2 will be used. If bus 1 recovers, bus 1 will be used.

Bus switching is performed in every path up to the communication destination. In the following figure, if a communications error occurs between the L2SW cable and station C, bus 1 is used between station A and station B, and bus 2 is used between station A and station C.

If the L2SW itself on bus 1 is defective, bus 2 will be used between stations A and B and between stations A and C. If a defective L2SW reverts to normal, bus 1 resumes.



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Figure Selection of Transmission Path

2.2 Communications for Duplexed FCSs, Duplexed SCSs and V net Routers

The duplexed FCSs, duplexed SCSs and V net routers have two CPUs. Each of two CPUs is connected to L2SWs in dual-redundant Vnet/IP. As described before, a Vnet/IP station has information for other stations on Vnet/IP, including control information.

A station on the transmission side determines whether information should be transmitted to either the control side or standby side from the type of communication and the duplexed stations control information on the receiving side.

2.3 System Configuration with Open Communications

■ Data Flowing to Bus-2 Side

Open communications are implemented on the bus-2 side.

HIS/ENG/SENG functions and general-purpose open-based communications devices use open communications.

Information flowing to the bus-2 side from the HIS/ENG/SENG station includes:

- Equalization communications (between ENG and HIS) (with shared files)
- Multihost-based engineering (with shared files)
- Sequence table/drawing/SEBOL/SFC status display data acquisition (between ENG and HIS)
- Other stations' trends (between HIS and other HISs) (socket communications)
- Download, IOM download, tuning parameter saving in an operating status display window (between HIS and ENG) (with shared files)
- Long-term data archive (when data are saved on another PC disk) (with shared files)
- HIS recipe equalization (between HIS and other HISs)
- Process management server/client processing (between HIS and other HISs)
- Database download to APCS or GSGW (between ENG and APCS, between ENG and GSGW)
- Open data interface (between a Supervisory PC and HIS)
- CENTUM integration information transfer (between SENG and ENG)

Vnet/IP open communications use open-based communications devices that can communicate with CENTUM or ProSafe-RS systems. As general-purpose open-based communications devices, the following may be used:

- SBPs (Solution-based Packages) including Exaopc client, Exapilot client, Exaquantum client, and the like
- PRM client, PRM server
- Subsystem communications devices (Ethernet communications)
- Network printers
- General-purpose PCs (for historical data management)

■ Bandwidth that can be used for open communications

In a Vnet/IP domain, the bandwidth for control communications is automatically controlled to not exceed 500 Mbps. Open communications use a remaining bandwidth of 500 Mbps. This is to ensure that control communications and open communications do not affect each other even in the case where dual-redundant bus 1 is abnormal, and control communications and open communications coexist on bus 2. Among 500 Mbps open communications, a bandwidth of 200 Mbps is for traffic use, transmitted from HIS or ENG open communications, and is controlled so as not to exceed 200 Mbps in the entire network.

Therefore, if general-purpose open-based communications devices are connected to the bus-2 side, the bandwidth for open-based communications devices on a network should be within 300 Mbps for each domain so that control communications operate under a steady state.

TIP

Precautions for connecting a multicasting open-based communications device to Vnet/IP:

A communication speed of SCS and V net router is 100 Mbps. Use an intelligent switch as a L2SW to connect SCS and V net router and set the L2SW to avoid inflow of multicast through open communications in case a multicasting open-based communications device is connected.

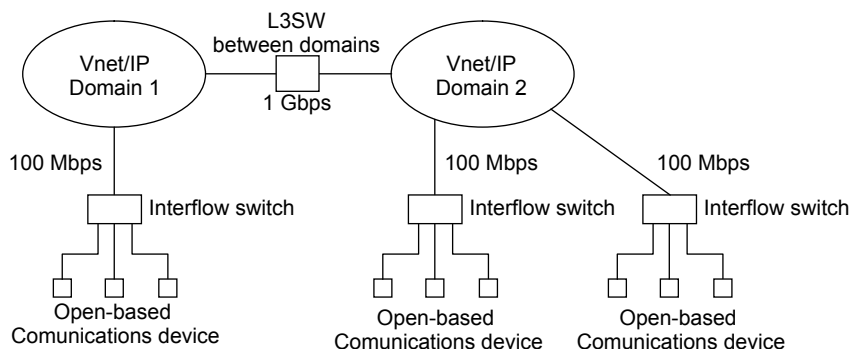
As for setting, please contact Yokogawa's sales representative.

■ Limitations of Bandwidth for Open-based Communications Devices

In order to keep the bandwidth for open-based communications devices within 300 Mbps, an interflow switch (see the figure below) is used and the open-based communications device port rate is limited. This bandwidth restriction is realized by setting the total amount of the bit rates of the cables connected to the interflow switch. A non-intelligent type of switch can be used for the interflow switch. For such purposes, select a switch having the required port rates to limit bandwidth.

■ Applications Where Multiple Domains Exist

Connections between Vnet/IP domains use 1 Gbps. The traffic for all open-based communications devices (within bandwidth of 300 Mbps) in one domain will flow in another domain. In order to make bandwidth for open-based communications devices 300 Mbps or less for each domain, the total bandwidth for open-based communications devices flowing in all domains should be 300 Mbps. In the following figure, to domain 1, the traffic for open-based communications devices within bandwidth of 200 Mbps flow from domain 2, so the bandwidth for open-based communications devices in domain 1 should be 100 Mbps. To domain 2, the traffic for open-based communications devices within bandwidth of 100 Mbps flow from domain 1, so the bandwidth for open-based communications devices in domain 2 is a maximum of 200 Mbps.



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Figure Open Communications in Multiple Domains

2.4 IP Address Specifications for Vnet/IP

Devices connected to Vnet/IP require IP addresses for control and open communications. This section provides IP addresses for Vnet/IP.

■ Network Address Used for Vnet/IP

A class C private address is used for Vnet/IP. Class C private addresses range from 192.168.0.0 to 192.168.255.255 (subnetmask 255.255.255.0).

The network address is determined by the domain number and bus system. Domain number is set with a DIP switch for each Vnet/IP station. Domain numbers should not overlap in Vnet/IP or a V net system.

Network addresses are determined by domain numbers as follows:

Table Network Address

Bus line	Network Address
Bus-1 side	192.168. (domain number).0
Bus-2 side	192.168.128+ (domain number).0

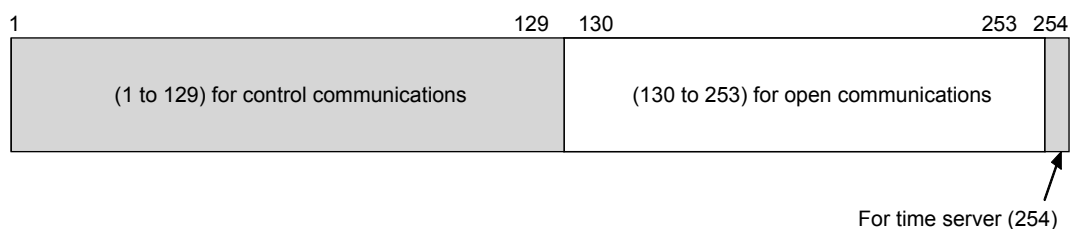
■ Host Address for Control Communications

A host address for control communications can be automatically set, ranging from 1 to 129 from station number. Station numbers are set with a DIP switch for each device. In addition, the time server host address is fixed at 254 (*1).

*1: It can be changed in Domain Properties in CENTUM VP and CENTUM CS 3000 R3.08 or later.

■ IP Address for Open Communications

IP addresses for open communications in a Vnet/IP station, as well as for general-purpose, open-based communications devices and network devices, are not automatically set. Network addresses should be set in conformity with an address system for control communications. Addresses 1 to 129 and 254 are set aside for control communications, so select from 130 to 253 as the host address for open communications.



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Figure Host Address Allocation

■ Virtual IP Address for Control Bus TCP/IP Communications

Control Bus TCP/IP communications are used to download recipe data from an HIS to an FCS in CENTUM. In ProSafe-RS, it is used for communication between SENG SCS Manager and SCS.

For compatibility with existing V net systems, TCP/IP communications (TCP/IP over V net) using a Vnet/IP protocol are supported, so a virtual IP address for TCP/IP over V net should be specified. This IP address is a virtual address and automatically determined according to domain number and station number. In normal situations, the automatically determined setting should be used.

The following is a automatically-determined setting value.

IP address: 172.16.<domain number>.<station number>
Subnet mask: 255.255.0.0

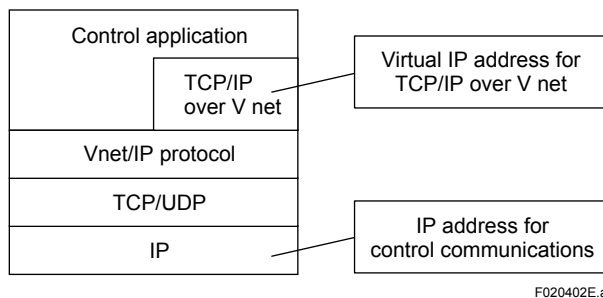


Figure Virtual IP Address for Control Bus TCP/IP Communications

■ Problems with Overlapping IP Addresses

No particular attention is given on a network address if the Vnet/IP network is not connected with other networks. However, if connected to other networks, pay special attention to prevent overlapping with other addresses. IP addresses for control communications are automatically set from the domain and station numbers. If automatically set IP addresses overlap with existing network addresses, the utility functions allow the IP addresses to be changed. Overlapping can be avoided by changing the domain number on the CENTUM side.

Vnet/IP stations incorporate many IP addresses. Special attention should be given to avoid overlapping all of these IP addresses when connecting to other networks.

