Transparent Factory
User and Planning Guide

490 USE 133 00 Version 1.0

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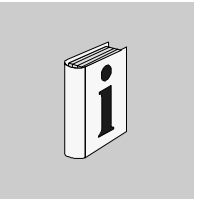
About the Book



At a Glance

Document Scope

This User and Planning Guide presents an overview of the Transparent Factory concepts and introduces Ethernet-based systems. It gives a general description of the Schneider Electric products used in Ethernet network environments.
It provides Schneider Electric customers with an understanding as to why Ethernet networks should be designed in a particular manner to use Schneider products, why the rules of network design need to be followed, and which Schneider Electric products should be used in a particular situation.
This manual is intended for users of Schneider Electric Transparent Factory products and should be used as a supplement to product user manuals.

This manual is organized as follows.

Chapter/Appendix	Description
Chapter 1 Transparent Factory	Introduces the Transparent Factory objectives and gives a brief description of the innovative products that support this strategy. Also describes this manual and provides customer support contact information.
Chapter 2 Ethernet In The Industrial Environment	Describes the specific Ethernet requirements related to the industrial environment
Chapter 3 Transparent Factory Ethernet Service Layers	Describes the four layers of services that are supported by Transparent Factory Ethernet
Chapter 4 Transparent Factory Ethernet Products and Components Selection Guide	Provides descriptions of Schneider Electric's Ethernet products and components suitable for Transparent Factory applications
Chapter 5 Ethernet Cabling Information	Provides cabling information for designing Ethernet networks using Schneider Electric's products and components
Chapter 6 Web-based Solutions	Provides a detailed description of Transparent Factory's Web-based management features.
Appendix	Contains detailed information concerning Ethernet implementation.
Glossary	Provides a complete glossary of terms related to Ethernet, Web and Internet technologies

Validity Note

The data and illustrations found in this book are not binding. We reserve the right to modify Schneider Automation's products in line with Schneider Automation's policy of continuous product development. The information in this document is subject to change without notice and should not be construed as a commitment by Schneider Electric.

Related Documents

Title of Documentation	Reference Number
Transparent Factory Network Design and Cabling Guide	490 USE 134 00
ConneXium Ethernet Cabling System Switch Management Manual	490 USE 135 00
FactoryCast User's Guide For Quantum and Premium	890 USE 152 00
ConneXium Ethernet Cabling System: Quick Reference Guide	490 USE 136 00
170 ENT 110 00 Ethernet Communication Adapter User Guide	870 USE 112 00
Quantum Automation Series NOE 771 Ethernet Module User Guide	840 USE 116 00
Ethernet Modbus/TCP/IP Developers Guide (Software)	
Ethernet Modbus/TCP/IP Developers Guide (Hardware)	
PL7 Junior/Pro Communication Applications	TLX DS COM PL7
TSX Micro Modules TSX ETZ 410/510 Implementation Manual	

For technical support:

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- Tel: Other countries: contact your local Schneider Electric agent
- Fax: All (978) 975-9301
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All pertinent state, regional and local safety regulations must be observed when installing and using this product. For reasons of safety and to assure compliance with documented system data, only the manufacturer should perform repairs to components.

User Comments

We welcome your comments about this document. You can reach us by e-mail at TECHCOMM@modicon.com

Transparent Factory

1

At a Glance

Overview

Transparent Factory is Schneider Automation's innovative Web-based architecture, providing seamless manufacturing control from any location in the world. Transparent Factory incorporates the latest technology combined with the dynamics of Web technology.

What's in this Chapter?

This chapter contains the following maps:

Topic	Page
What is Transparent Factory?	10
How Transparent Factory Takes Form	11

What is Transparent Factory?

At the Beginning

In the beginning, Transparent Factory was an attempt to answer the question: "Why couldn't the 'information enabling' properties of the Internet be transferred to the manufacturing environment?" After all, thousands of users are communicating and sharing information without ever having to decide on the "right" bus, the "right" operating system, the "right" software or the "fastest" PC.
The ability to obtain and act upon real-time information is critical to a company's ability to be globally competitive. The major goal is to have timely information for decision making within the corporation to drive performance and cost reductions.

Historically

Historically, the data used in operating manufacturing equipment has been the domain of the PLC. Therefore, access to the data from higher systems required special proprietary knowledge about where and how data is stored and knowledge of the methods and protocols required to import or export the data. The multi-vendor environment crystallized every plant in several layers, making difficult access to real-time information. This in turn hampered decision-making and hindered the realization of a company's performance and cost objectives.

Transparent Factory's Three-Stage Strategy

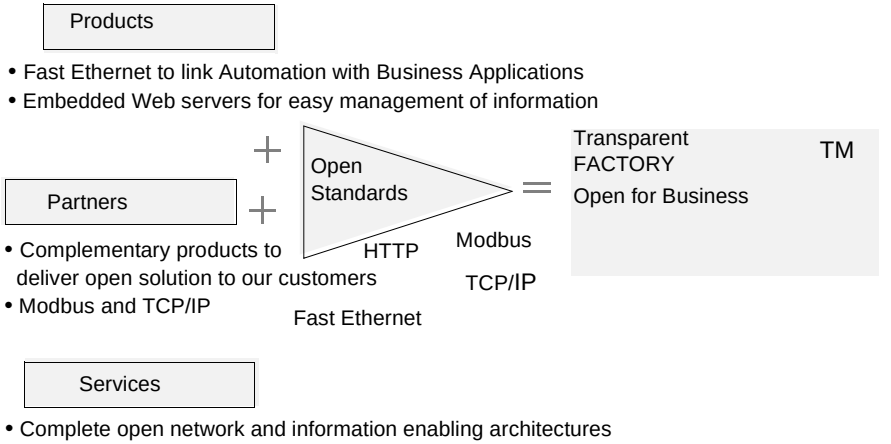
Today, Transparent Factory solves these issues by developing a three-stage strategy.

- Expose PLC information using open or de facto standards.
  OPC and Embedded Web server products open Schneider Automation PLC controllers to several systems, systems that can easily access information and knowledge buried in the controllers. Furthermore, the Web server technology allows any qualified personnel within the enterprise to interact with the automation system using standard tools.
- Interface / Integrate automation systems with business applications.
  Using the PLC as a data server within a client/server architecture allows Schneider alliances to easily develop interfaces to business systems in Windows or UNIX environments.
- Develop an open infrastructure that supports real-time and determinism behaviors.
  The network is the backbone for an efficient information exchange. Ethernet and TCP/IP, along with the worldwide standard MODBUS, are Schneider's primary choices for delivering a truly open network.Switches and hubs help to build real-time and highly available subnetwork and to address a broad range of applications.

How Transparent Factory Takes Form

The Transparent Factory Concept

The following figure illustrates the basic components involved in the Transparent Factory concept.



Innovative Products

Schneider supports the Transparent Factory concept with many innovative products.

- Communication modules for Premium (ETY), Quantum (NOE), and Micro (ETZ)
- Controllers with embedded Ethernet on the Momentum (M1E)
- Ethernet I/Os using the communication adapter for the Momentum line (ENT)
- Embedded Web servers for Premium (ETY), Quantum (NOE), and Micro (ETZ)
- OPC Factory server (OFS)
- Infrastructure components, i.e. hubs (NEH, NOH), switches (NES, NOS), transceivers (NTR) and accessories/cables
- Access to information from the installed base using bridge products: MODBUS and MODBUS Plus to MODBUS Ethernet TCP/IP

Solutions

Schneider Alliances program supports our network of partners around the world to deliver complete solutions to our customers. Complementary products and system integrators are the two main categories addressed by the Schneider Alliance program.

Services

We offer complete assistance to our customers covering initial design network/ information consulting, program management and servicing.

Ethernet in the Industrial Environment

2

At a Glance

Overview

This chapter describes the specific Ethernet requirements related to the industrial environment.

What's in this Chapter?

This chapter contains the following maps:

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Industrial Environment and Ethernet

Overview

Ethernet has been well-known in the office environment for a number of years. The advantages of Ethernet in office environments are well proven. Ethernet brought information to the desk of anybody connected on the network allowing quick and efficient decision making.
This technology is now being used in industrial environment. The deployment of such technology in this type of environment raises new questions that standard Ethernet does not address.

Industry Trends

Changing manufacturing practices are leading towards a new industrial automation and infrastructure. As firms move into the global marketplace and implement advanced production systems, new technologies – such as Internet, wireless communications, graphical client/server applications, smart devices and decision support systems – are being deployed to reduce costs and streamline operations
The Internet today focuses on people going to information-rich servers. The next stage of information technology development is for Internet to extend beyond people to network-enable all the devices in an entire manufacturing operation.
Adding new processes, systems and technologies to today's automation and control communication infrastructure will stress it unbearably. The bottlenecks caused by the classic architecture of three discrete networks (plant, control, and device) need to be removed before networks become a transparent and plant wide utility.

Recent Enhancements

Over the past five years there have been many enhancements to Ethernet standards, especially in areas of determinism, speed and prioritization. There is no longer any reason why Ethernet cannot be used to build deterministic fieldbus solutions that are cost effective and open. Since Ethernet is already the network of choice for business computing, its presence at the control level will make sensor-to-boardroom integration a reality rather than a goal for manufacturers.
To meet the demands of the next generation of automation and control system, the network will require a new architecture comprising four key dimensions: real-time, migration from legacy systems, fault-tolerance, and capability to operate in harsh environments.

Rough Environment

The industrial environment is a lot tougher than office environment. Any piece of equipment located in such locations requires conformance to very demanding standards. Usually a standard "office" component does not fulfill these requirements or must be isolated in an artificial micro "office environment" (usually, a dedicated room, or a specific temperature and moisture control cabinet).

Industrial Environment Requirements

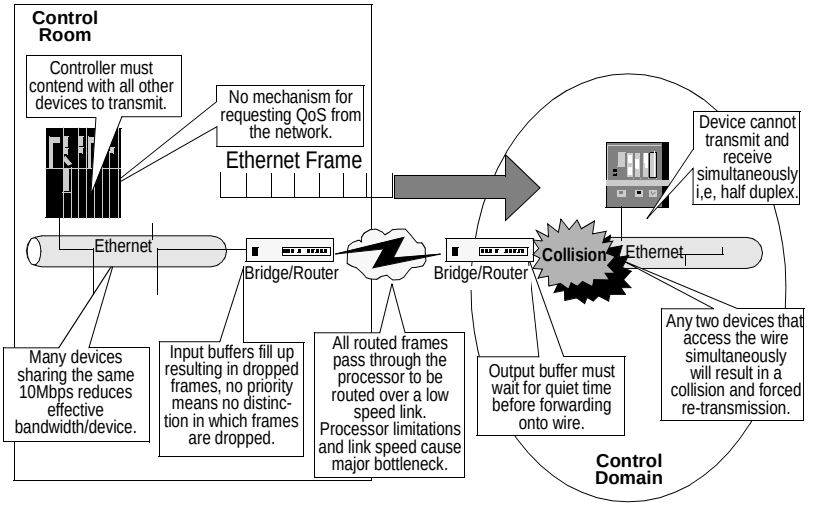
Our Ethernet products comply to the following requirements.

- Extended temperature range, 0-60°C minimum
- High MTBF rates
- DIN rail mountable
- 24VDC power supply
- CE, FCC, UL, FM approved
- Plug and play installation (no specific tool required to replace a faulty component)

Real-time and Determinism

Bottlenecks to Overcome

In the past, there were concerns over Ethernet's ability to deliver the levels of deterministic performance demanded by real-time Industrial applications and processes.
The diagram below shows network issues and bottlenecks that needed to be overcome before Ethernet could be considered a 'real-time' network.



Infeasibility of Real-time Transmission

This example highlights why real time transmission has, in the past, not been feasible. As data travels over the Ethernet frame, that data could be held up in any number of places as it journeys from a controller to device. Terms such as latency, jitter, head of line blocking, frame loss, and errors are often used to measure forwarding performance and capabilities. In this configuration, these tests and measurements would confirm that once loading reached 30%, the network would be noticeably slower; at 50% it will cause application to time out.
No guarantees are given that the data will arrive at its destination: **shared Ethernet will just do its best!**

Summary

To summarize, the issues that have prevented Ethernet being used for real-time applications and processes in the past are as follows.

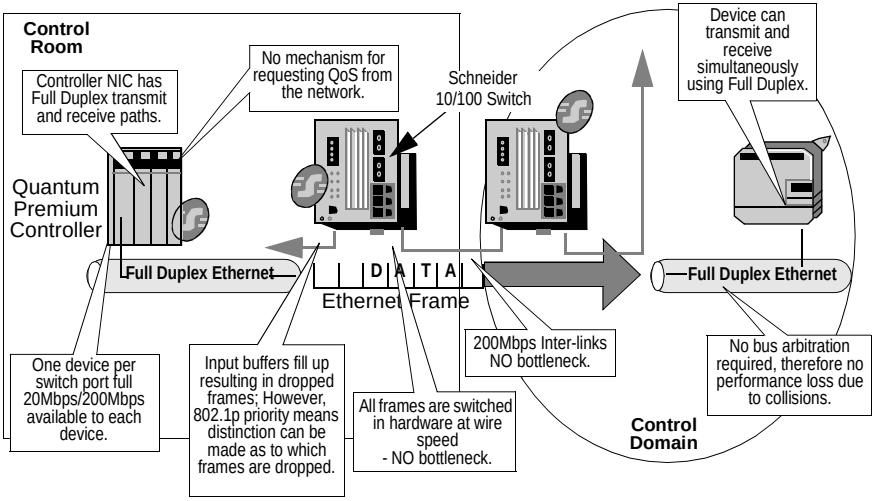
- Bandwidth is shared not dedicated.
  - Sharing necessitated bus arbitration with no concept of priority
  - Sharing results in collisions when 2 or more devices transmit simultaneously
  - Collisions block the network and prevent all devices from transmitting
  - More devices on one segment increases the probability of collisions
- Large broadcast domains eat up usable bandwidth.
- There is no way to differentiate between high priority and low priority traffic.
- There is no way to provide a low delay path for real time traffic.

In conclusion - a shared Ethernet system can never offer determinism.

Switched 10/100 Mbps Ethernet—Implicit Quality of Service (QoS)

Implicit QoS

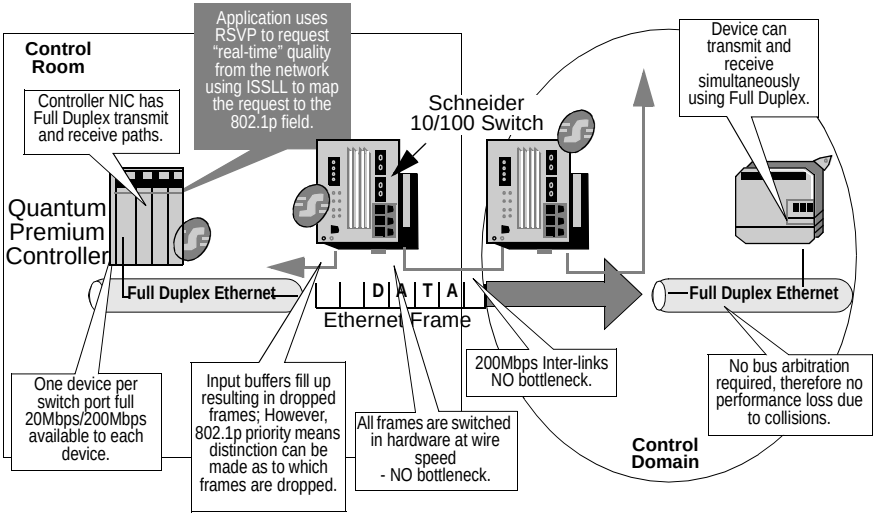
This following figure shows that by removing the bottlenecks from the network and having the ability to differentiate between traffic types it is possible to architect, design and build Ethernet networks where the QoS is implicit in the type of physical connection given to the device. Prioritization is not dynamic, as the application is still unable to request QoS from the network. Deterministic performance can be achieved by having devices with dedicated ports and allocating adequate bandwidth to the network.
Transparent Factory reduces bottlenecks as information moves from the control room to the control domain.



Switched 10/100 Mbps Ethernet—Explicit Quality of Service (QoS)

Explicit QoS

The following figure introduces Explicit QoS, whereby the application or process itself can dynamically request a communication path that exhibits a particular set of characteristics. These might include delay, jitter and errors. The network would then respond to the request if such a path was available.
The Explicit Quality of Service (QoS) is shown below.



