Modicon M580

System Planning Guide

09/2014

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www.schneider-electric.com

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

Table of Contents

Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER
DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING
WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

CAUTION
CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE
NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

BEFORE YOU BEGIN

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

⚠ WARNING

UNGUARDED EQUIPMENT

- Do not use this software and related automation equipment on equipment which does not have point-of-operation protection.
- Do not reach into machinery during operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This automation equipment and related software is used to control a variety of industrial processes. The type or model of automation equipment suitable for each application will vary depending on factors such as the control function required, degree of protection required, production methods, unusual conditions, government regulations, etc. In some applications, more than one processor may be required, as when backup redundancy is needed.

Only you, the user, machine builder or system integrator can be aware of all the conditions and factors present during setup, operation, and maintenance of the machine and, therefore, can determine the automation equipment and the related safeties and interlocks which can be properly used. When selecting automation and control equipment and related software for a particular application, you should refer to the applicable local and national standards and regulations. The National Safety Council's Accident Prevention Manual (nationally recognized in the United States of America) also provides much useful information.

In some applications, such as packaging machinery, additional operator protection such as point-of-operation guarding must be provided. This is necessary if the operator's hands and other parts of the body are free to enter the pinch points or other hazardous areas and serious injury can occur. Software products alone cannot protect an operator from injury. For this reason the software cannot be substituted for or take the place of point-of-operation protection.

Ensure that appropriate safeties and mechanical/electrical interlocks related to point-of-operation protection have been installed and are operational before placing the equipment into service. All interlocks and safeties related to point-of-operation protection must be coordinated with the related automation equipment and software programming.

NOTE: Coordination of safeties and mechanical/electrical interlocks for point-of-operation protection is outside the scope of the Function Block Library, System User Guide, or other implementation referenced in this documentation.

START-UP AND TEST

Before using electrical control and automation equipment for regular operation after installation, the system should be given a start-up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check be made and that enough time is allowed to perform complete and satisfactory testing.

⚠ CAUTION

EQUIPMENT OPERATION HAZARD

- Verify that all installation and set up procedures have been completed.
- Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.
- Remove tools, meters, and debris from equipment.

Failure to follow these instructions can result in injury or equipment damage.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and temporary grounds that are not installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:
- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove all temporary grounds from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

OPERATION AND ADJUSTMENTS

The following precautions are from the NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.
- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

About the Book

At a Glance

Document Scope

PlantStruxure is a Schneider Electric program designed to address the key challenges of many different types of users, including plant managers, operations managers, engineers, maintenance teams, and operators, by delivering a system that is scalable, flexible, integrated, and collaborative.

This document presents one of the PlantStruxure features, using Ethernet as the backbone around the Modicon M580 offer and connecting an M580 *local rack* and M580 *RIO drops*.

This guide provides detailed information about the M580 system, including the following:

- Ethernet I/O networks (RIO and distributed equipment integrated on the same physical network)
- topology rules and recommendations for choosing a network configuration
- role of dual-ring switches (DRSs)
- system commissioning and maintenance
- system performance and limitations
- system diagnostics

NOTE: The specific configuration settings contained in this guide are intended to be used for instructional purposes only. The settings required for your specific configuration may differ from the examples presented in this guide.

Validity Note

This document is valid for the M580 system when used with Unity Pro 8.1 or later.

The technical characteristics of the devices described in this document also appear online. To access this information online:

Step	Action
1	Go to the Schneider Electric home page *www.schneider-electric.com*.
2	In the **Search** box type the reference of a product or the name of a product range. ● Do not include blank spaces in the model number/product range. ● To get information on grouping similar modules, use asterisks (*).
3	If you entered a reference, go to the **Product Datasheets** search results and click on the reference that interests you. If you entered the name of a product range, go to the **Product Ranges** search results and click on the product range that interests you.
4	If more than one reference appears in the **Products** search results, click on the reference that interests you.
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.

Step	Action
6	To save or print a data sheet as a .pdf file, click **Download XXX product datasheet**.

The characteristics that are presented in this manual should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the manual and online information, use the online information as your reference.

Related Documents

Title of Documentation	Reference Number
Modicon M580 Hardware Reference Manual	EIO0000001578 (English), EIO0000001579 (French), EIO0000001580 (German), EIO0000001581 (Spanish), EIO0000001582 (Italian), EIO0000001583 (Chinese)
Modicon M580 Remote I/O Modules Installation and Configuration Guide	EIO0000001584 (English), EIO0000001585 (French), EIO0000001586 (German), EIO0000001587 (Spanish), EIO0000001588 (Italian), EIO0000001589 (Chinese)
Modicon M580 BME NOC 03•1 Ethernet Communication Module Installation and Configuration Guide	HRB62665 (English), HRB65311 (French), HRB65313 (German), HRB65314 (Italian), HRB65315 (Spanish), HRB65316 (Chinese)
Modicon M580 Change Configuration on the Fly User Guide	EIO0000001590 (English), EIO0000001591 (French), EIO0000001592 (German), EIO0000001593 (Spanish), EIO0000001594 (Italian), EIO0000001595 (Chinese)
Modicon M340/X80 BMX NRP 0200/0201 Fiber Converter Module User Guide	EIO0000001108 (English), EIO0000001109 (French), EIO0000001110 (German), EIO0000001111 (Spanish), EIO0000001112 (Italian), EIO0000001113 (Chinese)

Title of Documentation	Reference Number
Modicon eX80 BME AHI 0812 HART Analog Input Module & BME AHO 0412 HART Analog Output Module User Guide	EAV16400 (English), EAV28404 (French), EAV28384 (German), EAV28413 (Italian), EAV28360 (Spanish), EAV28417 (Chinese)
Modicon M340/X80 with Unity Pro Analog Input/Output Modules User Manual	35011978 (English), 35011979 (German), 35011980 (French), 35011981 (Spanish), 35011982 (Italian), 35011983 (Chinese)
Modicon M340/X80 with Unity Pro Discrete Input/Output Modules User Manual	35012474 (English), 35012475 (German), 35012476 (French), 35012477 (Spanish), 35012478 (Italian), 35012479 (Chinese)
Modicon M340/X80 with Unity Pro BMX EHC 0200 Counting Module User Manual	35013355 (English), 35013356 (German), 35013357 (French), 35013358 (Spanish), 35013359 (Italian), 35013360 (Chinese)
Grounding and Electromagnetic Compatibility of PLC Systems Basic Principles and Measures User Manual	33002439 (English), 33002440 (French), 33002441 (German), 33002442 (Spanish), 33003702 (Italian), 33003703 (Chinese)
Unity Pro Program Languages and Structure Reference Manual	35006144 (English), 35006145 (French), 35006146 (German), 35006147 (Spanish), 35013361 (Italian), 35013362 (Chinese)
Unity Pro Operating Modes	33003101 (English), 33003102 (French), 33003103 (German), 33003104 (Spanish), 33003696 (Italian), 33003697 (Chinese)

Title of Documentation	Reference Number
Unity Pro Installation Manual	35014792 (French), 35014793 (English), 35014794 (German), 35014795 (Spanish), 35014796 (Italian), 35012191 (Chinese)

You can download these technical publications and other technical information from our website at www.schneider-electric.com.

Part I
Modicon M580 System Introduction

Introduction

This part introduces the Modicon M580 system, the specific modules required, and the available features.

What Is in This Part?

This part contains the following chapters:

Chapter 1
Modicon M580 System

Introduction

This chapter introduces the Modicon M580 system, including system components and features.

What Is in This Chapter?

This chapter contains the following topics:

Modicon M580 System Introduction

Introduction

A Modicon M580 system is designed and tested for simultaneous use of:

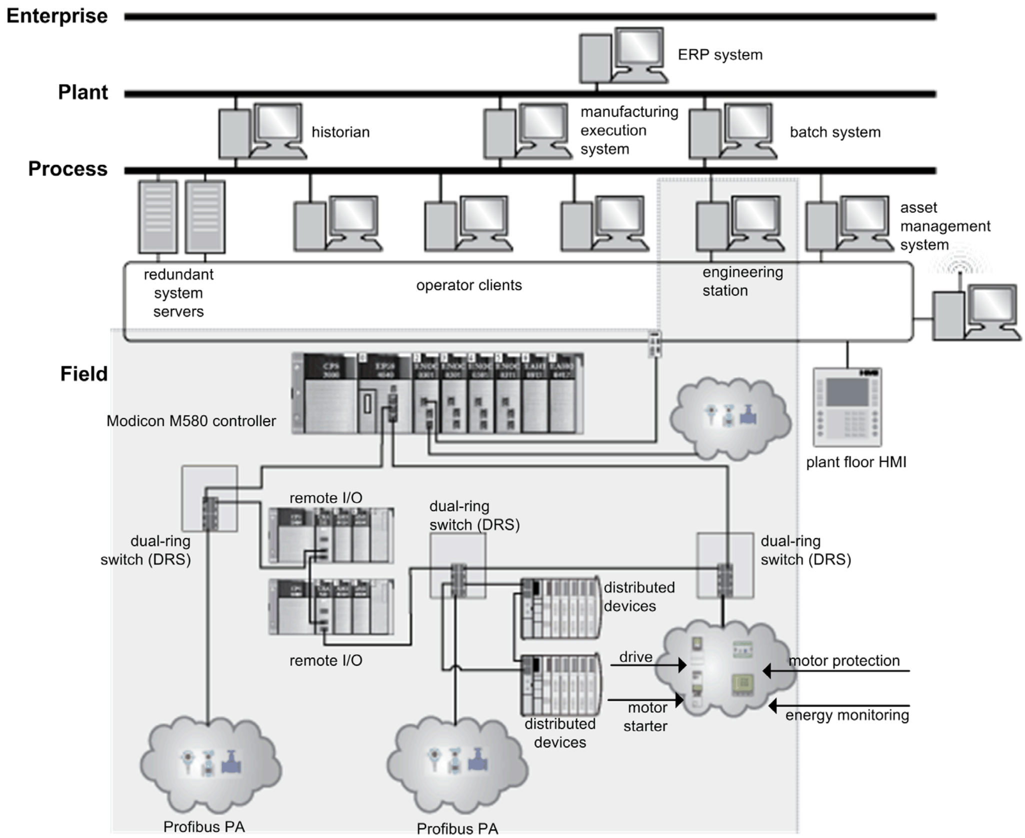
- a main local rack *(see page 23)* and the ability to extend to other local racks
- RIO drops *(see page 25)* that support Ethernet and X Bus communications across the backplane
- Ethernet distributed equipment *(see page 29)*
- ConneXium extended managed switches, preconfigured to serve as dual-ring switches (DRSs) *(see page 26)*
- RIO and distributed equipment integrated on the same physical network
- third-party modules and devices
- daisy-chain loop architectures provided by DRSs and communication modules with dual Ethernet ports

An M580 system provides automatic network recovery of less than 50 ms and *deterministic* RIO performance.

An M580 system uses Modicon X80 I/O modules, many of which are used in an M340 system. The system also supports several Ethernet-based *eX80* I/O modules, which can be installed on both the main local rack and main remote racks. The local rack can also support an extension rack of Premium I/O modules.

M580 Architecture

The following graphic outlines a typical M580 architecture, encompassing the enterprise, plant, process, and field levels of a manufacturing plant. An M580 device system is shown at the field level.



⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Do not install more than 1 standalone PAC in an M580 device network.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

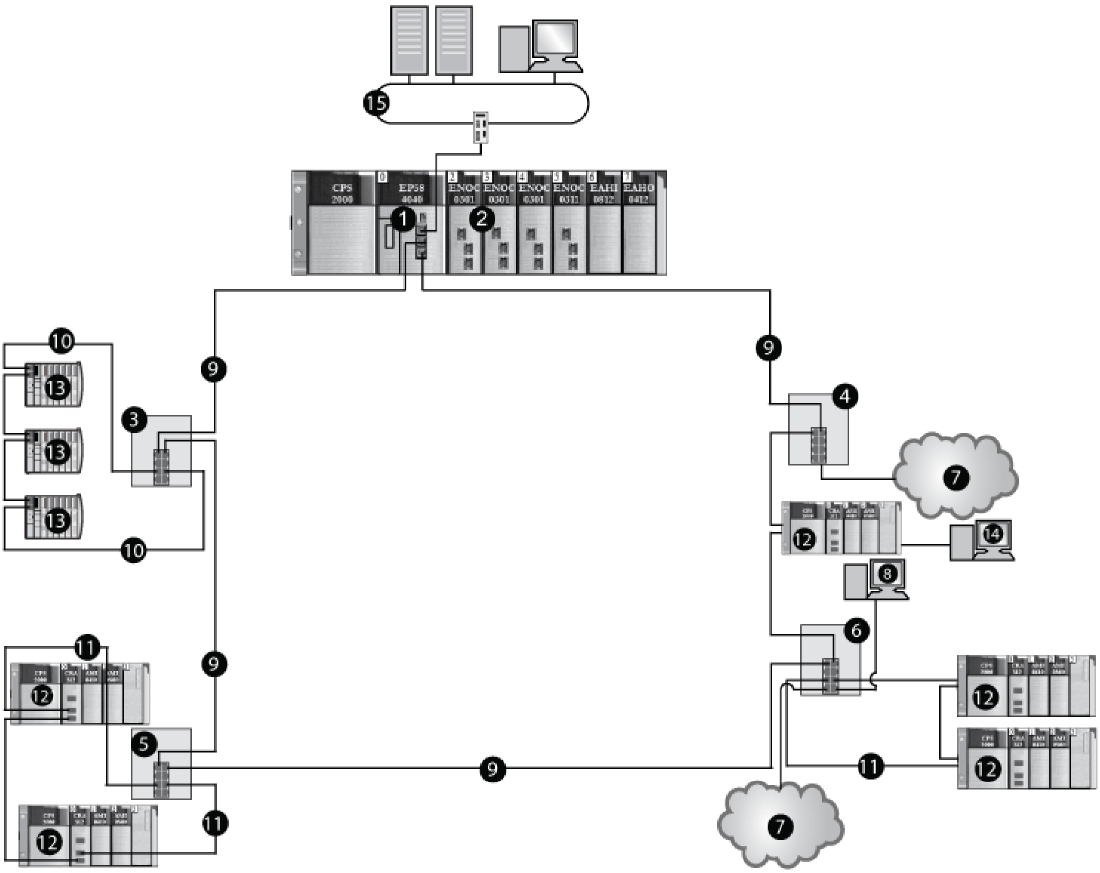
M580 Life Cycle

The life cycle of an M580 network comprises the following phases:

Life Cycle Phase	Feature	Description
design phase	standard	reduce the learning and engineering time (use standard Ethernet technology, Modicon X80 common modules,and Unity Pro software for device configuration
	open	collaborate with third-party solutions
	flexible	adapt the control architecture to the plant topology
	efficient	design the solution without constraints
operation phase	transparent	provide access to I/O modules and devices from the control network
	accessible	change configuration without stopping the process, get diagnostic information from any location in the network, no switch required to create a complete M580 system
renew phase	sustainable	preserve long-term investment, allow smooth migration

M580 Example

The following graphic is an example of a viable M580 network, integrating RIO devices and distributed equipment on a main ring with sub-rings.



1 An M580 CPU with RIO scanner capabilities (for the RIO scanner service, select a CPU with a commercial reference that ends in *40*)
2 BME NOC 03•1 Ethernet communication module connected to the CPU via the Ethernet backplane and managing the distributed equipment in the system
3 DRS (connected to a DIO sub-ring)
4 DRS (connected to a DIO cloud)
5 DRS (connected to an RIO sub-ring)
6 DRS (connected to an RIO sub-ring, DIO cloud, and PC/port mirror)
7 DIO cloud
8 PC for port mirroring
9 main ring
10 DIO sub-ring
11 RIO sub-ring

12 X80 RIO drops (including a BME CRA 312 10 eX80 performance EIO adapter module)
13 distributed equipment (STB NIP 2311 NIM on an STB island)
14 Unity Pro connection using the service port on the BME CRA 312 10 module
15 control network, connected via dual-ring switch (DRS) to the service port of the CPU

NOTE: A BME NOC 03•1 module can support distributed equipment via its Ethernet backplane connection to the CPU **and** via its device network port(s) on the front panel, respecting the limitation of 128 devices scanned per BME NOC 03•1 module.

Modicon M580 System Components

Introduction

When you connect the M580 *local rack* to one or more *RIO drops* in an M580 system, you establish the *RIO main ring*.

NOTE: Be aware that some M580 CPU models do not support RIO scanning. CPUs with commercial references ending in *20* support only local I/O and distributed equipment (DIO scanning). CPUs with commercial references ending in *40* support RIO scanning as well as local I/O and DIO. For a detailed discussion of M580 CPU capabilities, refer to the *Modicon M580 Hardware Reference Manual*.

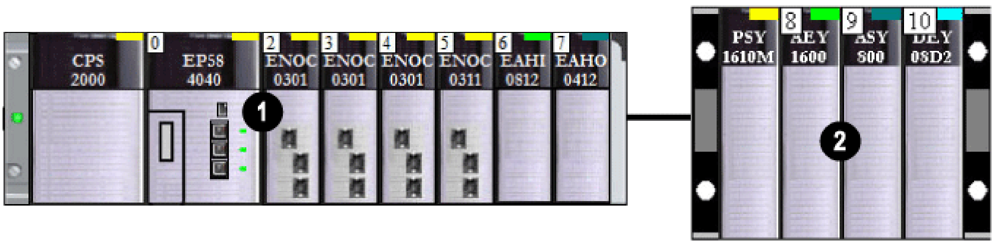
There can be 3 types of devices within an RIO main ring: a local rack, RIO drops, and pre-configured dual-ring switches (*DRSs*). You can connect *sub-rings* to the main ring via DRSs, and they also enable *distributed equipment* to connect to the RIO network.

Local Rack

Within the *main ring* in an M580 system, a *local rack* contains the CPU, a power supply, and a maximum of four BME NOC 03•1 Ethernet communication modules or other communication modules (depending upon the CPU you choose *(see page 75)*), and appropriate expert and/or I/O modules.

A local rack consists of 1 main rack and up to 7 full extended racks (up to 14 Premium half racks *(see page 85)*), depending on the CPU you use. The main rack is required in the M580 architecture; extended racks are optional, and when present, are considered part of the local rack. You can install a maximum of 7 extended local racks, depending upon the CPU type.

The following graphic is an example of an M580 local rack with an extended rack.



1 main local rack
2 extended local rack

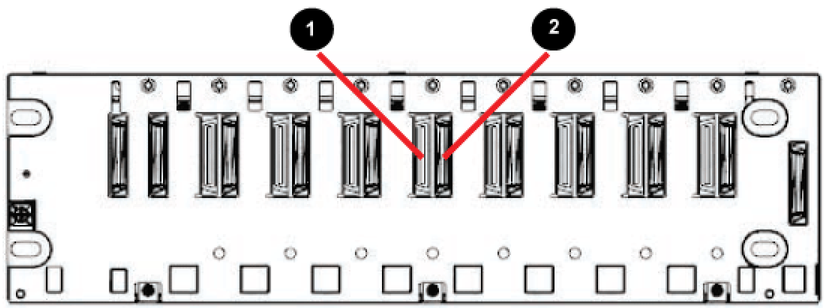
- The main local rack can be installed on a BME XBP ••00 Ethernet backplane or a BMX XBP ••00 X Bus backplane (PV:02 or later).
- The extended racks are either BMX XBP ••00 X Bus backplanes or, for Premium I/O, TSX RKY •EX backplanes.

Module/backplane compatibility:
- You can install Modicon X80 I/O modules on BME XBP ••00 Ethernet or BMX XBP 0•00 X Bus backplanes.
- You can install Modicon eX80 (example: PME SWT 0100 and BME AH• 0•12} modules) on BME XBP ••00 Ethernet backplanes only.
- You can install Premium I/O modules on TSX RKY •EX Premium backplanes only.

Backplane compatibility:

	Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
BME XBP ••00 Ethernet	X	—	X	—
BMX XBP 0•00 X Bus	X[1]	X	X[2]	X
TSX RKY •EX Premium	—	X	—	—
X: allowed —: not allowed [1] Requires a hardware revision of PV:02 or later. [2] Requires a hardware revision PV:02 or later f you use a BME CRA 312 10 eX80 performance EIO adapter module.				

BME XBP ••00 backplanes also provide X Bus connections across the backplane, and are therefore compatible with Modicon X80 modules supported by the M580 system. BMX XPB ••00 X Bus backplanes, on the other hand, do not have the connections required to support eX80 modules.