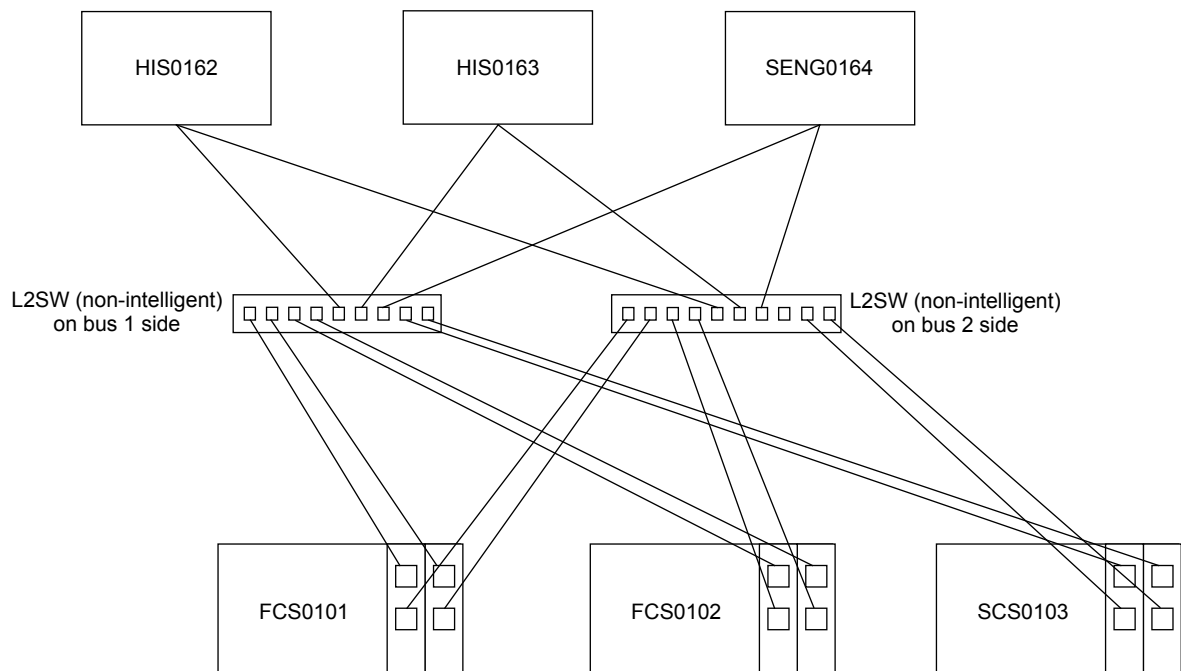
3. Vnet/IP Network Configuration Examples

This manual has so far described network specifications. This chapter describes specifically the relationship between the network configuration and specifications in the Vnet/IP system. The following gives information, along with considerable examples, to note when configuring a network.

3.1 Connection within One Domain

■ System Configuration in One Domain

If the maximum of 64 Vnet/IP stations is present in the system, it can be configured in one Vnet/IP domain. The following figure shows a system configuration, consisting of two HISs, one SENG, two duplexed FCSs and one duplexed SCS.



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Figure Example of Connection within One Domain

Vnet/IP Station IP Address

In the system shown in “Figure Example of Connection within One Domain”, the following IP addresses are used. IP addresses for control communications are automatically set from domain and station numbers. So, users no longer need to set IP addresses. IP addresses for open communications should be set in conformity with an automatically set control communication's IP address system. In this example, non-intelligent L2SWs are used, so no IP address setting for the switches is required. The table below shows the IP address setting example.

Table Vnet/IP Station IP Address Example

Station	Domain number	Station number	IP address			Setting procedure
HIS0162	1	62	Control communications	Bus-1 side	192.168.1.124/24	Automatic setting
				Bus-2 side (*1)	192.168.129.124/24	Automatic setting
			Open communications (Bus-2 side)		192.168.129.130/24	Set in OS (Windows) and ENG Systemview
			Control bus TCP/IP communications (*2)		172.16.1.62/16	Set in OS (Windows) and ENG Systemview
HIS0163	1	63	Control communications	Bus-1 side	192.168.1.126/24	Automatic setting
				Bus-2 side (*1)	192.168.129.126/24	Automatic setting
			Open communications (Bus-2 side)		192.168.129.131/24	Set in OS (Windows) and ENG Systemview
			Control bus TCP/IP communications (*2)		172.16.1.63/16	Set in OS (Windows) and ENG Systemview
HIS0164	1	64	Control communications	Bus-1 side	192.168.1.128/24	Automatic setting
				Bus-2 side (*1)	192.168.129.128/24	Automatic setting
			Open communications (Bus-2 side)		192.168.129.132/24	Set in OS (Windows) and SENG SCS Manager
			Control bus TCP/IP communications (*2)		172.16.1.64/16	Set in OS (Windows) and SENG SCS Manager
FCS0101	1	1	Control communications	Bus-1 side	192.168.1.2/24	Automatic setting
				Bus-2 side (*1)	192.168.1.3/24	Automatic setting
			Control bus TCP/IP communications (*2)	Bus-2 side (*1)	192.168.129.2/24	Automatic setting
				Bus-2 side (*1)	192.168.129.3/24	Automatic setting
FCS0102	1	2	Control communications	Bus-1 side	192.168.1.4/24	Automatic setting
				Bus-2 side (*1)	192.168.1.5/24	Automatic setting
			Control bus TCP/IP communications (*2)	Bus-2 side (*1)	192.168.129.4/24	Automatic setting
				Bus-2 side (*1)	192.168.129.5/24	Automatic setting
SCS0103	1	3	Control communications	Bus-1 side	192.168.1.6/24	Automatic setting
				Bus-2 side (*1)	192.168.1.7/24	Automatic setting
			Control bus TCP/IP communications (*2)	Bus-2 side (*1)	192.168.129.6/24	Automatic setting
				Bus-2 side (*1)	192.168.129.7/24	Automatic setting
SCS0103	1	3	Control bus TCP/IP communications (*2)		172.16.1.3/16	Set in SENG SCS Manager

*1: If bus 1 fails, control communications is performed using bus 2.

*2: IP address for control bus TCP/IP communications is a virtual address.

IP addresses for control communications use host addresses 1 to 129. Use 130 or later for a host address for open communications. In the above example, host addresses 130 to 132 are used for open communications.

■ Virtual IP Addresses for Control Bus TCP/IP Communications

Use a default IP address for control bus TCP/IP communications. By default, a class B address, 172.16. (domain number). (station number) has been set. This IP address has no connection with path information, so there is no need to conform to the IP address system for control communications.

■ Number of Ports Required for L2SW

One L2SW manages the network of one bus. For bus 1 and bus 2, you need at least one L2SW each. If no open-based communications devices are present, the number of ports required for a L2SW may be expressed mathematically by:

Number of ports required for a L2SW = (number of Vnet/IP stations that use Vnet/IP interface cards) + (number of single FCSs and single SCSs) + (number of duplexed FCSs and duplexed SCSs) x 2

The above configuration example (figure) uses two HISs, one SENG, two duplexed FCSs and one duplexed SCS, so the number of ports required is calculated as:
 $3 + 3 \times 2 = 9$

Hence, nine ports are required on the bus-1 side and nine ports are required on the bus-2 side.

■ L2SW Setting

Use a L2SW with 1000BASE-T with full-duplex port features incorporated.

● Port Transmission Rate

The port transmission rate may be set by default to autonegotiation. Connection with a Vnet/IP station, set autonegotiation.

If the transmission rate set by switches is different from the transmission rate set by devices connected to switches, proper communications will not be made. When specifying the transmission rate, confirm the destination equipment setting.

Take note that an SCS is different from other Vnet/IP stations. Its transmission rate is 100 Mbps.

● IGMP Snooping

Disable IGMP snooping

● Spanning Tree

Disable spanning tree

3.2 Connection with Existing Systems

A V net router allows connection to systems using other V nets or VL nets. Existing HF- or RL-bus systems cannot be connected directly to Vnet/IP, but they can be connected via a BCV on a V net. Hierarchical system connections using L3SWs and V net routers allow system expansion exceeding the maximum system as given in the previous sections. In other words, hierarchical expansion systems with other control systems hierarchically connected can be achieved.

3.2.1 Connection with V net Systems

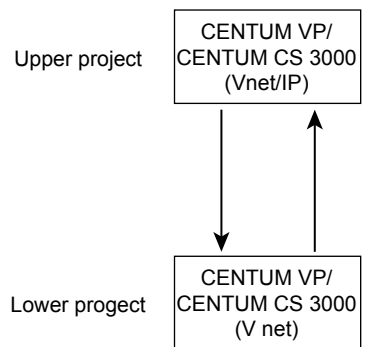
A V net and Vnet/IP are connected with a V net router. Set up the Ethernet on the V net side to the Vnet/IP bus-2 side via a L3SW.

■ Connection Types

When integrating Vnet/IP and V net projects, bi-directional or hierarchical connection can be used.

● Bi-Directional Connection

In a bi-directional connection, both upper and lower projects can operate and monitor each other. HISs in both domains can perform operation and monitoring of the other domain. Bi-directional connection can be applied for CENTUM VP/CENTUM CS 3000 and CENTUM VP/CENTUM CS 3000 projects only.



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Figure Bi-Directional Connection

● Hierarchical Connection

With a hierarchical connection, the lower project can be operated and monitored from the upper project HIS. The upper project must be CENTUM VP or CENTUM CS 3000. The lower project cannot operate or monitor the upper project. The followings are available for hierarchical connection.