Explicit QoS will be implemented later in our PLC programming packages.

Summary of Switched Network Solutions

Features of Switched Network Solutions

In conclusion, switched network solutions bring the following features to support real-time industrial applications:

- Bandwidth is dedicated (although it still can be shared with mixed architectures)
- Port switching overcomes the needs for bus arbitration
- Full 10 Mbps or 100 Mbps per device (10 Mbps for Micro)
- Full duplex eliminates collision
- Bandwidth is scalable
- Fast Ethernet provides 200 Mbps of bandwidth in the backbone using full duplex transmission

Additional Features

The switched network architectures using Explicit QoS (driven by programming languages, function blocks, and data types), will provide these additional services.

- Meet the IEEE802.1p/Q standards for delivery of priority and QoS fields to the standard Ethernet frame format
- SVP, ISSLL, IEEE802.1p/Q standards provide explicit techniques for requesting granularity of QoS
- Data prioritization and multiple queues for data ensure that real time traffic is given the fastest path through the network

Migration from Legacy Systems

Overview

Implementing Ethernet in new projects does not require new device suppliers or expensive gateways to an existing insallation.
Today, many devices are connected to a control network through proprietary serial cabling and protocols. Information is then consolidated from the control network running at speeds typically under 2Mbps. For this information to reach the corporate systems it must cross the divide between the control network and the information network with its links back into the enterprise office automation network. Typically, a PC based gateway or HMI workstation carries out this function. With interfaces to the proprietary control network on the one side and the Ethernet MODBUS TCP/IP based information network on the other, the gateway provides a route, albeit restricted, across the divide.

Migrating Legacy Systems

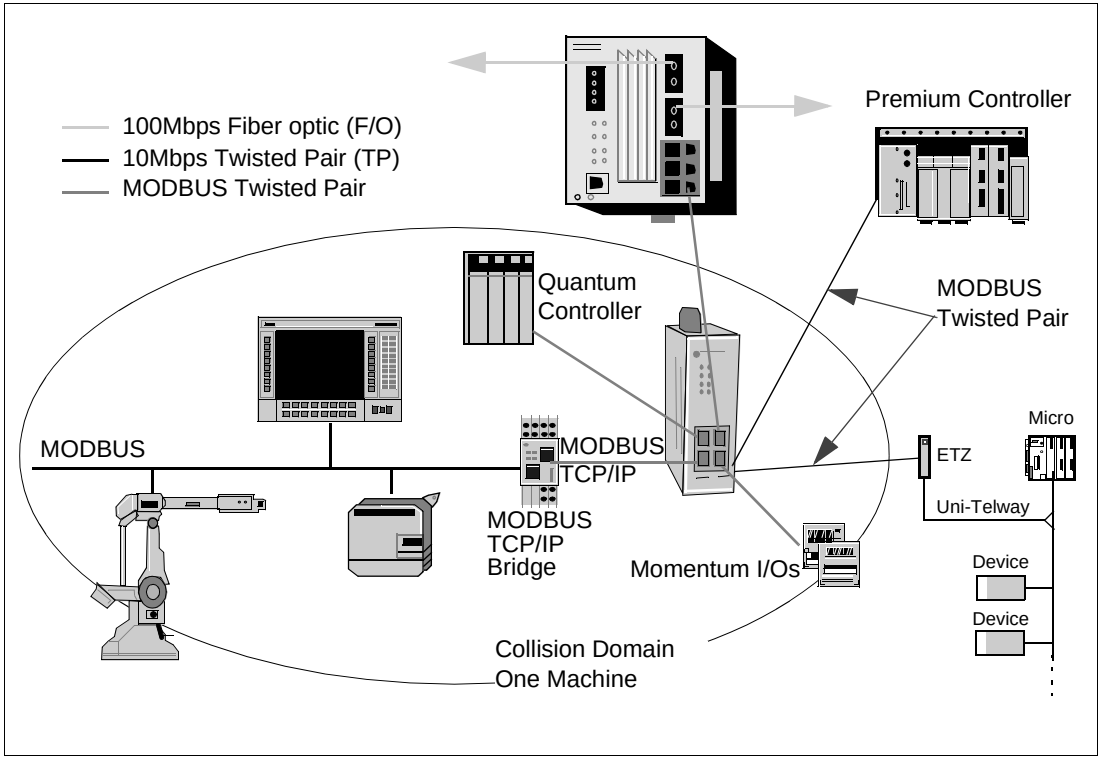
The first casualty of the information explosion will be the legacy fieldbus system with 2Mbps as its upper limit. Shared 10Mbps Ethernet will also be replaced initially by 10Mbps switched increasing to 100Mbps as need dictates. Ethernet will also extend its reach, driving the technology closer to intelligent devices and remote I/O.

Improved Functionalities

The Internet and modern networking designs will enable three major functions to be radically improved.

- Use HTTP server and browser technology to monitor status and perform setup and reconfiguration, resulting in easier product installation for remote or local personnel
- Use SNMP, FTP, peer-to-peer, or HTTP technology to
  - Find and solve problems with a devices' mission using diagnostics and repair help
  - Execute memory dumps sent to the host for analysis
  - Download programs to RAM or flash memory
- Use the HTTP server to gather a wealth of information from a device

Improved functionalities occur as a result of implementing Transparent Factory.



High Availability

Overview

According to International Data Corporation, "A system is considered to be highly available if, when failure occurs, data is not lost, and the system can recover in a reasonable amount of time." Therefore keeping the network available is one of the top priorities. Above average availability of the system is required for a mission-critical application or when equipment and industrial systems are located in a harsh environment. Today, it is estimated that at least 30 to 40% of applications require a high level of availability.

Ethernet Standard 802.3 Compliance

All Schneider Automation products are fully compliant to Ethernet standard 802.3. Where further standards apply which are essential for industrial network design, for example in delivering QoS and security, Schneider Automation adopts standards such as IEEE 802.1p/Q. Where implementation issues or standards fall short of industrial networking requirements, Schneider Automation leads the world in the development of value added features that make Transparent Factory products unique.

These features include the following:

- Fast Path Recovery time - <300msec maximum
- Multiple levels of Redundancy tailored to application requirements
- Single and double optical ring structures
- Dual 24VDC power inputs
- Robust design for harsh conditions
- Extended operating temperature (0C - 60C) without fan

Spanning Tree

Path recovery times of less than one second are not achievable with spanning tree, the Ethernet 802.1d standard for layer 2 link recovery. Typically spanning tree will take on the order of 30 - 60 seconds to detect and bypass a communication path failure, whilst doing so all networked devices will be isolated. This solution is acceptable for applications within an office automation environment but not for a mission-critical industrial solution.

Ethernet Ring

Ethernet ring topologies use ConneXium switches to provide network path resilience in many traditional systems. However, Ethernet ring technology is new. Ethernet is a bus architecture that uses broadcast messages to resolve addresses of connected devices. If a ring, or more importantly a loop, is created, any Ethernet broadcast frame will be sent around the loop, eventually degrading network performance to unacceptable levels.

Redundancy Manager

Schneider Automation has included in each Ethernet switch a "Redundancy Manager" which adds the ability to overcome the architectural limitation of Ethernet described above. In addition to performing all the standard Ethernet switching functions, the Redundancy Manager allows a physical 200Mbps ring to be created by terminating both ends of the traditional Ethernet Bus (fiber or copper). Logically there are two sides to the Redundancy Manager; each is continuously transmitting and receiving real-time diagnostic messages to the other around the ring. The result is a real-time report on the actual state of the network at any instant. In the case of a failure in the ring (i.e. either a node or a link has been lost) the Redundancy Manager will interpret the loss of diagnostic data as a network failure. When the network failure is detected, the Redundancy Manager connects the two interfaces internally. This will return the network to full operational status. The detection and network healing process will be complete in between 20 and 300 msec, depending on the size of the ring.

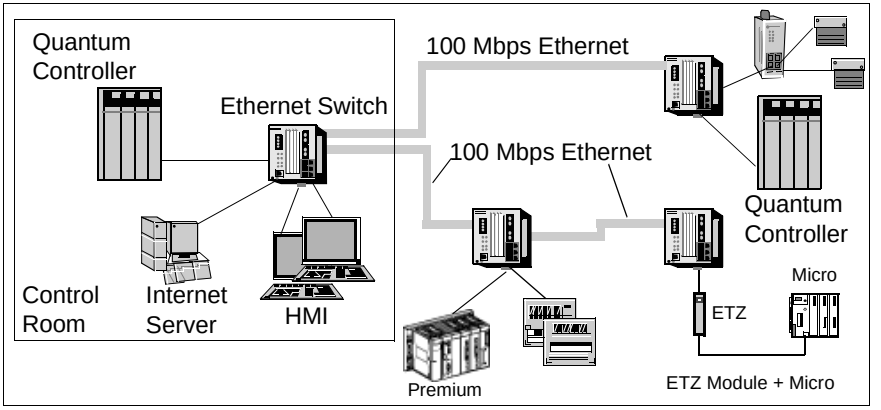
Four Levels of Resilience

Resilience Supported by Transparent Factory Ethernet

The Transparent Factory Ethernet architecture implements four levels of resilience to meet the needs of most, if not all applications. Resilience is not just a function of the network nodes and communication paths. The network extends all the way into the attached system via the network interface and driver software. Therefore the higher levels of resilience depend on the combined capabilities of the networked devices and the infrastructure.

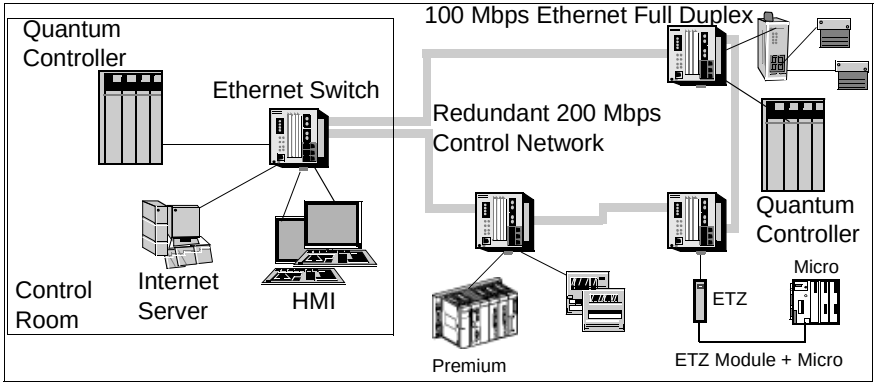
Resilience Level 1

A resilience level 1 architecture (shown below) does not support redundancy. Single network failures will break down part of the system. It is a very cost-effective solution with single network interfaces at each device.



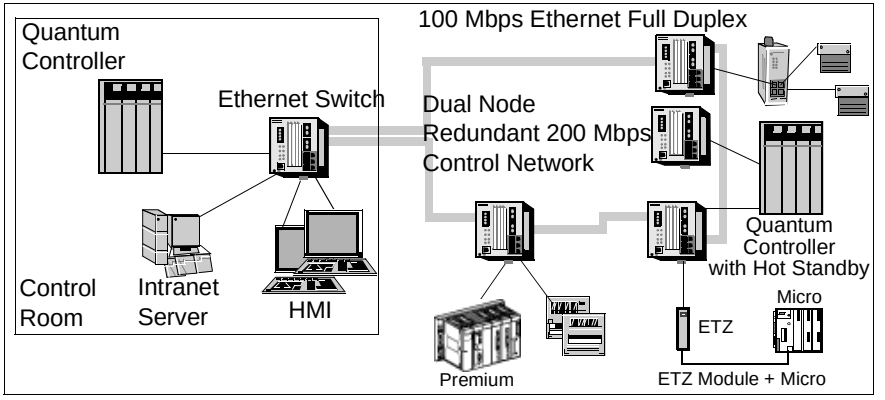
Resilience Level 2

A resilience level 2 architecture (shown below) supports a redundant communication path. It tolerates a single failure in the network. There is still a single network interface at each device. If a device's network interface fails, that part of the system is not able to communicate with the rest of the system.



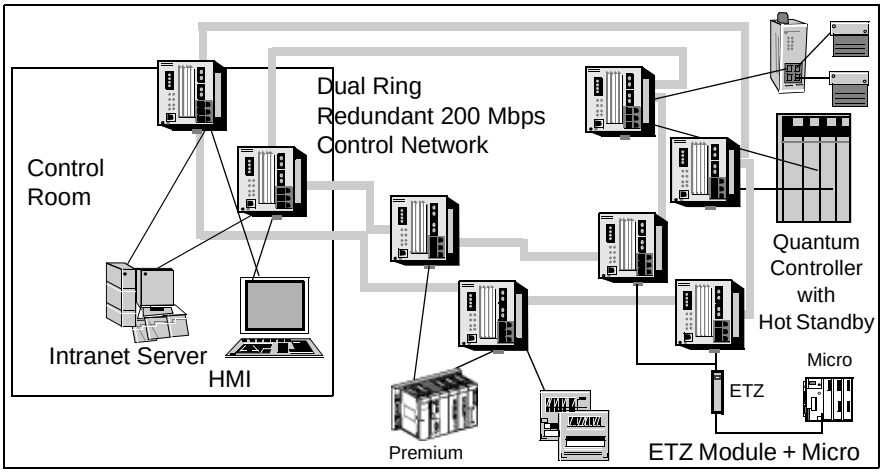
Resilience Level 3

Building on the level 2 resilience features, a level 3 architecture (shown below) also supports tolerance of a node or network interface failure. Combined with the hot standby capability of the Quantum or the warm standby capability of Premium, this architecture delivers a high level of resilience.



Resilience Level 4

Level 4 provides the highest level of resilience (shown below): each node is doubled, allowing a second failure of the communication path without impact on the whole system.



The appropriate level of availability is application-dependent. The greater the need for mission-critical uptime, the greater the justification for high availability.

Transparent Factory Ethernet Service Layers

3

At a Glance

Introduction

This chapter describes the four layers of services that are supported by Transparent Factory Ethernet.

What's in this Chapter?

This chapter contains the following maps:

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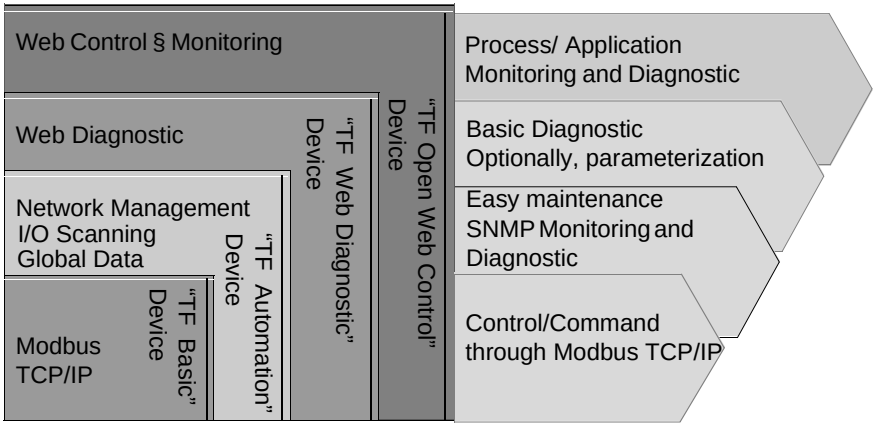
Services Supported by TF Ethernet

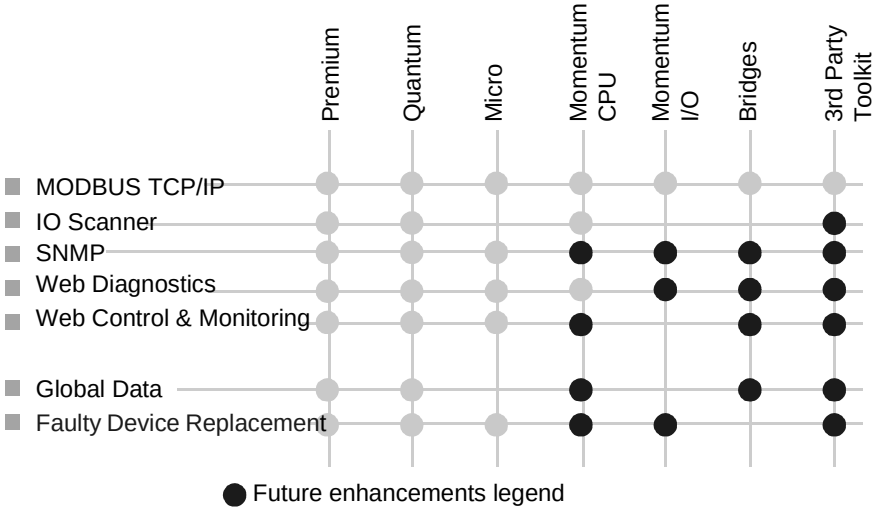
The Four Layers of Services

Transparent Factory Ethernet defines four service layers. Ethernet Basic is the minimum level of services to implement in a device. FactoryCast is the maximum level of services that can be supported by intelligent devices.
The four levels of services are depicted below.