1 Ethernet connector
2 X Bus connector

NOTE: Ethernet racks are also described in further detail in the *Modicon M580 Hardware Reference Manual*.

RIO Drops

An *RIO drop* consists of 1 or 2 racks of Modicon X80 I/O modules and/or third-party PME SWT 0100 modules. An RIO drop is connected to the daisy-chain loop on which the Ethernet RIO network resides. Each remote drop contains one BM• CRA 312 •0 performance EIO adapter module. Each rack in a remote drop contains its own power supply module.

RIO drops provide deterministic communication on the *main ring* so that RIO modules synchronize with CPU tasks (MAST, FAST, AUX0, AUX1); whereas, DIO drops are not deterministic.

Remote performance EIO adapter modules are available as Ethernet (BME) and X Bus (BMX) communicators. If you plan to use X80 I/O modules that require Ethernet, then choose a *BME-style X80 EIO adapter module*. If your X80 I/O uses only X Bus for backplane communication, then you can use a *BMX-style X80 EIO adapter module* or a *BME-style X80 EIO adapter module*.

RIO drops are connected to the Ethernet RIO network in the following ways:

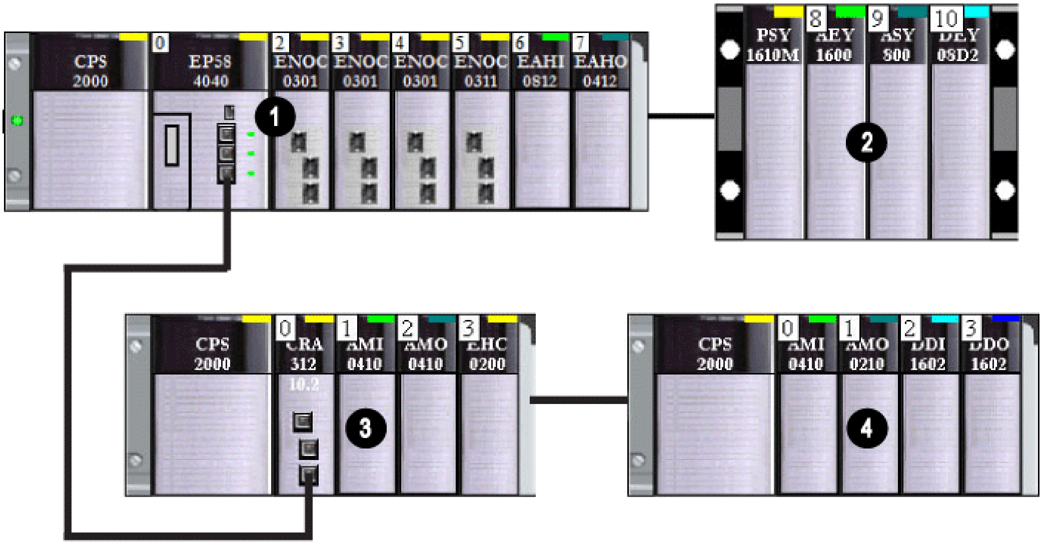
- on the *main ring*: connected via copper cable to the CPU with Ethernet I/O scanner service *(see page 75)* on the *local rack* or to another RIO drop (which may be connected to another RIO drop or the CPU on the local rack)
- on a *sub-ring*: connected via copper cable to a DRS located on the main ring

An RIO drop consists of 1 or 2 remote racks, depending on the remote adapter module used. If you use a BMX CRA 312 00 *X80 standard EIO adapter module,* you cannot add an extender rack to the drop. If you use a BM• CRA 312 10 *X80 performance EIO adapter module*, you can add 1 extender rack to the drop.

The adapter module is installed in slot 0 (directly to the right of the power supply) in the main rack of the drop.

A maximum of 16 RIO drops can be supported in an M580 network.

The following graphic shows an RIO drop (with a remote extended rack) connected to a local rack (with a local extended rack):



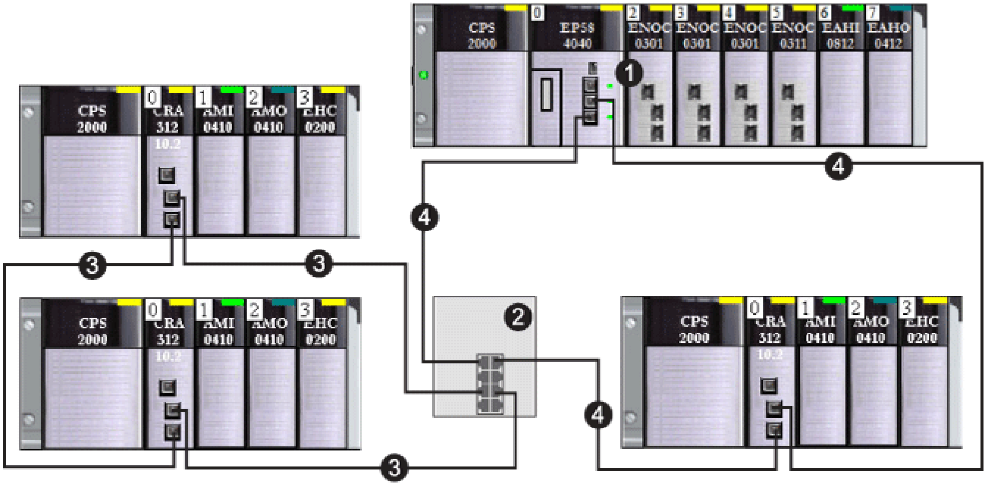
1 local main rack
2 local extended rack
3 remote main rack
4 remote extended rack

Dual-Ring Switches (DRSs)

A ConneXium extended managed switch that has been configured to operate on an M580 network is called a dual-ring switch (*DRS*). DRS predefined configurations *(see page 93)* provided by Schneider Electric can be downloaded to a ConneXium extended managed switch to support the special features of the *main ring / sub-ring* architecture. A switch with one of these DRS predefined configurations is one of the 4 types of M580 devices *(see page 34)*.

A DRS can be used to:
- enable the use of fiber cable for distances greater than 100 m between 2 contiguous remote devices (You can also use BMX NRP 020• *(see page 88)* fiber converter modules for this purpose.)
- enable distributed equipment to participate on the RIO network
- enable *RSTP* recovery support for devices and cables on the sub-rings
- isolate the sub-rings from one another and from the main ring to improve system robustness

This is a simple view of a DRS connecting an RIO sub-ring to the main ring.

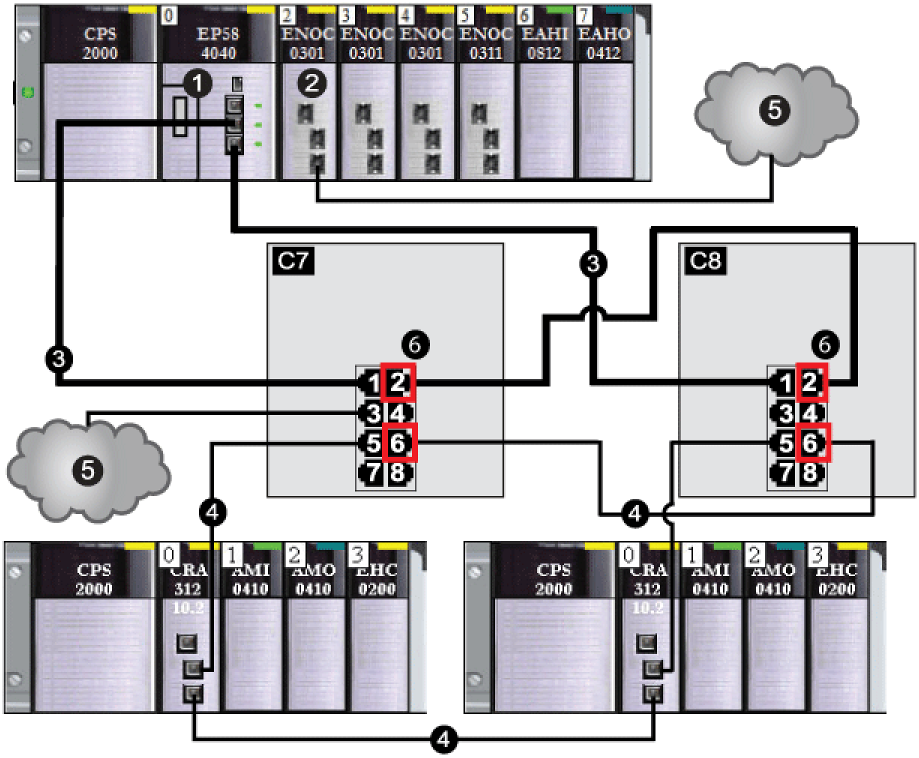


1 CPU with Ethernet I/O scanner service on the local rack
2 dual-ring switch (DRS) connecting the RIO sub-ring (3) to the main ring (4)
3 RIO sub-ring
4 main ring

Main Ring / Sub-ring Redundant Connections

Use 2 DRSs (one installed with a *master* predefined configuration and other installed with a corresponding *slave* predefined configuration) to provide a redundant connection between the main ring and the sub-ring. The *master* DRS passes data between the main ring and the sub-ring. If the *master* DRS becomes inoperable, the *slave* DRSs takes control and passes data between the main ring and the sub-ring.

The following illustration is an example of main-ring/sub-ring DRS redundant connections in an M580 network:



C7 DRS using the C7 predefined configuration file for a *master* copper main ring with an RIO sub-ring and DIO clouds

C8 DRS using the C8 predefined configuration file for a *slave* copper main ring with an RIO sub-ring and DIO clouds

1 CPU with Ethernet I/O scanner service on the local rack

2 BME NOC 03•1 Ethernet communication module managing distributed equipment on the device network

3 main ring

4 RIO sub-ring

5 DIO cloud

6 DRS inner ports (The master and slave DRSs are linked together through ports 2 and 6. Ports 1 are linked to the main ring, and ports 5 are linked to the RIO sub-ring.)

DRSs *(see page 93)* are discussed in detail later in this guide.

NOTE: A BME NOC 03•1 module can support distributed equipment via its Ethernet backplane connection to the CPU and via its device network port(s) on the front panel, respecting the limitation of 128 devices scanned per BME NOC 03•1 module.

Fiber Converter Modules

You can install a BMX NRP 020• fiber converter module *(see page 88)* on a Modicon X80 rack and Modicon X80 Ethernet RIO drops to convert copper cable to fiber for distances greater than 100 m.

NOTE: You cannot use these modules to connect RIO or DIO sub-rings to the main ring.

Distributed Equipment

In an M580 system, *distributed equipment* can be:

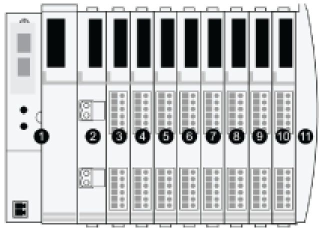
- **Connected** to the Ethernet RIO network. The distributed equipment is connected to the main ring via a DRS or the service port of a BM• CRA 312 10 EIO adapter module located on the main ring. Special types of distributed equipment that have 2 Ethernet ports and support *RSTP* may be connected directly to a *sub-ring*. Many types of distributed equipment may be connected to the DRS as distributed clouds.
  (*Refer to the DIO clouds topic (see page 30) to see how DIO clouds can be connected to the device network.*)
  A BME NOC 03•1 Ethernet communication module connects DIO networks to the M580 *device network* when its Ethernet backplane connection is enabled, allowing it to communicate with the CPU. Enabling the Ethernet backplane connection links the BME NOC 03•1 module and M580 network port connections together, allowing either device to manage the distributed equipment.
- **Not connected** to the Ethernet RIO network. The distributed equipment is in DIO clouds that can be managed by either a CPU (independent of any RIO network) or a BME NOC 03•1 module whose Ethernet backplane connection is disabled. These DIO clouds may contain equipment such as TeSys T motor drives, islands of STB devices, SCADA and HMI devices, and PCs. If you use a device that has 2 Ethernet ports and supports RSTP, you can connect the device in a star or a daisy chain loop. In this instance, the distributed equipment is isolated *(see page 76)* and is not a physical or logical part of the Ethernet RIO network.

Distributed equipment can be connected to the M580 network through DRSs, or the service port of a BM• CRA 312 10 EIO adapter module on an RIO drop. They cannot be connected directly to the main RIO ring.

The maximum load the network can process from distributed equipment is 5 Mbps per DRS port or service port.

Example of Distributed Equipment:

Advantys STB islands are used as an example of distributed equipment in this document. When an STB island is used with an STB NIP 2311 EtherNet/IP network interface module (NIM), the island can be connected directly to a DIO sub-ring. The STB NIP 2311 NIM has 2 Ethernet ports and it supports RSTP, enabling it to operate on a DIO sub-ring.

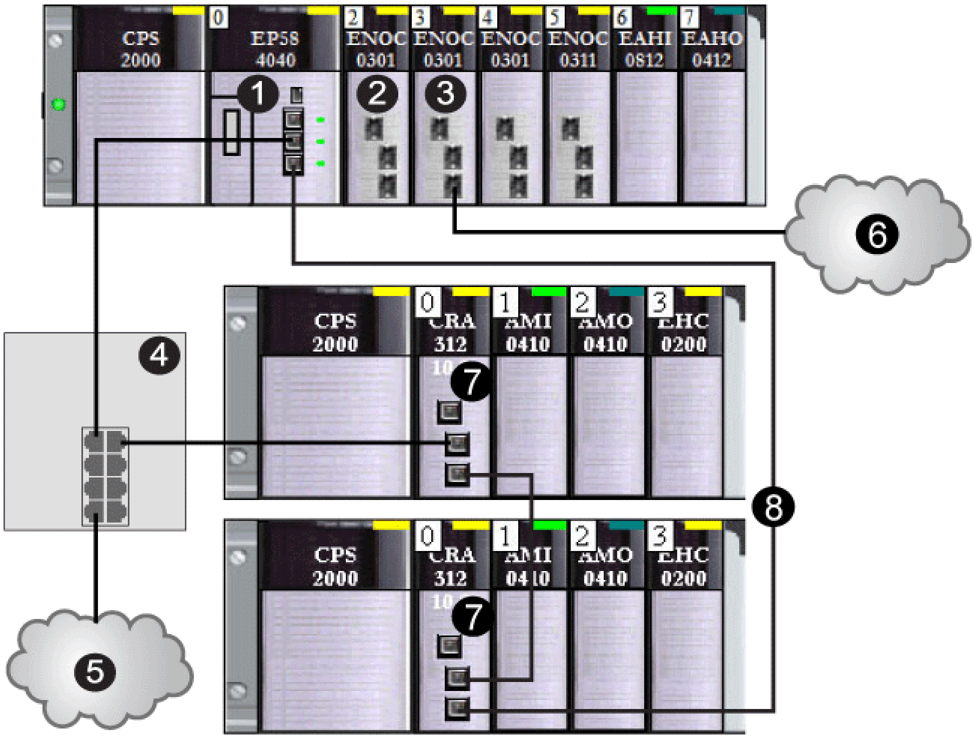


1 STB NIP 2311 NIM
2 STB PDT 3100 (24 Vdc power distribution module)
3 STB DDI 3230 24 Vdc (2-channel digital input module)
4 STB DDO 3200 24 Vdc (2-channel digital output module)
5 STB DDI 3420 24 Vdc (4-channel digital input module)
6 STB DDO 3410 24 Vdc (4-channel digital output module)
7 STB DDI 3610 24 Vdc (6-channel digital input module)
8 STB DDO 3600 24 Vdc (6-channel digital output module)
9 STB AVI 1270 +/-10 Vdc (2-channel analog input module)
10 STB AVO 1250 +/-10 Vdc (2-channel analog output module)
11 STB XMP 1100 (island bus termination plate)

DIO Clouds

A *DIO cloud* contains distributed equipment that may support *RSTP*. DIO clouds require only a single (non-ring) copper wire connection. They can be connected to some of the copper ports on DRSs, or they can be connected directly to a BME NOC 03•1 Ethernet communication module or the CPU on the *local rack*. DIO clouds cannot be connected to *sub-rings*.

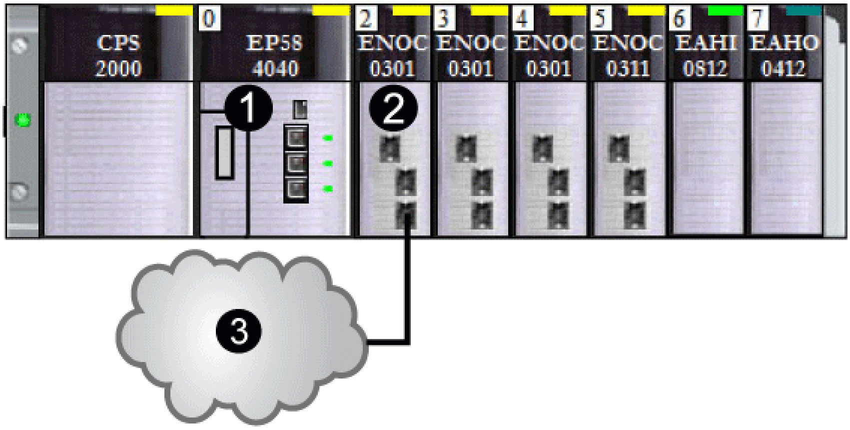
When a DIO cloud is connected to the *main ring* (via a DRS or the service port on a BM• CRA 312 10 EIO adapter module on an RIO drop), distributed equipment within the cloud communicates with the M580 network.



1 CPU with Ethernet I/O scanner service
2 BME NOC 03•1 Ethernet communication module (Ethernet backplane connection enabled) managing distributed equipment on the device network
3 BME NOC 03•1 module (Ethernet backplane connection disabled) managing an *isolated* DIO cloud (6)
4 dual-ring switch (DRS) connecting (5) and (7) to the main ring
5 DIO cloud connected to the main ring via (4)
6 isolated DIO cloud managed by (3)
7 BM• CRA 312 10 X80 performance EIO adapter module on an RIO drop
8 main ring

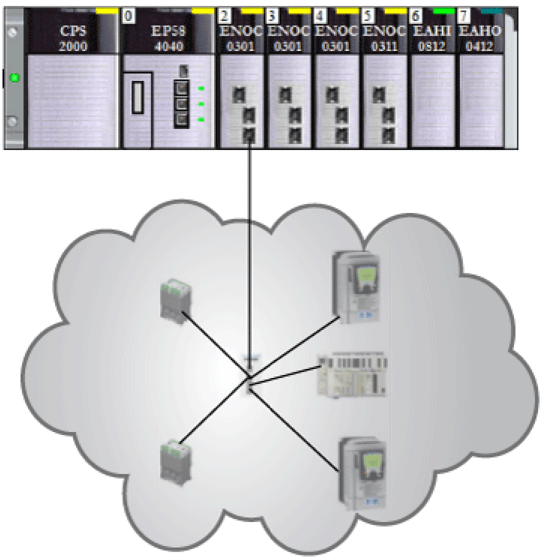
NOTE: A BME NOC 03•1 module can support distributed equipment via its Ethernet backplane connection to the CPU and via its device network port(s) on the front panel, respecting the limitation of 128 devices scanned per BME NOC 03•1 module.

When a DIO cloud is connected directly to a BME NOC 03•1 module or a CPU with DIO scanner service, distributed equipment may be *isolated* from the RIO network.



1 CPU with DIO scanner service
2 BME NOC 03•1 Ethernet communication module (Ethernet backplane connection disabled)
3 DIO *isolated* cloud

A cloud can contain one or many devices. When many devices are present, they can be connected in a star, mesh, or daisy chain topology *(see page 37)*. The following example shows a cloud with devices connected in a star topology.