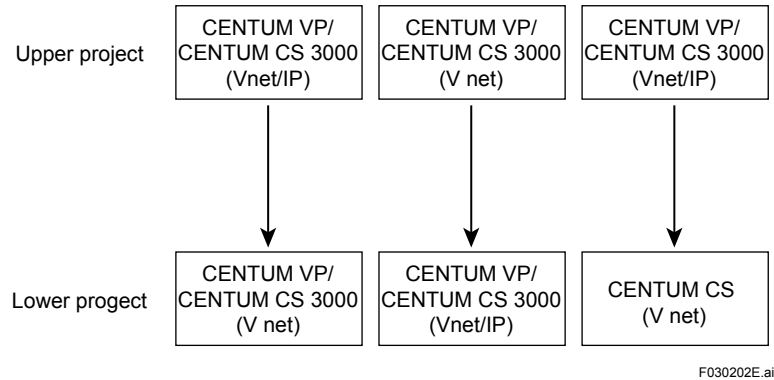


Figure Hierarchical Connection

TIP

Connection with V net Domains of CENTUM CS 3000 R3.04 or Earlier

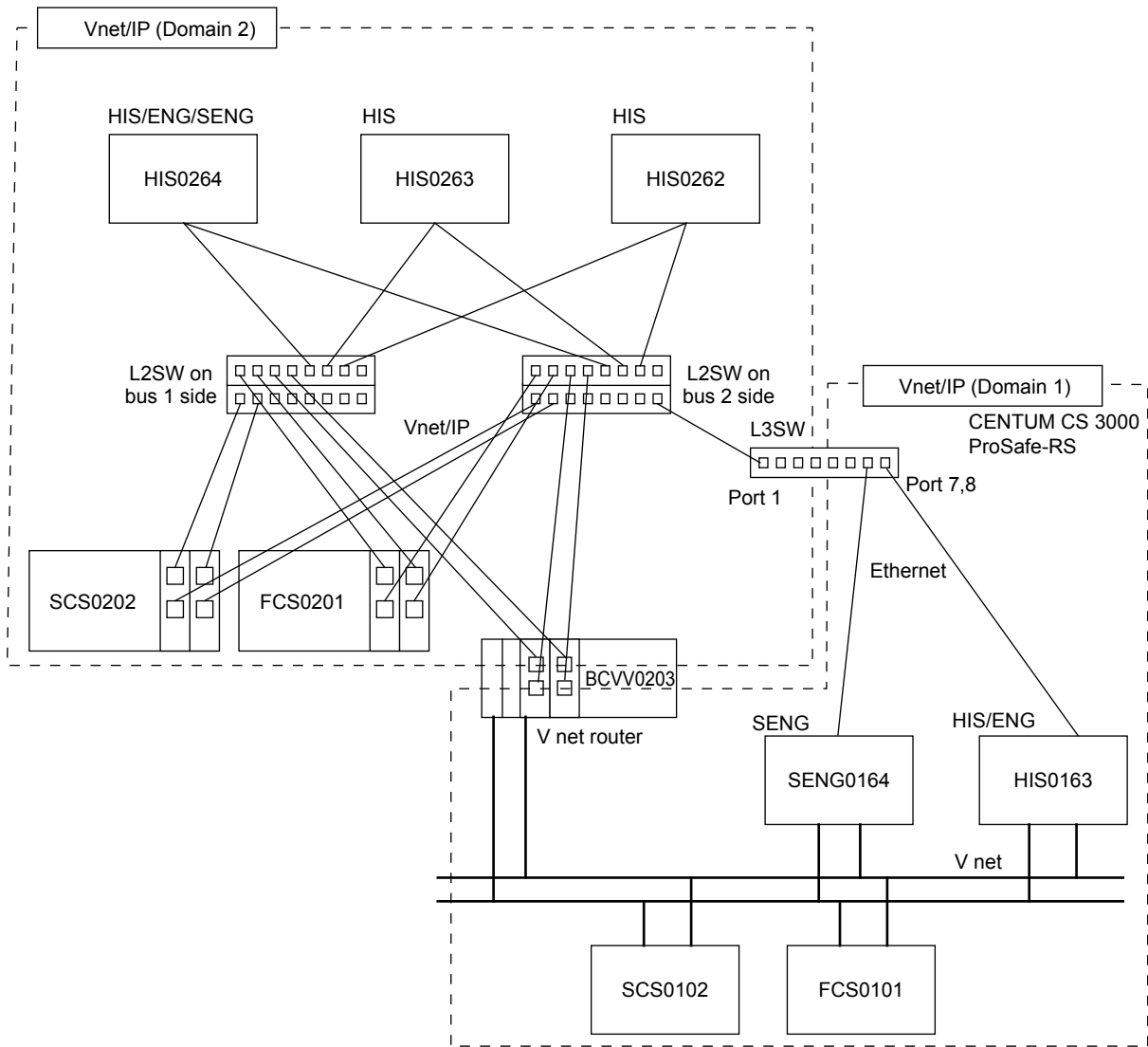
To connect with V net domains of CENTUM CS 3000 R3.04 or earlier, integrate them with multiple projects in which Vnet/IP side projects are classified as upper projects.

To connect Vnet/IP domains with existing V net domains, the HIS function running in CENTUM CS 3000 R3.04 or earlier has the following restrictions. However, the HIS function on the Vnet/IP side has no restriction.

- The network type on the Vnet/IP side is displayed as "V net."
- In the event of Vnet/IP bus status abnormality, a message indicating that control bus communication failure in all domains of Vnet/IP is displayed.
- The running status of the control station FFCS-L (AFV10S/AFV10D) becomes the same as the FFCS.
- The System Status Overview window of Vnet/IP domains calls up a window by window name specification.

■ Example of Connecting with V net

The following example shows the bi-directional connection configuration of Vnet/IP system (domain 2) of a higher order than a V net system (domain 1) for an existing CENTUM CS 3000 and ProSafe-RS system.



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Figure Example of Connecting with V net

■ IP Addresses

In the system shown in “Figure Example of Connection with V net”, the IP addresses required for the net configuration are given below. The setting of IP addresses for control communications, which are automatically determined by the domain and station numbers, is not required.

Table IP Address Example (Vnet/IP Side in Domain 2)

Station	Domain number	Station number	IP address			Setting Procedure	
HIS0262	2	62	Control communications	Bus-1 side	192.168.2.124/24	Automatic setting	
				Bus-2 side (*1)	192.168.130.124/24	Automatic setting	
			Open communications (Bus-2 side)			192.168.130.130/24	Set in OS (Windows) and ENG Systemview
			Control bus TCP/IP communications (*2)			172.16.2.62/16	Set in OS (Windows) and ENG Systemview
HIS0263	2	63	Control communications	Bus-1 side	192.168.2.126/24	Automatic setting	
				Bus-2 side (*1)	192.168.130.126/24	Automatic setting	
			Open communications (Bus-2 side)			192.168.130.131/24	Set in OS (Windows) and ENG Systemview
			Control bus TCP/IP communications (*2)			172.16.2.63/16	Set in OS (Windows) and ENG Systemview
HIS0264	2	64	Control communications	Bus-1 side	192.168.2.128/24	Automatic setting	
				Bus-2 side (*1)	192.168.130.128/24	Automatic setting	
			Open communications (Bus-2 side)			192.168.130.132/24	Set in OS (Windows) and ENG Systemview
			Control bus TCP/IP communications (*2)			172.16.2.64/16	Set in OS (Windows) and ENG Systemview
FCS0201	2	1	Control communications	Bus-1 side	192.168.2.2/24	Automatic setting	
					192.168.2.3/24	Automatic setting	
				Bus-2 side (*1)	192.168.130.2/24	Automatic setting	
					192.168.130.3/24	Automatic setting	
			Control bus TCP/IP communications (*2)			172.16.2.1/16	Set in ENG Systemview
SCS0202	2	2	Control communications	Bus-1 side	192.168.2.4/24	Automatic setting	
					192.168.2.5/24	Automatic setting	
				Bus-2 side (*1)	192.168.130.4/24	Automatic setting	
					192.168.130.5/24	Automatic setting	
			Control bus TCP/IP communications (*2)			172.16.2.2/16	Set in SENG SCS Manager
BCVV0203	2	3	Control communications	Bus-1 side	192.168.2.6/24	Automatic setting	
					192.168.2.7/24	Automatic setting	
				Bus-2 side (*1)	192.168.130.6/24	Automatic setting	
					192.168.130.7/24	Automatic setting	

Table IP Address Example (V net Side in Domain 1)

Station	Domain number	Station number	IP address		Setting Procedure
HIS0163	1	63	Ethernet communications	172.17.1.63/16	Set in OS (Windows) and ENG Systemview
			Control bus TCP/IP communications (*2)	172.16.1.63/16	Set in OS (Windows) and ENG Systemview
HIS0164	1	64	Ethernet communications	172.17.1.64/16	Set in OS (Windows) and ENG Systemview
			Control bus TCP/IP communications (*2)	172.16.1.64/16	Set in OS (Windows) and ENG Systemview
FCS0101	1	1	Control bus TCP/IP communications (*2)	172.16.1.1/16	Set in ENG Systemview
SCS0102	1	2	Control bus TCP/IP communications (*2)	172.16.1.2/16	Set in SENG SCS Manager

*1: If bus 1 fails, control communications is performed using bus 2.

*2: IP address for control bus TCP/IP communications is a virtual address.

If the information bus on the V net side (Ethernet) is connected to the bus-2 side on Vnet/IP, use the L3SW (because the address systems are different between these two nets).

Use the following two IP addresses for L3SW:

172.17.1.253/16 on the domain-1 side

192.168.130.253/24 on the domain-2 side

■ Setting V net Router

A V net router is set using Vnet/IP engineering functions for CENTUM. The table below lists the V net router settings in the system shown in “Figure Example of Connection with V net”.

Table V net Router Settings Example (1/2)

Classification	Setting item	Setting value	Description
Type	Station Type	AVR10D	V net router
	Domain Number	2	Domain number of Vnet/IP
	Station Number	3	Vnet/IP station number
	Component Number	(Up to 4 single-byte characters)	For device identification. Can be omitted.
	Station Comment	(Up to 24 single-byte characters)	For device identification. Can be omitted.
	Alias of Station	(Up to 8 single-byte characters)	An alternative of station name. Can be omitted.
	Station Status Display	(Up to 16 single-byte characters)	A window can be designated to display the station status on HIS instead of using the HIS station status display panel. Can be omitted.
	Upper Equipment Name	(Equipment name defined by Plant Hierarchy Builder)	The name of the higher-level process equipment. Can be omitted.
Constant	Lower Address	Domain Number: 1 Station Number: 3	Domain number and station number of V net.
	FCS Message Communication - Transfer upper	Check	FCS and SCS messages generated on the V net side will/will not be transferred to the Vnet/IP side.
	FCS Message Communication - Transfer lower	Check	FCS and SCS messages generated on the Vnet/IP side will/will not be transferred to the V net side.
	HIS Message Communication - Transfer upper	Check	HIS messages generated on the V net side will/will not be transferred to the Vnet/IP side.
	HIS Message Communication - Transfer lower	Check	HIS messages generated on the Vnet/IP side will/will not be transferred to the V net side.
	Own Station Message Communication - Transfer upper	Check	Messages generated on the V net router will/will not be transferred to the Vnet/IP side.
	Own Station Message Communication - Transfer lower	Check	Messages generated on the V net router will/will not be transferred to the V net side.
	Transfer System Time - Transfer upper	None (fixed)	Setting not allowed. The system time cannot be transferred from V net to Vnet/IP.
	Transfer System Time - Transfer lower	Check	The time setting will/will not be transferred from Vnet/IP to V net.
	Transfer TCP/IP to FCS	Check	TCP/IP communication between an HIS and an FCS will/will not be transferred. When engineering an SCS on a V net via a V net router from an SENG in a Vnet/IP domain, check the check box.