Service Layer Implementation by TF Product

Minimum internal resources are required to implement the TF Basic layer, while higher resources are needed to embed a TF Control layer in a device.
The following matrix shows which service layer is implemented in which product.



The following sections explain the content of each of the Transparent Factory layers illustrated above.

Transparent Factory Basic Level

Basic Level of Service

TCP/IP is the common transport protocol of the Internet and is actually a set of layered protocols, providing a reliable data transport mechanism between machines. Ethernet has become the de facto standard of corporate enterprise systems, so it comes as no surprise that it has also become the de facto standard for factory networking.

In order to move MODBUS protocol into the 21st century, an open MODBUS TCP/IP specification was written. Combining a versatile, scalable, and ubiquitous physical network (Ethernet) with a universal networking standard (TCP/IP) and a vendor-neutral data representation (MODBUS) gives a truly open, accessible network for exchange of process data. It is also extremely simple to implement for any device that supports TCP/IP sockets.

MODBUS/TCP is a variant of the MODBUS family of simple, vendor-neutral communication protocols intended for supervision and control of automation equipment. Specifically, it covers the use of MODBUS messaging in an Intranet or Internet environment using the TCP/IP protocols. The most common use of the protocols at this time is for Ethernet attachment of PLCs, I/O modules, and gateways to other simple field buses or I/O networks.

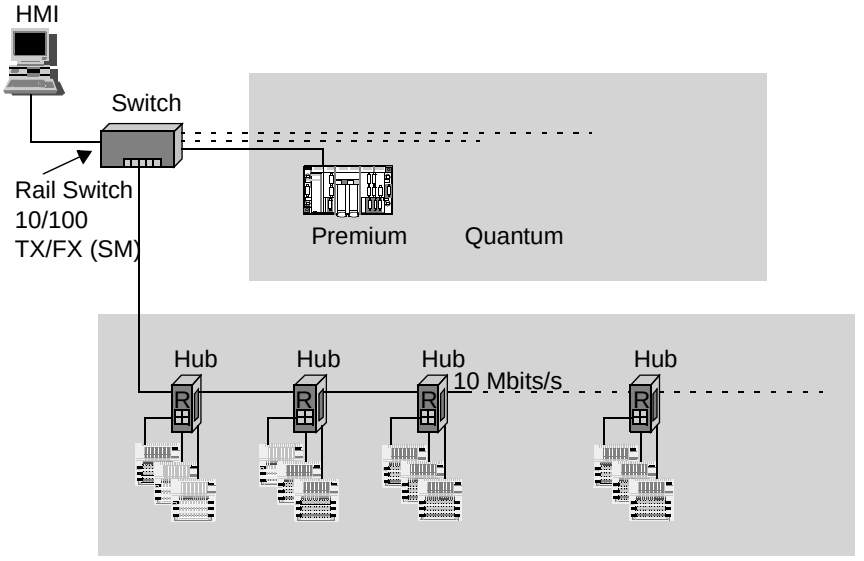
The MODBUS/TCP protocol is being published as a (de facto) automation standard.

Note: The MODBUS/TCP specification can be obtained in this Web site: http://www.modicon.com/openmbus/standards/openmbus.htm

Transparent Factory Automation Level

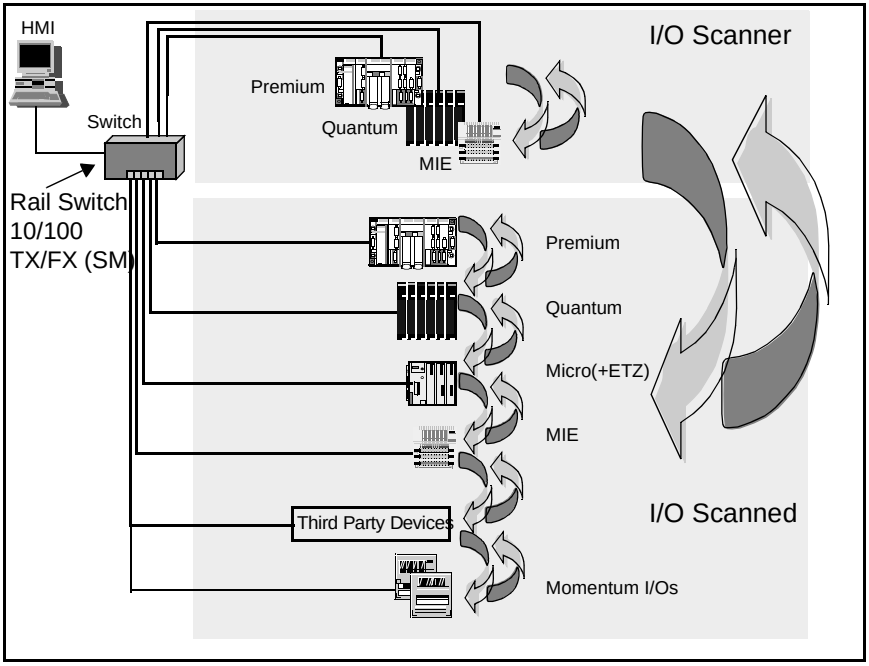
I/O Scanner

One controller scans I/O modules on an Ethernet network at 10 Mbps. In this case, the controller is configured as the I/O scanner (master), which accesses the I/O-scanned slaves (such as Momentum) through read and write operations.The maximum number of I/O scanned modules is 64.
It is also possible to configure a second (or more) I/O scanner on different controllers to operate a sub-set of the same I/O devices or a separate set of I/O devices.



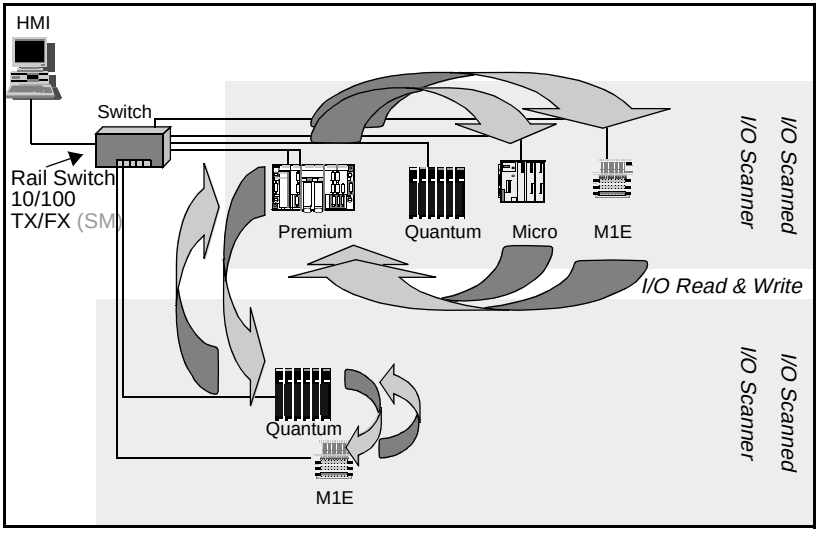
Coordination between Controllers

Controllers can exchange data among each other through the I/O scanning service. This ensures automatic Modbus read/write over TCP/IP without any programming. In the case below the same controller operates in a scanner (master) and scanned (slave) mode transparently, enabling the application to coordinate controllers by means of read/ write requests.



Coordination between Controllers & I/O Access

The same controller can exchange data with another controller and in parallel access to I/O modules. This enables the application to coordinate operations among controllers and at the same time to operate remote I/O modules.



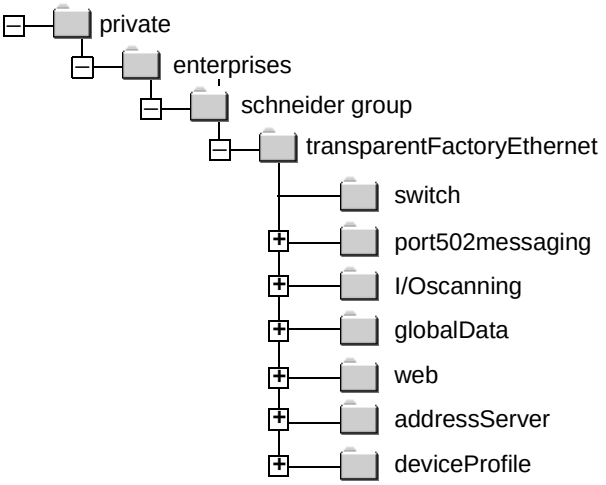
SNMP Facility

SNMP Communication on UDP/IP

The SNMP as implemented in ETY, NOE, ETZ, and ENT modules defines network management solutions in terms of protocol and the exchange of supervised data. The SNMP structure relies on the following essential elements:

- The **manager** allows entire or partial network supervision,
- One or more **agents**. Each supervised device has a software module named **agent**, used by the SNMP protocol.
- A **MIB** (Management Information Base) is a data base or collection of objects.

The SNMP module agent is implemented on all modules. This allows a manager to access MIB-II standardized objects from the agent via the SNMP protocol. The MIB-II allows management of TCP/IP communication layers. It is possible to access objects from the MIB Ethernet Transparent Factory, which provides specific information on global data, I/O scanning, and messaging utilities.
Following is a branching view of the MIB Ethernet Transparent Factory:



The source file of the private MIB Ethernet Transparent Factory is available on the module. It can be downloaded from an Internet browser by clicking on the "Download MIB file" link on the HTTP server index page. This file may be compiled by industry-standard SNMP managers.

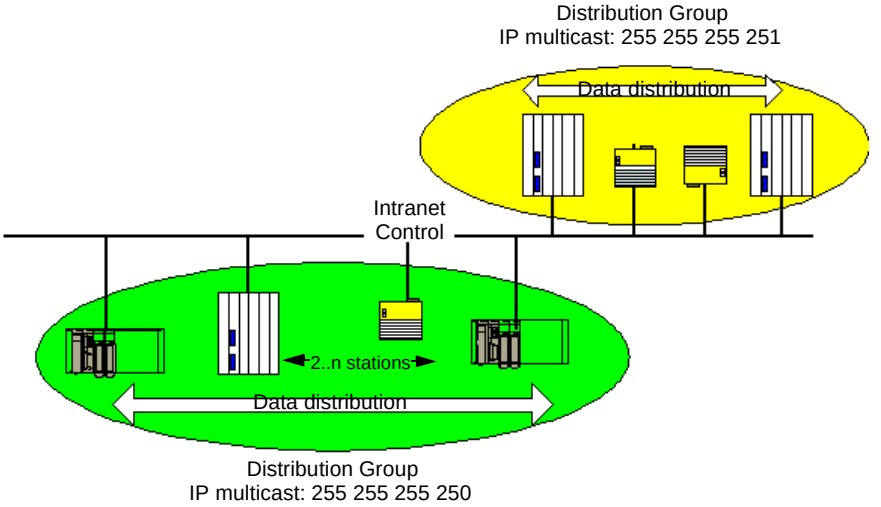
Global Data Utility

Overview

The Global Data service allows several PLCs to exchange data through a Publish/subscribe mechanism and is supported by ETY, NOE modules.

Operation

By this service, one controller publishes an array of variables on the network. Several others controllers can subscribe to these variables.
Up to 64 controllers can share information through this service. with a very simple configuration.
This efficient way to share information relies on TCP/IP Multicast and takes advantage of "Multicast filtering" technology. When used on a switched network, Multicast Filtering allows control of the traffic generated by the muticasting.



A publication/subscription protocol on UDP/IP is used for data distribution. The publication of a variable is synchronized at the start of the PLC cycle. Subscribed variables are recopied in the PLC application memory at the end of the cycle.
The PLC memory zones, which receive the various subscribed variables, should not be recovered.

Managing Faulty Devices

Replacing Faulty Remote Stations

The objective of the faulty device replacement utility is to provide automatic recovery of remote I/O module parameters or intelligent modules connected to a Transparent Factory Ethernet sub-segment when exchanging a faulty module with a functioning module.

Objective

The objective of the faulty device replacement utility is:

- to supply an IP address to a remote station from the name given to this station (**role name**)
- to give a remote station the capacity to store parameters and also to recover them, if required.

Note: The role name is limited to 16 characters in ASCII.

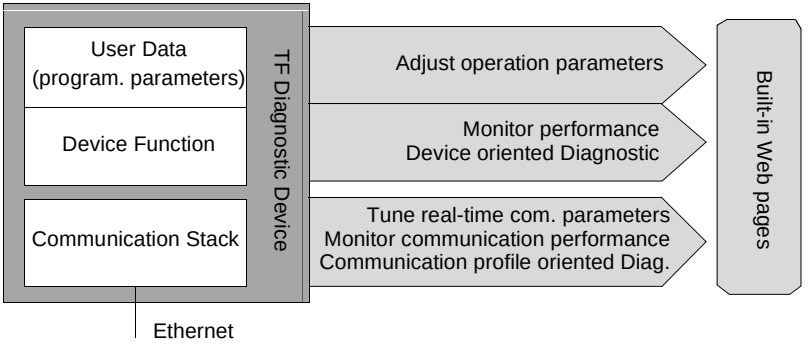
Operation

The faulty device replacement utility requires the use of the DHCP address server and the FTP/TFTP server of the ETY 410/510 module or possibly ETZ or NOE or ENT module.

Transparent Factory Web Diagnostic

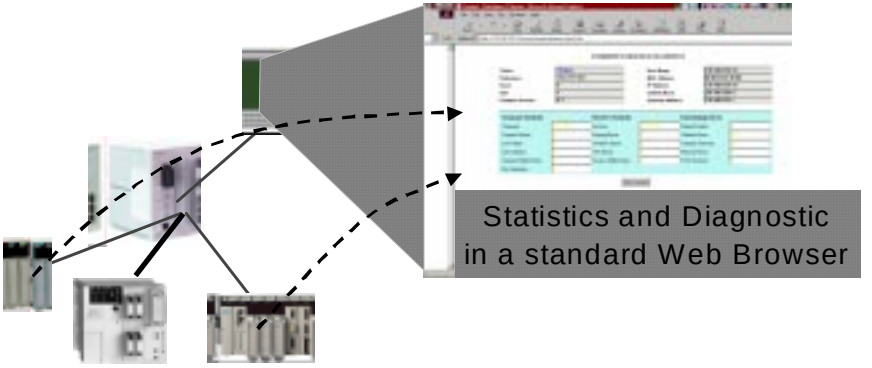
How it Works

Modules, I/Os or devices connected on TF Ethernet can embed diagnostic screens as HTML pages. These pages are pre-defined and not modifiable by the end user. The user can view these diagnostic screens using any Web browser.
Dedicated screens can also be embedded to allow the user to change some configuration parameters after identification.



Example

The following figure illustrates an example with NOE, ETY and ETZ modules that embed Configuration screens to tune the communication stack, Ethernet statistics and diagnostic screens.



Transparent Factory Ethernet Products and Components Selection Guide

4

At a Glance

Introduction

This chapter provides descriptions of Schneider Electric's Ethernet products and components suitable for Transparent Factory applications.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
4.1	Ethernet Products	42
4.2	Ethernet Components	54

4.1 Ethernet Products

Ethernet Products Listing

Introduction

This section contains a brief summary of Schneider Electric's Premium, Quantum, Momentum, and Micro Ethernet product lines.

Premium, Quantum, & Momentum Ethernet Products

The products described in this section are listed below.

Part Number	Description
TSX ETZ 410	Ethernet Module for Micro
TSX ETZ 510	Ethernet Module for Micro
TSX ETY 110	Ethernet Module for Premium
TSX ETY 110WS	Ethernet Module for Premium
TSX ETY 410	Ethernet Module for Premium
TSX ETY 510	Ethernet Module for Premium
140 NOE 211 00	Ethernet Module for Quantum
140 NOE 211 10	Ethernet Module for Quantum
140 NOE 251 00	Ethernet Module for Quantum
140 NOE 251 10	Ethernet Module for Quantum
140 NOE 771 00	Ethernet Module for Quantum
140 NOE 771 10	Ethernet Module for Quantum
170 CCC 960 20	Ethernet Momentum Processor
170 CCC 980 20	Ethernet Momentum Processor
170 ENT 110 00	Ethernet Momentum I/O Device

List of Services for Premium

The following table details the services available with the Premium line of Ethernet products.