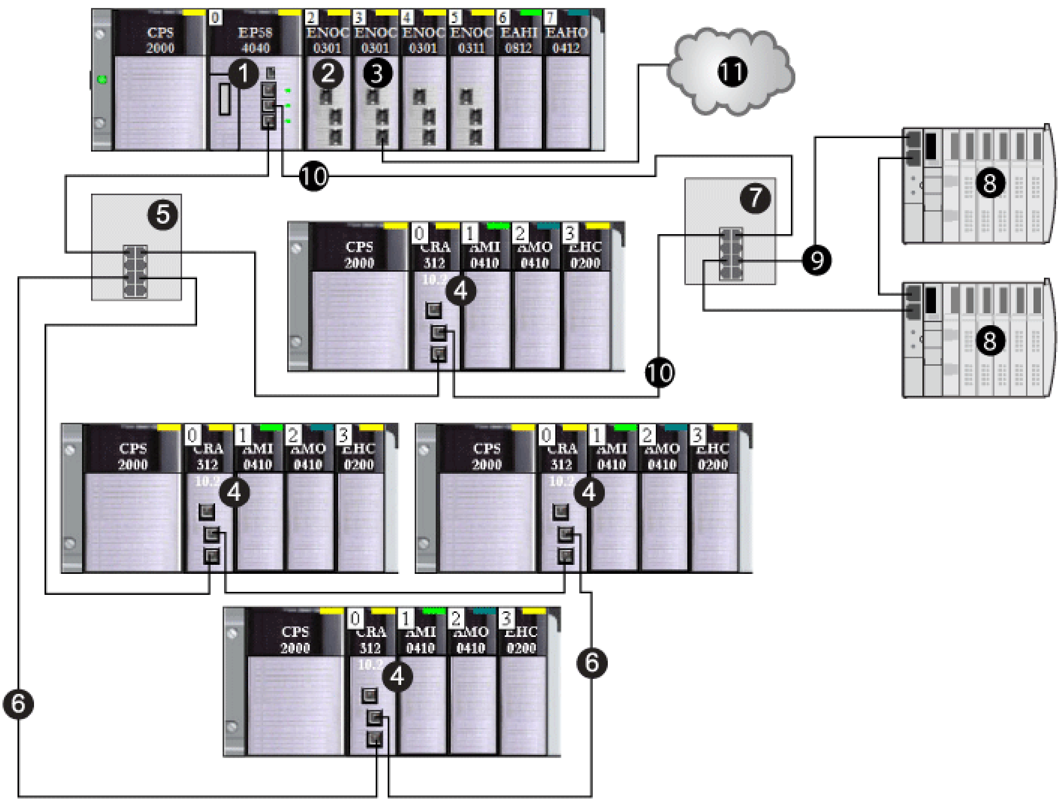
Sub-rings

Sub-rings are connected to the *main ring* via DRSs. There are 2 types of sub-rings: RIO sub-rings and DIO sub-rings.

- RIO sub-rings contain only RIO modules, including one BM• CRA 312 •0 EIO adapter module on each RIO drop. A maximum of 16 RIO drops can be supported in an M580 network.
  - DRS predefined configuration files C1, C3, C7, C8, C11, and C12 *(see page 93)* support RIO sub-ring connections to the main ring.
- DIO sub-rings contain only distributed equipment that have 2 Ethernet ports and support *RSTP*. A maximum of 128 distributed devices can be supported by each DIO sub-ring.
  - DRS predefined configuration files C2, C4, C5, C6, C9, C10, C13, and C14 *(see page 93)* support DIO sub-ring connections to the main ring.

NOTE: You cannot combine RIO modules and distributed equipment in the same sub-ring.

The following graphic shows an RIO sub-ring (4) and a DIO sub-ring (6).



1 CPU with Ethernet I/O scanner service on the local rack
2 BME NOC 03•1 Ethernet communication module (Ethernet backplane connection enabled) managing distributed equipment (8) on the device network

3 BME NOC 03•1 module (Ethernet backplane connection disabled) managing an *isolated* DIO cloud (11)
4 RIO drop, including a BM• CRA 312 10 X80 performance EIO adapter module
5 DRS connecting an RIO sub-ring (6) to the main ring
6 RIO sub-ring
7 DRS connecting a DIO sub-ring (8) to the main ring
8 distributed equipment (STB NIP 2311 NIM on an STB island)
9 DIO sub-ring
10 main ring
11 isolated DIO cloud

NOTE: A BME NOC 03•1 module can support distributed equipment via its Ethernet backplane connection to the CPU **and** via its device network port(s) on the front panel, respecting the limitation of 128 devices scanned per BME NOC 03•1 module.

Copper and Fiber Cables

Copper and fiber cable types and maximum distances for RIO modules are discussed in the cable installation topic in the *Modicon M580 Remote I/O Modules Installation & Configuration Guide*.

Calculating Maximum Devices for an RIO Network

The main ring in an M580 system supports up to 32 devices. The 4 valid types of devices are:

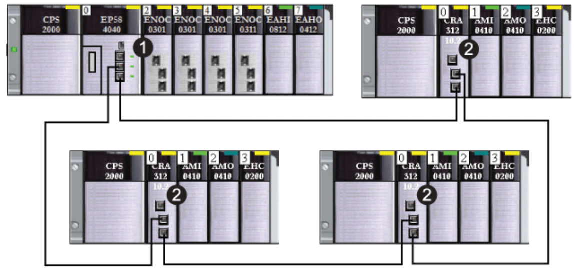
1. a local rack *(see page 23)* (containing the CPU, communication modules and I/O modules)
2. a maximum of 16 RIO drops *(see page 25)* (each drop containing a BM• CRA 312 •0 EIO adapter module)
3. DRSs *(see page 26)*, each counted as 2 devices in your main ring capacity calculations
4. BMX NRP 020• fiber converter modules
   - If you use less than 100 m of fiber cable, do not count the BMX NRP 020• modules in your calculations[1].
   - If you use more than 100 m of fiber cable, count the BMX NRP 020• modules as single DRSs in your calculations[1].

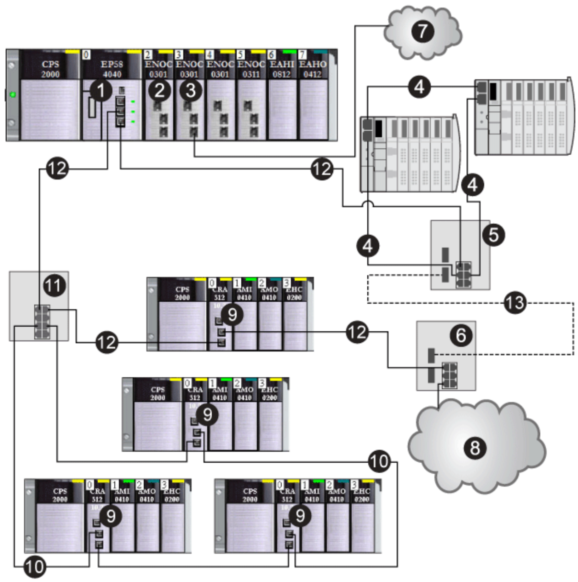
   [1] = *32 maximum devices in the main ring*

NOTE: The maximum number of BM• CRA 312 •0 EIO adapter modules in an RIO network is 16. However, the maximum number of BM• CRA 312 •0 EIO adapter modules in the main ring is 16 minus (2 x the number of DRSs).

RIO Network Topologies

In an M580 system, RIO modules are connected in a daisy chain loop topology. The RIO network utilizes the following 2 types of loop topologies:

Topology Type	Definition	Example
simple daisy chain loop	A *simple daisy chain loop* consists of a *local rack* (containing a CPU with Ethernet I/O scanner service and one or more M580 or Modicon X80 *RIO drops* (each drop containing a BM• CRA 312 •0 EIO adapter module). No *sub-rings* are used. The RIO drops are connected directly to the main ring; no DRSs are used.	 **1** CPU with Ethernet I/O scanner service on the local rack **2** BM• CRA 312 •0 EIO adapter module on a Modicon X80 Ethernet RIO drop

Topology Type	Definition	Example
high-capacity daisy chain loop	A *high-capacity daisy chain loop* uses DRSs to connect sub-rings (RIO or distributed equipment) and/or DIO clouds to the RIO network.	 **1** CPU with Ethernet I/O scanner service on the local rack **2** BME NOC 03•1 Ethernet communication module (Ethernet backplane connection enabled) managing distributed equipment **3** BME NOC 03•1 module (Ethernet backplane connection disabled) managing an isolated DIO cloud (7) **4** DIO sub-ring **5** DRS connecting a DIO sub-ring (4) to the main ring **6** DRS connecting a DIO cloud (8) to the main ring) **7** isolated DIO cloud **8** DIO cloud **9** RIO drop **10** RIO sub-ring **11** DRS connecting an RIO sub-ring (10) to the main ring **12** main ring **13** fiber wire used between 2 DRSs to extend the distance between the RIO and DIO sub-rings beyond 100 m

NOTE: Diagrams and details of each topology are shown in the Selecting a Topology topic (*see page 65*).

RIO Main and Sub-Ring Design Examples

Given the considerations set forth above, with respect to RIO main and sub-rings, you could construct an M580 network in the following designs, to deploy the maximum number of RIO modules.

Design 1:

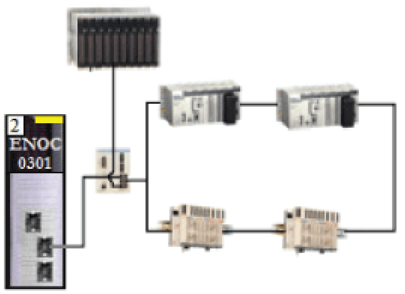
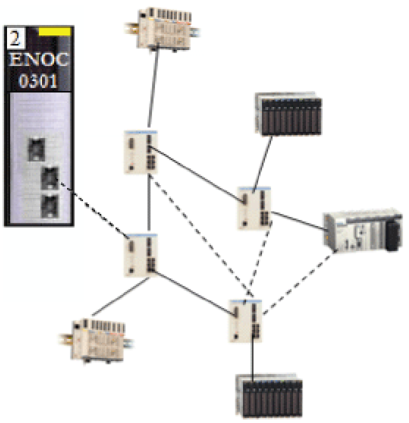
- a *main ring* with:
  - 1: CPU with Ethernet I/O scanner service
  - 16: BM• CRA 312 •0 EIO adapter modules in RIO drops
- no RIO sub-rings

Design 2:

- a *main ring* with:
  - 1: CPU with Ethernet I/O scanner service
  - 11: BM• CRA 312 •0 EIO adapter modules in RIO drops
  - 10: DRSs, each supporting an RIO sub-ring (each sub-ring supporting two BM• CRA 312 •0 EIO adapter modules in RIO drops

DIO Network Topologies

Topology Type	Definition	Example
star	In a star topology, single-port Ethernet devices are connected through an intermediate device, such as a DRS.	

Topology Type	Definition	Example
ring (loop)	In a ring topology (also known as a daisy chain loop), dual-port Ethernet devices that support RSTP are connected in a ring. With a ring topology, network redundancy is achieved. Use the 2 Ethernet ports of the BME NOC 03•1 to connect the 2 ends of the ring. If only 1 Ethernet port is available on the BME NOC 03•1 module, connect the port to a DRS, which will connect the 2 ends of the ring. **NOTE:** Single-port Ethernet devices can connect to the M580 network via a DRS, but they are not part of the ring.	
mesh	In a mesh topology, single-port Ethernet devices are connected to each other through intermediate devices, such as a ConneXium extended managed switch (not required to be configured as a DRS). With a mesh topology, network redundancy is possible.	

Device Network

A *device network* is an Ethernet RIO network where distributed equipment can be installed with RIO modules.

In this type of network, RIO traffic has higher priority on the network, so it is delivered ahead of DIO traffic, providing deterministic RIO exchanges.

The device network contains a local rack, RIO drops, distributed equipment, DRSs, adapter class devices, and so on. Devices connected to this network follow certain rules to provide RIO *determinism*. Details about determinism are discussed in the Application Response Time *(see page 168)* section.

Control Network

A *control network* is an Ethernet-based network containing PLCs, SCADA systems, an NTP server, PCs, AMS system, switches, and other appropriate equipment. Two kinds of topologies are supported:

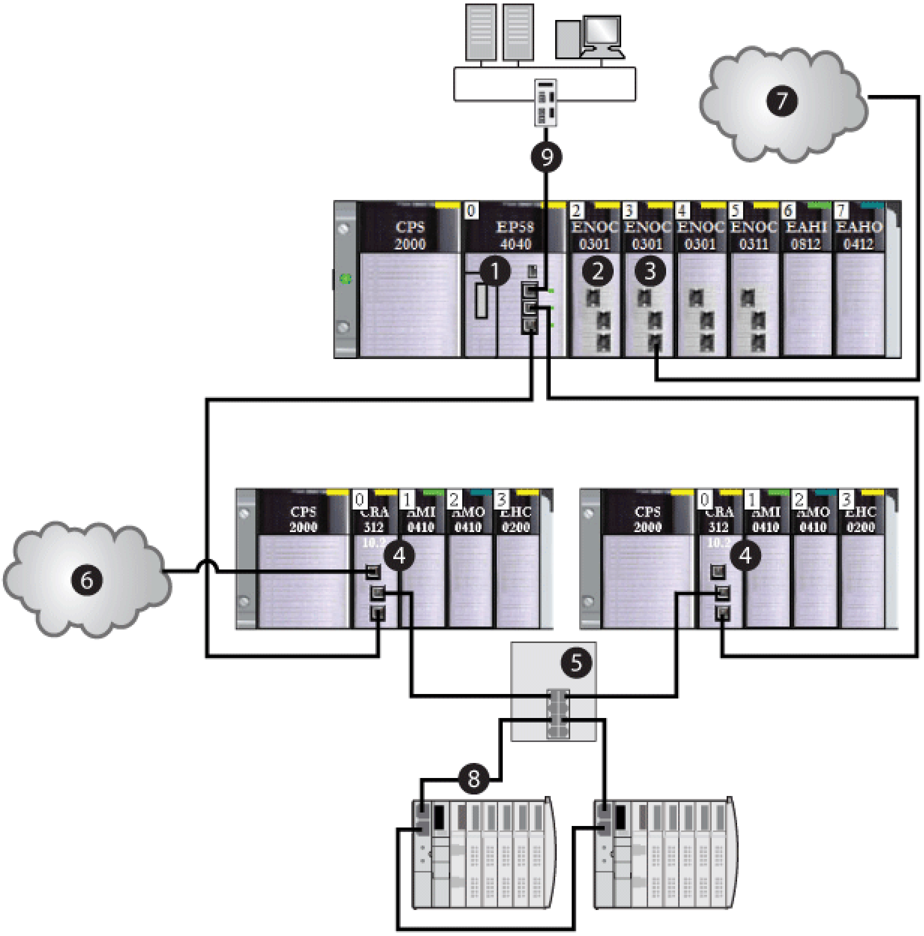
- flat: Devices in this network belong to the same subnet.
- 2 levels: The network is split into an operation network and an inter-controller network. These 2 networks can be physically independent, but are linked by a routing device.

Via the service port on a CPU or a BME NOC 03•1 module, you can connect your device network to the control network. The following figure shows a device network connected to a switch on the control network, where a SCADA system can be used to monitor and communicate with the device network.

NOTE:

Do not connect the service ports on different CPUs together through the control network.

- If Ethernet transparency is needed between a device network and the control network, make the connection with router as shown in the following figure.
- If Ethernet transparency is not needed, connect the control network to the service port of a BME NOC 03•1 module, and disable the module’s Ethernet backplane port.



1 CPU with Ethernet I/O scanner service on the local rack
2 BME NOC 03•1 Ethernet communication module (Ethernet backplane connection enabled) managing distributed equipment on the device network
3 BME NOC 03•1 module (Ethernet backplane connection disabled) managing an *isolated* DIO cloud (7)
4 RIO drop on the device network
5 DRS connecting a DIO sub-ring (8) to the main ring
6 DIO cloud connected to the device network via the service port of a BM• CRA 312 10 EIO adapter module
7 isolated DIO cloud
8 DIO sub-ring connected to the main ring via (5)
9 connection between the device network and the control network

Modicon M580 System Features

Introduction

An M580 system can include software configuration, services, and features that you may already use in your existing system.

Unity Pro Software

Unity Pro software, V9.0 or later, is used in an M580 system.

For detailed Unity Pro configuration procedures, refer to the respective *Modicon M580 [Module] Installation and Configuration Guide*.

CCOTF Function

The Change Configuration on the Fly (CCOTF) function allows I/O configuration changes in the Ethernet RIO drops when the CPU is in STOP or RUN mode.

Detailed information is available in the *Modicon M580 Change Configuration on the Fly User Guide*.

Time Stamping

- For Modicon X80 RIO drops on an *X Bus backplane* (*see page 23*), time stamping is managed by a BMX ERT 1604 module installed on the RIO drop with a resolution of 1 ms. The BMX CRA 312 10 X80 performance EIO adapter module also manages this functionality.
- For Modicon X80 RIO drops on an *Ethernet backplane*, time stamping is managed by a BME CRA 312 10 X80 performance EIO adapter module installed on the RIO drop with a resolution of 10 ms.
- Several X80 I/O modules also have time stamping capabilities.

The BMXCRA31210 and BMECRA31210 have the same resolution/accuracy for a given NTP server. The accuracy is better if a dedicated NTP server is used, compared to using M580 CPU as the NTP server.

Ethernet Services

As mentioned previously, some CPUs support both RIO and DIO scanning services, and others support only DIO services, The Ethernet services that can be used on these 2 classes of M580 CPU differ as follows:

Service	CPUs that Support RIO	CPUs that Support DIO
Security	X	X
IPConfig	X	X
RSTP	X	X
SNMP	X	X

Service	CPUs that Support RIO	CPUs that Support DIO
NTP	X	X
Switch	--	X
QoS	--	X
ServicePort	X	X
Advanced Settings	--	X

M580 modules communicate using the following parameters, which can be configured with Unity Pro 9.0 or later.

- IP address (See the configuration topic in the respective *Modicon M580 [Module] Installation and Configuration Guide*.)
  NOTE: The BM• CRA 312 •0 EIO adapter modules automatically receive an IP address. Do not change this IP address.
- RSTP (See the configuration topic in the respective *Modicon M580 [Module] Installation and Configuration Guide*.)
- SNMP (See the configuration topic in the respective *Modicon M580 [Module] Installation and Configuration Guide*.)
- service port (See the configuration topic in the respective *Modicon M580 [Module] Installation and Configuration Guide*.)
- SNTP (See the configuration topic in the respective *Modicon M580 [Module] Installation and Configuration User Guide*.)

Explicit Messaging

M580 CPUs and Ethernet communication modules support explicit messaging via EtherNet/IP and Modbus TCP protocols. This feature is detailed in the respective *Modicon M580 [Module] Installation and Configuration Guide*.

Explicit messaging is useful for extended diagnostics (see the system diagnostics topic *(see page 197)*). Two methods can be used for explicit messaging in an M580 system:

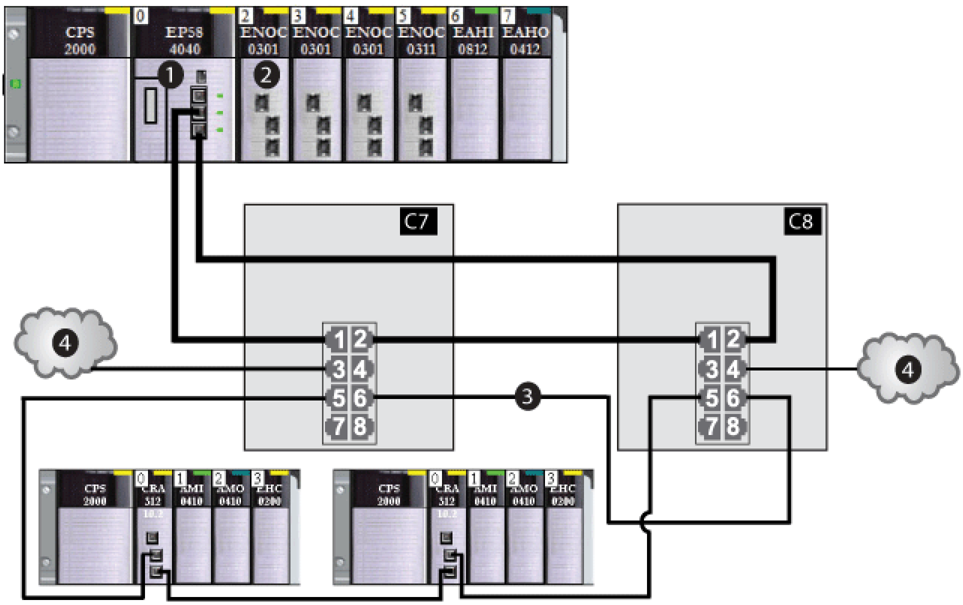
- EtherNet/IP or Modbus TCP explicit messaging using one of the following function blocks:
  - WRITE_CMD_MX
  - READ_PARAM_MX
  - WRITE_PARAM_MX
  - SAVE_PARAM_MX
  - RESTORE_PARAM_MX
  - READ_VAR
  - WRITE_VAR
  - DATA_EXCH
- explicit messaging via the Unity Pro graphic user interface, as described in manuals such as the *M580 Hardware Reference Guide* and the *BME NOC 03•1 Ethernet Communications Module Installation and Configuration Guide.*

NOTE: For detailed information regarding these function blocks, refer to the *Extended* part in the *Unity Pro Communication Block Library* user manual.