Table V net Router Settings Example (2/2)

Classification	Setting item	Setting value	Description
Upper-Level Domain	Target Domain	(Check the check box of the target domain.)	When the transmission destination address of a frame from a V net domain matches the upper domain definition, that frame will be relayed. Also, only a broadcast frame from a Vnet/IP domain specified in Upper-Level Domain will be relayed to a V net domain. It is not necessary to set a Vnet/IP domain to which this V net router is connected (a frame is always relayed).
Lower Gateway Definition	Station Name	(Station name) (*1)	Specify the station address of the bus converter defined in a lower domain and the number of the lower level domain. When the transmission destination address of a frame from a Vnet/IP domain matches the lower gateway definition, that frame will be relayed. Also, only a broadcast frame from the domain specified in the lower gateway definition will be relayed to a Vnet/IP domain. It is not necessary to set a V net domain to which this V net router is connected (a frame is always relayed).
	Domain Number	(1 to 64)	

*1: BCVVddss, BCVHddss, or BCVLddss (dd: domain number, ss: station number)

■ Setting L2SW

Use a L2SW with 1000BASE-T with full-duplex port features incorporated.

● Port Transmission Rate

The port transmission rate may be set by default to autonegotiation. Connection with a Vnet/IP station set it to autonegotiation.

If the transmission rate set by the switches is different from the transmission rate set by devices connected to the switches, proper communications will not be made. When specifying the transmission rate, confirm the destination equipment setting.

Take note that an SCS and V net router are different from other Vnet/IP stations. Their transmission rate is 100 Mbps.

● IGMP Snooping

Disable IGMP snooping

● Spanning Tree

Disable spanning tree

■ Setting L3SW

Communications between the Ethernet in domain 1 and bus 2 in domain 2 require that L3SW routing be set. To set switch routing, set the IP address to an interface for each domain.

The following shows the L3SW settings for routing. For detailed setting procedures, refer to the separate manual supplied with the L3SW.

● Setting VLAN

VLAN (Virtual LAN) is a function which separates LANs logically within a switch. A logical separation of communicable groups allows a network configuration in which each group can be connected to separate switches. In a Vnet/IP system, VLANs are set on a domain-by-domain basis. VLANs need their identification names, VLANID, or the like. After defining VLANs, specify each switch port to which the VLANs will belong.

In the system shown in “Figure Example of Connection with V net”, port 1 is assigned to a VLAN in domain 2, and ports 7 and 8 are assigned to VLANs in domain 1.

● Enabling Routing Functions

Enable the routing functions if they remain disabled.

● Setting IP Address to Each VLAN Interface

Set the IP address to each interface. In the system shown in “Figure Example of Connection with V net”, set the IP address 172.17.1.253 to the interface on the domain-1 side, and 192.168.130.253 to the interface on the domain-2 side.

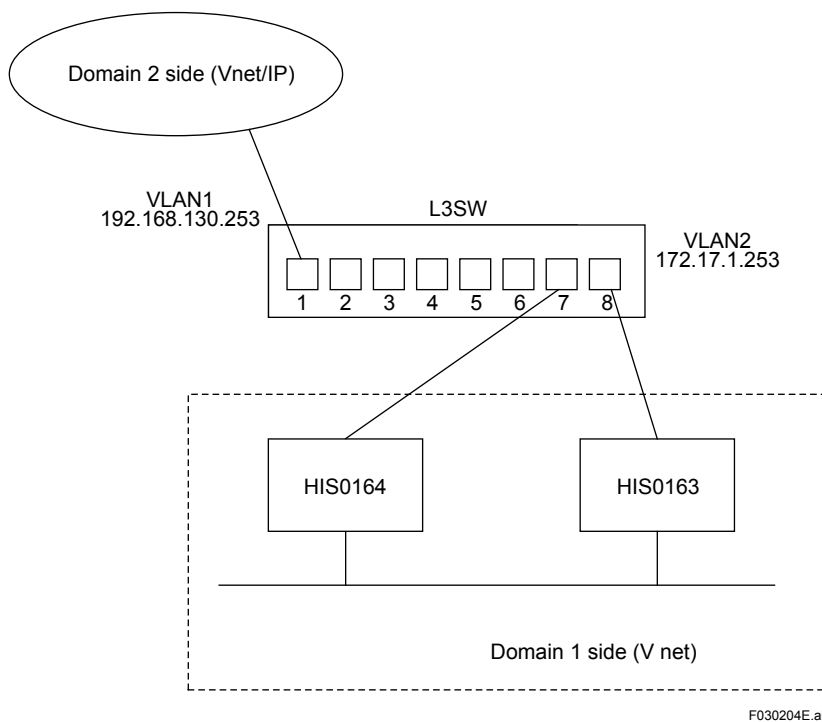


Figure IP Address Example to Each VLAN Interface

Table IP Address Example to Each VLAN Interface

Bus	VLAN	Port belonging to VLAN	Interface IP address
L3SW on bus-2 side	Domain 1	7, 8	172.17.1.253/16
	Domain 2	1	192.168.130.253/24

3.2.2 Connection with VL net Systems

For connections between a VL net and Vnet/IP, use a V net router as in the case of connecting with a V net. Though CENTUM CS 1000 systems do not require information buses, if they are connected to a Vnet/IP system, use Ethernet. Ethernet should be connected to a Vnet/IP bus 2 via a L3SW.

If multiple project connection functions are used, the Vnet/IP side will always be an upper-level project.

The following example shows the configuration of Vnet/IP system (domain 2) of a higher order than a VL net system (domain 1) for an existing CENTUM CS 1000 system.

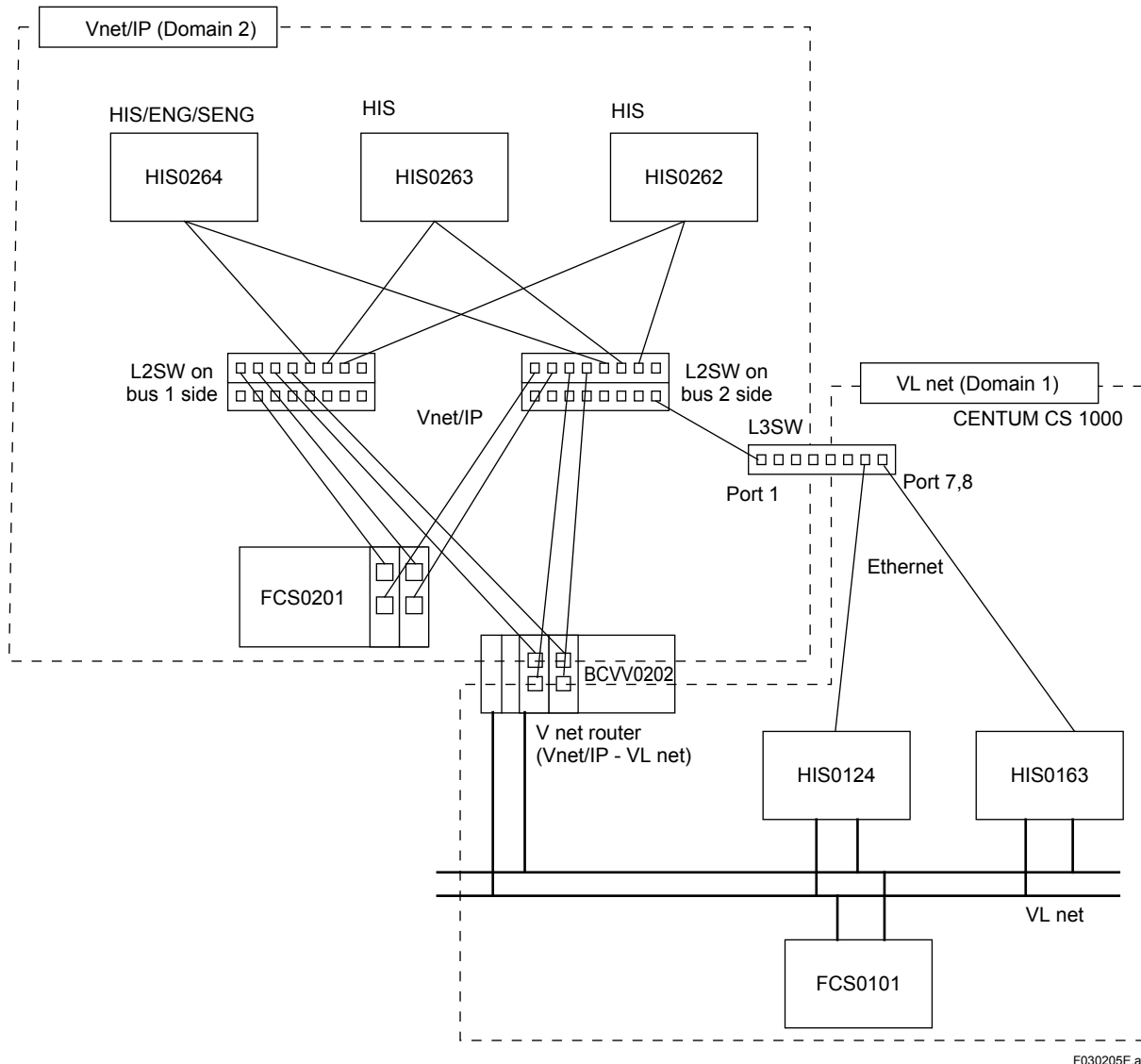
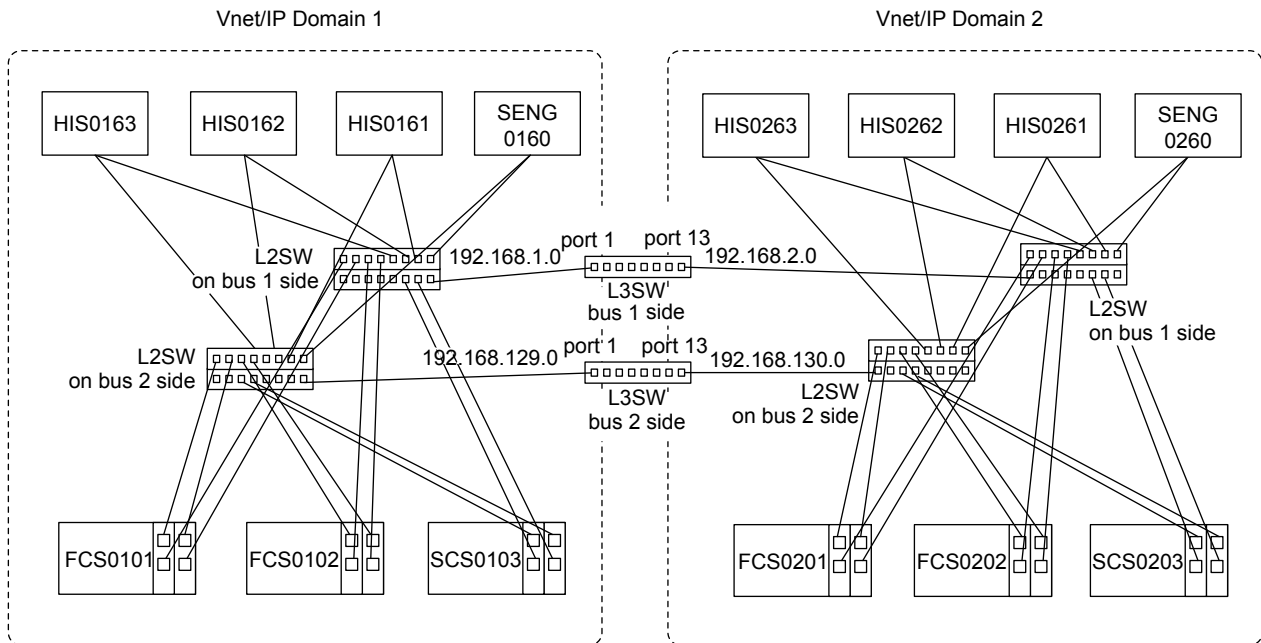