Service	TSX ETY 110	TSX ETY 110WS	TSX ETY 410	TSX ETY 510
MB – TCP/IP	X	X	X	X
I/O – scanner			X	X
Coordination between controllers	X	X	X	X
Web diagnostic	X	X	X	X
Web control and monitoring		X		X
Global Data			X	X
10 Mbps	X	X	X	X
100 Mbps			X	X
Electrical connectors	X	X	X	X
Optical connectors				

List of Services for Quantum

The following table details the services available with the Quantum line of Ethernet products.

Services	140 NOE 211 00	140 NOE 211 10	140 NOE 251 00	140 NOE 251 10	140 NOE 771 00	140 NOE 771 10
MB – TCP/IP	X	X	X	X	X	X
I/O scanner	X		X		X	
Coordination between controllers	X		X		X	
Web diagnostic	X	X	X	X	X	X
Web control and monitoring		X		X		X
Global Data					X	X
10 Mbps		X	X	X	X	X
100 Mbps					X	X
Electrical connectors		X			X	X
Optical connectors			X	X	X	X

List of Services for Momentum

The following table details the services available with the Momentum line of Ethernet products.

Services	174 CEV 300 10	174 CEV 200 3010	170 CCC 960 20	170 CCC 980 20	170 ENT 110 00
MB – TCP/IP	X	X	X	X	X
I/O – scanner			X	X	
Coordination between controllers			X	X	
Web diagnostic					
Web control and monitoring					
10 Mbps	X	X	X	X	X
100 Mbps					
Electrical connectors	X	X	X	X	X
Optical connectors					

List of Sevices for Micro

The following table details the services available with the Micro line of Ethernet products.

Service	ETZ 410	ETZ 510
MB – TCP/IP	X	X
I/O – scanner		
Coordination between controllers	X	X
Web diagnostic	X	X
Web control and monitoring		X
10 Mbps	X	X
100 Mbps	X	X
Electrical connectors	X	X
Optical connectors		

What's in this Section?

This section contains the following maps:

Topic	Page
Ethernet Premium Products	46
Ethernet Quantum Products	48
Ethernet Momentum/Adapters Products	51
Ethernet Micro Products	53

Ethernet Premium Products

Overview

This section describes the Ethernet Premium products.

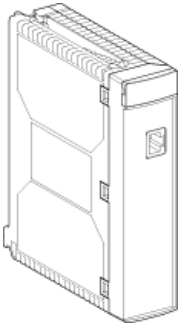
Premium TSX ETY 110 & 110WS Module

A summary of the TSX ETY 110 and 110WS modules features follows.

Function	Description
Speed	Ethernet 10 Mbit/s
Interfaces	10BaseT (RJ45 connector) 10Base5 (AUI connector)
Transmission media	Shielded twisted pair cable Tri-axial cable
Configuration	Maximum number of stations: 64 Maximum lengths: ● 100 meters with STP cable to hub or switch ● 50 meters with several tap-off cables (TSX ETY CB 0··) end to end to a transceiver (TSX ACC2) on trunk cable Maximum stations/PLC rack: 4 (RJ45 connections) / 2 (AUI connections)
Services	ETHWAY: Handling messages (Uni-TE, application to application, PLC scanning), Common words TCP/IP: message handling X-Way / Uni-TE / MODBUS FactoryCast: Diagnostic, monitoring, and control of the application via Web browser.

Premium TSX ETY 410 & 510

A summary of the TSX ETY 410 and 510 modules features follows.

Function	Description
Speed	Ethernet 100 Mbit/s
Interfaces	10/100BaseTX (RJ45 connector) Auto Sensing 10 Mbps/100 Mbps/Half/Full duplex
Transmission media	Shielded twisted pair cable
Configuration 	Maximum number of stations: 64 Maximum lengths: ● 100 m with SFTP cable to hub or switch Maximum stations/PLC rack: 4 RJ45 connections
Services	SNMP TCP/IP: message handling Uni-TE/MODBUS I/O Scanner up to 64 devices Web based Management Global Data FactoryCast (TSX ETY 510 only)

Ethernet Quantum Products

Overview

This section describes the Ethernet Quantum products.

Quantum 140 NOE 211 00 & 211 10 Modules

A summary of the NOE 211 00/10 modules features follows.

Function	Description
Speed	Ethernet 10 Mbits/
Interfaces	10BaseT (RJ45 connector)
Transmission media	Shielded twisted pair cable
Configuration	Maximum number of stations : 64 Maximum lengths: 100 meters with STP cable to hub/ switch/transceiver Maximum stations/PLC rack: 6
Services	Message handling: MODBUS FactoryCast: Diagnostic, monitoring and control of the application via a Web browser

Quantum 140 NOE 251 00 & 251 10 Modules

A summary of the NOE 251 00/10 features follows.

Function	Description
Speed	Ethernet 10 Mbit/s
Interfaces	10BaseFL (BFOC or ST connector)
Transmission media	Fiber optic
Configuration	Maximum number of stations : 64 Maximum lengths: 3000m with multi-mode fiber Maximum stations / PLC rack: 6
Services	Message handling: MODBUS FactoryCast: Diagnostic, monitoring and control of the application via a Web browser

Quantum 140 NOE 771 00 & 771 10 Modules

A summary of the NOE 771 00/10 modules features follows.

Function	Description
Speed	Ethernet 10/100 Mbit/s
Interfaces	10/100BaseTX (RJ45 connector) Mbps / 100 Mbps / Half / Full duplex 100BaseFX multi-mode (MT-RJ connector)10BaseT (RJ45 connector) Half / Full duplex
Transmission media	Shielded twisted pair cable/Optic fiber
Configuration	Maximum number of stations: 64 Maximum lengths: ● 100 meters with STP cable to hub switch or transceivers ● 3000 meters with multi-mode fiber Maximum stations / PLC rack: 6
Services	Message handling: MODBUS Automatic scanner of 128 I/O devices FactoryCast: Diagnostic, monitoring, and control of the application in a Web browser

Ethernet Momentum/Adapters Products

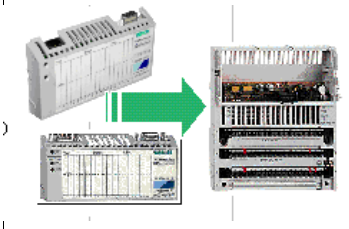
Overview

This section describes the Ethernet Momentum products.

Momentum 171 CCC 960 20 / 171 980 20 Adapters

The following table describes these adapters:

- 171 CCC 960 x0: Ethernet RJ45 port and I/O communications
- 171 CCC 980 x0: Ethernet RJ45 port and RS485 communications

Function	Description
Speed	Ethernet 10 Mbit/s
Interfaces	10BaseT (RJ45 connector) 10 Mbps: Half duplex
Transmission media	Shielded twisted pair cable
Configuration 	Maximum number of stations: 64 Maximum lengths:100m with STP cable-to-hub, or to station
Services	TCP/IP: message handling MODBUS VO Scanner up to 64 devices Web-based management

Momentum 170 ENT 110 00 Adapter

A summary of the 170 ENT 11000 adapter features follows.

Function	Description
Speed	Ethernet 10 Mbit/s
Interfaces	10BaseT (RJ45 connector) 10 Mbps: Half duplex
Transmission media	Shielded twisted pair cable
Configuration 	Maximum number of stations : 64 Maximum lengths:100m with STP cable-to-hub, or to station
Services	Associated with all Momentum I/O BasesI/O scanning compatibility TCP/IP: message handling MODBUS

Ethernet Micro Products

Overview

This section describes the Ethernet Micro products.

Micro TSX ETZ 410 & 510 Modules

A summary of the TSX ETZ 410 and 510 modules features follows.

Function	Description
Speed	Ethernet 100 Mbit/s
Interfaces	1 x RJ45 for Uni-telway 1 x 10/100 Base TX (RJ45 connector) Auto sensing 10 Mbps (Half/full duplex) /100 Mbps (Half duplex) for Ethernet 1 x RS-485 (terminal port) 1x RS-232 serial link for modem
Transmission Media	RJ45 and RS-484: Sheilded twisted pair cable RS-232: NULL modem cable
Configuration 	Maximum number of stations: 32 Maximum lengths: 100 meters with STP cable to hub or switch Maximum stations per PLC rack: 1
Services	SNMP TCP/IP: message handling Uni-TE MODBUS I/O scanned Web-based management Factory cast (ETZ 510 only)

4.2 Ethernet Components

Ethernet Components Listing

Premium, Quantum, & Momentum Ethernet Products

This section contains a brief summary of Schneider Electric's Ethernet hubs, switches, and transceiver product lines. The products described in this section are listed below.

Part number	Description
499NEH00410	Ethernet Hub 10Mbps 4TP
499NEH04100	Ethernet Hub 100Mbps 4TX
499NOH00510	Ethernet Hub 10Mbps 3TP/2FL
174CEV20030	MODBUS Plus to Ethernet TCP/IPBridge
174CEV30010	MODBUS to Ethernet TCP/IPBridge
499NES07100	Ethernet Switch 10/100Mbps 7TX
499NOS07100	Ethernet Switch 10/100Mbps 5TX/2FX
499NTR00 010	Ethernet Transceiver 10Mbps TP/FL
499NTR00100	Ethernet Transceiver 100Mbps TX/FX

What's in this Section?

This section contains the following maps:

Topic	Page
Ethernet Hubs	55
Ethernet TCP/IP Bridges	58
Ethernet Switches	61
Ethernet Transceivers	64

Ethernet Hubs

Overview

This section describes the Transparent Factory Ethernet hubs.

499NEH00410 Ethernet Hub 10Mbps 4 TP

A summary of the 499 NEH 004 10 Ethernet hub features follows.

Function	Description
Speed	Ethernet 10 Mbit/s
Interfaces	4 x 10BaseT ports (RJ45 connector)
Transmission media	Shielded twisted pair cable
Configuration	Various topologies for small and medium sized networks: Star topology and Bus topology via twisted pair cable Maximum: 4 cascading 499NEH410 in a star configuration Maximum range TP-line length: max. 100 meters with 100 ohms (max. 330 ft.)
Services	Fault tolerant 24VDC power supply Specific signaling contact for function control
Propagation Delay	Transition: TP Port <-> TP port Propagation Equivalent: 190 meters (312 ft.) Variability Value: 4 BT

499NEH04100 Ethernet Hub 100Mbps 4 TX

A summary of the 499 NEH 04 100 Ethernet hub features follows.

Function	Description
Speed	Ethernet 100 Mbit/s
Interfaces	4 x 100BaseTx ports (RJ45 connector)
Transmission media	Shielded Twisted Pair cable
Configuration	Various topologies for small and medium sized networks: Star topology and Bus topology via twisted pair cable Maximum: 2 cascading 499NEH04100 in a star configuration Maximum range TP-line length: max. 100 meters with 100 ohms (max. 330 ft.)
Services	Fault tolerant 24VDC power supply (12 to 48VDC)
Propagation Delay	Transition: TP Port <-> TP port Mark round trip delay: 92 BT

499NOH00510 Ethernet Hub 10Mbps 3TP/2 FL

A summary of the 499 NOH 005 10 Ethernet hub features follows.

Function	Description
Speed	Ethernet 10 Mbit/s
Interfaces	3 10BaseT ports (RJ45 connector) 2 10Base-FL ports (ST connector) 10 Mbps/Half duplex or Full duplex
Transmission media	Shielded Twisted Pair cable Fiber optic
Configuration	Various topologies for small and medium sized networks: ● Optical ring via optic fiber ● Star topology and Bus topology via fiber optic and twisted pair cable Maximum: 11 499NOH00510 in a fiber optical bus/ ring configuration with a maximum length < 1180 meters Maximum: 4 cascading 499NOH00510 in a star configuration Maximum range on 50/125m fiber: max.2,600 meter (max. 8,500 ft.) > 11 dB Link Budget Maximum range on 62, 5/125m-fiberon 62,65/125m-fiber: max. 3,100 meters (max. 10,000 ft.) > 14 dB Link Budget Maximum range on TP-line length: max. 100 meters with 100 ohms (max. 330 ft.) TP-line length: max 100 meters with 100 ohms (max. 330 ft.)
Services	Fault tolerant 24VDC power supply Specific signaling contact for function control Fault tolerant network with redundant copper ring structure
Propagation Delay	See table below.

The following table shows the propagation delay for the 499NOH00510 Ethernet Hub 10 Mbps 3TP/2 FL.

Transition	Propagation Delay	Propagation Equivalent	Variability Value
TP port < - > TP port	1, 9 s	190 meters (623 ft.)	3 BT
TP port < - > OF port	3, 6s	360 meters (1,181 ft.)	6 BT
TP port < - > OF port	2, 6s	260 meters (853 ft.)	3 BT

Ethernet TCP/IP Bridges

Overview

This section describes the Transparent Factory Ethernet TCP/IP Bridges.

174 CEV 300 10 MODBUS to Ethernet TCP/IP Bridge

The 174 CEV 300 10 supports multiple devices on the serial line and multiple MODBUS TCP connections.

A summary of the 174 CEV 300 10 MODBUS to Ethernet TCP/IP bridge follows.

Function	Description
Speed	Ethernet 10 Mbit/s
Ethernet Interfaces	10BaseT network interface, with a shielded connector. Ethernet v2 encapsulation, TCP/IP Version 4. Good link indicator LED. Up to 8 quasi-simultaneous connections.
Power Supply	9-30 VDC, suitable for 12V and 24V operated systems. DC inrush and surge protected. Power requirement is 3 Watts maximum total.
Case	Approximately 35 x 95 x 60 mm (Approx. 1.4 x 3.7 x 2.4 inches). DIN rail snap mounting.
Operating Environment	0 to 60°C, 20% to 90% humidity, non-condensing.
Configuration Parameters	IP address, gateway, netmask. Baud rate, parity, number of bits, stop bits, 2/4 wire operation. MODBUS RTU/ASCII or other protocol, PLC address, time-outs. Configuration parameters are stored in non-volatile memory.
Status Indicators	Six colored LEDs display Ethernet, MODBUS and device status.
Functions	Conversion of MODBUS RTU or MODBUS ASCII protocol to MODBUS/TCP (slave functionality). Conversion of MODBUS/ TCP to MODBUS RTU or MODBUS ASCII (master functionality). Enables multiple Masters (MMI, DCS, PLC) to access devices connected to serial port. Two units can be used to bridge a MODBUS connection over a TCP/IP network.
Serial Interface	RS232 or RS485 interface, switch selectable. RS485 two-wire and 4-wire operation. MODBUS RJ45 connector for RS232, can be wired to PLC with straight patch cable.

174 CEV 200 30 MODBUS Plus to Ethernet TCP/IP Bridge

The 140 CEV 200 30 bridge is a compact industrial PC with Ethernet and MODBUS Plus interfaces plus bridge software.

A summary of the 140 CEV 200 30 bridge follows.

Function	Description
Speed	Ethernet 10Mbit/s
Ethernet Interfaces	10 base-T (RJ45), 10 base-2 (BNC), 10 base-5 (AUI) network interface
Serial Interface	1 dual/single cable MODBUS Plus
Power Supply	110/220 v AC, auto sensing
Mounting	Vertical panel or horizontal shelf
Case	122 x 229 x 248 mm (4.8 x 9 x 9.8 inches)

Ethernet Switches

Overview This section describes the Transparent Factory Ethernet Switches.

499NES07100 Ethernet Switch 10/100Mbps 7 TX

A summary of the 499 NES 071 00 Ethernet Switch 10/100Mbps 7 TX follows.