Redundancy on Main Ring / Sub-ring Connections

Two DRSs can be used to provide a redundant connection between the main ring and the sub-ring. One DRS is installed with a *master* predefined configuration, and the other is installed with a corresponding *slave* predefined configuration. The *master* DRS passes data between the main ring and the sub-ring. If the *master* DRS becomes inoperable, the *slave* DRS takes control and passes data between the main ring and the sub-ring. For details, refer to the *Predefined Configuration Files chapter*.

This example shows 2 DRSs that create a redundant connection between the main ring and the RIO sub-ring:



C7 DRS using the C7 predefined configuration file for a *master* copper main ring with an RIO sub-ring and DIO clouds

C8 DRS using the C8 predefined configuration file for a *slave* copper main ring with an RIO sub-ring and DIO clouds

1 CPU with Ethernet I/O scanner service on the local rack

2 BME NOC 03•1 Ethernet communication module managing distributed equipment on the device network

3 RIO sub-ring

4 DIO cloud

Chapter 2
Modules in an M580 System

Overview

This chapter describes required and compatible modules in an M580 system.

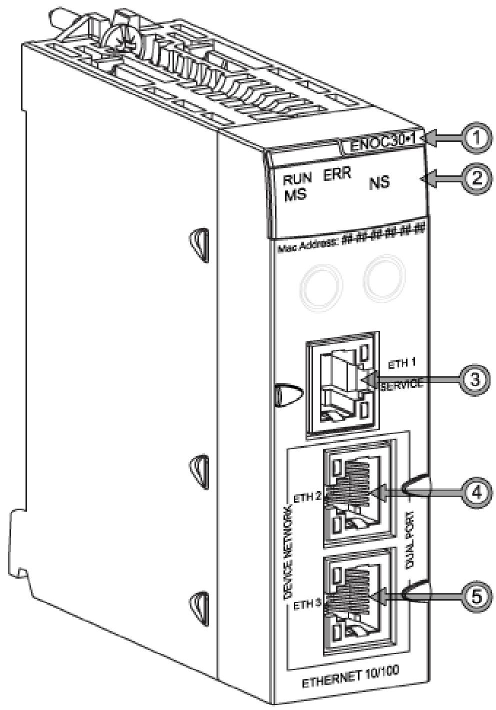
What Is in This Chapter?

This chapter contains the following topics:

Modules and Switches in an M580 System

Ethernet Communication Modules

The following table shows the Ethernet communication modules that can be used on a local rack in an M580 system:

Reference	Description	Picture
BME NOC 03•1: a BME NOC 0301 is a generic Ethernet DIO communication module, and the BME NOC 0311 is a comparable Ethernet communication module with additional FactoryCast capabilities	Ethernet communication module with standard Web services **NOTE:** In an M580 rack, you can install a maximum of four BME NOC 03•1 modules, depending upon the CPU you choose *(see page 75)*. When the Ethernet backplane connection is enabled, the module can manage distributed equipment on the device network. When the Ethernet backplane connection is disabled, the module can support distributed equipment on an isolated network only. The BME NOC 03•1 module is designed to be installed on an Ethernet backplane (connector on rear right side). For information about the BME NOC 03•1 modules, refer to the *Modicon M580* BME NOC 03•1 *Ethernet Communication Module Installation and Configuration Guide*.	 **1** module name **2** LED display **3** SERVICE port (ETH 1) **4** DEVICE NETWORK port (ETH 2) **5** DEVICE NETWORK port (ETH 3)

NOTE: Cover unused Ethernet ports with dust plugs.

EIO Adapter Modules

The following X80 EIO adapter modules are used in an M580 system.

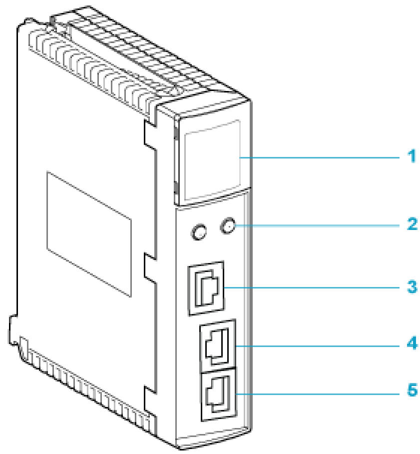
<table>
<tr><th>Reference</th><th>Description</th><th>Picture</th></tr>
<tr>
<td>BME CRA 312 10</td>
<td>X80 performance EIO adapter module
The BME CRA 312 10 module iscan be installed on an Ethernet backplane (connector on rear right side) to support eX80 I/O modules that require Ethernet across the backplane.

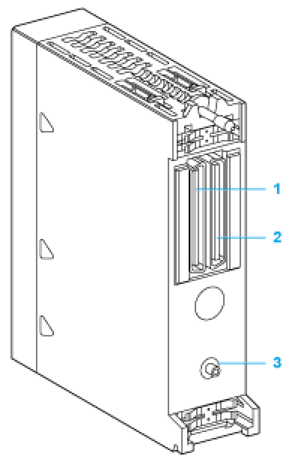
NOTE: The keying pin on the rear side of the module does not allow you to install this module on unsupported backplanes (see page 23).

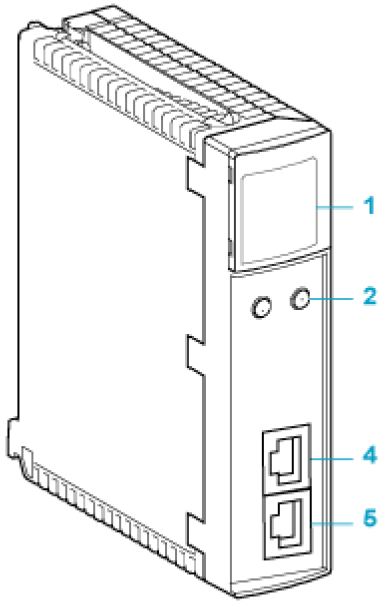
NOTE: Only one BM• CRA 312 •0 module can be installed on an X80 RIO drop.

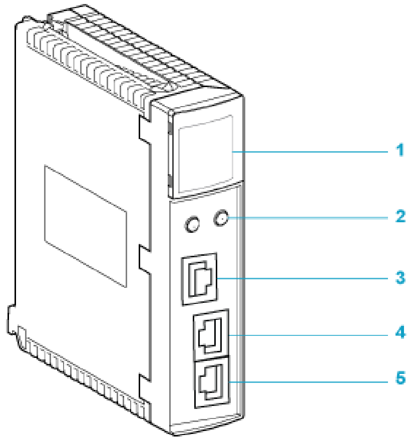
NOTE: This adapter module has a service port (3) and a time stamping feature. This module supports an extended remote rack.

NOTE: This adapter module supports expert modules (see page 56) and CCOTF.

For information about BME CRA 312 •0 modules, refer to the Modicon M580 Remote I/O Modules Installation and Configuration Guide.</td>
<td>
1 LED display
2 rotary switches
3 service port (ETH 1)
4 device network port (ETH 2)
5 device network port (ETH 3)


1 X Bus connector (left side)
2 Ethernet connector (right side)
3 keying pin that does not allow you to install this module on unsupported backplanes</td>
</tr>
</table>

Reference	Description	Picture
BMX CRA 312 00	X80 standard EIO adapter module **NOTE:** Only one BM• CRA 312 •0 module can be installed on an X80 RIO drop. **NOTE:** This adapter module does **not** have a service port or a time stamping feature. This module supports an extended remote rack. **NOTE:** This adapter module only supports X80 analog and discrete modules *(see page 54)* that do not require an Ethernet backplane. For information about BM• CRA 312 •0 modules, refer to the *Modicon M580 Remote I/O Modules Installation and Configuration Guide*.	 **1** LED display **2** rotary switches **4** device network port (ETH 2) **5** device network port (ETH 3)

Reference	Description	Picture
BMX CRA 312 10	X80 performance EIO adapter module **NOTE:** Only one BM• CRA 312 •0 module can be installed on an X80 RIO drop. **NOTE:** This adapter module has a service port (3) and a time stamping feature. This module supports an extended remote rack. **NOTE:** This adapter module supports X80 expert modules *(see page 56)* and CCOTF as well as analog and discrete modules *(see page 54)* that do not require an Ethernet backplane. For information about BM• CRA 312 •0 modules, refer to the *Modicon M580 Remote I/O Modules Installation and Configuration Guide*.	 **1** LED display **2** rotary switches **3** service port (ETH 1) **4** device network port (ETH 2) **5** device network port (ETH 3)

Dual-Ring Switches (DRSs)

A DRS can be used to:

- integrate fiber cable on the main ring for distances greater than 100 m between 2 contiguous remote drops. (You may also use BMX NRP 020• *(see page 88)* fiber converter modules for this purpose.)
- enable distributed equipment to participate on the RIO network
- enable RSTP recovery support for devices on the sub-rings
- isolate the sub-rings from one another and from the main ring to improve system robustness
- provide redundancy between the main ring and a sub-ring when 2 DRSs are installed next to each other with specific predefined configuration files *(see page 93)*

The following graphics are example of DRSs with copper ports and copper/fiber ports. The numbers in the graphics refer to the ports on the DRSs, which correspond to elements of predefined configurations you will download to the switch. Refer to the *Predefined Configuration Files chapter (see page 93)* for details.

NOTE: Use the predefined DRS configurations. Since they are optimized to support 50 ms maximum recovery time, the system can recover within 50 ms from a communication disruption on the main ring or on a sub-ring. If you need to customize a configuration, contact your local Schneider Electric office before adapting a switch configuration for your system.

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

ConneXium switch with 8 copper ports:

ConneXium switch with 6 copper ports and 2 fiber ports:

These 3 ConneXium extended managed switches are currently the only DRSs that can be used in an M580 system.

Part	ConneXium Switch	Ports
TCSESM083F23F1	8TX 1280	• copper (8)
TCSESM063F2CU1	6TX/2FX-MM	• multi-mode fiber (2) • copper (6)
TCSESM063F2CS1	6TX/2FX-SM	• single-mode fiber (2) • copper (6)
NOTE: These 3 switches use firmware version 6.0 or later. **NOTE:** You can achieve up to 2 km with multi-mode fiber cables and up to 15 km with single-mode fiber cables in an M580 system.		

The following predefined DRS configurations can be downloaded to the switches. These predefined configurations are discussed in the Predefined Configuration Files chapter *(see page 93)*.

Switch	DRS Preconfiguration
TCSESM083F23F1	C1: RIOMainRing_RIOSubRing_DIOCloudsVx.xx.cfg
	C2: RIOMainRing_DIOSubRing_DIOCloudsVx.xx.cfg
	C7: Master_RIOMain_RIOSubRing_DIOCloudsVx.xx.cfg
	C8: Slave_RIOMain_RIOSubRinig_DIOCloudsVx.xx.cfg
	C9: Master_RIOMain_DIOSubRing_DIOCloudsVx.xx.cfg
	C10: Slave_RIOMain_DIOSubRing_DIOCloudsVx.xx.cfg
TCSESM063F2CU1 or TSCESM063F2CS1	C3: RIOMainRingFx_RIOSubRingTx_DIOCloudsVx.xx.cfg
	C4: RIOMainRingFx_DIOSubRingTx_DIOCloudsVx.xx.cfg
	C5: RIOMainRingFxTx_RIOSubRingTx_DIOCloudsVx.xx.cfg
	C6: RIOMainRingFxTx_DIOSubRingTx_DIOCloudsVx.xx.cfg
	C11: Master_RIOMainFxTx_RIOSubRingTx_DIOCloudsVx.xx.cfg
	C12: Slave_RIOMainFxTx_RIOSubRingTx_DIOCloudsVx.xx.cfg
	C13: Master_RIOMainFxTx_DIOSubRingTx_DIOCloudsVx.xx.cfg
	C14: Slave_RIOMainFxTx_DIOSubRingTx_DIOCloudsVx.xx.cfg
	C15: CRPLinkHotStandbyLDVx.xx.cfg

NOTE: Download an appropriate predefined DRS configuration to each switch. Do not try to configure the switches yourself. The predefined configurations *(see page 93)* have been tested so that they meet the determinism and cable redundancy standards of the M580 system.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Upgrading the firmware for a ConneXium extended managed switch removes all predefined configuration file settings. Re-download the predefined configuration file to the switch before placing the switch back in operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

When you download a predefined configuration file to a switch, the file provides a set of operating parameters that enable the switch to operate with high efficiency in the specified architecture.

To determine which predefined configuration you need to download to each DRS in your network, refer to the *DRS Predefined Configuration Files* chapter *(see page 93)*.

Modicon X80 I/O Modules

Introduction

The following I/O modules can be mounted in local racks or RIO drops in an M580 system.

Some of these modules also contain embedded web pages that can be used for configuration and diagnostics. Web page descriptions are provided in the appropriate product documentation and in Unity Pro help.

NOTE: Conformally coated (hardened H) versions of many of these modules are also available.

Modicon X80 Analog and Discrete Modules

Modules that require Ethernet across the backplane can be installed only in main local or remote local racks. They cannot be installed in extended racks.

These I/O modules are supported in Modicon X80 local racks containing a CPU and RIO drops:

Type of Module	Module	Comments	Installation on...			
			Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
Analog I/O Modules						
input	BME AHI 0812[1]	These require an Ethernet backplane and a BME CRA 312 10 eX80 performance EIO adapter module if they are inserted in a remote drop.	X	—	X	—
output	BME AHO 0412[1]		X	—	X	—
input	BMX AMI 0410	No backplane or EIO adapter module restrictions	X	X	X	X
input	BMX AMI 0800		X	X	X	X
input	BMX AMI 0810		X	X	X	X
input/output	BMX AMM 0600		X	X	X	X

1 These modules require an Ethernet backplane.
2 In the CPU configuration screen in Unity Pro, you can configure a digital I/O module channel as a **RUN**/**STOP input** by selecting this check box. This can be performed on a local I/O channel in topological I/O data type only.
3 Before installation of I/O modules that use a 125 Vdc power supply, refer to the temperature derating information in I/O module hardware guides for your platform.
X allowed
— not allowed

Type of Module	Module	Comments	Installation on...			
			Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
output	BMX AMO 0210		X	X	X	X
output	BMX AMO 0410		X	X	X	X
output	BMX AMO 0802		X	X	X	X
input	BMX ART 0414	The FAST task is not supported.	X	X	X	X
input	BMX ART 0814		X	X	X	X
Discrete I/O Modules(2)						
input	BMX DAI 0805		X	X	X	X
input	BMX DAI 1602		X	X	X	X
input	BMX DAI 1603		X	X	X	X
input	BMX DAI 1604		X	X	X	X
output	BMX DAO 1605		X	X	X	X
input	BMX DDI 1602		X	X	X	X
input	BMX DDI 1603		X	X	X	X
input	BMX DDI 1604(3)		X	X	X	X
input	BMX DDI 3202 K		X	X	X	X
input	BMX DDI 6402 K		X	X	X	X
input/ output	BMX DDM 16022		X	X	X	X
input/ output	BMX DDM 16025		X	X	X	X
input/ output	BMX DDM 3202 K		X	X	X	X
output	BMX DDO 1602		X	X	X	X
output	BMX DDO 1612		X	X	X	X
output	BMX DDO 3202 K		X	X	X	X
output	BMX DDO 6402 K		X	X	X	X
output	BMX DRA 0804(3)		X	X	X	X
output	BMX DRA 0805(3)		—	—	X	X
output	BMX DRA 1605		—	—	X	X

1 These modules require an Ethernet backplane.
2 In the CPU configuration screen in Unity Pro, you can configure a digital I/O module channel as a **RUN/STOP input** by selecting this check box. This can be performed on a local I/O channel in topological I/O data type only.
3 Before installation of I/O modules that use a 125 Vdc power supply, refer to the temperature derating information in I/O module hardware guides for your platform.
X allowed
— not allowed

NOTE: Schneider Electric recommends that you use Unity Loader to upgrade the modules with the latest available version. (It is not necessary to update a BMX ART 0414 module, V2.1 or later, as it works correctly with a BM• CRA 312 •0X80 EIO adapter module.)

Intelligent and Special Purpose Modules

These intelligent/special purpose modules are supported in M580 local racks (containing a CPU with Ethernet I/O scanner service) and RIO drops that contain a BM• CRA 312 •0 X80 EIO adapter module:

Type	Module	Comment	Installation on...			
			Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
communication	BMX NOM 0200(1)(2)(3)	The FAST task is not supported.	X	X	X	X
	BMX NOR 0200(1)(2)	Not supported in RIO drops. The FAST task is not supported.	X	X	—	—
	BMX EIA 0100	A maximum of 4 AS-i modules per main/extended local racks is allowed. A maximum of 2 AS-i modules per drop is allowed. A maximum of 16 AS-I modules is allowed in the drops in an M580 system.	X	X	X	X

1 If a BMX NOM 0200 module and a BMX EIA 0100 module are included on the same RIO drop, only one of each module is allowed.
2 Only MAST tasks are supported.
3 The Modbus character mode is supported.
X allowed
— not allowed

NOTE: The maximum number of communication modules you can install on the local rack depends upon the CPU you choose *(see page 75)*.

Type	Module	Comment	Installation on...			
			Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
counting	BMX EHC 0200		X	X	X	X
	BMX EHC 0800		X	X	X	X
	BMX EAE 0300	In RIO drops: ● Events are not supported. If events are needed, move the module to the local rack. ● A maximum of 36 channels can be configured.	X	X	X	X
time stamping	BMX ERT 1604T		X	X	X	X
fiber cable conversion	BMX NRP 0200		X	X	X	X
motion	BMX MSP 0200	It is not supported in RIO drops	X	X	—	—
weighing	PME SWT 0100(5)	This is an Ethernet weighing transmitter (1 channel).	X	—	X	—

1 If a BMX NOM 0200 module and a BMX EIA 0100 module are included on the same RIO drop, only one of each module is allowed.
2 Only MAST tasks are supported.
3 The Modbus character mode is supported.
X allowed
— not allowed

NOTE: The maximum number of communication modules you can install on the local rack depends upon the CPU you choose (*see page 75*).

Modicon X80 Analog and Discrete Module Versions

When the following modules are used in a local rack (containing a CPU) and RIO drops, they require these versions:

Module	Product Version	Software Version
BMX AMI 0410	PV5	SV1.1
BMX AMM 0600	PV5 or later	SV1.2
BMX AMO 0210	PV7 or later	SV1.1

Module	Product Version	Software Version
BMX ART 0414	PV5, PV6	SV2.0
	PV7	SV2.1
BMX ART 0814	PV3, PV4	SV2.0
	PV5 or later	SV2.1
BMX EHC 0200	PV3	SV1.1
BMX EHC 0800	PV3	SV1.1

Hardened Modules

These hardened modules are supported in M580 local racks (containing a CPU) and RIO drops that contain a BM• CRA 312 •0 EIO adapter module. For details regarding hardened modules, refer to the manuals for each of these modules.

Type of Module	Module
counting	BMX ECH 0200 H
synchronous serial interface (SSI)	BMX EAE 0300 H
analog input	BMX ART 0414 H
	BMX ART 0814 H
	BMX AMI 0810 H
analog output	BMX AMP 0210 H
	BMX AMO 0410 H
	BMX AMO 0810 H
discrete input	BMX DDI 1602 H
	BMX DDI 1603 H
discrete output	BMX DAO 1602 H
	BMX DDO 1605 H
	BMX DDO 1612 H
	BMX DRA 0805 H
	BMX DRA 1605 H
discrete input/output	BMX DAI 1602 H
	BMX DAI 1603 H
	BMX DAI 1604 H
	BMX DDM 16022 H
	BMX DDM 16025 H
TELEFAST wiring accessories	ABE7 CPA 0410 H
	ABE7 CPA 0412 H

Premium I/O Modules

Using Premium I/O Modules in an M580 System

Premium analog and discrete I/O modules can be connected on an extended local rack *(see page 83)* in an M580 system. Premium modules cannot be used in Modicon X80 RIO drops.

NOTE: Premium motion, communication, and safety modules are not supported in an M580 system.