Figure Example of Connecting with VL net

3.3 Connecting Multiple Vnet/IP Domains

If there are more than 64 Vnet/IP stations, configure the Vnet/IP network with two or more domains.

The following figure shows an example of separating domains.



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Figure Example of Connecting Multiple Vnet/IP Domains

Up to 64 Vnet/IP stations can be connected on each domain. Connections between domains use a L3SW. Set the transmission rate as high as 1 Gbps for the connection between domains (L3SW - L2SW).

Up to 15 levels (16 hierarchical connections) of Vnet/IP domains can be connected. Vnet/IP domain connection topology includes bi-directional, hierarchical and bridge connections. In bi-directional connections, HISs in both domains can perform operation and monitoring of the other domain.

Connection topology is set in Domain Properties in CENTUM engineering function.

To communicate between stations of ProSafe-RS in different domains, set "ON" for TCP/IP communication transmission in Domain Properties in CENTUM engineering function.

**SEE
ALSO**

For more information about the Vnet/IP domain connection topology, refer to the following:

"1.4 Vnet/IP System Specifications ■ Inter-domain Connections"

■ Setting L2SW

The same setting as described in “3.1 Connection within One Domain” is required.

■ Setting L3SW

L3SW routing is set to communicate between domains. To set switch routing, first set the IP address to an interface for each domain, meeting the IP address for control communications. The following shows the required L3SW settings for routing. For detailed setting procedures, refer to the separate manual supplied with the L3SW. The following shows an example of a specific setting of an HIS and an FCS extracted from “Figure Example of Connecting Multiple Vnet/IP Domains”.

● Setting VLAN

VLAN (Virtual LAN) is a function which separates LANs logically within a switch. A logical separation of communicable groups allows a network configuration in which each group can be connected to separate switches. In a Vnet/IP system, VLANs are set on a domain-by-domain basis. VLANs need their identification names, VLANID, or the like. After defining VLANs, specify each switch port to which the VLANs will belong.

In the example, port 1 is assigned to a VLAN in domain 1, and port 13 is assigned to a VLAN in domain 2.

● Enabling Routing Functions

Enable the routing functions if they remain disabled.

● Setting IP Address to Each VLAN Interface

Set the IP address to each interface. In the example below, for a L3SW on the bus-1 side, set IP addresses 192.168.1.253 to the interface on the domain-1 side and 192.168.2.253 to the interface on the domain-2 side. For a L3SW on the bus-2 side, set IP addresses 192.168.129.253 to the interface on the domain-1 side and 192.168.130.253 to the interface on the domain-2 side.

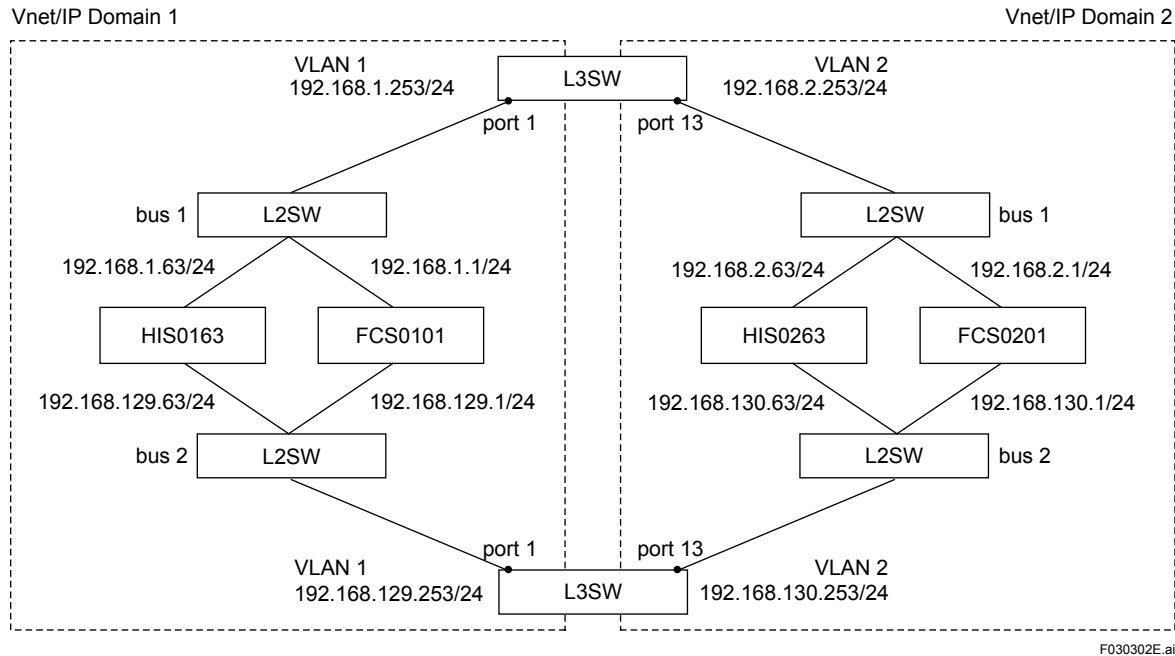


Figure Example of IP Address to Each VLAN Interface

The L3SW setting required to create routing information on the bus-1 and bus-2 sides is given below:

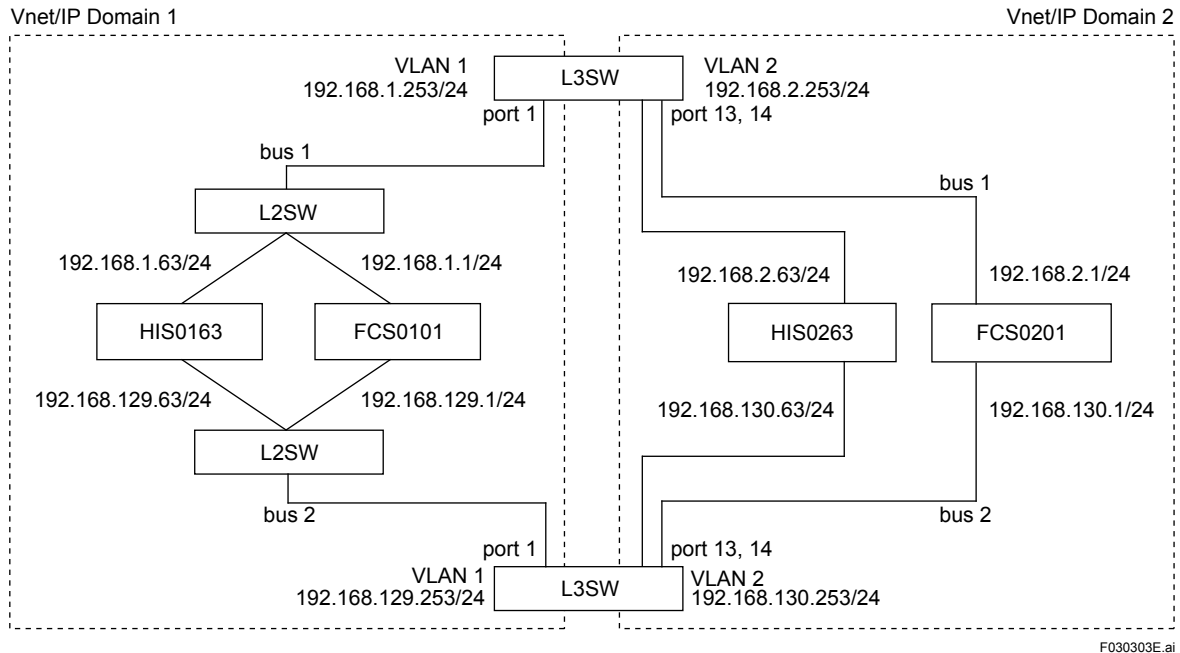
Table Example of IP Address to Each VLAN interface

Bus	VLAN	Port belonging to VLAN	Interface IP address
L3SW on bus-1 side	Domain 1	1	192.168.1.253/24
	Domain 2	13	192.168.2.253/24
L3SW on bus-2 side	Domain 1	1	192.168.129.253/24
	Domain 2	13	192.168.130.253/24

● Direct Connection to L3SW

If a L3SW has a sufficient number of ports, Vnet/IP stations and open-based communications devices can be connected directly to the L3SW.