Function	Description
Speed	Ethernet 10/100 Mbit/s
Interfaces	5 10/100Base-TX (RJ45 connector) with auto-negotiation 2 10/100Base-TX (RJ45 connector) for backbone in redundant ring
Transmission media	Shielded Twisted Pair cable Various topologies for small and medium sized networks
Configuration	Redundant copper ring, Star topology, Bus topology via twisted pair. Maximum cascading depth / up: 50 (actual products to confirm it with new products) 499NES07100 (manageable by ring manager so with 5 ports: 250 users with a recovery time < 300 ms. The 50 switches network can achieve 5 km with twisted pair (full duplex) (perimeter of the copper ring). Maximum range on TP-line length : max. 100 meters with 100 ohms (max. 330 ft)
Services	Fault tolerant network with redundant copper ring structure Self learning Store & Forward Switch Fault tolerant 24VDC power supply (18VDC to 32VDC) Specific signaling contact for function control SNMP, RMON, VLAN Manageable via a Web browser
Performances	Fast recovery time in copper ring : ● on shared 10 Mbps / 100 Mbps architecture (hubs) (worst case ● on switched 200 Mbps architecture (switches) The configurable controller switch manages the redundant switched ring. It supervises the ring and is responsible for recognition and elimination of occurring faults in the ring within less than 300 ms.

499NOS07100 Ethernet Switch 10/100Mbps 5TX/ 2FX

A summary of the 499 NOS 071 00 Ethernet Switch 10/100Mbps 5TX/2FX follows.

Function	Description
Speed	Ethernet 10/100 Mbit/s
Interfaces	5 10/100Base-TX (RJ45 connector) with auto-negotiation
Transmission media	Shielded Twisted Pair cable Fiber optic
Configuration	Various topologies for small and medium sized networks: ● Redundant optical ring via optic fiber ● Star topology via optic fiber and twisted pair ● Bus topology via optic fiber and twisted pair Maximum cascading depth / up: 50 499NOS07100 (manageable by optical ring manager so with 5 ports: 250 users with a recovery time < 300 ms. Maximum range on 50/125m-fiber: max. 2.600 m (max. 8.500 ft.), > 11 dB Link Budget Maximum range on 62,5/125m-fiber: max. 3.100 m (max. 10.000 ft.), > 14 dB Link Budget Maximum range on TP-line length: max. 100 m with 100 ohms (max. 330 ft.)
Services	Fault tolerant network with redundant copper ring structure Self learning Store & Forward SwitchFault tolerant 24VDC power supply (18VDC to 32VDC Specific signaling contact for function control SNMP, RMON, VLAN Manageable via a Web browser
Performances	Fast recovery time in optical ring: ● on shared 10 Mbps / 100 Mbps architecture (hubs) (worst case) ● on switched 200 Mbps architecture (switches) The configurable controller switch manages the redundant switched ring. It supervises the ring and is responsible for recognition and elimination of occurring faults in the ring within less than 300 ms.

Ethernet Transceivers

Overview

This section describes the Transparent Factory Ethernet Transceivers.

499NTR00010 Ethernet Transceiver 10Mbps TP/FL

A summary of the 499 NTR 000 10 Ethernet Transceiver 10Mbps TP/FL follows.

Function	Description
Speed	10Mbit/s
Interfaces	10BaseT (RJ45 connector) 10Base FL (ST connector) 10 Mbps / Half duplex or full duplex auto-negotiation
Transmission media	Shielded Twisted Pair cable Fiber optic
Configuration	Maximum range on 50/125m-fiber: max. 2.600 m (max. 8.500 ft.), > 11 dB Link Budget Maximum range on 62,5/125m-fiber: max. 3.100 m (max. 10.000 ft.), > 14 dB Link Budget Maximum range on TP-line length: max. 100 m with 100 ohms (max. 330 ft.)
Services	Fault tolerant 24VDC power supply Specific signaling contact for function control
Propagation Delay	Transition: TP Port <-> OF port Propagation Delay: 0, 5s Propagation Equivalent: 50 meters (164 ft.) Variability Value: 1 BT

499NTR00100 Ethernet Transceiver 100Mbps TX/FX

A summary of the 499 NTR 00 100 Ethernet Transceiver 100Mbps TX/FX follows.

Function	Description
Speed	Ethernet 100 Mbit/s
Interfaces	100BaseT (RJ45 connector) 100Base FX (SC connector) Half duplex or full duplex
Transmission media	Shielded and Foiled Twisted Pair cable Fiber optic
Configuration	Maximum range on 50/125m-fiber: max. 2.600 m (max. 8.500 ft.), > 11 dB Link Budget Maximum range on 62,5/125m-fiber: max. 3.100 m (max. 10.000 ft.), > 14 dB Link Budget Maximum range on TP-line length: max. 100 m with 100 ohms (max. 330 ft.)
Services	Fault tolerant 24VDC power supply (12VDC to 48VDC) Specific signaling contact for function control
Performances	Transceiver failure recognized in less than XXms

Ethernet Cabling Information

5

At a Glance

Introduction

This chapter provides cabling information for designing Ethernet networks using Schneider Electric's Ethernet products and components.

What's in this Chapter?

This chapter contains the following maps:

Topic	Page
Shielded Twisted Pair Cable	68
Optical Patch Cables	71
10 Mbps Connection Guide	73
100Mbps Connection Guide	75
Distance Rules for Designing Networks	77

Shielded Twisted Pair Cable

Description

The low cost connection of devices can be implemented with the Ethernet shielded twisted pair cable (490NTW000xx, 490NTC000xx). This is an STP category 5 cable. It is suitable for installation in industrial environments subject to electromagnetic interference. The flexibility of the cables allows simple installation.

Because links to cascade Ethernet components are subject to a crossover function in the IEEE 802.3 norm, hubs and switches can be interconnected with a dedicated crossed cable (490NTC000xx).

Common Features

The cord is made of 4 twisted pairs and has the following features:

- 100 ohms cable impedance
- Category 5 according to EIA/TIA-568, and to class Dq—IEC 11801 / EN 50173
- Material is LSZH: Low Smoke Zero Halogen and flame-retardant—NFC32 070 N°1 (C2) and CEI 332/1
- Double shielding for industrial applications (STP technology / screens: foil + braid tin)
- Connectors pre-assembled with two shielded RJ45 connectors according to EIA/TIA-568, and to class D—IEC 11801 / EN 50173 (easiness, reliability in environment)
- Approvals: EN50167, EN50168, EN50169, ISO 11801, EN50173 (Europe)
- 490NTW/NTC000xxU cables are not "Zero Halogen," but are UL approved. These cables are not suitable for European sale.

Note: For a full explanation of cabling rules, refer to Transparent Factory Network Design and Cabling Guide (490 USE 13400).

Non-Crossing Ethernet Cabling Part Numbers

This type of cord allows connection links between Ethernet module (NOE, TSX ETY) or Central Unit fit out with Ethernet and components (hubs, switches, routers). The following table indicates the connector pinouts for a 490NTW000xx non-crossover cable.

Connector A				**Connector B**		
Pair 1		pin 4	<--------->	pin 4		blue (white)
		pin 5	<--------->	pin 5		white-blue
Pair 2	TD^+	pin 3	<--------->	pin 3	TD^+	white-orange
	TD^-	pin 6	<--------->	pin 6	TD^-	orange-white
Pair 3	RD^+	pin 1	<--------->	pin 1	RD^+	white-green
	RD^-	pin 2	<--------->	pin 2	RD^-	green (white)
Pair 4		pin 7	<--------->	pin 7		white-brown
		pin 8	<--------->	pin 8		brown (white)

Non-Crossing Ethernet Cabling Part Numbers

The following table lists the part numbers for 490NTW000xx Ethernet non-crossover cables.

Cable	**Length**	**Part Number**
STP category 5 RJ45	2 meters	490NTW00002
STP category 5 RJ45	5 meters	490NTW00005
STP category 5 RJ45	12 meters	490NTW00012
STP category 5 RJ45	40 meters	490NTW00040
STP category 5 RJ45	80 meters	490NTW00080

Crossover Wire Ethernet Cable 490NTC000xx

The following table indicates the connector pinouts for a 490NTW000xx non-crossover cable.

Connector A				**Connector B**		
Pair 1		pin 4	<--------->	pin 7		blue (white)
		pin 5	<--------->	pin 8		white-blue
Pair 2	TD^+	pin 3	<--------->	pin 1	TD^+	white-orange
	TD^-	pin 6	<--------->	pin 2	TD^-	orange-white
Pair 3	RD^+	pin 1	<--------->	pin 3	RD^+	white-green
	RD^-	pin 2	<--------->	pin 6	RD^-	green (white)
Pair 4		pin 7	<--------->	pin 4		white-brown
		pin 8	<--------->	pin 5		brown (white)

Crossover Ethernet Cabling Part Numbers

The following table lists the part numbers for 490NTC000xx Ethernet crossover cables.

Cable	**Length**	**Part Number**
STP category 5 RJ45 crossed over	5 meters	490NTC00005
STP category 5 RJ45 crossed over	15 meters	490NTC00015
STP category 5 RJ45 crossed over	40 meters	490NTC00040
STP category 5 RJ45 crossed over	80 meters	490NTC00080

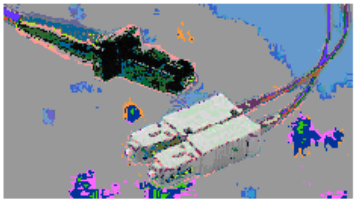
Optical Patch Cables

Three Versions Available

Three versions of optical patches -- SC duplex, ST or MT-RJ -- are available in order to connect the MT-RJ equipped optical port of Ethernet Module to a patch panel, a hub or a switch.

- One MT-RJ connector and two ST connectors (490NOT00005)

- One MT-RJ and one SC duplex connectors (490NTC00005)



- Two MT-RJ connectors

Common Features

The cord is composed of 2 fibers and has the following features

- Two 62.5/125 Multi mode glass fibers; it is used in 1300 nano-meters wavelength
- Low Smoke Zero Halogen according to HD.624-7
- Flame-retardant according to NFC32 070 N°1 (C2) and CEI 332/1
- Approvals: ANSI/TIA/ EIA -568-B, ISO/IEC 11801, CENELEC

Optical Cable Part Numbers

Part numbers for the three versions of optical patch cable are listed below.

Cable	Length	Part Number
MT-RJ/SC duplex optical patch	5 meters	490NOC00005
MT-RJ/ST optical patch	5 meters	490NOT00005
MT-RJ/MT-RJ optical patch	5 meters	490NOR00005

10 Mbps Connection Guide

Overview

The following sections provide connection information for Schneider Electric's components running at 10 Mbps.

Product Selection Guide

The following table provides product selection information for Schneider Electric's Ethernet products running at 10Mbps.

Product	RJ45	BFOC or ST
Premium		
TSX ETZ 410 Ethernet Module	**X**	
TSX ETZ 510 Ethernet Module	**X**	
TSX ETY 110 Ethernet Module	**X**	
TSX ETY 110WS Ethernet Module	**X**	
TSX ETY 410 Ethernet Module	**X**	
TSX ETY 510 Ethernet Module	**X**	
Quantum		
140 NOE 211 00 Ethernet Module	**X**	
140 NOE 211 10 Ethernet Module(WS)	**X**	
140 NOE 251 00 Ethernet Module		**X**
140 NOE 251 10 Ethernet Module(WS)		**X**
140 NOE 771 00	**X**	**X**
140 NOE 771 10	**X**	**X**
174 CEV 300 10 MODBUS / Ethernet TCP/IP Bridge	**X**	
174 CEV 200 3010 MODBUS Plus / Ethernet TCP/IP Bridge	**X**	
Momentum		
170 CCC 96020 Ethernet Processor	**X**	
170 CCC 98020 Ethernet Processor	**X**	
170 ENT 11000 Ethernet I/O Device	**X**	

Component Selection Guide

The following table provides component selection information for Schneider Electric's Ethernet components running at 10Mbps

Component	RJ45	BFOC or ST
Transceivers		
TSX ETH NTR 1 Mini transceiver 10 Mbps TP/AUI	**1 port**	
499NTR00010 Ethernet 10Mbps TP/FL	**1 port**	**1 port**
Hubs		
TSX ETH NEH 8 Ethernet Hub 8 TP/1 AUI	**1 port**	
499NEH00410 Ethernet 10Mbps 4TP	**4 ports**	
499NOH00510 Ethernet 10Mbps 3TP/2FL	**3 ports**	**2 ports**
Switches		
499NES07100 Ethernet 10/100Mbps 7TX	**5 ports (10/ 100Mbps)**	
499NOS07100 Ethernet 10/100Mbps 5TX/2FX	**5 ports (10/ 100Mbps)**	

Cables

The following table provides cabling information for Schneider Electric's Ethernet components running at 10Mbps.

Cable	RJ45	BFOC or ST
Shielded Twisted Pair		
490NTW000xx Ethernet STP cat 5 RJ45 non-crossover cable for connections to a hub, switch, or transceiver	**2 connectors**	
490NTC000xx Ethernet STP cat 5 RJ45 crossover cable for connection to inter hubs, switches, or transceivers	**2 connectors**	
Fiber Optic Patch		
490NOT00005 Ethernet MT-RJ/ST for product connection to patch panel, hub, or transceiver		**2 connectors (xmitter/receiver**)

100Mbps Connection Guide

Product Selection Guide

The following table provides connection information for Schneider Electric's Ethernet products running at 100Mbps.

Product	RJ45	MT-R
Micro		
TSX ETZ 410 Ethernet Module	**X** half duplex	
TSX ETZ 510 Ethernet Module	**X** half duplex	
Premium		
TSX ETY 410	**X** full duplex	
TSX ETY 510	**X** full duplex	
Quantum		
140 NOE 771 00 Ethernet Module	**X** full duplex	**X**
140 NOE 771 10 Ethernet Module(WS)	**X** full duplex	**X**

Component Selection Guide

The following table provides connection information for Schneider Electric's Ethernet components running at 100Mbps.

Component	RJ45	SC
Transceivers		
499NTR00100 Ethernet 100Mbps TX/FX	**1 port**	**1 port**
Hubs		
499NEH00410 Ethernet 100Mbps 4TX	**4 ports**	
Switches		
499NES07100 Ethernet 10/100Mbps 7TX	**7 ports**	
499NOS07100 Ethernet 10/100Mbps 5TX/2FX	**5 ports**	**2 ports**

Cables

The following table provides connection information for Schneider Electric's Ethernet cables running at 100Mbps.

Cable	RJ45	MT-RJ	SC
Shielded Twisted Pair			
490NTW000xx Ethernet STP cat 5 RJ45 non-crossover cable for connections to a hub, switch, or transceiver	**2 connectors**		
90NTC000xx Ethernet STP cat 5 RJ45 crossover cable for connection to inter hubs, switches, or transceivers	**2 connectors**		
Fiber Optic Patch			
490NOC00005 Ethernet MT-RJ/SC duplex for product connection to patch panel, switch, or transceiver		**1 connector (xmitter/ receiver)**	**1 connector (xmitter/ receiver)**
490NOR00005 Ethernet MT-RJ/MT-RJ for product connection to patch panel, or switch		**2 connectors (xmitter/ receiver)**	

Distance Rules for Designing Networks

10Mbps Hubs

The following rules apply to Ethernet networks using 10Mbps hubs.

Condition	No. of Hubs/Cable Length
Cascaded hubs (*****)	**4 hubs**
Hubs in optical ring	**11 hubs**
Cabling between hubs / hub and station on copper media	**100 meters**
Cabling between stations in copper bus (with 4 cascaded 10 Mbps hubs)	**500 meters**
Cabling between stations in copper / optical bus (with 2 cascaded 10 Mbps hubs)	**3100 meters**
(*****) according to 802.3 norm	

100Mbps Hubs

The following rules apply to Ethernet networks using 100Mbps hubs.

Condition	No. of Hubs/Cable Length
Cascaded hubs (*****) class 2	**2 hubs**
Cabling between hubs / hub and station on copper media	**100 meters**
Cabling between stations in copper bus (with 2 cascaded 100 Mbps hubs)	210 meters
(*****) according to 802.3u norm	

Ethernet Cabling System Distances

The following table provides cabling distance information for Ethernet network design.

Condition	Standard	IEEE 802.3 Norm
Copper cable length limit (10 / 100 Base T / TX)	**100 meters**	**100 meters**
Collision Domain Limit with 10Mbps hubs and STP cable	**500 meters**	**500 meters**
Collision Domain Limit with 10Mbps hubs and optical cable(s)	**Between 1180 & 3100 meters**	
Maximum number of Hubs in ring	**11 hubs**	
Maximum number of Switches in copper or optical ring	50 switches	
Maximum optical cable length between switches (full duplex 100BaseFX)	**3,000 meters**	**2,000 meters**
Maximum optical cable length between switches (half duplex 100BaseFX)	**412 meters**	**412 meters**

Note: Optical fiber is Multimode fiber 62.5/125.