These analog and discrete I/O modules are supported in a TSX RKY •EX Premium rack used as extended local rack:

Type of Module	Module
Analog I/O Modules	
input	TSX AEY 1600
input	TSX AEY 1614
input	TSX AEY 414
input	TSX AEY 420
input	TSX AEY 800
input	TSX AEY 810
output	TSX ASY 410
output	TSX ASY 800
terminal connector	TSX BLY 01
Discrete I/O Modules	
input	TSX DEY 08D2
input	TSX DEY 16A2
input	TSX DEY 16A3
input	TSX DEY 16A4
input	TSX DEY 16A5
input	TSX DEY 16D2
input	TSX DEY 16D3
input	TSX DEY 16FK
input	TSX DEY 32D2K
input	TSX DEY 32D3K
input	TSX DEY 64D2K
output	TSX DMY 28FK
output	TSX DSY 08R4D
output	TSX DSY 08R5
output	TSX DSY 08R5A

Type of Module	Module
output	TSX DSY 08S5
output	TSX DSY 08T2
output	TSX DSY 08T22
output	TSX DSY 08T31
output	TSX DSY 16R5
output	TSX DSY 16S4
output	TSX DSY 16S5
output	TSX DSY 16T2
output	TSX DSY 16T3
output	TSX DSY 32T2K
output	TSX DSY 64T2K
Intelligent and Special Purpose Modules	
counting	TSX CTY 2A
	TSX CTY 4A
weighing	TSX ISP Y101
safety (12I 2Q 24VDC)	TSX PAY 262
safety (12I 4Q 24VDC)	TSX PAY 282

Distributed Equipment

Distributed Equipment

Distributed equipment can be connected to an M580 system in the following 2 ways:

- a DIO cloud *(see page 30)*
- a DIO sub-ring *(see page 33)*

Distributed devices in a sub-ring have 2 Ethernet ports (to maintain the ring), and they support RSTP. An example of equipment on a DIO sub-ring would be several STB islands that use STB NIP 2311 NIMs.

Ethernet distributed equipment that can be put on distributed device clouds include 2 families of devices:

I/O Scanned Equipment	Equipment that Cannot be I/O Scanned
variable speed drives — Altivar ATV 32, 61, 71	Magelis HMI controllers
main protection and control functions — TeSys T	Pelco cameras
ETB (I/O modules), OTB (DIO modules), and STB (modules connected on a single island)	
remote masters — Profibus master interface, ETG1000 master interface, Hart master interface	
EtherNet/IP adapter devices	

Part II
Planning and Designing an M580 Network

Introduction

This part describes the process of selecting the proper topology for your system, as well as the limitations involved in constructing your network and the role of determinism in an RIO network.

What Is in This Part?

This part contains the following chapters:

Chapter 3
Selecting the Correct Topology

Overview

An M580 system provides deterministic services to remote I/O drops and to individual RIO modules. Distributed equipment does not have the same level of determinism, but it can participate on an RIO network without disrupting the determinism of the RIO modules.

In order to achieve this determinism, the RIO network follows a set of simple rules that are explained in this chapter.

- One CPU with Ethernet I/O scanner service is installed in the local rack.
- One BM• CRA 312 •0 X80 EIO adapter module is installed in each RIO drop.
- DRSs are optimized with predefined configurations *(see page 93)* that support 50 ms ring recovery time.
- Follow the rules regarding the maximum number of devices allowed (e.g., 32 devices, in the main ring, including the local rack, and 16 RIO drops in the RIO network), the types of cables you select, and respect Unity Pro messages during programming and diagnostic checks *(see page 197)*.
- Optional elements include a maximum of four BME NOC 03•1 Ethernet communication modules on the local rack *(see page 75)*. (These modules cannot be installed on an RIO drop.)
- DRSs may also be used to attach sub-rings to the main ring.

Each M580 CPU supports only 1 Ethernet RIO network. This section helps you select the RIO network that allows improved response time for remote equipment operations.

In addition, preferred DIO network topologies are discussed in detail so that you can construct a device network that works harmoniously with the RIO network's deterministic operation.

NOTE: The architectures described in this document have been tested and validated in various scenarios. If you intend to use architectures different than the ones described in this document, test and validate them thoroughly before implementing.

If you require a topology not discussed on the following pages, contact your local Schneider Electric office. Service personnel from the *Customer Care Center* can help you determine your network bandwidth and provide calculations for improved performance.

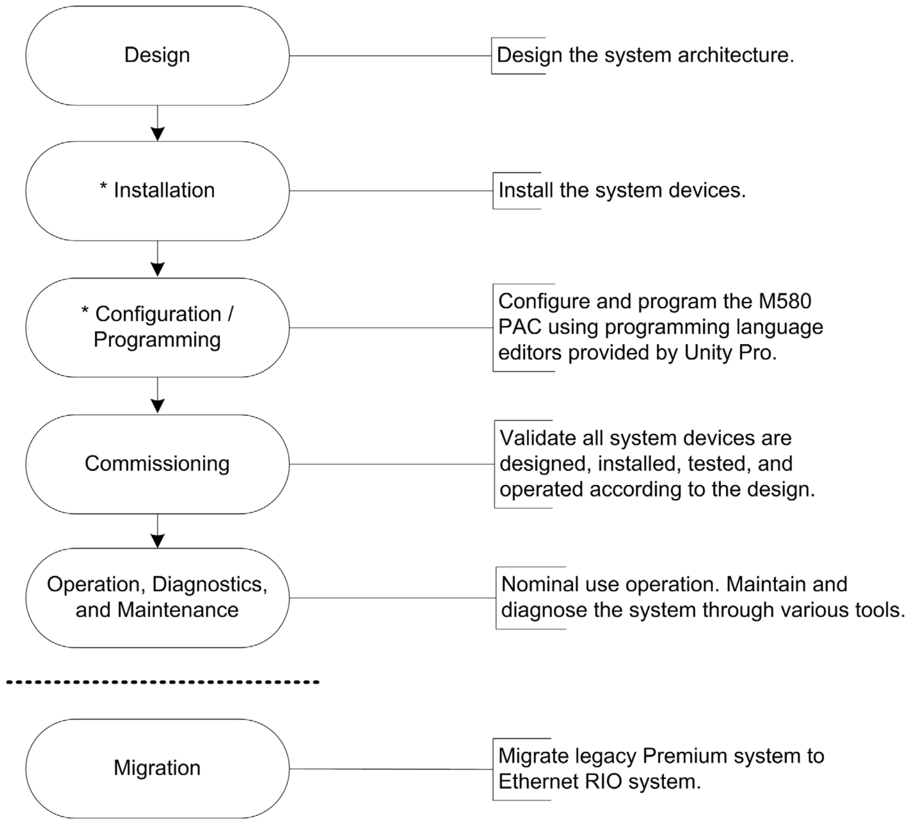
What Is in This Chapter?

This chapter contains the following topics:

Project Life Cycle

Project Life Cycle

Before you turn to the topic of planning your network topology, it may be helpful to see the life cycle of a project within the M580 system.



* **NOTE**: Installation and configuration/programming instructions are explained in the *Modicon M580 Hardware Guide* and the respective *Modicon M580* communication/adapter module user guide.

Planning the Appropriate Network Topology

Key Points when Planning a Topology

Consider the following key points when choosing an M580 network topology:

- distance between 2 contiguous drops (and the potential need for DRSs or BMX NRP 020• *(see page 88)* fiber converter modules and fiber cable on the main ring)
- network topology (ring or star)
- local rack configuration
- distributed equipment requirements
- isolation requirements (e.g., if the local rack and the drops are on different grounding systems)
- redundancy requirements for the main ring / sub-ring connections

These points are discussed in the following paragraphs.

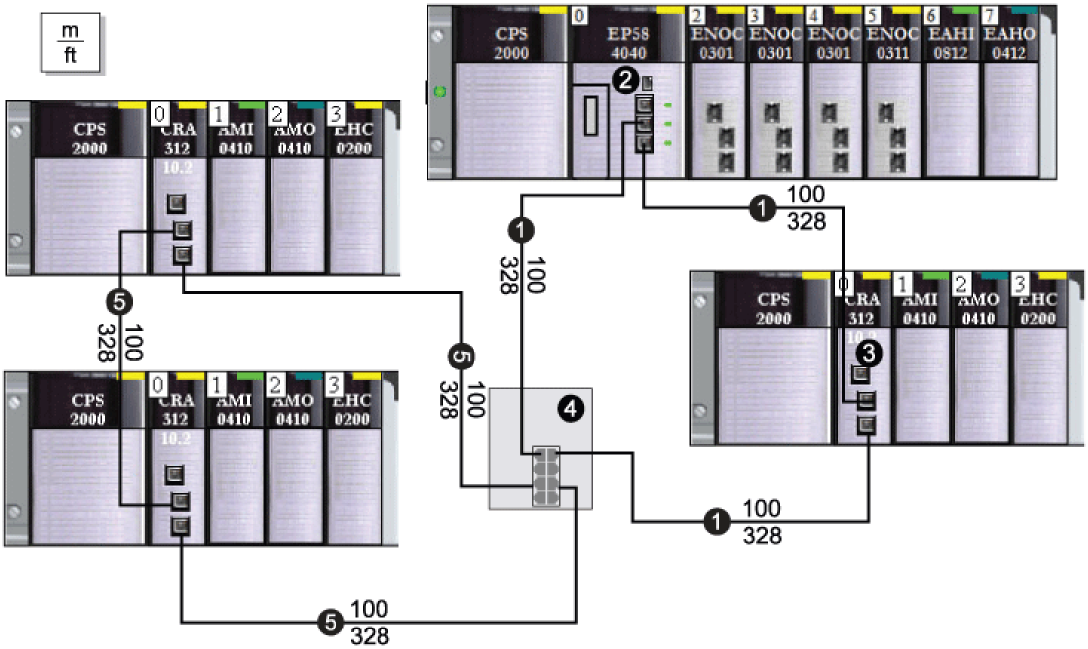
Distance Between 2 Drops

The distance between 2 drops determines the choice of physical layer.

If you are using copper cable, the maximum distance between 2 contiguous drops is 100 m. If the drops are more than 100 m apart, use 1 or more DRSs. A DRS can be used to extend a copper cable run or to transition the main ring from copper to fiber. You can also install BMX NRP 020• fiber converter modules to convert copper cable to fiber. A fiber cable can run as long as 15 km (for single-mode fiber).

If Distance Between 2 Remote Drops is Less than 100 m...

A copper Ethernet network provides a valid solution.



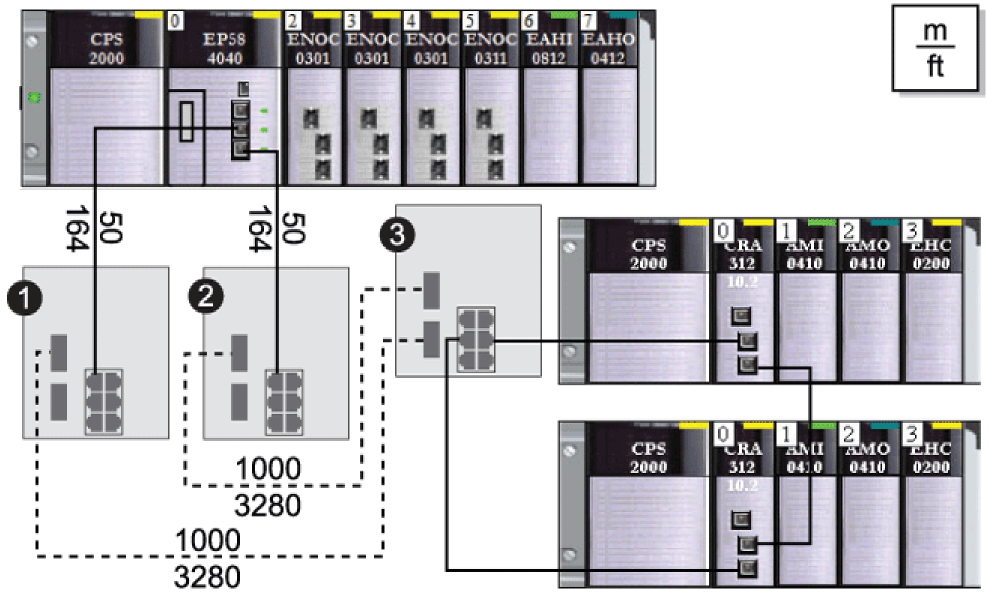
Note The solid line represents copper wire.

1 main ring
2 CPU with Ethernet I/O scanner service on the local rack
3 RIO drop (including a BM• CRA 312 •0 X80 EIO adapter module) on the main ring
4 DRS with a C1 predefined configuration to support an sub-ring
5 RIO sub-ring

If Distance Between 2 Remote Drops is More than 100 m...

DRSs may be used to increase the distance between 2 contiguous RIO modules, including the distance between the CPU and an RIO drop. To connect the fiber to the copper cables, insert a DRS at each end of the fiber link. Thus, 2 DRSs are used to establish 1 fiber link.

In this example, cable distances less than 100 m are copper cable and distance greater than 100 m are fiber.



Note The dashed line represents fiber cable, and the solid line represents copper wire.

1 and 2 2 DRSs with C5 predefined configurations to use only 1 fiber port. They support a copper-to-fiber and a fiber-to-copper transition. They enable the fiber-based network to connect to the copper ports on the CPU with Ethernet I/O scanner service in the local rack.

3 A DRS with a C3 predefined configuration to use 2 fiber ports and support an sub-ring and a cloud.

Using Fiber Converter Modules

Follow these steps to install fiber converter modules to extend the distance between the local rack and the first RIO drop on the main ring:

Step	Action
1	Install a BMX NRP 020• fiber converter module on a local rack.
2	Connect the BMX NRP 020• module on the local rack via copper cable to the CPU.
3	Install a BMX NRP 020• module on the first RIO drop on the main ring.
4	Connect the fiber cable between the BMX NRP 020• module on the local rack and the BMX NRP 020• module at the RIO drop. The BMX NRP 020• module uses small form-factor plugs (SFPs) (transceivers) for the fiber ports. Choose single-mode or multi-mode SFPs. ● Use multi-mode fiber and a (BMX NRP 0200) module to connect the NRP module to the main ring if the distance between the NRP and the next Ethernet RIO drop is less than 2 km. ● Use the single-mode fiber module (BMX NRP 0201) to connect the NRP module to the main ring if the distance between the NRP and the next Ethernet RIO drop is between 2 km and 15 km.

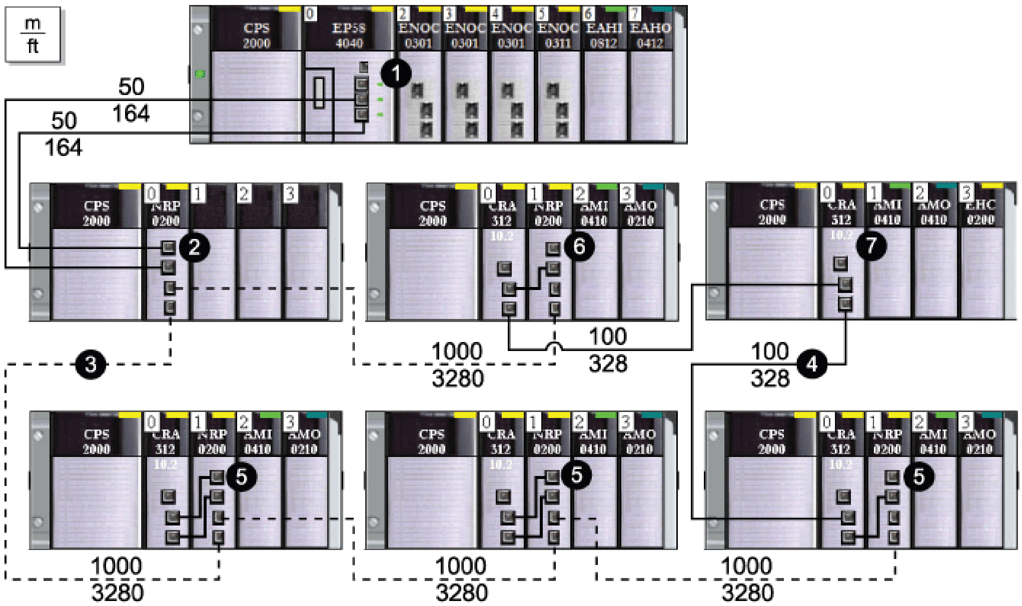
Step	Action
5	Interlink the 2 copper ports of the BMX NRP 020• module with the 2 Ethernet ports of the BM• CRA 312 •0 X80 EIO adapter module on the RIO drop.
6	To extend the distance between other RIO drops on the main ring, connect the BMX NRP 020• module on an RIO drop to a BMX NRP 020• module on the next drop. Then, follow step 5.

To close the ring:

Step	Action
1	Interlink a copper port on the BMX NRP 020• module with an Ethernet port on the BM• CRA 312 •0 X80 EIO adapter module on the last RIO drop.
2	Connect the BMX NRP 020• module on the RIO drop via fiber cable to the BMX NRP 020• module on the local rack.

Follow these steps to install fiber converter modules to extend the distance between RIO drops on the main ring or a sub-ring:

Step	Action
1	Install BMX NRP 020• modules on the 2 RIO drops for which you wish to extend the distance.
2	Connect the BMX NRP 020• module on one drop to the BMX NRP 020• module on the next drop. The BMX NRP 020• module uses small form-factor plugs (SFPs) (transceivers) for the fiber ports. Choose single-mode or multi-mode SFPs. ● Use the multi-mode fiber module (BMX NRP 0200) to connect the NRP module to the ring if the distance between the NRP and the next drop is less than 2 km. ● Use the single-mode fiber module (BMX NRP 0201) to connect the NRP module to the ring if the distance between the NRP and the next drop is between 2 km and 15 km.
3	Interlink the 2 copper ports of the BMX NRP 020• module with the 2 Ethernet ports of the BM• CRA 312 •0 on the drop.
4	To extend the distance between other RIO drops on a ring, repeat steps 1-3.



1 local rack, showing the CPU with Ethernet I/O scanner service and the copper connection to the BMX NRP 020• fiber converter module
2 BMX NRP 020• module connected to the local rack via copper cable and to the remote rack via fiber cable
3 *(dashed line)*: fiber portion of the main ring
4 *(solid line)*: copper portion of the main ring
5 BMX NRP 020• module on an RIO drop connected to the main ring via fiber cable
6 BMX NRP 020• module on an RIO drop connected to the main ring via copper and fiber cable
7 RIO drop connected to the main ring via copper cable (no BMX NRP 020• module installed on drop)

NOTE:

- Use multi-mode fiber to connect the BMX NRP 020• module to the main ring if the distance between the local rack and the RIO drop is less than 2 km.
- You cannot use BMX NRP 020• modules to connect RIO or DIO sub-rings to the main ring.

Topology Choices

Your Ethernet I/O network will comprise one of the following topologies:
- a simple daisy chain loop *(see page 77)*
- a high-capacity daisy chain loop *(see page 79)*

Choose a topology based on the distributed equipment and/or modules in your system and the types of Ethernet ports on the equipment/modules.

To Insert in the Network...	Use...	Topology Type
distributed equipment with a single Ethernet port	a DIO cloud (with devices in a star topology)	You can connect a DIO cloud to a *high-capacity daisy chain loop (see page 79)*. ● A DIO cloud participates in the RIO network only if it is connected to a DRS that resides on the main ring in a high-capacity daisy chain loop. Connect the DRS to a CPU with Ethernet I/O scanner service on the local rack. **NOTE:** The cloud is not part of the deterministic RIO network.
distributed equipment with dual Ethernet ports	● a DIO cloud (with devices in a star topology) — or — ● a DIO sub-ring (with equipment in a daisy chain loop, if they support RSTP)	You can connect a DIO cloud or DIO sub-ring via either a BME NOC module or a DRS that resides on the main ring in a high-capacity daisy chain loop *(see page 79)*.
RIO modules with dual Ethernet ports	an Modicon X80 drop on the main ring or an RIO sub-ring	● If you want to use RIO drops on the main ring only, plan a simple daisy chain loop *(see page 77)*. ● If you want to use RIO drops and DRSs (for distance) on the main ring only, plan a high-capacity daisy chain loop *(see page 79)*. ● If you want to use RIO sub-rings connected to the main ring via DRSs, plan a high-capacity daisy chain loop *(see page 79)*.

Distributed Equipment

The number and location of distributed equipment in the network impact the module choice.

If Distributed Equipment Is ...	Then ...
in an **isolated DIO network or cloud** *(see page 76)*: distributed equipment that **is not** a physical part of the deterministic RIO network	Each BME NOC 03•1 Ethernet communication module can manage up to 128 isolated distributed devices. The number of BME NOC 03•1 modules supported in a local rack is based on the CPU model that you are using. Refer to the *Selecting a CPU for your System (see page 75)* topic for details regarding the number of DIO devices a CPU can manage. **NOTE:** A local rack can have a maximum of 4 communication modules, depending upon which CPU you choose *(see page 75)*.