The same setting as the L2SW is required for the L3SW's port to which Vnet/IP station or open-based communications device is connected directly.



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Figure Example of IP Address in Direct Connection to L3SW

The information setting for the above example is given below:

Table Example of IP Address in Direct Connection to L3SW

Bus	VLAN	Port belonging to VLAN	Interface IP address
L3SW on bus-1 side	Domain 1	1	192.168.1.253/24
	Domain 2	13, 14	192.168.2.253/24
L3SW on bus-2 side	Domain 1	1	192.168.129.253/24
	Domain 2	13, 14	192.168.130.253/24

● Enabling RIP

Enable RIP for interfaces on the domain-1 and domain-2 sides. Enabling RIP allows the RIP packet to be sent and received, dynamically creating routing information between domains 1 and 2.

● Setting RIP Update Period

Set the RIP update timer to one second.

● Specifying the Version of RIP Packet to Be Sent

Set the RIP packet to be sent to each interface to the RIP1-compatible mode for RIP2.

- **Enabling IGMP**

IGMP is a protocol used between multicast routers on LAN and IP hosts, allowing message exchanges. It also provides a periodic confirmation of members of multicast groups on a LAN. Enable IGMP for each interface.

- **Enabling DVMRP or PIM-DM**

DVMRP and PIM-DM are the multicast routing protocol. Enable DVMRP or PIM-DM for each interface.

- **Summary of Set Information**

The L3SW allows network routing between domain 1 and domain 2 on each bus 1 and bus 2. When the L3SW is on, path information is automatically created. Vnet/IP stations support the RIP. Devices that support the RIP automatically create path information.

3.4 Connection with External Network

If Vnet/IP is connected with an external network such as a business network, the security countermeasures to protect a control communications network are required. Consult the network administrator to determine the network configuration.

**SEE
ALSO**

For more information about the security countermeasures, refer to the following:

TI 33Y01B30-01E Security Standard of System Product

4. Selection of Network-related Devices

The following describes the functions required for commercially available network devices for use in Vnet/IP. For use in Vnet/IP, select commercially available network devices meeting the functions described herein.



IMPORTANT

Yokogawa tests the behavior of specific network-related devices with Yokogawa's products. For Vnet/IP, select commercially available network devices that have been tested. You can contact Yokogawa's sales representative for more information about network-related devices that have been tested.

4.1 L2SW

Select a L2SW with the functions described below:

■ Port

- **Connection with Vnet/IP Stations (except SCS and V net Router) and Open-based Communications Devices**

1000BASE-T, Full Duplex

- **Connection with SCS and V net Router**

100BASE-TX, Full Duplex

- **Connection between Switches**

1 Gbps or greater, Full Duplex, 1000BASE-T, 1000BASE-LX, etc.

■ Autonegotiation Function

Be sure to set autonegotiation for Vnet/IP.

In addition, it is recommended that switches allow manual setting of the transmission rate and mode.

■ Switching Capacity

1 Gbps (1.4 Mpps @ 64 byte) or greater

■ Packet Buffer

128 Kbyte or greater (non-intelligent switch)

■ IGMP Snooping

When an open-based communication device that performs multicast communication is connected to a Vnet/IP network, IGMP Snooping is mandatory for the L2SW connected to the 100BASE-TX Vnet/IP station (SCS or V net router).

■ Disable unwanted functions

If there are any functions (especially vendor-specific functions) that are not used by the standard Vnet/IP, you need to disable that function.

■ Installation Environment

For harsh environmental conditions, select industrial instruments.

TIP

- SNMP

Devices incorporating SNMP features are called managed type devices. For a simple network configuration with two usual hierarchical network structures or so, no managed-type L2SW is required. If multiple network configurations with many devices are used, managed-type L2SWs are recommended.

- Dual Redundancy

Multiple devices are connected to a L2SW. So, if the L2SW stops, all communications by devices connected to the switch will stop. Vnet/IP is a dual-redundant network, so, even if bus 1 stops, control communications by bus 2 will continue. However, attention needs to be paid so as not to stop both buses at the same time.

4.2 L3SW

The L3SW, having routing functions, is used for connections between domains. This section provides necessary functions for a L3SW transmitting data between domains. The L3SW includes functions that a L2SW has, enabling, as a switch connecting devices within a domain, the combined use of functions incorporated in a L2SW.

■ L2SW equivalent performance and function

The performance and function of an L3SW must be equivalent to that of an L2SW, as described in “4.1 Selection of L2SW.”

■ Unicast Routing

- RIPv2 (RIPv1 compatible mode required)

Vnet/IP employs, if multiple domains are present, dynamic routing allowing automatic determination of a path between domains.

■ Multicast Routing

- Supported in IGMPv2 or later
- Supported in PIM-DM (*1)

*1: You can use multicast routing protocols other than PIM-DM (for example, DVMRP). However, this needs to be standardized for all L3SWs used.

■ QoS

- IPv4 TOS (Precedence) priority control function
- Relay bandwidth restriction function

■ Number of MAC address registrations

Above 4000

4.3 Boundary Router

A boundary router is used to connect a remote network and a Vnet/IP network (network for control communications). Usually, only the bus-2 side is used. Boundary routers shall meet the requirements given below.

■ L3SW Function

Boundary routers need to include functions equivalent to those a L3SW has. For connections with a remote network, static routing functions in unicast routing are needed. No multicast routing functions are required.

■ Firewall Function

A boundary router with firewall functions is needed to ensure network security for control communications.

4.4 Remote Router

If wide-area communications are required, contact Yokogawa's sales representative.

4.5 Cable

■ Metal Cable

Select CAT5e (enhanced category 5) or higher UTP metal cables.
Select RJ-45 connectors. The cable can be up to 100 meters long.

■ Optical Cable

For future use, it is recommended that single mode cables (IEC B1.1 type, ITT-U, G652 or JIS SSMA type) be selected. Select similar cables conformable to the above single-mode cables for devices.

Single-mode cables of 1000BASE-LX can be up to 5 km long.

If multimode cables are used, note that special cords like mode-conditioning patch cords are required.

5. Appendix

5.1 Glossary of Network Terms

Commercially available network devices are used to construct a Vnet/IP system between Vnet/IP stations. This section provides a brief description of the network terms used in this manual.

■ 1000BASE-LX

One of Gigabit Ethernet standards specified in IEEE 802.3. It uses a fiber-optic cable and has a transmission rate of 1 gigabit per second.

■ 1000BASE-T

One of Gigabit Ethernet standards specified in IEEE 802.3. It uses an enhanced Category 5 (Cat5e) UTP cable and has a transmission rate of 1 gigabit per second.

■ 100BASE-TX

One of Fast Ethernet standards specified in IEEE 802.3. It uses a Category 5 (Cat5) UTP cable and has a transmission rate of 100 megabit per second.

■ Autonegotiation

Autonegotiation is a function which allows automatically setting of the transmission rate and full-duplex or half-duplex transmission between switches and terminal equipment.

■ DVMRP (Distance Vector Multicast Routing Protocol)

A DVMRP is one of multicast routing protocols and is used to control a routing path for multicast communications. Path control functions are used to create a multicast routing table from adjacent and group information acquired using the multicast routing protocol. The DVMRP is a distance vector routing path control protocol.

■ Fiber-optic Cable

A cable made of glass or plastic for optical communications. From the viewpoint of cable extensions, cable laid between buildings, and use in noisy locations, it is recommended that fiber-optic cables be used. LAN standards, 100BASE-FX, 1000BASE-SX, and 1000BASE-LX apply to fiber-optic cables. Each standard specifies types of fiber-optic cables, their extensions, and the like. For detailed specifications, refer to the applicable network device manuals, and the IEEE 802 standard and reference.

■ Firewall

This is a generic term to prevent devices or functions from being affected by illegal access from a remote network.

■ Gigabit Ethernet

An Ethernet standard for 1 Gbps transmission rate, as defined by IEEE802.3. There are different standards, such as 1000BASE-LX, which uses optical fiber, or 1000BASE-T, which uses UTP cable.

■ IGMP (Internet Group Management Protocol)

An IGMP informs adjacent multicast routers of multicast groups in which Internet hosts are participating.

■ IGMP Snooping

This function is used to suppress unnecessary traffic in multicast communication for L2SW. The switch only forwards multicast communication to ports with the required host by snooping IGMP packets between routers and hosts.

■ Intelligent Switch

Other than the simple transmission function, this is a switch that enables configuration of different settings such as the transmission rate for VLAN, QoS, and ports. It also enables management and configuration of SNMP through the network.

■ L2SW (Layer 2 Switch)

A network device that transmits packets based on information in Layer 2 (Data Link Layer) of the OSI reference model. The function of these switches is similar to that of a bridge. A layer 2 switch is a switching hub that relays data only to the MAC address terminal that has been specified as the destination.

■ L3SW (Layer 3 Switch)

A network device that transmits packets based on information in Layer 3 (Network Layer) of the OSI reference model. This switch is a switching hub with optimized hardware routing processing. Compared to normal routers, the L3SW allows high-speed routing processing on low-cost switch hubs.

■ MAC Address (Media Access Control Address)

MAC address is a unique address assigned to each Ethernet interface for identification.

■ Multicast Communications

Multicast communications are intended for communicating to multiple terminal equipment in a group.

■ Multicast Routing

Multicast routing is the multicast communications routing process.