Web-Based Solutions

6

At a Glance

Introduction

This chapter describes Transparent Factory's Web-based management features. Internet technology gives you access to any information available in each server connected to the Internet or an Intranet.
Transparent Factory uses the same technology to connect PLCs together over TCP/IP. By embedding Web servers in PLCs, Transparent Factory makes it possible for authorized users to view and interact with control processes over an Intranet or the Internet.The following sections present services delivered using this technology.

What's in this Chapter?

This chapter contains the following maps:

Topic	Page
Embedded Diagnostics	80
Web-Based Network Management	81
FactoryCast	82
MonitorPro Web Client	85
OPC Factory Server	87

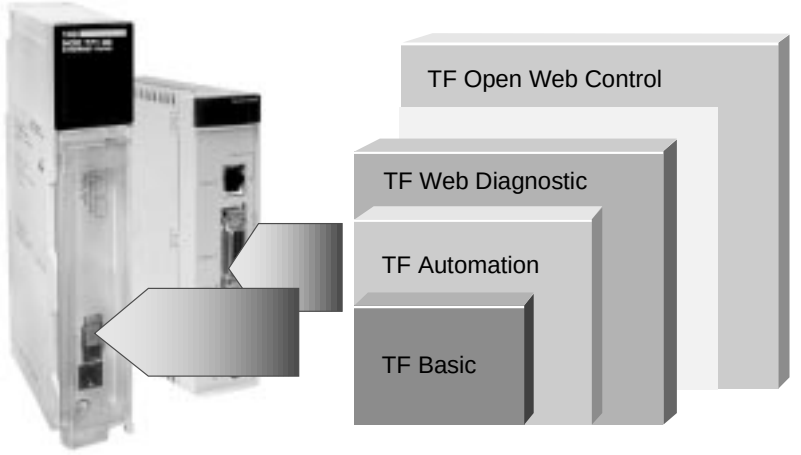
Embedded Diagnostics

Transparent Factory Web Diagnostic Layers

Transparent Factory Ethernet modules (NOE, ETY and ETZ) support the first three Transparent Factory layers:

- Modbus and UNI-TE Messaging and BootP for the Transparent Factory Basic
- SNMP and I/O scanning master to support Transparent Factory Automation
- An embedded Web server to deliver network statistics, module health status, and advanced diagnostic via embedded Web pages. This sophisticated level of services is part of the Transparent Factory Web Diagnostic layer.

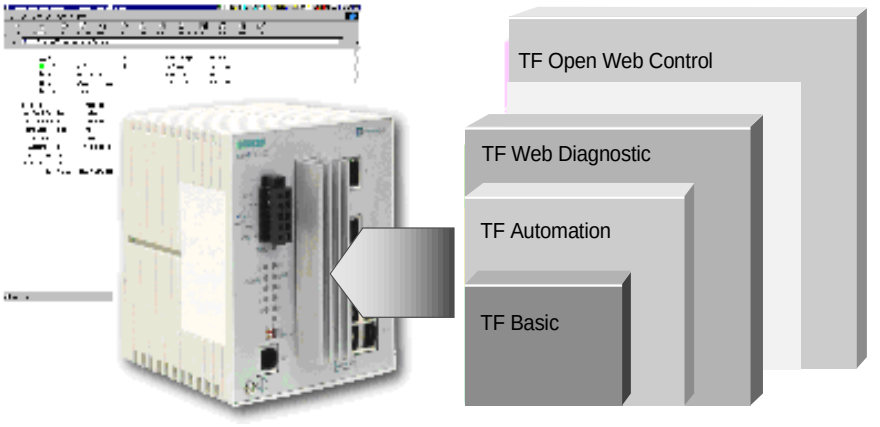
The following diagram describes the first three Transparent Factory layers of a Transparent Factory Ethernet module.



Web-Based Network Management

Support for the First Three Transparent Factory Layers

ConneXium switches also support the first three Transparent Factory layers.



- ConneXium switches are key components in the building of Transparent Factory Ethernet architectures. They support MODBUS TCP/IP to complete the TF basic layer.
- SNMP is part of each switch, including a standard and Transparent Factory MIB. This permits standard network management tools to monitor and troubleshoot applications with the Transparent Factory switch.This is an important element in conforming to the Transparent Factory Automation layer.
- ConneXium NxS switch maintenance can be done remotely via any standard Web browser. A Web server, including standard Web pages, is embedded in each NxS switch allowing the customer to view the status of the switch, including ports, power supply and network health.

FactoryCast

What is FactoryCast?

FactoryCast is the ultimate range of new Transparent Factory Ethernet modules. It includes all features of a standard communication module with an embedded Web server and FTP support. FactoryCast is available on Micro, Premium, and Quantum PLCs, and the package includes:

- hardware module,
- software for administering the Web pages, which runs in a Windows environment, and
- CD-ROM user manual.

The FactoryCast module is a standard in-rack module for both Premium and Quantum PLCs. It is an external device that is plugged into a COM port for Micro PLCs.

Communication Features

FactoryCast hardware contains standard communication features, including:

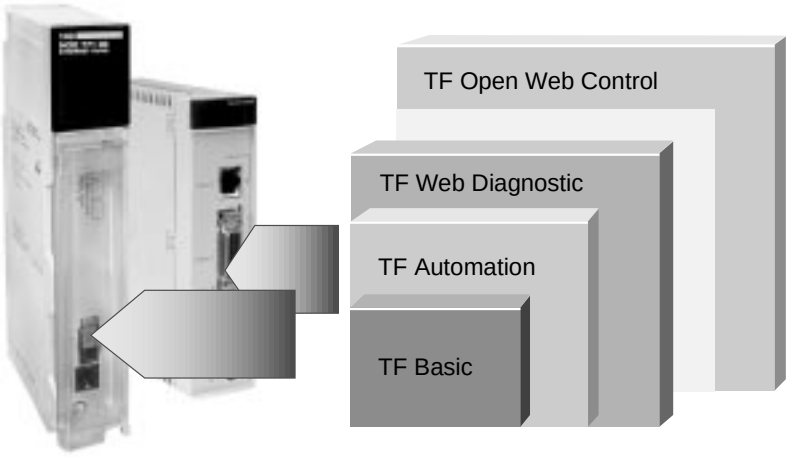
- Uni-Telway and MODBUS protocol,
- SNMP profile (Simple Network Management Protocol), and
- I/O scanner services and Global Data management for various modules.

Embedded Web Server

The embedded Web server available in FactoryCast is a standard Web server. It features a standard HTTP (HyperText Transfer Protocol) and an FTP (File Transfer Protocol) server. Real time PLC data is presented in standard Web pages, and can be accessed via any standard Web browser (Internet Explorer, Netscape, etc....).FactoryCast contains a set of predefined web pages designed to help the user diagnose and maintain the installation and extra memory required to host web pages. Users that want to create custom web pages must use a standard HTML editor (Front Page, Dreamweaver, etc.).standard Web browser (Internet Explorer, Netscape, etc....). FactoryCast contains a set of pre-defined Web pages designed to help the user diagnose and maintain the installation and extra memory required to host Web pages.Users that want to create custom Web pages must use a standard HTML editor (Front Page, Dreamweaver, etc.).

Illustration

The following diagram describes the features of new Transparent Factory Ethernet modules.



What Services are Available with FactoryCast?

The pre-defined web pages deliver the following services:

- Automatic learning of the configuration;
- Graphic visualization of the PLC configuration, including distributed and remote I/O;
- Display of status, health, and diagnostic specific to each module;
- Data editor that controls, monitors, and troubleshoots a PLC application. A spreadsheet is embedded in the Web server with variable names coming directly from the programming software package. The user can view or modify PLC variables, if authorized to do so. For example, tables can be built and stored in the server for later use to decrease downtime;
- Graphic editor that allows the user to build custom screens in order to view and interact with the process. The FactoryCast module contains a pre-defined set of graphic objects, including bar graphs, sliders, buttons, etc.;
- Alarm viewer to view, acknowledge, and manage alarms stored in the buffer of the Premium PLC;
- Capability of writing specific HTML pages that can embed the standard graphic objects shipped with the product. Hyperlinks can be integrated in these pages to get access to Enterprise or supplier databases; and
- Java applets can be developed with the Applet Java Toolkit and downloaded in the FactoryCast modules to add specific features to the product.

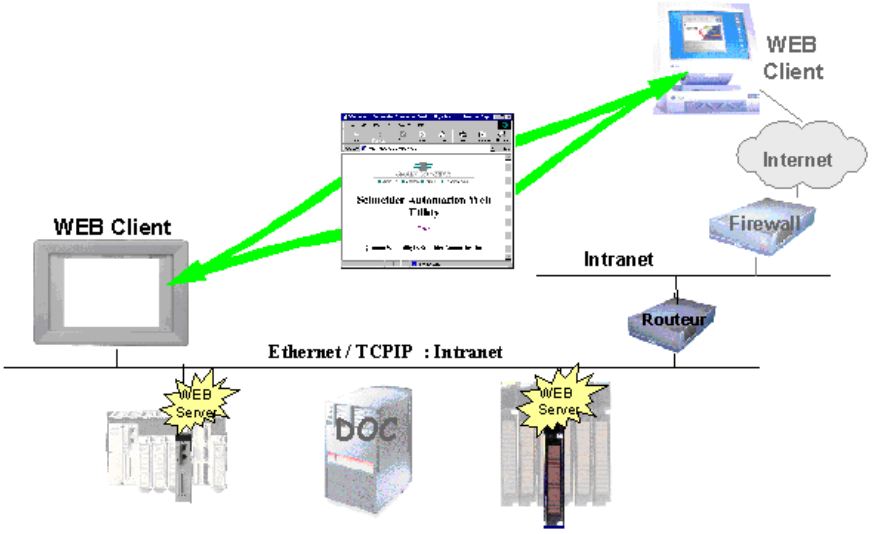
FactoryCast Configurator

The configurator shipped with FactoryCast is a stand-alone tool that operates in a Windows environment to:

- manage the security of the Web site,
- save and restore user-defined Web pages,
- prepare the list of PLC variables that are accessed via Web pages, and
- manage the Web site (backup, restore, etc.).

Illustration

All services from FactoryCast products can be activated locally via any standard Web server connected to the network using the standard architecture, as shown below.



MonitorPro Web Client

Introduction

MonitorPro WebClient provides the capability to remotely monitor and control MonitorPro applications using the Microsoft Internet Explorer browser or any other ActiveX-enabled application. Using Internet standard technology, application information is communicated across either an Internet or Intranet connection, allowing either full-control bi-directional connections or secure view-only connections.

WebClient

WebClient adds to the MonitorPro architecture, by allowing graphics to be executed on a remote workstation or client. WebClient's provide several configuration options including different levels of security for a MonitorPro application.
WebClient remote users can display all MonitorPro windows and, if configured for full-control, can control the application. In a default full-control connection the user has access to all the features and controls of the MonitorPro application.In addition, full-control users can alter set points, adjust controls, and respond to alarms just as if connected over the local network. This is in addition to standard security measures built into the application, such as supervisor passwords.All configuration and enforcement of these levels of control occurs on the server side.

View-only WebClient

When user control is not required or not prudent, the remote users can be configured as view-only, making them unable to write information to the real-time database. View-only WebClient connections provide the maximum level of security for MonitorPro applications. Remote users configured as view-only can write only to a small subset of tags in the MonitorPro real-time database as specifically configured on the server.

MonitorPro

The MonitorPro application developer has some flexibility in defining the set of tags view-only connections can write to.
The remote user can view the application in exactly the same manner as a local user, changing windows and navigating to different views; however, control of the application via buttons, sliders, input text, and other controls is limited.

ActiveX Control

The client software consists of an ActiveX control, which enables the graphic display of information to the user in a Microsoft Internet Explorer browser. A standard HTML page containing the codes required to start the ActiveX control and connection to the server is loaded. Included with the client software is a task used to connect to a MonitorPro server from a remote node, executing outside the ActiveX control or a container application, such as Internet Explorer.

Tasks Associated with WebClient

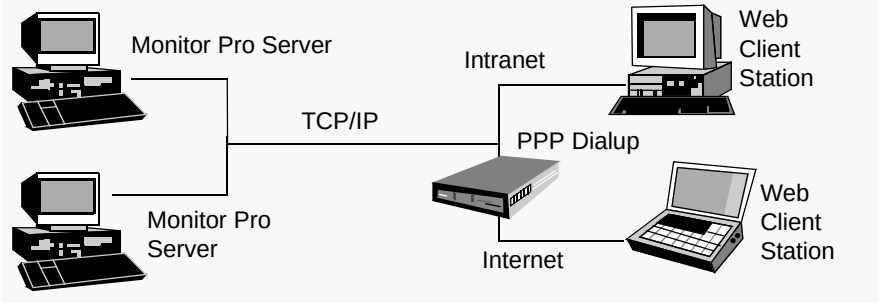
On the server side, two tasks manage the functions associated with WebClient. One task manages the WebClient connection to the application, accepting incoming connections and terminating connections as WebClients disconnect.
The other task is initiated when remote users request server connections. This task interfaces with the real-time database, performs file transfer functions, and manages security operations. It also prevents unauthorized real-time database writes, based on who is connected.

WebClient Benefits

WebClient benefits include:

- **A real client server architecture**: The application runs on the server and is automatically distributed to client stations. Thin client architecture requires no specific development on client stations.
- **Share functions between users**: Local or remote multi-station control; an ideal tool for maintenance.
- **Reduce cost of implementation**: Single-server applications are more cost-effective than individual, networked stations. A centralized application reduces maintenance and administration costs. Concurrent WebClient licenses reduce the number of SCADA licenses required.
- **Reduce downtime**: Allow authorized personnel to access SCADA applications remotely to diagnose production process problems.

An example of real client server architecture is illustrated below.



OPC Factory Server

Introduction

Using the OPC Foundation standard, makers and integrators of software and hardware product no longer need to spend time developing communications drivers for every hardware vendor's products. The OPC interface provides standard access to real-time information for all products with OPC Clients available to access OPC Servers.

MODBUS

End users can use every OPC Client application compliant with the OPC standard version 1.1 and 2.0 via Modicon MODBUS® over the following:

- TCP/IP, Modicon MODBUS Plus®
- Uni-TE UNITELWAY
- FIPWAY
- ETHWAY
- ISAWAY
- Uni-TE over TCP/IP

Schneider's PLC Products Compatible with OPC Factory Server

The OPC Factory Server provides access to Schneider's PLC families including:

- Premium
- Micro
- Nano
- Quantum
- Momentum
- Compact

Modicon IEC1131 Concept Software

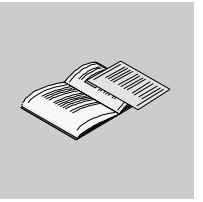
Of particular interest to end users and OEMs is this solution's ability to dynamically access Schneider's Modicon IEC1131 Concept programming software database with the OPC Factory Server. This server provides access to located and unlocated variables for use by OPC Client applications including HMI, Batch, MES. This is a feature of the Schneider Automation OPC Server that no other products offer.

Additional Features

The OPC Factory Server offers the following features:

- OFS, the Schneider Automation OPC server
- Connection to Schneider Automation PLCs
- Openness to many clients for off the shelf and custom applications via OPC Automation and OPC Custom Interfaces
- Compliant with the OPC standard V 1.0a and 2.01
- Supports Modicon Modsoft®, ConCept, and PL7 programming software database access via an export feature.
- Interfaces OPC Automation, OPC Custom (including browser)
- Tested with leading HMI products from Wonderware, Intellution, and Iconics with excellent results
- Local or Remote Server access
- Multi PLC (Quantum, Premium, Micro, Nano, Momentum...)
- Multi Communication Protocols (MODBUS and Uni-TE V2.0)
  - MODBUS RTU, MODBUS Plus, MODBUS TCP/IP
  - Unitelway, Fipway, Ethway, Uni-TE on Isabus, Uni-TE on TCP/IP (XIP)
- Multi Clients
- Address and Symbol variable access
- Read/Write device variables
  - Synchronous or Asynchronous
  - Symbolic access from Concept, Modsoft, PL7, ProWorks
- Direct access to the Concept symbols database - Symbolic access
- Located/unlocated variables
- Simple or structured variables
- Browse interface for symbol databases

Appendices



At a Glance

Purpose

This part provides supplemental information on the Ethernet Frame.