If Distributed Equipment Is ...	Then ...
on a **DIO sub-ring or cloud** *(see page 76)*: distributed equipment that **is** a physical part of the deterministic RIO network	In addition to a CPU with Ethernet I/O scanner service and BME NOC 03•1 modules on the local rack, one or more DRSs may be necessary to create DIO sub-rings or clouds. The distributed equipment cannot be connected directly to the main ring. A CPU with Ethernet I/O scanner service can manage as many as to128 modules in the RIO network and up to 64 or 128 distributed devices, depending on the model you are using. Refer to the *Selecting a CPU for your System* *(see page 75)* topic for details regarding the number of DIO devices a CPU can manage. **NOTE:** A local rack can have a maximum of 4 communication modules, depending upon which CPU you choose *(see page 75)*.

Isolation Requirements

DANGER

ELECTRICAL SHOCK HAZARD

- Switch off the power supply to the PAC at both ends of the connection before inserting or removing an Ethernet cable.
- Use suitable insulation equipment when inserting or removing all or part of this equipment.

Failure to follow these instructions will result in death or serious injury.

If isolation is required in your network (e.g., if the local rack and RIO drops are on different grounding systems), then use fiber cable to connect devices that are on separate grounding systems.

Refer to the ground connections information in the *Grounding and Electromagnetic Compatibility of PLC Systems Basics Principles and Measures User Manual* (33002439) to comply with EMC certifications and deliver expected performance.

Sub-ring Redundancy Requirements

Two DRSs can be used to provide a redundant connection between the main ring and the sub-ring. One DRS is installed with a *master* predefined configuration, and the other is installed with a corresponding *slave* predefined configuration. The *master* DRS passes data between the main ring and the sub-ring. If the *master* DRS becomes inoperable, the *slave* DRS takes control and passes data between the main ring and the sub-ring. For details, refer to the *Predefined Configuration Files chapter*.

Selecting a CPU for your M580 System

Introduction

A local rack *(see page 23)* in an M580 system contains one CPU. The following table provides information that helps you select which CPU to configure in your system.

Communication Capability	BME P58 1020	BME P58 2020	BME P58 2040	BME P58 3020	BME P58 3040	BME P58 4020	BME P58 4040
maximum number of RIO drops	–	–	8	–	16	–	16
maximum number of local racks (main rack + extended rack)	4	4	4	8	8	8	8
maximum number of communication modules on the local rack(1)	2	2	2	3	3	4	4
Ethernet I/O scanning service	DIO	DIO	RIO and DIO	DIO	RIO and DIO	DIO	RIO and DIO
maximum number of distributed devices managed by a CPU's DIO scanner service	64	128	64	128	64	128	64
maximum number of discrete I/O channels	1024	2048	2048	3072	3072	4096	4096
maximum number of analog I/O channels	256	512	512	768	768	1024	1024

– not available

(1) includes BME NOC 03•1, BMX EIA 0100, BMX NOR 0200, and BMX NOM 0200 communication modules

NOTE:

- M580 CPUs have 3 Ethernet ports. The top port is the service port.
- A device network contains both RIO modules and distributed equipment.

Planning an Isolated DIO Network

Introduction

An isolated DIO network is not part of the RIO network. It is an Ethernet-based network containing distributed equipment on a copper wire running from a single port connection or on a ring running off a BME NOC 03•1 Ethernet communication module. If you use dual-port distributed equipment that support RSTP, you can connect the equipment in a daisy-chain loop to the 2 device network ports on a BME NOC 03•1 module.

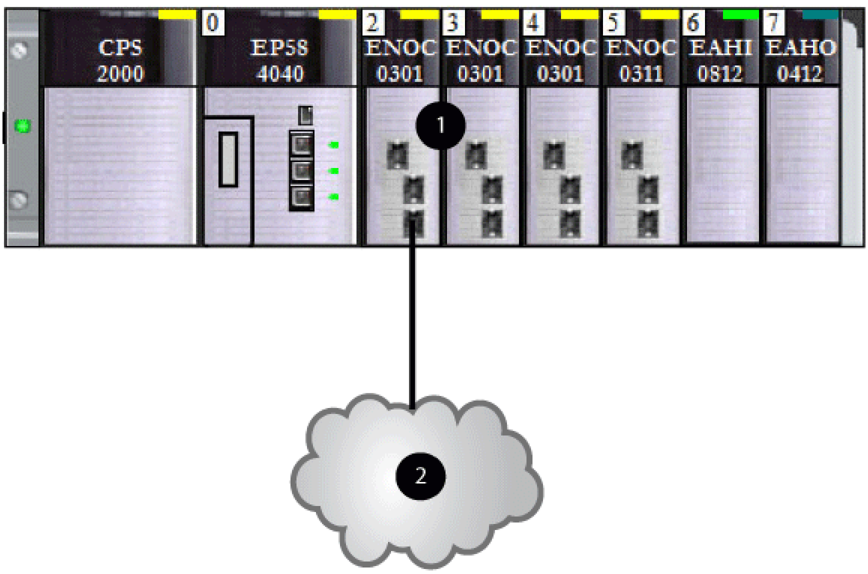
Attaching an Isolated DIO Network

To attach an isolated DIO network to an M580 system:

Step	Action
1	Disable the Ethernet backplane connection of the BME NOC 03•1 module.
2	Connect one of the *device network ports* of the BME NOC 03•1 module to the DIO network. **NOTE:** If you use dual-port equipment that support RSTP, you can connect the equipment in a daisy chain loop to both *device network ports* on the BME NOC 03•1 modules.

Example

The following graphic shows an isolated DIO network. The CPU with DIO scanner service is not connected to any other communication module on the local rack.



1 BME NOC 03•1 module
2 DIO cloud, which does not communicate with the M580 network

Planning a Simple Daisy Chain Loop

Introduction

A simple daisy chain loop contains a local rack and one or more RIO drops.

Implement a simple daisy chain loop network if only Ethernet RIO drops are included in the loop. The maximum number of RIO drops in the loop is 16. The local rack consists of a CPU with Ethernet I/O scanner service.

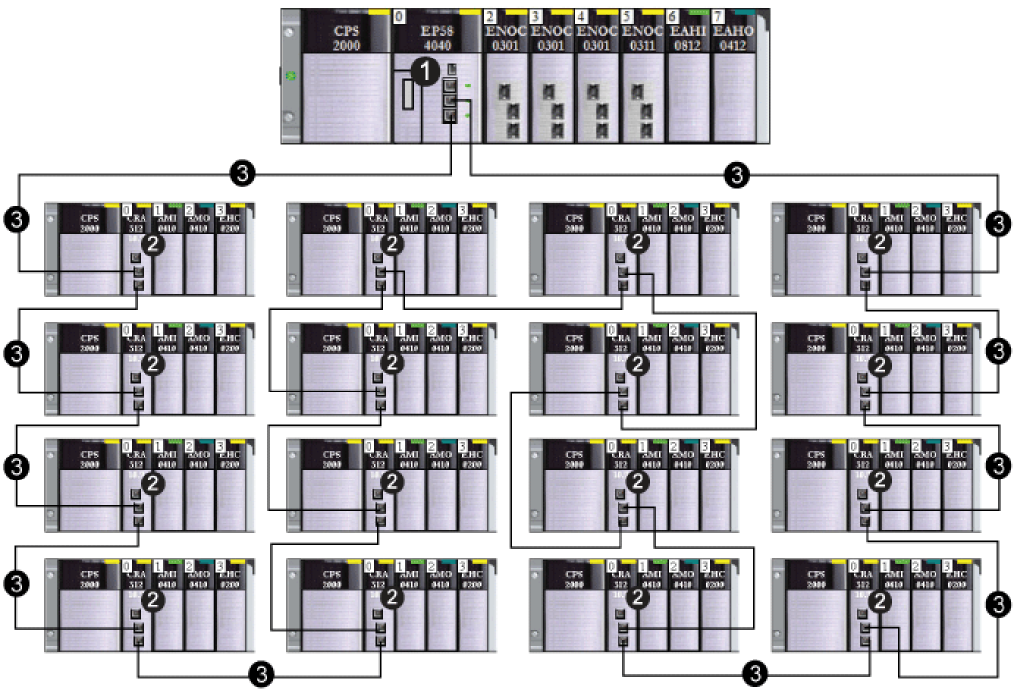
NOTE: Sub-rings and distributed equipment are not used in a simple daisy chain loop network.

Requirements

A simple daisy chain loop configuration provides cable redundancy that anticipates possible communication disruptions such as a broken wire or a non-operating RIO drop. Detecting a break in the main ring is discussed later in this guide *(see page 197)*.

DRSs are not needed in a simple daisy chain loop configuration.

The following graphic shows a CPU with Ethernet I/O scanner service in the local rack and Ethernet RIO drops on the main ring.



1 CPU with Ethernet I/O scanner service on the local rack
2 BM• CRA 312 •0 X80 EIO adapter module on an X80 RIO drop
3 main ring

NOTE:

- Verify that the CPU in the local rack supports RIO scanning. You can also add a maximum of 4 communication modules, depending upon the CPU you choose *(see page 75)*.
- A maximum of 16 remote drops is supported.
- Only copper cable can be used, so there is a maximum distance of 100 m between any 2 consecutive RIO modules on the main ring. If you want to extend the distance beyond 100 m, use DRSs *(see page 93)* or BMX NRP 020• *(see page 88)* fiber converter modules to convert the copper cable to fiber.
- If you connect a DIO cloud to the CPU on the local rack, the cloud is not part of the simple daisy-chain loop. The CPU services the control logic for the DIO cloud only after it has completed the logic scan for the RIO.

Planning a Simple Daisy Chain Loop

Follow the steps below to plan a simple daisy chain loop network. Configuration procedures are discussed in the respective *Modicon M580* Ethernet communication/adapter module user guide.

Step	Action
1	Plan the local rack (including the M580 CPU with Ethernet I/O scanner service and the power supply module.
2	Plan the Ethernet RIO drops. (Each drop includes a BM• CRA 312 •0 X80 EIO adapter module.)
3	Select a CPU that supports RIO and configure the Ethernet I/O scanner service for RIO.
4	Connect the Device Network port on the CPU to an Ethernet port on the adapter module at one of the drops. This completes the loop. Do not use the Service port or ETH 1 port on the CPU for this connection.

NOTE:

- CPUs and X80 EIO adapter modules do not have any fiber ports. Therefore, the maximum distance between the CPU and the first drop and between any 2 contiguous drop is less than 100 m, using shielded twisted 4-pair CAT5e or greater (10/100 Mbps) cable. (Do not use twisted 2-pair CAT5e or CAT6 cables.) If you want to extend the distance beyond 100 m, use DRSs *(see page 93)* or BMX NRP 020• *(see page 88)* fiber converter modules to convert the copper cable to fiber.
- The Ethernet ports are clearly labeled on both the CPU with Ethernet I/O scanner service and the BM• CRA 312 •0 X80 EIO adapter module. **If you connect these modules to the wrong ports, system performance will be affected.**

Planning a High-Capacity Daisy Chain Loop

Introduction

A high-capacity daisy chain loop incorporates DRSs in the RIO network. The following are possible:

- RIO sub-rings
- DIO sub-rings
- DIO clouds
- fiber cable implementations (You can also use BMX NRP 020• *(see page 88)* fiber converter modules for this purpose.)

Planning a High-Capacity Daisy Chain Loop

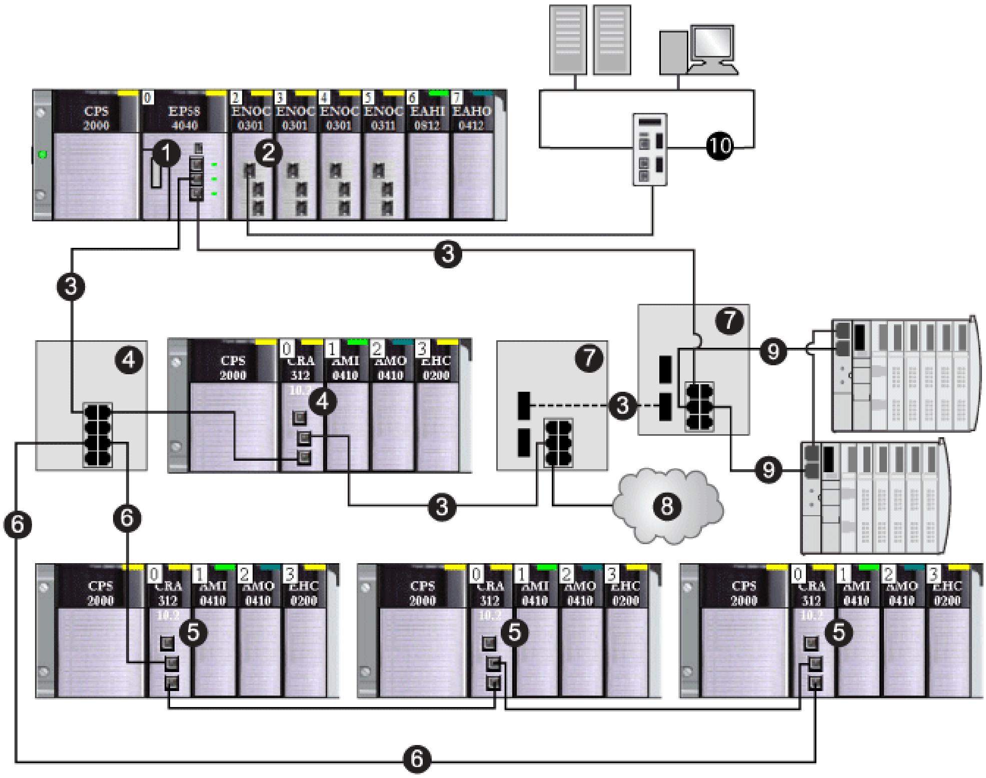
An M580 local rack contains a CPU and supports a maximum of 4 communication modules, depending on which CPU you choose *(see page 75)*. If you use both RIO and distributed equipment in the main ring, use a CPU that supports both RIO and DIO scanning *(see page 75)*, referred to in this guide as a CPU with Ethernet I/O scanner service. These are the CPUs with commercial references that end in *40*.

NOTE:

- You can detect sub-ring loop breaks *(see page 204)* using explicit messaging.
- RIO drops maintain their determinism and cable redundancy in a high-capacity daisy chain loop network. If a communication disruption (for example, a broken wire) occurs on the main ring or any of the RIO sub-rings, the network will recover within 50 ms.
- To keep the network recovery time within the 50 ms limit, a maximum of 32 devices (including a CPU with Ethernet I/O scanner service in the local rack) are allowed on the main ring. Count a DRS as 2 devices.
- Connect DRSs to the main ring ***before*** you connect them to sub-rings. **If a DRS is not connected to the main ring properly, the sub-rings do not operate.** Refer to the DRS chapter for installation details *(see page 93)*.
- A maximum of 16 RIO drops (each drop containing a BM• CRA 312 •0 X80 EIO adapter module) are allowed on the RIO network.

Connecting Distributed Equipment to the RIO Network

This graphic shows a sample high-capacity daisy chain loop network configuration. The local rack contains a BME P58 ••40 CPU , a CPU with Ethernet I/O scanner service:



1 CPU with Ethernet I/O scanner service
2 BME NOC 03•1 Ethernet communication module (Ethernet backplane connection enabled) managing distributed equipment on the device network and connected to the control network (10) via the service port
3 main ring
4 DRS (connecting an RIO sub-ring (6) to the main ring)
5 Ethernet RIO drops on the sub-ring (which include a BM• CRA 312 •0 X80 EIO adapter module)
6 RIO sub-ring
7 DRSs configured for copper-to-fiber and fiber-to-copper transition (also connecting a DIO cloud (8) and a DIO sub-ring (9) to the main ring)
8 DIO cloud
9 DIO sub-ring
10 control network

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file of a DRS. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

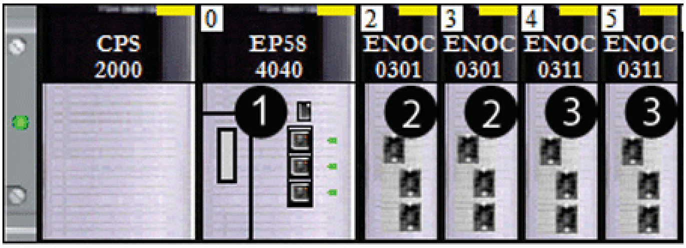
⚠ WARNING
UNEXPECTED EQUIPMENT BEHAVIOR Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

NOTE: Download an appropriate predefined DRS configuration to each switch. Do not configure the switches yourself. The predefined configurations *(see page 93)* have been tested so that they meet the determinism and cable redundancy standards of the M580 system.

Local Rack Communication Module Installation

Introduction

An M580 local rack *(see page 23)* can contain one CPU and up to four BME NOC 03•1 Ethernet communication modules modules, depending upon the CPU you choose *(see page 75)*. You can also use up to four BMX NOR 0200 Ethernet communicaton modules or BMX NOM 0200 Modbus communication modules, depending upon the CPU.



1 M580 CPU with Ethernet I/O scanner service
2 BME NOC 0301 Ethernet communication module with standard Web services
3 BME NOC 0311 Ethernet communication module with FactoryCast Web services

The BME NOC 0311 module has all the capability and functionality of the BME NOC 0301, plus access to FactoryCast services. For more information about these modules, refer to the *M580 BME NOC 03•1 Ethernet Communication Module Installation and Configuration Guide*.

For further details about other types of modules you can install, refer to the local rack topic *(see page 23)*.

Maximum Number of Communication Modules on the Local Rack

The following table shows the maximum number of communication modules you can install on the local rack, depending upon which CPU you choose.

CPU	Maximum Number of Communication Modules*
BME P58 1020	2
BME P58 2020	2
BME P58 2040	2
BME P58 3020	3
BME P58 3040	3
BME P58 4020	4
BME P58 4040	4
* includes BME NOC 03•1, BMX NOR 0200, and BMX NOM 0200 modules	

Using Premium Racks in an M580 System

Introduction

An M580 system allows TSX RKY •EX Premium extended local racks. Using Premium racks in an M580 system allows you to preserve cabling in an existing configuration.

Premium rack compatibility:

	Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
TSX RKY ••EX(C) Premium	—	X	—	—
● X: allowed ● —: not allowed				

NOTE: Only TSX RKY ••EX(C) racks are allowed in an M580 system. TSX RKY ••E) racks are not compatible.

NOTE: Refer to the *Premium and Atrium using Unity Pro (Processors, Racks, and Power Supply Modules) Implementation Manual* for detailed information regarding Premium hardware.

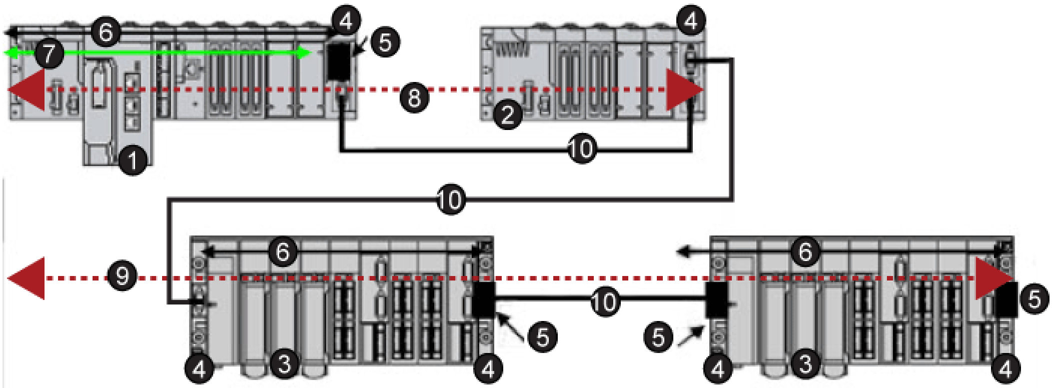
Installing Premium Racks

The following steps provide an overview of how to install Premium racks in an M580 system.

Step	Action
1	Install an M580 CPU on the main local rack.
2	Connect a Modicon X80 extended rack to the main local rack via X Bus extension cable. **NOTE:** The maximum X Bus cable length between the M580 main local rack and the Modicon X80 extended local rack is 30 m (98 ft).
3	Connect a TSX RKY •EX Premium rack to the Modicon X80 extended local rack via X Bus extension cable.
4	If desired, connect a Premium extended rack to the Premium main rack via X Bus extension cable. **NOTE:** The maximum X Bus cable length between the M580 main local rack and the Premium extended local rack is 100 m (328 ft).