■ Non-intelligent switch

A switch that has only the simple transmission function.

■ OPC (OLE for Process Control)

This is a standard interface that supports the development of the measurement control system using Microsoft COM/DCOM.

■ PIM-DM (Protocol Independent Multicast-Dense Mode)

This is a multicast routing control protocol independent of a unicast IPv4 path mechanism as in DVMRP. Unnecessary paths are excluded after transmitting the packets.

■ RIP (Routing Information Protocol)

A router or L3SW transmits data referring to the path information table, which may be created by a person or automatically created by a router or L3SW. An RIP allows a router or L3SW to automatically create the path information. In the RIP, adjacent routers exchange routing information. A router that has received information adds it to its own path information.

■ Router

A router is a network device that transmits packets between networks based on information in the network layers (Layer 3 of the OSI reference model). Routers incorporate communications frame routing functionality, allowing connections between network domains as well as with other media over a wide-area network.

In recent years, multifunctional routers that include security functions, firewalls, dual-redundant functions, and the like have generally been used.

■ SNMP (Simple Network Management Protocol)

SNMP is used for management of network devices via network. It is effective in observing network conditions, and finding and solving network problems.

■ SNTP (Simple Network Time Protocol) Server

A server that provides the time in response to a time retrieval request from a client that uses SNTP. SNTP is a type of protocol for time synchronization through the network.

■ Spanning Tree

A function that prevents communication data from continuously circulating in a loop even when the network is physically structured in a loop.

■ Switching Capacity

Switching capacity is one of numeric values indicating the processing capacity of switches. The amount of data processed per second by switches is indicated. The switching capacity is also called the backplane capacity, switching fabric or internal bus rate.

■ Switching Hub

A hub with a bridge function has functions to store received packets in buffer memory, analyzing destination addresses in order to transmit packets to their required ports. No frames are relayed to all segments unlike repeater hubs, so switching hubs are effective in network load sharing.

Some feature-rich switching hubs are available with functions including autonegotiation, fiberoptic interface, gigabit Ethernet interface, VLAN, SNMP, STP, port mirroring, L3SW, and the like.

■ Unicast Communications

One-to-one communications to a single destination host.

■ Unicast Routing

This is the routing process for communicating to a single host.

■ UTP (Unshielded Twisted Pair) Cable

A most commonly used cable. CAT5e or higher UTP cables are used for 1000BASE-T. In addition, there are two types of cables: cross cable and straight cable. Choose these cables as required. Generally, straight cables are used when nodes are connected to hubs, whereas, cross cables are used when two hubs or two nodes are connected together. Specifications vary depending on the network devices used; refer to the appropriate manuals for the network devices actually used. As both-end connectors, commonly used RJ-45 modular connectors are used.

■ VLAN (Virtual Local Area Network)

VLAN is a function which separates LANs logically within a switch. Intentional restriction of broadcast packet transmission and logical separation of communicable groups allow a network configuration in which each group is connected to a separate switch. Broadcast packets are transmitted to the same VLAN only, thus highly effective networks can be established.

5.2 IP Address for Control Communications

■ IP Address in Vnet/IP

Devices connected to Vnet/IP have control communications and open communications IP addresses. Bus 1 and bus 2 are separate subnets, so separate IP addresses are needed for each bus. (Open communications use bus 2 only, so an IP address for bus 1 is not needed.)

Duplexed FCSs, duplexed SCSs and V net routers incorporate IP addresses on a CPU basis.

(Example)

- HIS, SENG: Two IP addresses for control communications (for bus 1 and bus 2) and one IP address for open communications (for bus 2)
- Single FCS, single SCS: Two IP addresses (for bus 1 and bus 2)
- Duplexed FCS duplexed SCS, V net router: Four IP addresses (for right-side CPU bus 1, right-side CPU bus 2, left-side CPU bus 1 and left-side CPU bus 2)

In addition, virtual IP addresses for control bus TCP/IP communications (for use with CS 3000 Batch between SCS and SENG, etc.) on a V net are set for the HISs, FCSs and SCSs. These IP addresses are not used directly for communications, so there is no need for them to coincide with the address system for control communications.

The following shows the IP addresses incorporated in Vnet/IP on a Vnet/IP station basis.

Table IP Addresses Incorporated in Vnet/IP (1/2)

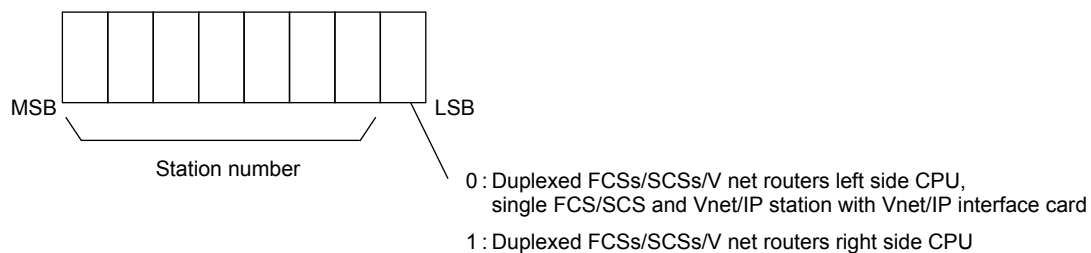
Station		Required IP addresses	Setting procedure
HIS or SENG		For bus 1 for control communications	Set automatically from domain and station numbers
		For bus 2 for control communications	
		For open communications	Set in OS (Windows) and ENG Systemview
		Control bus TCP/IP communications	
FCS or SCS	Single CPU	For bus 1 for control communications	Set automatically from domain and station numbers
		For bus 2 for control communications	
		Control bus TCP/IP communications	Set FCS in ENG Systemview, SCS in SENG SCS Manager
	Duplexed CPU	For bus 1 for control communications (for CPU 1)	Set automatically from domain and station numbers
		For bus 2 for control communications (for CPU 1)	
		For bus 1 for control communications (for CPU 2)	
		For bus 2 for control communications (for CPU 2)	
		Control bus TCP/IP communications	Set FCS in ENG Systemview, SCS in SENG SCS Manager

Table IP Addresses Incorporated in Vnet/IP (2/2)

Station	Required IP addresses	Setting procedure
APCS: Advanced Process Control Station	For bus 1 for control communications	Set automatically from domain and station numbers
	For bus 2 for control communications	
	For open communications (for use in database loading)	Set in OS (Windows) and ENG Systemview
GSGW: Generic Subsystem Gateway	For bus 1 for control communications	Set automatically from domain and station numbers
	For bus 2 for control communications	
	For open communications (interface with OPC server or with PLC on Ethernet)	Set in OS (Windows) and ENG Systemview
SIOS: System Integration OPC Station	For bus 1 for control communications	Set automatically from domain and station numbers
	For bus 2 for control communications	
	For open communications (interface with OPC server or with PLC on Ethernet)	Set in OS (Windows) and ENG Systemview
Exaopc: OPC Interface Package	For bus 1 for control communications	Set automatically from domain and station numbers
	For bus 2 for control communications	
	For open communications	Set in OS (Windows)
PRM: Field Communications Server	For bus 1 for control communications	Set automatically from domain and station numbers
	For bus 2 for control communications	
	For open communications	Set in OS (Windows)
V net Router	For bus 1 for control communications (communications module 1)	Set automatically from domain and station numbers
	For bus 2 for control communications (communications module 2)	
	For bus 1 for control communications (communications module 1)	
	For bus 2 for control communications (communications module 2)	

The host address in an IP address for control communications is configured as given below.

A duplexed FCS, duplexed SCS and V net router incorporate IP addresses on a CPU basis. The CPU is indicated by the least significant bit of the host address as given below.



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Figure Host Address (8-bit) Part**Table Host Address Part**

Station	Host address part
Duplexed FCSs/SCSs/V net routers left side CPU, single FCS/SCS, Vnet/IP station with Vnet/IP interface card	Station number x 2
Duplexed FCSs/SCSs/V net routers right side CPU	Station number x 2 + 1

Note: Host address 1 has been reserved.

5.3 Time Synchronization

Vnet/IP synchronizes the time between the Vnet/IP stations connected to a Vnet/IP network. The time synchronization system in a Vnet/IP station is the same as that in a V net.

■ Kinds of Clock Times

A Vnet/IP station (such as HIS, ENG or SENG) that uses a general-purpose PC as its platform has the following two clock times.

system time: Time managed by the system software of Vnet/IP station.

network time: Time synchronized between Vnet/IP stations. Synchronized as the standard time following the time master. This clock time is retained by the Vnet/IP station hardware.

The system time of FCS, SCS, and V net router always synchronizes with the network time.

■ Time Synchronization System

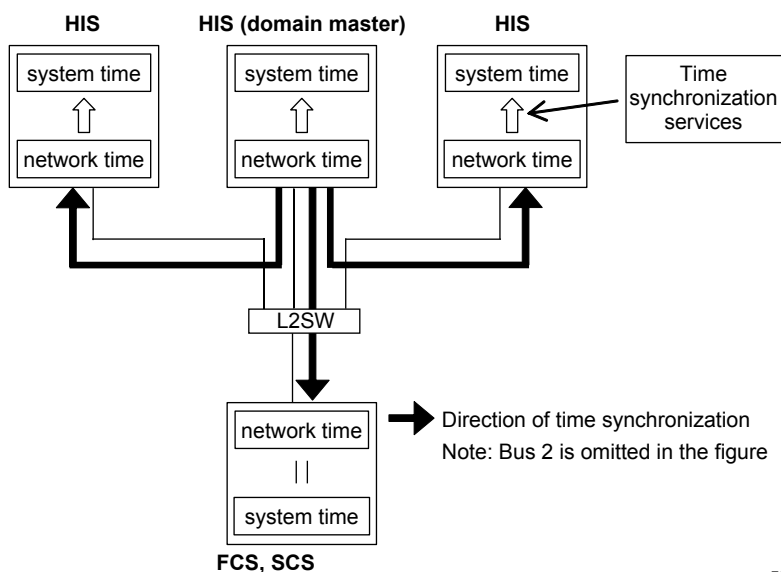
Time synchronization sets the network time in each Vnet/IP station in Vnet/IP to be the same. The system software of a Vnet/IP station references the network time, and adjust its own system time to the network time.