What's in this Appendix?

The appendix contains the following chapters:

Chapter	Chapter Name	Page
A	Ethernet Frame	91

A

Ethernet Frame

At a Glance

Purpose

This appendix provides definitions and parameters for the Ethernet frame.

What's in this Chapter?

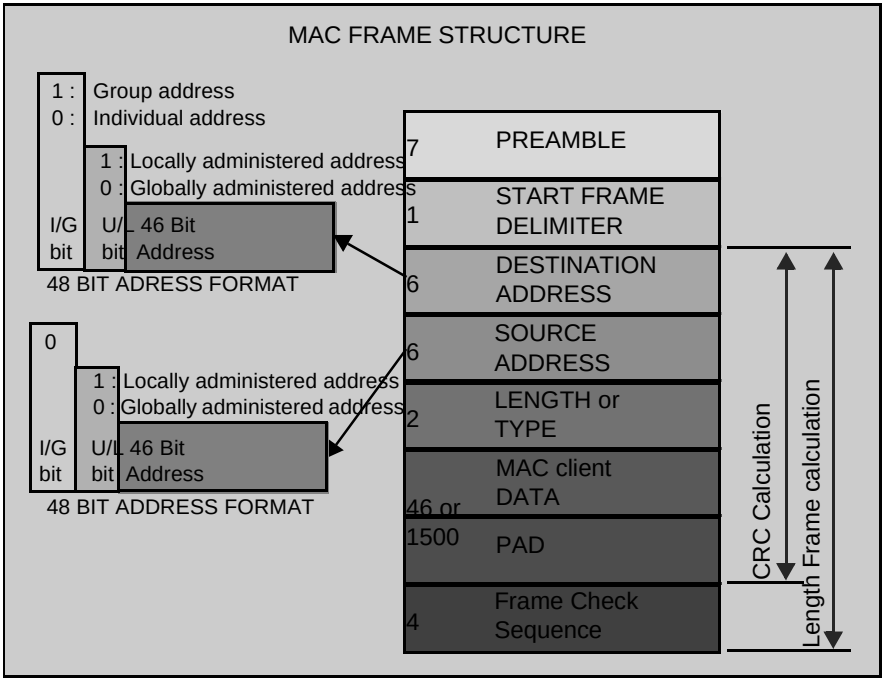
This chapter contains the following maps:

Topic	Page
Ethernet Frame Definition	92
Frame Cells Definition	93

Ethernet Frame Definition

Frame Structure

An Ethernet frame carries between 46 and 1500 data bytes with an 18-byte fixed overhead, coming before a 64-bit preamble and start frame delimiter. These give a maximum frame size of 1518 bytes and a minimum frame size of 64 bytes.
The following diagram describes the MAC frame structure.



Note: The maximum and minimum frame sizes include the destination address field through the FCS field preamble. Preamble and SFD fields are not included.

Frame Cells Definition

Preamble

The preamble comes in first and allows the receiver's clock to synchronize on the emitter's clock.
The preamble is at the physical level, since other frame's fields are issued from the MAC layer.
The preamble field is a 7-octet field formed by a succession of 1,0 bits following.
The preamble field is immediately followed by the 1-octet Start Frame Delimiter field (10101011) which indicates the start of the frame's MAC fields.

MAC Address

Each MAC frame contains two address fields: First, the destination address field, followed by the source address field. The source and the destination address sizes shall be the same for all stations on a given network.
In the IEEE 802.3 standard, the first address bit for destination address is named Individual/Group (I/G). This bit is always at 0 in the source address field and reserved for later use.

1. *Individual address:* The address corresponding to a particular station on the network.
2. *Group address:* A multi-destination address corresponding with one or more stations on a given network.

There are two types of multi-destination address:

1. *Multicast-group-address:* An address attached to a group of stations.
2. *Broadcast-address:* for all stations of a particular network.

The destination address field with all bits set to 1 involves a broadcast address. The second bit (U/L) indicates if the address is either of universal type or locally administered type.
Universal type: U/L = 0: The three first octets identify the manufacturer of the card and the other next three the coupler number with this constructor. This address is globally administered.
The numbers of these first three octets are attributed at the word level by the IEEE. e.g.:

Address	**is assigned to**
00-00-CC	CISCO
i00-AA-00	INTEL
02-60-8C	3COM
00-00-54	Modicon, Inc.
00-80-F4	Telemecanique Electrique
00-80-67	SquareD

Address field:

1-octet	**2-octet**	**3-octet**	**4-octet**	**5-octet**	**6-octet**
Constructor number			Card number		

(256^3 possibilities = 16.78 millions)
Locally administered type: U/L = 1: The 47 bits following are selected by the user and locally administered.
When a broadcast address is used this bit is also assigned with 1.

Length/ Type Field

Indicates the number of MAC client data octets / the protocol see in the data field. If the value is less than the minimum required by the protocol, a PAD field is added at the end of the data field.

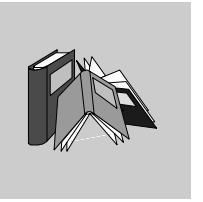
Data and PAD Fields

The Data field contains n octets (46 <= n <= 1500). This field has no meaning for the MAC layer.
If the higher layer supply less than 46 octets then the data field is completed with a PAD.
In this case, the data field is completed by appending extra bits in order to reach the minimum frame length. The content of the PAD has no meaning.
The length of PAD required is computed as follows: max (0, min. Frame Size - (8 n + 2 address Size + 48)) bits.

Frame Check Sequence (FCS) Field

The FCS field contains a 4-octet (32 bits) cyclic redundancy check (CRC) value and place at the end of the frame. This value is computed as a function of the contents of the source and destination address, length, data and PAD if used.
The CRC calculation is done with a 32 degree polynomial generator.
The receiving station uses this CRC field to decide if the frame is correct and can be send to the higher layer.
This is the only field that is transmitted with the most significant bit at left (X^{31} coefficient first, tailing X^{0}).

Glossary



#

100BaseT4 100-Mbps Ethernet running on four pairs of Category 3, 4, or 5 UTP wire.

10Base-F 10 Mbps Ethernet running on optical fiber. 10BASE-F is a point-to-point network media: hub / switch device to station.

10Base-T 10 Mbps Ethernet running on unshielded twisted pair (UTP) cable. 10BASE-T is a point-to-point network media: hub / switch device to station.

10Base2 10 Mbps Ethernet running on thin coax network cable.

10Base5 10 Mbps Ethernet running on Thick wire network cable.

802 IEEE specifications for local area networks (LANs) and metropolitan area networks (MANs).

802.1 general management and inter-network operations such as bridging.

802.2 sets standards at the logical link control sub-layer of the data link layer.

802.3 CSMA/CD (Ethernet) standards, which apply at the physical layer and the media access control (MAC) sub-layer.

802.4 Token passing bus standards.

802.5 Token ring standards.

802.6 MAN standards. IEEE 802 standards become ANSI standards and usually are accepted as international standards.

A

AUI (Attachment Unit Interface) A 15-pin shielded, twisted pair Ethernet cable used to connect network devices and a Medium Attachment Unit (like transceiver).

Auto-Negotiation / Auto-sensing The ability (MAC sub-layer) of a device to identify the speed (10 or 100 Mbps) and the duplex or half mode of connection, and to adjust it, according to the Clause 28 of the IEEE 802.3u standard.

B

Backbone The main cable of the network.

Bandwidth The range of frequencies that a line transmission can carry. The capacity of a digital channel is measured in "bits per seconds" (bit/s).

Base-band LAN A LAN that uses a single carrier frequency over a single channel. Ethernet uses base-band transmission.

bit/s Bits per second, units of transmission speed.

BNC (Bayonet Neill Concelman) Standard connector used to link 10Base2 thin coaxial cable to a transceiver.

BOOTP A TCP/IP network protocol that offers network nodes request configuration information from a BOOTP "server" node.

Bridge A networking device that connects two LANs and forwards or filters data packets between them, based on their destination addresses. Bridges operate at the data link level (or MAC-layer) of the OSI reference model, and are transparent to protocols and to higher level devices like routers.

Bridges are used to connect networks using dissimilar protocols and operate at the Data Link level or Layer Two of the OSI model. They are often described as media access control level or MAC level bridges. They do not carry out any interpretation of the information they are carrying. When two LANs are successfully bridged together, they become one effective LAN. Various load balancing techniques have been developed to combat the problems of bandwidth limitations and the failure of any element on the network. Bridges are increasingly used to control network traffic so that the rest of the network is not involved. This boosts network performance and is also useful for security purposes.

Bridge / Router A device that can provide the functions of a bridge, router or both concurrently. A bridge/router can route one or more protocols, such as TCP/IP and/or XNS, and bridge all other traffic.

Broadcast A broadcast cast is a message that is sent out to all devices on the network.

Brouter A device that routes specific protocols, such as TCP/IP and IPX, and bridges other protocols, thereby combining the functions of both routers and bridges.

Bus A LAN topology in which all the nodes are connected to a single cable. All nodes are considered equal and receive all transmissions on the medium.

C

Channel The data path between two nodes.

Circuit Switching A switched circuit is only maintained while the sender and recipient are communicating, as opposed to a dedicated circuit which is held open regardless of whether data is being sent or not.

Circuit-Switched Network Network that establishes a physical circuit temporarily, until it receives a disconnect signal.

Coaxial Cable An electrical cable with a solid wire conductor at its center surrounded by insulating materials and an outer metal screen conductor with an axis of curvature coinciding with the inner conductor.

Collision Collision is the result of two network nodes transmitting on the same line at the same time. The both transmitted data is not usable, so the stations have to sent again. A delay mechanism employed by both stations reduces the chances of another collision occurrence.

Collision Detection — In case of collision; a signal indicating that one or more stations are contending with the local station's transmission. The signal is sent by the Physical layer to the Data Link layer on an Ethernet/IEEE 802.3 node. With Ethernet, each device can detect collisions and try to send the signal again. CSMA/CD is based on this principle.

Communication Server — A dedicated, standalone system that manages communications activities for other computers.

Concentrator — In star-topology network, a concentrator is a device that serves as a wiring hub.

CRC (Cyclical Redundancy Check) — A way of checking for errors in a message by doing mathematical calculations on the number of bits in the message, which are then sent along with the data, to the recipient. The recipient checks what it has received and repeats the calculation. If there are any discrepancies in the two calculations, the recipient requests the originator to send the data again.

Crosstalk — Noise passed between communications cables or device elements.

CSMA/CD (Carrier Sense Multiple Access with Collision Detection) — CSMA/CD is Ethernet and IEEE 802.3 media access method. All network devices contend equally for access to transmit. If a device detects another device's signal while it is transmitting, it aborts transmission and retries after a random period of time.

Cut-through — Technique for examining incoming packets whereby an Ethernet switch looks only at the first few bytes of a packet before forwarding or filtering it. This process is faster than looking at the whole packet, but it also allows some bad packets to be forwarded.

D

Data Link — A logical connection between two nodes on the same circuit.

Data Link Layer — Layer 2 of the seven-layer OSI reference model for communication between computers on networks. This layer defines protocols for data packets and how they are transmitted to and from each network device. It is a medium-independent, link-level communications facility on top of the Physical layer, and is divided into two sub-layers: medium-access control (MAC) and logical-link control (LLC).

Datagram — A means of sending data by which parts of the message are sent in a random order and the recipient machine has the task of reassembling the parts in the correct order.

Distributed Processing — A system in which each station or node in the network performs its own processing and manages some of its data while the network facilitates communications between the stations.

Drop Cable — A cable that allows connection and access to the trunk cable in a network. It is also called AUI (Attachment Unit Interface) cable, and sometimes transceiver cable.

E

Encapsulation — Wrapping a data set in a protocol header. For example, Ethernet data is wrapped in a specific Ethernet header before network transit. Also, a method of bridging dissimilar networks where the entire frame from one network is simply enclosed in the header used by the link-layer protocol of the other network.

Ethernet — The most popular LAN technology used today. The IEEE standard 802.3 defines the rules for configuring an Ethernet network. It is a 10 or 100 Mbps, CSMA/CD base band network that runs over thin coax, thick coax, twisted pair or fiber optic cable.

F

Fault Tolerance — Increases network integrity and uptime. Failure of any one part of the network will not cause disruption of the network services.
Examples: redundant power supply on transceivers / hubs and switches; simple or doubled redundant optical or copper ring-topology.

FDDI (Fiber Distributed Data Interface) — Interface cable ability in transmitting data at 100 Mbps. Originally specified for fiber lines, FDDI can also operate over twisted-pair cable for short distances CDDI. ANSI standard for the use of fiber optics to provide networks up to 100 Mbps.

Fiber-Optic Cable — A transmission medium composed of two glass optical (or plastic) fibers. It transmits digital signals in the form of modulated light pulses from a laser or LED (Light-Emitting Diode).
Features thin filament of glass, typically 125 to 140 microns in overall diameter
Because of its high bandwidth and high immunity to interference, fiber-optic cable is used in long-haul or noisy applications.

File Server — A computer that stores data for network users and provides network access to that data.

Filtering	Process whereby an Ethernet switch or bridge reads the contents of a packet and then finds that the packet does not need to be forwarded, drops it. a filtering rate is the rate at which a device can receive packets and drop them without any loss of incoming packets or delay in processing.
Firewall	A router or workstation with multiple network interfaces that controls and limits specific protocols, types of traffic within each protocol, types of services, and direction of the flow of information.
FOIRL (Fiber Optic Inter-Repeater Link)	Fiber-optic signaling methodology based on the IEEE 802.3 fiber-optic specification.
Forwarding	Process whereby an Ethernet switch or bridge reads the contents of a packet and then passes that packet on to the appropriate attached segment. A forwarding rate is the time that it takes the device to execute all of the steps.
Fragment	A piece of a larger packet that has been broken down into smaller units.
Fragmentation	Breaking a packet into smaller units when transmitting over a network medium that cannot support the original size of the packet.
Frame	A group of bits sent over a link that contains its own control information, such as address and error detection. The size and composition of the frame varies according to the protocol. The terms frame and packet tend to used synonymously, although strictly speaking in OSI terms a frame is made at Layer Two, a packet at Layer Three or above.
Framing	Dividing data for transmission into groups of bits, and adding a header and a check sequence to form a frame.
FTP (File Transfer Protocol)	A TCP/IP protocol for file transfer.
Full Duplex	The ability of a device or line to transmit data independently and simultaneously in both directions, as opposed to half-duplex transmission.

G

Gateway A combination of hardware and software that interconnects otherwise incompatible networks or networking devices. Gateways include Packet Assembler / Disassembler (pads) and protocol converters. Gateways operate at levels five, six and seven layer OSI model; they are the Session, Presentation and Application layers respectively.

H

Half Duplex Data transmission that can occur in two directions over a single line, but only one direction at a time. Contrast full duplex.

Hardware Address See Network Address.

Head-end A central point or hub in broadband networks that receives signals on one set frequency band and retransmits them on another. Every transmission from one workstation to another has to go through the head-end in a broadband network. The head-end is the piece of hardware that enables a network to send and receive on the same piece of cable.

Header The control information added to the beginning of a transmitted message containing essential information such as the packet or block address, source, destination, message number, length and routing instructions.

Host Generally a node on a network that can be used interactively, i.e., logged into, like a computer.

Host Table A list of TCP/IP hosts on the network along with their IP addresses.

Hub The center of a star topology network or cabling system. A multi-node network topology that has a central multiplexer with many nodes feeding into and through the multiplexer or hub. The other nodes do not usually directly interconnect. LAN hubs are becoming increasingly popular with the growing of twisted pair of fiber optics and the need for LAN management.

I

IEEE 802.3 The IEEE (Institute of Electrical and Electronic Engineers) standard that defines the CSMA/CD media-access method and the physical and data link layer specifications of a local area network. Among others, it includes 10BASE2, 10BASE5, 10BASE-FL and 10BASE-T Ethernet implementations.

Internet A series of interconnected local, regional, national and international networks, linked using TCP/IP. Internet links many government, university and research sites. It provides E-mail, remote login and file transfer services.

Internetworking General term used to describe the industry composed of products and technologies used to link networks together.

IP Address The 32 bits address associated to workstation in connection with TCP/IP Internet.