NOTE: Use proper extender modules and bus terminators on each rack.

The following figure displays a Premium extended local rack connected to an M580 main local rack through a Modicon X80 extended local rack. The M580 CPU manages the I/O and intelligent/special purpose modules on the Premium local rack.



1 Modicon M580 main local rack
2 Modicon X80 extended local rack
3 Premium extended local rack
4 extension rack module
5 bus terminator module
6 X Bus connection on the rack
7 Ethernet connection on the rack
8 maximum X Bus cable length between the M580 main local rack (1) and the Modicon X80 extended local rack (2) is 30 m (98 ft)
9 maximum X Bus cable length between the M580 main local rack (1) and the Premium extended local rack (4) is 100 m (328 ft)
10 X Bus extension cable

NOTE: Premium remote racks that use TSX REY 200 modules are not supported.

NOTE: Premium motion, communication, and safety modules are not supported.

NOTE: Use Premium TSX TLY EX bus terminators on each end of the X Bus cable.

NOTE: Use TSX XTVS Y100 surge arrestors at both ends of Premium rack-to-rack cables that are greater than 28 m (91 ft).

NOTE: Connecting a Premium rack to a Modicon X80 **remote** rack is not supported.

Cable Installation

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK

Remove power from all local and remote equipment before installing or removing BMX XBC •••K or TSX CBY •••K cables.

Failure to follow these instructions will result in death or serious injury.

The following types of X Bus cables can be used to connect Premium racks to an M580 rack:

Part Number	Available Lengths
BMX XBC ••0K	0.8 m (2 ft, 7.5 in), 1.5 m (4 ft, 11 in), 3 (9 ft, 10 in), 5 (16 ft, 4 in), 12 (39 ft, 4 in)
TSX CBY •••K	1 m (3 ft, 3 in), 3 m (9 ft, 10 in), 5 m (16 ft, 4 in), 12 m (39 ft, 4 in), 18 m (59 ft), 28 m (91 ft, 10 in)
TSX CBY 380K	38 m (124 ft, 8 in)
TSX CBY 500K	50 m (164 ft)
TSX CBY 720K	72 m (236 ft, 2 in)
TSX CBY 1000K	100 m (328 ft, 1 in)

NOTE: If you install TSX CBY •••K cables, only use PV 03 or later.

Maximum Rack Installation

Depending on the number of slots per rack, you can install the following maximum number of Premium rack as extended local racks:

If the rack has this many slots...	You can install this many racks...	Comments
4, 6, or 8	14	14 half-racks = 7 full racks Two half racks that comprise each full rack share the same rack address. Therefore, there are a total of 7 unique rack addresses.
12	7	7 full racks, each with a unique rack address

NOTE: Refer to the *Modicon M580 Hardware Reference Manual* for configuration information regarding Premium racks.

Premium Analog and Digital Modules

These analog and digital I/O modules are supported in TSX RKY •EX Premium local racks within an M580 system:

Type of Module	Module
Analog I/O Modules	
input	TSX AEY 1600
input	TSX AEY 1614
input	TSX AEY 414
input	TSX AEY 800
input	TSX AEY 810
output	TSX ASY 410
output	TSX ASY 800
terminal connector	TSX BLY 01
Digital I/O Modules	
input	TSX DEY 08D2
input	TSX DEY 16A2
input	TSX DEY 16A4
input	TSX DEY 16D2
input	TSX DEY 16D3
input	TSX DEY 16FK
input	TSX DEY 32D2K
input	TSX DEY 32D3K
input	TSX DEY 64D2K
output	TSX DMY 28FK
output	TSX DSY 08R4D
output	TSX DSY 08R5
output	TSX DSY 08R5A
output	TSX DSY 08S5
output	TSX DSY 08T2
output	TSX DSY 08T22
output	TSX DSY 08T31
output	TSX DSY 16R5
output	TSX DSY 16S4
output	TSX DSY 16S5
output	TSX DSY 16T2

Type of Module	Module
output	TSX DSY 16T3
output	TSX DSY 32T2K
output	TSX DSY 64T2K
Intelligent and Special Purpose Modules	
counting	TSX CTY 2A
	TSX CTY 4A
weighing	TSX ISPY 101
NOTE: Motion, communication, safety, and remote X Bus modules are not supported.	

Using Fiber Converter Modules

Introduction

The BMX NRP 020• fiber converter module is an alternative method to using a DRS to provide fiber optic communications in an M580 system.

You can install BMX NRP 020• fiber converter modules on extended local racks and RIO drops to:
- Extend the total length of the M580 network when you have Ethernet RIO drops in separate areas of a factory that are more than 100 m apart.
- Improve noise immunity
- Resolve possible grounding issues when using different grounding methods is required between 2 sites.

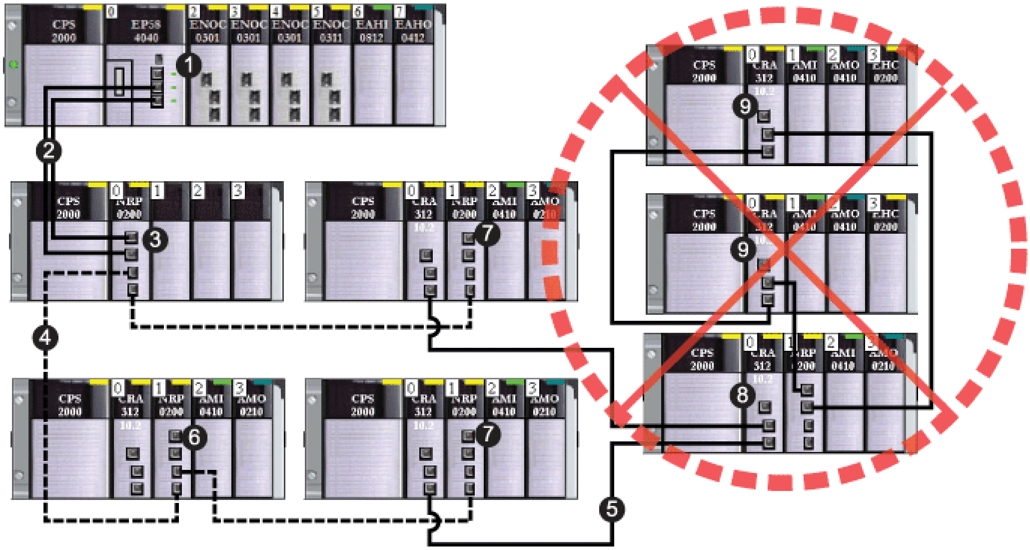
The BMX NRP 0200 has 2 types of fiber modules:

Module	Fiber Type	Use for distances...
BMX NRP 0200	multi-mode	less than 2 km
BMX NRP 0201	single-mode	up to 15 km

NOTE: Confirm that you connect the fiber and copper cable to the correct ports on the BMX NRP 020• module. Refer to the *BMX NRP 020• M340/X80 NRP Module User Guide* for details.

NOTE: You can install BMX NRP 020• modules on the main ring and sub-rings for copper-to-fiber transitions. However, you cannot use these modules to connect sub-rings **to** the main ring.

This figure shows that you cannot use BMX NRP 020• modules to connect sub-rings to the main ring:



- - - - fiber cable
—— copper cable

1 CPU with Ethernet I/O scanner service on the local rack
2 copper connection from the CPU on the local rack to the BMX NRP 0200 module (3) on a Modicon X80 rack
3 BMX NRP 0200 fiber converter module
4 fiber cable used for distances greater than 100 m
5 copper cable used for distances less than 100 m
6 Modicon X80 RIO drop connected to the main ring via fiber cable, using a BMX NRP 0200 module
7 Modicon X80 RIO drops connected to the main ring via copper and fiber cable. BM• CRA 312 •0 X80 EIO adapter modules connect the drops via copper cable, and BMX NRP 0200 modules connect the drops via fiber cable
8 RIO drop connected to the main ring via copper cable, using a BM• CRA 312 •0 X80 EIO adapter module
9 You cannot use a BMX NRP 020• module to connect a sub-ring to the main ring.

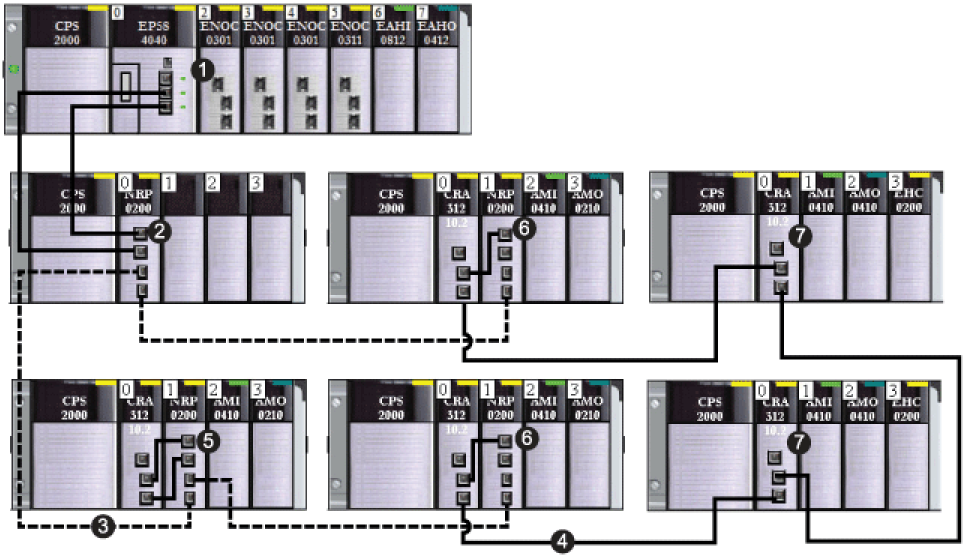
Extending Distance Between the Local Rack and an RIO Drop

The procedures for installing fiber between the local rack and a remote drop were described earlier in this manual *(see page 70)*.

The procedure for installing fiber between contiguous drops in an RIO network are described as well *(see page 70)*.

Interlinking BMX NRP 020• Modules on X Bus Racks

For a system that uses X Bus racks (not Ethernet racks), interlink the copper ports of a BMX NRP 020• module with the Ethernet ports of a BM• CRA 312 •0 X80 EIO adapter module on RIO drops:



- - - - fiber cable

—— copper cable

1 CPU with Ethernet I/O scanner service on the local rack
2 BMX NRP 0200 module on a Modicon X80 rack
3 fiber cable used for distances greater than 100 m
4 copper cable used for distances less than 100 m
5 Modicon X80 RIO drops connected to the main ring via copper and fiber cable. BM• CRA 312 •0 X80 EIO adapter modules connect the drops via copper cable, and BMX NRP 0200 modules connect the drops via fiber cable.
6 Modicon X80 RIO drops connected to the main ring via fiber cable, using a BMX NRP 0200 module
7 Modicon X80 RIO drops connected to the main ring via copper cable

Diagnosing Fiber Converter Modules

To diagnose the BMX NRP 020• fiber converter modules, refer to the *BMX NRP 0200/0201 M340/X80 Fiber Converter Module User Guide*.

Connecting an M580 Device Network to the Control Network

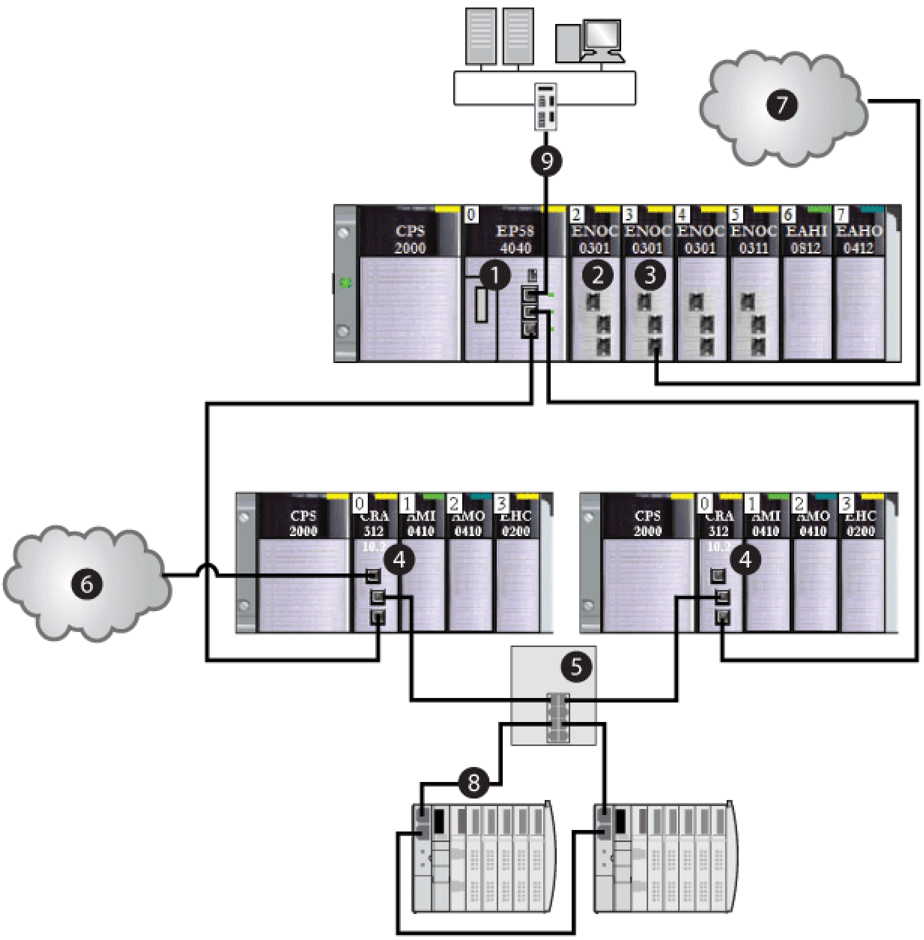
Introduction

Via the service port on a CPU, connect your device network to the control network. The following figure shows a device network connected to a switch on the control network, where a SCADA system can be used to monitor and communicate with the device network.

NOTE:

Do not connect the service ports on different CPUs together through the control network.

- If transparency is needed between a device network and the control network, make the connection with a switch as shown in the following figure.
- If transparency is not needed, use a BME NOC 03•1 Ethernet communication module and configure the module in isolated mode *(see page 76)*.



1 CPU managing RIO (4) within the device network

2 BME NOC 03•1 module (with the Ethernet backplane connection enabled) managing distributed equipment within the device network (6 & 8)

3 BME NOC 03•1 module (with the Ethernet backplane connection disabled) managing the isolated DIO cloud (7)

4 RIO drop on the device network

5 DRS on the device network connecting (8) to the main ring

6 DIO cloud on the device network, connected to the service port of a BM• CRA 312 •0 X80 EIO adapter module

7 DIO cloud managed by (3)

8 DIO sub-ring connected to the main ring via (5)

9 connection from the service port of the CPU (1) to the control network

Chapter 4
DRS Predefined Configuration Files

Overview

This chapter describes how to obtain and apply predefined configuration files provided by Schneider Electric. Use the files to configure ConneXium TCSESM-E extended managed switches to perform as dual-ring switches (DRSs) on M580 main rings and sub-rings.

What Is in This Chapter?

This chapter contains the following topics:

DRS Predefined Configuration Files

Introduction

Schneider Electric provides several predefined configuration files for its 8-port TCSESM-E dual-ring switches (DRSs). You can use these predefined configuration files to quickly apply DRS configuration settings, instead of manually configuring switch properties.

Each configuration is specifically designed for a TCSESM-E DRS with one of these port configurations:
- 8 copper ports (no fiber ports)
- 2 fiber ports, 6 copper ports

Apply a predefined configuration file only to a TCSESM-E DRS that is appropriate for that specific switch.

List of Switches

These 3 ConneXium extended managed switches are currently the only DRSs that can be used in an M580 system.

Part	ConneXium Switch	Ports
TCSESM083F23F1	8TX 1280	• copper (8)
TCSESM063F2CU1	6TX/2FX-MM	• multi-mode fiber (2) • copper (6)
TCSESM063F2CS1	6TX/2FX-SM	• single-mode fiber (2) • copper (6)
NOTE: These 3 switches use firmware version 6.0 or later. **NOTE:** You can achieve up to 2 km with multi-mode fiber cables and up to 15 km with single-mode fiber cables in an M580 system.		

Configuring an 8-Port TCSESM-E Dual-Ring Switch

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING
UNEXPECTED EQUIPMENT BEHAVIOR
Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Upgrading the firmware for a ConneXium extended managed switch removes all predefined configuration file settings

⚠ WARNING
UNEXPECTED EQUIPMENT BEHAVIOR
Re-download the predefined configuration file to the switch before placing a switch with upgraded firmware back in operation.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

When you download a predefined configuration file to a switch, the file provides a set of operating parameters that enable the switch to operate with high efficiency in the specified architecture.

To determine which predefined configuration file you need to download to each DRS in your network, refer to the diagrams later in this topic.

Changing a Predefined Configuration File

Overlaying a second predefined configuration file can damage the configuration file. Not disconnecting the cables that form the loop before you clear the first configuration file can cause a broadcast storm.

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION
Break the loop in the RIO network and delete the original predefined configuration file before downloading a different configuration file.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

If you decide to change a predefined configuration file that you downloaded to a DRS, follow the steps below.

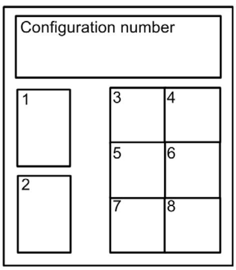
Step	Action
1	Disconnect the cables that form the daisy chain loop in the RIO network. The DRS can remain connected to the loop.
2	Delete the predefined configuration file that you downloaded to the DRS.
3	Download the new predefined configuration file to the DRS.
4	Reconnect the cables to form the daisy chain loop in the RIO network.

DRS Labels

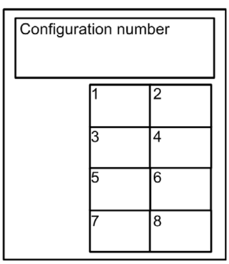
Labels are supplied in the box of the ConneXium extended managed switch. When you determine which predefined configuration you need to download to each DRS, write the respective configuration number on the label and affix to either side of the DRS.