■ Time Synchronization Within a Vnet/IP Domain

Time synchronization in each Vnet/IP station within a domain is performed so that the clock time is set to its own domain master station's clock. The domain master station is the station that manages the setting information within a domain. The master station within a domain is automatically selected from the Vnet/IP stations within the domain. Users need not be aware of the domain master station. The domain master station broadcasts its own network time (performs clock time multicasting) periodically to the Vnet/IP stations within the domains.

Vnet/IP stations that receive time-synchronization broadcasting communications from the domain master station will synchronize the time by comparing its own network time to the time sent from the master domain.

The time synchronization accuracy of the network time within a domain is expressed as below:
 ± 1 msec, When one bus is abnormal, the accuracy may become worse than ± 1 msec.



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Figure Time Synchronization within a Vnet/IP Domain

■ Time Synchronization Between Vnet/IP Domains

If multiple domains are present, Vnet/IP defines the time groups by domain property in CENTUM engineering function on a domain-by-domain basis. Time synchronization will be carried out between domains belonging to the same time group.

A time group allows the selection of a network time master from the domain master station within a domain belonging to the same time group. A network time master is also selected automatically. Users need not be aware of the network time master. The time group is specified by a number from 0 to 7. A domain specified with time group number 0 is a special domain that the time is synchronized within the domain, and it is not synchronized with other domains.

The time synchronization accuracy of the network time between domains is expressed as given below:

± 5 msec, When one bus is abnormal, the accuracy may become worse than ± 5 msec. Time synchronization accuracy deteriorates in proportion to transmission delay time variations between domains.

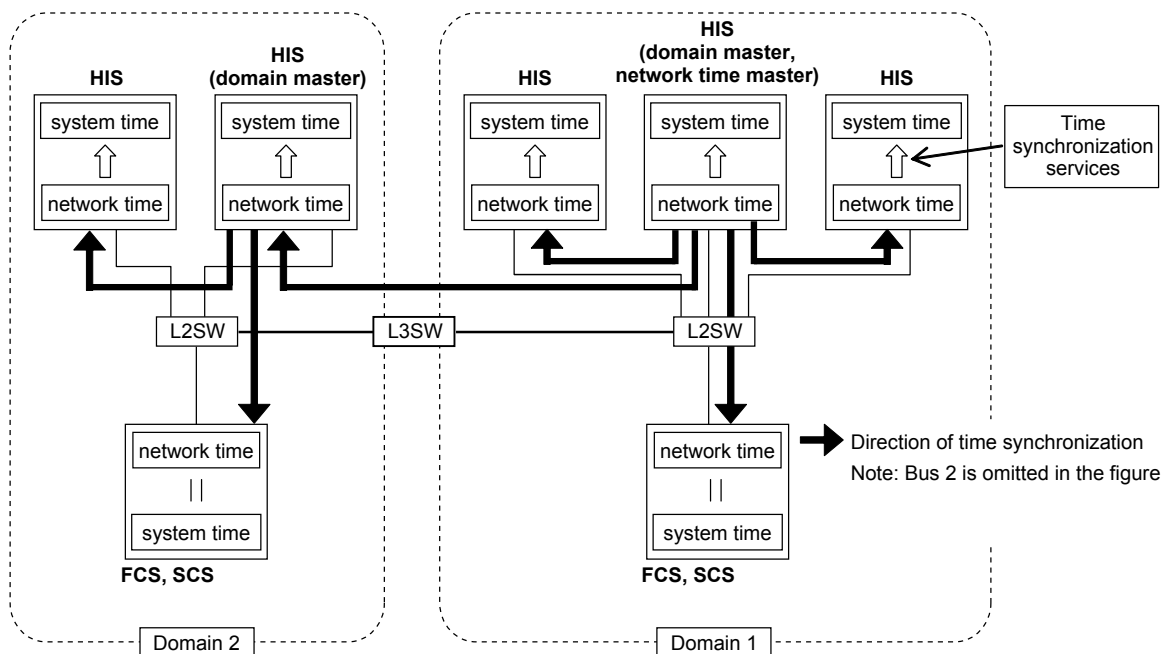
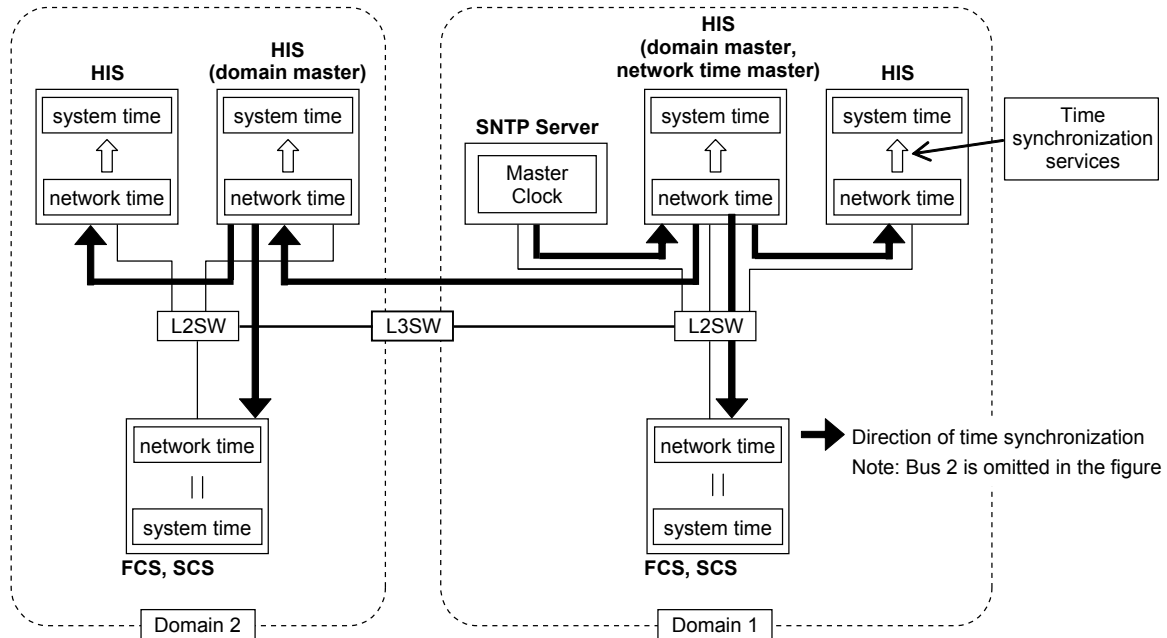


Figure Time Synchronization Between Domains in the Same Time Group

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■ Synchronization to Coordinated Universal Time

When the Vnet/IP station clock time is synchronized with UTC (Coordinated Universal Time), connect an SNTP server on a time group basis. Only one SNTP server should be connected in a time group. Connect the SNTP server on the bus-1 side. If the SNTP time server is dual-redundant, it can be added to the bus-2 side. If the SNTP time server is connected on Vnet/IP, the network time master will acquire the standard time from the SNTP server.



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Figure Time Synchronization Between Domains Using SNTP Server as a Master Clock

■ System Time and Network Time Synchronization

In a Vnet/IP system, the network time is the standard. The system software of a Vnet/IP station references the network time, and adjusts its own system time to the network time. Because of the differences in the time adjustment methods, the deviations between the system time and the network time are as shown below:

Table Accuracies of System Time

Station type	Error from network time	Time adjustment method
The stations operating on general-purpose PC, such as HIS, GSGW, etc.	Max. 0.5 sec	The deviation between the network time and the system time is checked. If there is a deviation of 0.5 sec or more, the system time is adjusted to the network time.
FCS, SCS, V net router	None	The system time always synchronizes with the network time.

■ Time Synchronization with V net Domain

When a V net domain is connected to a Vnet/IP network, the time on the Vnet/IP side will be used as the master time, and the time of V net domains synchronizes with it. It is not possible to set the time on the V net side as the master time.

Also, the V net router compares the time of Vnet/IP domains with the time of V net domains on a 2-minute cycle, and equalizes its time with the Vnet/IP domain time if a deviation of 5 seconds or more continues twice.

■ Operational Precautions

The network time is a master clock in the stations operating on general-purpose PC, such as an HIS. Even though the system time is adjusted from the Windows Control Panel, the correct time cannot be set because the time synchronization service program sets the system time to the network time. If you attempt to change the time, use the time set dialog in the system status display window for HIS to change the network time.

Note: When network time is synchronized with SNTP server time, network time cannot be changed from HIS or SENG.

5.4 Precautions When Installing Network Devices

■ Power Supply for Network Devices

Devices on a network require a specific equipment start time when devices are recovered from a power shutdown or for an autonegotiation time for an automatic transmission rate setting.

In addition, L3SWs and remote routers used to connect between domains require the time for reconfiguring routing information. This routing reconfiguration may take several minutes.

If a power failure occurs in dual-redundant buses, devices on both buses require time for recovery. It is required that power supplies be separated to prevent two buses from a power failure and that an uninterruptive power supply (UPS) be used.

■ Environmental Conditions

It is assumed that network devices are not installed in a harsh environment. If L2SWs are installed in a harsh environment, industrial-use L2SWs should be used. Network devices other than L2SWs should be included in a system configuration installed in an instrument room or the like.

For a remote installation system, L3SWs between domains should be installed in an instrument room, and their cables should be extended by means of cable conversion.

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Revision Information

Title : Vnet/IP Network Construction Guide (Legacy Edition)
Manual number : TI 30A10A10-01E

Sep. 2010, First Edition
Newly Published

Aug. 2011, 2nd Edition

Title Changed to "Vnet/IP Network Construction Guide (Legacy Edition)"
Introduction SEE ALSO is added to introduce the new guide
1.1 IEC 61784-2 Ed.1.0 is revised to IEC 61784-2 Ed.2.0

Written by	Yokogawa Electric Corporation
Published by	Yokogawa Electric Corporation 2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750, JAPAN
Printed by	KOHOKU PUBLISHING & PRINTING INC.