ISO Layered Model The International Standards Organization (ISO) sets standards for computers and communications. Its Open Systems Interconnection (OSI) reference model specifies how dissimilar computing devices such as Network Interface Cards (NICs), bridges and routers exchange data over a network. The model consists of seven layers. From lowest to highest, they are: Physical, Data Link, Network, Transport, Session, Presentation and Application. Each layer performs services for the layer above it.

J

Jabber Network error caused by an interface card placing corrupted data on the network. Or, an error condition due to an Ethernet node transmitting longer packets than allowed.

L

LAN (Local Area Network) Local Area Network, a data communications system consisting of a group of interconnected computers, sharing applications, data and peripherals. The geographical area is usually a building or group of buildings.

LAN Segmentation	Dividing LAN bandwidth into multiple independent LANs to improve performance.
Latency	The delay incurred by a switching or bridging device between receiving the frame and forwarding the frame.
Layer	In networks, layers refer to software protocol levels comprising the architecture, with each layer performing functions for the layers above it.
Line Speed	Expressed in bit/s, the maximum rate at which data can reliably be transmitted over a line using given hardware.
Link	Physical connection between two nodes in a network. It can consist of a data communication circuit or a direct channel (cable) connection.
LLC (Logical Link Control; Link Layer Control)	A data link protocol based HDLC, developed for LAN's by the IEEE 802 Committee and consequently common to all LAN standards for Data link (Upper part of ISO layer 2) transmission.
LNI (Local Network Interconnect)	A Port Multiplier, or concentrator supporting multiple active devices or communications controllers, either used standalone or attached to standard Ethernet cable.
Logical Link	A temporary connection between source and destination nodes, or between two processes on the same node.
LS (Low Smoke)	Cable ability to don't give off toxic smoke in case of fire.

M

MAC (Media Access Control)	Generic term for the way in which workstations gain access to transmission media. Most widely used in reference to LAN's.
MAC Address (Media Access Control Address)	The address of a device that is "burnt" into a DNI card and is added near the beginning of packets as opposed to an IP address which is software.
MAN (Metropolitan Area Network)	A network spanning a geographical area greater than a LAN but less than a WAN (Wide Area Network). IEEE 802.6 specifies the protocols and cabling for a MAN. However, they could be superseded by ATM.

MAU (Medium Attachment Unit) A device used to convert signals from one Ethernet medium to another. Transceiver is a MAU.

MIB (Management Information Base) A database of network parameters used by SNMP and CMIP (Common Management Information Protocol) to monitor and change network device settings. It provides a logical naming of all information resources on the network that are pertinent to the network's management.

MII (Media Independent Interface) New standard developed for Fast Ethernet in IEEE 802.3u specification. The Fast Ethernet equivalent to the AUI in 10 Mbps Ethernet, allowing different types of Fast Ethernet media to be connected to a Fast Ethernet device via a common interface.

MMF (Multi Mode Fiber) This cable passes light instead of electronic pulses. The maximum length is 2 KM, using point-to-point connections only. This has been classified as the best type of cable to use between buildings.

MT-RJ A new standard connector for optical cables.

Multi-port Repeater A repeater, either standalone or connected to standard Ethernet cable, for interconnecting up to eight Thin-wire Ethernet segments.

Multicast A multicast is a message that is sent out to multiple devices on the network by a host.
A special form of broadcast where copies of the packet are delivered only to a subset of all possible destinations.

N

Name Server Software that runs on network hosts charged with translating (or resolving) text-style names into numeric IP addresses.

Network An interconnected system of computers that can communicate with each other and share files, data and resources.

Network Address Every node on a network has one or more addresses associated with it, including at least one fixed hardware address such as "ae-34-2c-1d-69-f1" assigned by the device's manufacturer. Most nodes also have protocol specific addresses assigned by a network manager.

Network Management Administrative services for managing a network, including configuring and tuning, maintaining network operation, monitoring network performance, and diagnosing network problems.

NIC (Network Interface Card) — An adapter card that is inserted into a computer, and contains the necessary software and electronics to enable the station to communicate over the network.

Node — Any intelligent device connected to the network. This includes terminal servers, host computers, and any other devices (such as printers and terminals) that are directly connected to the network. A node can be thought of as any device that has a "hardware address".

O

OSI (Open Systems Interconnection / Open System Interconnect) — A structure for internetworking heterogeneous computers for distributed applications processing according to international standards.

OSI Reference Model — Seven-layer network architecture model of data communication protocols developed by ISO and CCITT. Each layer specifies particular network functions such as addressing, flow control, error control, encapsulation and reliable message transfer.

P

Packet — A series of bits containing data and control information, formatted for transmission from one node to another, including a preamble, or header, with a start frame, source and destination addresses, control data, the message itself, and the post-amble or trailer, with error control data called the frame check sequence.

Packet-switched network — A network in which data is transmitted in units called packets. The packets can be routed individually over the best available network connection and reassembled to form a complete message at the destination.

Physical Address — An address identifying a single node.

Physical Control Layer — Layer 1 in the SNA architecture model.

Physical Layer Layer 1, the bottom layer of the OSI model, is implemented by the physical channel. The Physical layer insulates Layer 2, the Data Link layer, from medium-dependent physical characteristics such as base-band, broadband or fiber-optic transmission. Layer 1 defines the protocols that govern transmission media and signals.

Physical Layer First layer of the OSI Reference Model; governs hardware connections and byte-stream encoding for transmission. It is the only layer that involves a physical transfer of information between network nodes.

Physical Media Any physical means for transferring signals between OSI systems. Considered outside the OSI Model, and sometimes referred to as "Layer 0," or the bottom of the OSI Reference Model.

Ping (Packet internet groper) A program used to test reachability of destinations by sending them an ICMP echo request and waiting for a reply. Ping is used as a verb: "Ping the host to see if it is available".

Point-to-Point A circuit connecting two nodes only, or a configuration requiring a separate physical connection between each pair of nodes.

Port The physical connector on a device enabling the connection to be made.

Port Multiplier A concentrator providing connection to a network for multiple devices.

PPP Point-to-Point Protocol. The successor to SLIP, PPP provides router-to-router and host-to-network connections over both synchronous and asynchronous circuits.

Print Server A dedicated computer that manages printers and print requests from other nodes on the network.

Protocol Any standard method of communicating over a network.

R

Remote Access Access to network resources not located on the same physical Ethernet (Physical Ethernet here refers to an entire site network topology).

Remote Control Form of remote access where a device dialing in assumes control of another network node - all keystrokes on the remote are translated into keystrokes on the network node. Used primarily with IPX protocol.

Remote Node	Form of remote access where the device dialing in acts as a peer on the target network. Used with both IP and IPX protocols.
Repeater	A network device for connecting one Ethernet segment to another within the same local area network. The repeater transmits signals both ways between the segments. It amplifies the electrical signals, regenerates the preamble of each packet, extends packet fragments and performs auto-segmentation and auto-reconnection on ports with continuous collisions.
Ring	A network topology in which the nodes are connected in a closed loop. Data is transmitted from node to node around the loop, always in the same direction.
RJ Connectors	This is a connector type used with twisted pair UTP / STP. One example is RJ45.
RMON (Remote Monitoring)	Subset of SNMP MIB II allows flexible and comprehensive monitoring and management capabilities by addressing up to 10 different groups of information.
RMON MIB (Remote Monitor Management Information Base)	The nine (Ethernet) levels of network management statistics reporting.
Router	Device capable of filtering/forwarding packets based upon data link layer information. Whereas a bridge or switch may only read MAC layer addresses to filter, routers are able to read data such as IP addresses and route accordingly.
Routers	Unlike bridges, routers operate at level 3 (Network Layer) of the OSI seven layer model. Also unlike bridges, routers are protocol specific, acting on routing information carried by the communications protocol in the Network layer. Bridges pass Layer Two (Data Link) packets directly onto the next segment of a LAN whereas a router is able to use the information it has about the network topology and so can choose the best route for a Layer Three packet to follow. Because routers operate at level 3, they are independent of the Physical level (Layer One) and so can be used to link a number of different network types together. They have to be able to exchange information between themselves so that they know the conditions on the network; which links are active and which nodes are available.
Routing	The process of delivering a message across a network or networks via the most appropriate path. While simple in principle, routing uses a specialized, complex science, influenced by a plethora of factors. The more networks are joined together, the more esoteric it is set to become.
Routing Bridge	MAC-layer bridge that uses network layer methods to determine a network's topology.

Routing Protocol Protocol that accomplishes routing through the implementation of a specific routing algorithm.

Routing Table Table stored in a router or some other internetworking device that keeps track of routes (and, in some cased, metrics associated with those routes) to particular network destinations.

Routing Update Message sent from a router to indicate network reachability and associated cost information. Routing updates are typically sent at regular intervals and after a change in network topology.

S

Segment A bus LAN term meaning an electrically continuous piece of the bus. Segments can be joined together using repeaters, or bridges.

Segment Delay The amount of time it takes a signal to propagate from one end of the segment to the distant end.

Segmentation Splitting an overloaded ring into two or more separate rings, linked by a bridge/ router or multipurpose hub.

Server A computer that provides resources to be shared on the network, such as files (file server) or terminals (terminal server).

Session A connection to a network service.

Shared Ethernet Ethernet configuration in which a number of segments are bound together in a single collision domain. Hubs produce this type of configuration where only one node can transmit at a time.
Conventional CSMA/CD Ethernet configuration, where all stations are attached to a hub sharing 10 Mbps of bandwidth; only one station can transmit at a time. simplex transmission Data transmission that can occur in only one direction on a given line. Compare half duplex and full duplex.

SLIP Serial Line Internet Protocol, a protocol for running TCP/IP over serial lines.

Smart Wiring Hub This is a network concentrator enabling multiple media to be supported and managed from a central location. When supporting structured wiring systems, smart hubs provide port management.

SMF (Single Mode Fiber)	A fiber having a small core diameter, approximately three micrometers, with a cladding having a refractive index very close to that of the core. Will transmit light rays that enter at narrow angle but will transmit over very wide bandwidth. Single Mode Fiber Fiber with a relatively narrow diameter, through which only one mode will propagate. Carries higher bandwidth than multi mode fiber, but requires a light source with a narrow spectral width.
SNA	Systems Network Architecture. IBM's layered protocols for mainframe communications.
SNMP	Simple Network Management Protocol, allows a TCP/IP host running an SNMP application to query other nodes for network-related statistics and error conditions. The other hosts, which provide SNMP agents, respond to these queries and allow a single host to gather network statistics from many other network nodes.
SNMP	The simple Network Management protocol consists of three part: structure of management information (SMI), management information base (MIB), and the protocol itself. The SMI and MIB define and store the set of managed entities; SNMP itself conveys information to and from these entities. The public domain standard is based on the operational experience of TCP/IP internet works within DARPA/ NSFnet.
SNP (Sub-network Protocol)	(TCP/IP) Protocol residing in the Sub-Network layer below IP that provides data transfer through the local Sub-Net. In some systems, an adapter module must be inserted between IP and the Sub-Network Protocol to reconcile their dissimilar interfaces.
Spanning Tree	A technique that detects loops in a network and logically blocks the redundant paths, ensuring that only one route exists between any two LANs; used in an IEEE 802.1d bridged network.
Spanning Tree Algorithm	An algorithm used by bridges to create a logical topology that connects all network segments, and ensures that only one path exists between any two stations.
Star Topology	A network where each workstation is connected to a central hub through a dedicated point to point connection.
Store and Forward	Technique for examining incoming packets on an Ethernet switch or bridge whereby the whole packet is read before forwarding or filtering takes place. Store and forward is a slightly slower process than cut-through, but it does ensure that all bad or misalign packets are eliminated from the network by the switching device.
STP (Shielded Twisted Pair)	Common transmission medium which consists of a Receive (RX) and a Transmit (TX) wire twisted together to reduce crosstalk. The twisted pair is shielded by a braided outer sheath.

Switch Multi-port Ethernet device designed to increase network performance by allowing only essential traffic on the attached individual Ethernet segments. Packets are filtered or forwarded based upon their source and destination addresses.

Switched Ethernet An Ethernet hub with integrated MAC layer bridging or switching capability to provide each port with 10 Mbps of bandwidth; separate transmissions can occur on each port of the switching hub, and the switch filters traffic based on destination MAC address.

Switched Virtual LAN A logical network consisting of several different LAN Emulation domains controlled through and intelligent network management application.

Switching Hubs Hubs that use intelligent Ethernet switching technology to interconnect multiple Ethernet LANs and higher-speed LANs such as FDDI.

T

T-Connector A T-shaped device with two female and one male BNC connectors.

TCP/IP (Transmission Control Protocol/ Internet Protocol) Set of protocols developed by the U.S. Defense Department's Advanced Research Projects Agency (ARPA) during the early 1970s. Its intent was to develop ways to connect different kinds of networks and computers. TCP/IP does not have the functionality that OSI provides.
Transmission Control Protocol/Internet Protocol (TCP/IP) is a transport and internet working protocol; that is de factor networking standard. It is commonly used over X.25 and Ethernet wiring and is viewed as one of the few protocols available that is able to offer a true migration path towards OSI. TCP/IP is able to operate in most environments. TCP/IP operates at Layers Three and Four of the OSI model (Network and Transport respectively).
Transmission Control Protocol (TCP) and Internet Protocol (IP) are the standard network protocols in UNIX environments. They are almost always implemented and used together and called TCP/IP.

Terminal Server A concentrator that facilitates communication between hosts and terminals.

Terminator Used on both ends of a standard Ethernet or Thin wire Ethernet segment, this special connector provides the 50 ohm termination resistance needed for the cable.

TFTP (Trivial File Transfer Protocol) On computers that run the TCP/IP networking software, TFTP is used to quickly send files across the network with fewer security features than FTP.

Thick Wire Half-inch diameter coax cable.

Thin Wire Thin coaxial cable similar to that used for television/video hookups.

Topology The arrangement of the nodes and connecting hardware that comprises the network. Types include ring, bus, star and tree.

TP (Twisted Pair) Cable consisting of two 18 to 24 AWG (American Wire Gauge) solid or stranded copper conductors, each coated in an insulating material, that are twisted together. The twisting provides a measure of protection from electromagnetic and radio-frequency interference.

Transceiver A network device, capable of both transmitting and receiving messages, that serves as the interface between a user device and a network, so that actively converts signals between the network and the local node

Transceiver Cable Cable that attaches a device either to a standard or thin coax Ethernet segment.

Twisted-Pair Cable Inexpensive, multiple-conductor cable comprised of one or more pairs of 18 to 24 gauge copper strands. The strands are twisted to improve protection against electromagnetic and radio frequency interference. The cable, which may be either shielded or unshielded, is used in low-speed communications, as telephone cable. It is used only in base-band networks because of its narrow bandwidth.

U

UL Approval Tested and approved by Underwriters Laboratories, Inc.

UL Cable Certification In conjunction with several manufacturers, UL has developed a data transmissions performance level marking program. This approval is printed on a cable as shown below. The UL program identifies five Levels of performance requirements as follows:
Level I - Level I cable performance is intended for basic communications and power-limited circuit cable.
Level II - Level II cable performance requirements are similar to those for Type 3 cable (multi-pair communications cable) of the IBM Cabling System Technical Interface Specification (GA27-3773-1). These requirements apply to both shielded cable with two-to-25-pair conductors.

	Level III - Level III data cable complies with the transmission requirements in the EIA/TIA Wiring Standard for Horizontal Unshielded Twisted Pair (UTP) Cable and with the requirements for Category 3 in the proposed EIA/TIA 568A Standard. These requirements apply to both shielded and unshielded cables. Level IV Level IV cable complies with the requirements in the proposed National Electrical Manufacturer's Association (NEMA) Standard for Low-Loss Premises Telecommunications Cable. Level IV - Level IV requirements are similar to Category 4 requirements of the proposed EIA/TIA 568A Standard. These requirements apply to both shielded and unshielded cable constructions. Level V Level V cable complies with the requirements in the proposed NEMA Standard for Low-Loss Extended-Frequency Premises Telecommunications Cable. Level V requirements are similar to Category 5 requirements of the EIA/TIA 568A Standard. These requirements apply to both shielded and unshielded cable constructions.
UTP	Unshielded twisted pair, one or more cable pairs surrounded by insulation. UTP is commonly used as telephone wire.

W

WAN (Wide Area Network)	A network using common carrier transmission services for transmission of data over a large geographical area.
Workgroup Switching	Configuration in which a number of users are connected to an Ethernet network via a switch. Switching allows each user to get greater throughput than would be available through a hub.