DRS label with fiber/copper ports:

- TCSESM063F2CU1 – 6TX/2FX-MM switch with 2 multi-mode fiber ports and 6 copper ports
- TCSESM063F2CS1 – 6TX/2FX-SM switch with 2 single-mode fiber ports and 6 copper ports

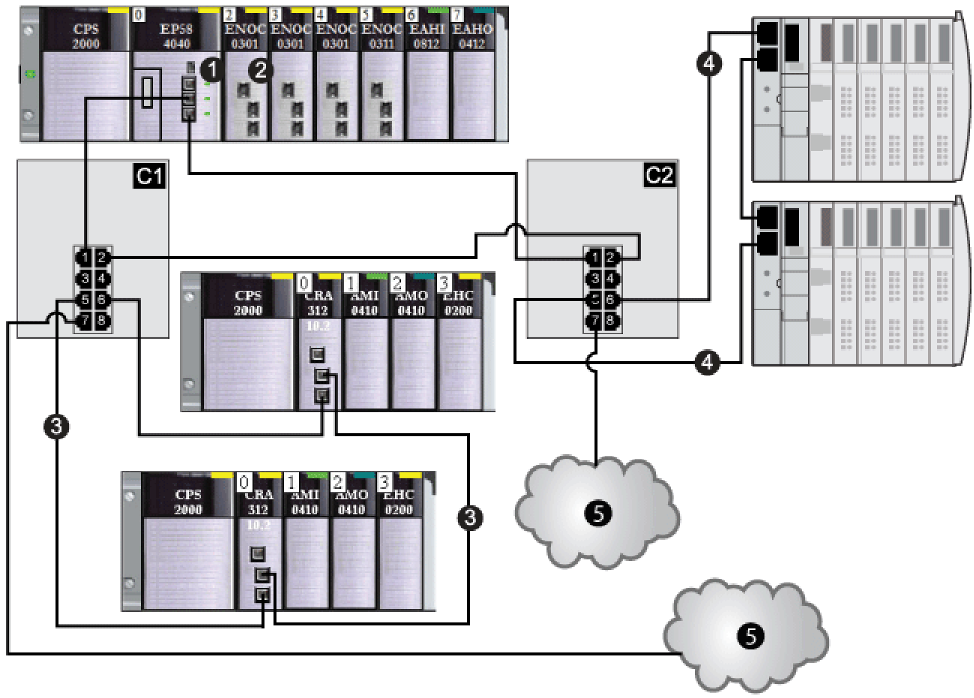


DRS label with copper ports only: TCSESM083F23F1 – 8TX 1280



Copper Main Ring Configurations

Some predefined configuration files let you use a TCSESM-E DRS with 8 copper ports to connect an RIO copper main ring to either an RIO sub-ring or a DIO sub-ring:

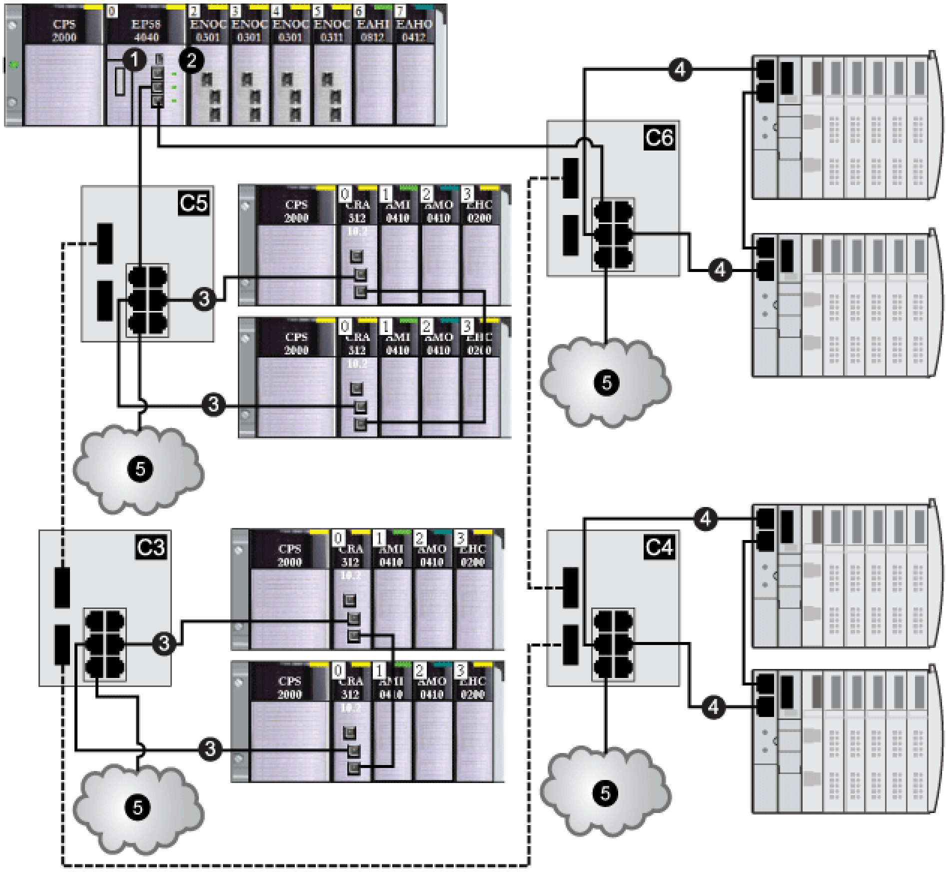


This table describes the switch configurations and the port functionality in the above illustration:

C1	This DRS uses the C1 predefined configuration file for a copper main ring with an RIO sub-ring and DIO clouds *(see page 103)*.
C2	This DRS uses the C2 predefined configuration file for a copper main ring with a DIO sub-ring and DIO clouds *(see page 106)*.
1	CPU with Ethernet I/O scanner service on the local rack
2	BME NOC 03•1 Ethernet communication module
3	RIO sub-ring
4	DIO sub-ring
5	DIO cloud

Fiber Main Ring Configurations

Some predefined configuration files let you use a TCSESM-E DRS with 2 fiber ports and 6 copper ports to connect an RIO copper main ring to either an RIO sub-ring or a DIO sub-ring:



This table describes the switch configurations and the port functionality in the above illustration:

C3	This DRS uses the C3 predefined configuration file for a fiber main ring and copper RIO sub-ring with DIO clouds *(see page 109)*.
C4	This DRS uses the C4 predefined configuration file for a fiber main ring and copper DIO sub-ring with DIO clouds *(see page 112)*.
C5	This DRS uses the C5 predefined configuration file for fiber/copper main ring connections and an RIO sub-ring with DIO clouds *(see page 116)*.
C6	This DRS uses the C6 predefined configuration file for fiber/copper main ring connections and a DIO sub-ring with DIO clouds *(see page 121)*.

1	CPU with Ethernet I/O scanner service on the local rack
2	BME NOC 03•1 module
3	RIO sub-ring
4	DIO sub-ring
5	DIO cloud

Main Ring / Sub-Ring Redundant Connections

Use 2 DRSs (one installed with a *master* predefined configuration and the other installed with a corresponding *slave* predefined configuration) to provide a redundant connection between the main ring and the sub-ring. The *master* DRS passes data between the main ring and the sub-ring. If the *master* DRS becomes inoperable, the *slave* DRS takes control and passes data between the main ring and the sub-ring.

NOTE: Do not connect devices between the master and slave DRS. Connect at least 1 operating link between the master and slave DRS for the redundant connections to function properly.

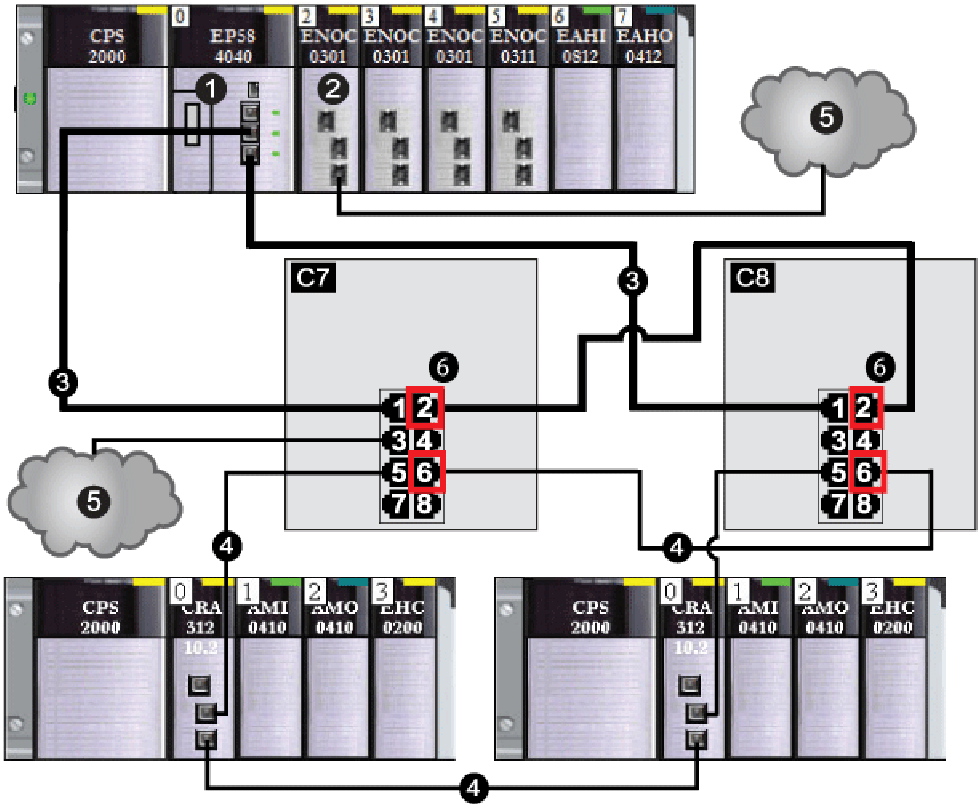
NOTE:

DRS **inner ports** are the 2 ports on the switch that are connected to the main ring. When using 2 DRSs, connect the designated master inner ports to the designated slave inner ports.

- For copper port master and slave DRS redundant configurations, the inner ports (port 2) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.
- For copper/fiber port master and slave DRS redundant configurations, the inner ports (port 3) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.

NOTE: If you are using a single DRS but plan to convert to redundant configurations in the future, record these port configurations to reduce the number of any schematic changes required because of the conversion.

This figure shows 2 DRSs that create a redundant connection between the main ring and the RIO sub-ring:



- Connect the inner port 2 on the master and slave DRSs to each other. (Port 1 on both DRSs form the main ring.)
- Connect the inner port 6 on the master and slave DRSs to each other. (Port 5 on both DRSs form the sub-ring.)

This table describes the switch configurations and the port functionality in the above illustration:

C7	A master DRS uses a C7 predefined configuration file for redundancy between the main ring and an RIO sub-ring (with non-redundant connections to DIO clouds) *(see page 124)*.
C8	A slave DRS uses a C8 predefined configuration file for redundancy between the main ring and an RIO sub-ring (with non-redundant connections to DIO clouds) *(see page 127)*.
1	CPU with Ethernet I/O scanner service on the local rack
2	BME NOC 03•1 module
3	main ring

4	RIO sub-ring
5	DIO cloud
6	4 inner ports (ports 2 for main ring, ports 6 for sub-ring)

NOTE: A BME NOC 03•1 module can support distributed equipment via its Ethernet backplane connection to the CPU and via its device network port(s) on the front panel, respecting the limitation of 128 devices scanned per BME NOC 03•1 module.

Comparison of Master/Slave Configuration and Auto Configuration

In the DRS web pages, you can select one of the following configurations:

- In a *master/slave configuration*, if the master loses communication, the slave assumes the primary role. When the master regains communication, it resumes the primary role, and the slave resumes its standby role.
- In an *auto configuration*, if the master loses communication, the slave assumes the primary role. When the master regains communication, it does not resume its primary role. The slave continues acting as the primary DRS, and the master acts as the standby.

NOTE: In the event that both the master and slave DRSs lose communication and only the slave regains communication after a reboot, the slave,whether it has a master/slave or an auto configuration, is in a blocking state. The blocking state only changes to forwarding if the master DRS regains communication and its configuration is detected on at least one inner port.

Port Mirroring

In every predefined configuration, port 8 is reserved for port mirroring. Port mirroring lets you troubleshoot the transmissions sent over selected ports by copying the traffic that passes through these ports and sending the copied transmission to port 8, where you can examine the copied packets.

When using port mirroring, select the port(s), for which you want to analyze the traffic, as the source port(s) in the switch's port mirror web page. Select port 8 as the destination port, and enable port mirroring.

NOTE: The default configuration of port 8 has port mirroring disabled.

NOTE: Port mirroring does not affect the normal forwarding behavior of the mirrored ports.

To troubleshoot the selected ports, attach a PC with packet sniffing software to port 8 to analyze the mirrored traffic. When you finish troubleshooting, disable port mirroring.

Replacing a DRS Predefined Configuration File

If you decide to change a predefined configuration file that you downloaded to a DRS, follow the steps below:

Step	Action
1	Disconnect the cables that connect the DRS to the daisy chain loop.
2	Delete the predefined configuration file that you downloaded to the DRS.
3	Download the new predefined configuration file to the DRS.
4	Reconnect the cables to the DRS and the daisy chain loop.

NOTE: If you download a predefined configuration file to a DRS that has a previously loaded configuration file, the DRS may become inoperable.

NOTE: If you delete the predefined configuration file from the DRS before you disconnect the cables that connect the DRS to the daisy chain loop, a broadcast storm may occur.

C1: Copper RIO Main Ring and RIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C1_RIOMainRing_RIOSubRing_DIOCloudsVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Predefined Configuration

One of the many advantages of using the M580 architecture is to put some or all of your RIO drops on sub-rings. The RIO drops on the sub-rings are controlled by the PLC on the main ring the same way as RIO drops connected directly to the main ring. The sub-ring architecture lets you extend the distance between consecutive RIO drops and isolate the devices and cables on a sub-ring from those on the main ring and on other sub-rings.

Devices Supported and Restricted in this Predefined Configuration

The DRS predefined configuration described here is for a TCSESM083F23F1 ConneXium extended managed switch, which has 8 copper connection ports and no fiber port connections.

An RIO sub-ring can contain only approved Schneider Electric RIO modules, for example an RIO adapter in an M580 RIO drop.

Distributed equipment, such as TeSys T motor devices and islands of STB devices, can be connected to switch ports that are not reserved for main ring and RIO sub-ring connections. Each cloud uses only one DRS port connection. You cannot use this predefined configuration to connect distributed equipment directly on the sub-ring.

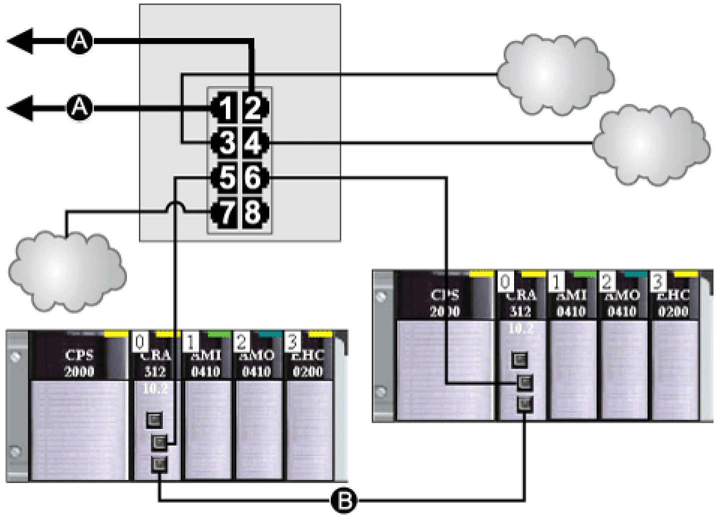
Predefined Port Connections

Use the 2 top ports (shown as 1 and 2 below) for connections on the main ring (A). Use ports 5 and 6 to connect the main ring to an RIO sub-ring (B).

Ports 3, 4, and 7 are configured for connecting DIO clouds to the network. Port 8 is reserved for port mirroring *(see page 101)* (to monitor the status of ports you previously selected in the switch's port mirror web page).

NOTE: The default configuration of port 8 has port mirroring disabled.

Example:



A DRS connections to the main ring
B RIO sub-ring connection

This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	100Base-TX	copper main ring connection
2	100Base-TX	copper main ring connection
3	100Base-TX	DIO cloud connection
4	100Base-TX	DIO cloud connection
5	100Base-TX	copper RIO sub-ring connection
6	100Base-TX	copper RIO sub-ring connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

C2: Copper RIO Main Ring and DIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C2_RIOMainRing_DIOSubRing_DIOCloudsVx.xx.cfg`, where *Vx.xx* references the version number of the file.

Use of this Predefined Configuration

In some applications, DIO clouds may not provide sufficient cable redundancy. With an M580 network, you can deploy distributed equipment in a way that takes advantage of the redundant cabling architecture. The following DRS predefined configuration enables you to support distributed equipment on sub-rings. A DIO sub-ring restores communications in the event of a broken wire or inoperable device on the sub-ring.

NOTE: Each DRS applies a lower priority to distributed equipment, and handles packets from an RIO network before handling packets relating to distributed equipment.

Devices Supported by this Predefined Configuration

The DRS predefined configuration described here is for a TCSESM083F23F1 ConneXium extended managed switch, which has 8 copper connection ports and no fiber ports.

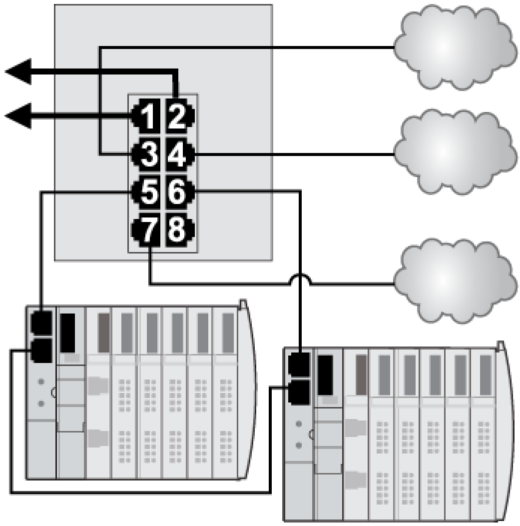
You cannot use RIO modules in a DIO sub-ring. Only distributed equipment with a dual-port embedded Ethernet switch and RSTP protocol support can be used. (In this manual, distributed equipment are represented by Modicon STB islands with STB NIP 2311 network interface modules.)

Predefined Port Connections

Use the 2 top ports (shown as 1 and 2 below) for the main ring connections. Use ports 5 and 6 to connect the DIO sub-ring to the main ring.

Ports 3, 4, and 7 can be used to connect DIO clouds to the M580 system. Port 8 is reserved for port mirroring *(see page 101)*, i.e., for monitoring the status of the ports you previously selected in the switch's port mirror web page.

NOTE: The default configuration of port 8 has port mirroring disabled.



This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	100Base-TX	copper main ring connection
2	100Base-TX	copper main ring connection
3	100Base-TX	DIO cloud connection
4	100Base-TX	DIO cloud connection
5	100Base-TX	copper DIO sub-ring connection
6	100Base-TX	copper DIO sub-ring connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

C3: Fiber RIO Main Ring and Copper RIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C3_RIOMainRingFX_DIOSubRingTX_DIOCloudsVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Predefined Configuration

In some applications, long distances (up to 15 km) may exist between consecutive RIO devices on an M580 network. You can span these distances using single-mode or multi-mode fiber optic cable on the main ring of your network.

The relationship between the main ring and the RIO sub-rings is essentially the same as with only copper connections *(see page 103)*, with 2 key differences:

- the type of cable used on part of the main ring
- the type(s) of DRS(s) that you use to make the fiber connections

Devices Supported by this Predefined Configuration

The predefined configuration described here can be used with a DRS that supports either single-mode or multi-mode fiber cables.

- A TCSESM063F2CU1 ConneXium extended dual ring switch has 2 ports that support multi-mode fiber.
- A TCSESM063F2CS1 ConneXium extended dual ring switch has 2 ports that support single-mode fiber.

Both switches have 6 ports that support copper connections. Fiber cable can be used only on the main ring, not on the sub-rings.

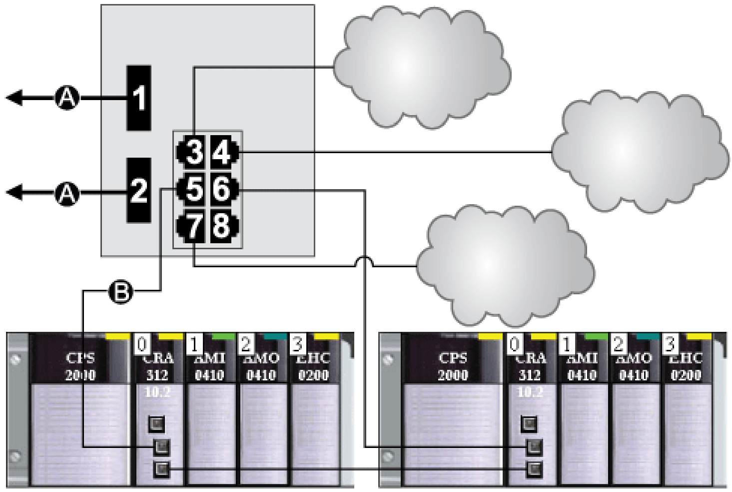
With single-mode fiber cable, you can achieve distances up to 15 km on the main ring. With multi-mode fiber cable, you can achieve distances up to 2 km.

Predefined Port Connections

For this predefined configuration, use the 2 fiber ports (ports 1 and 2) for the main ring (A) connections. Use the middle 2 copper ports (ports 5 and 6) to connect an RIO sub-ring (B) to the main ring. The sub-ring can contain only approved RIO modules. No distributed equipment is used in either the main ring or the sub-ring.

Ports 3, 4, and 7 on the DRS are available for additional optional connections, and can be used to connect DIO clouds to the M580 system. Port 8 is reserved for port mirroring *(see page 101)*, i.e., for monitoring the status of the ports you previously selected in the switch’s port mirror web page.

NOTE: The default configuration of port 8 has port mirroring disabled.



A main ring with 2 fiber connections (ports 1 and 2)
B RIO sub-ring with two copper connections (ports 5 and 6) to some M580 RIO drops

This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	FX	fiber main ring connection
2	FX	fiber main ring connection
3	100Base-TX	DIO cloud connection
4	100Base-TX	DIO cloud connection
5	100Base-TX	copper RIO sub-ring connection
6	100Base-TX	copper RIO sub-ring connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

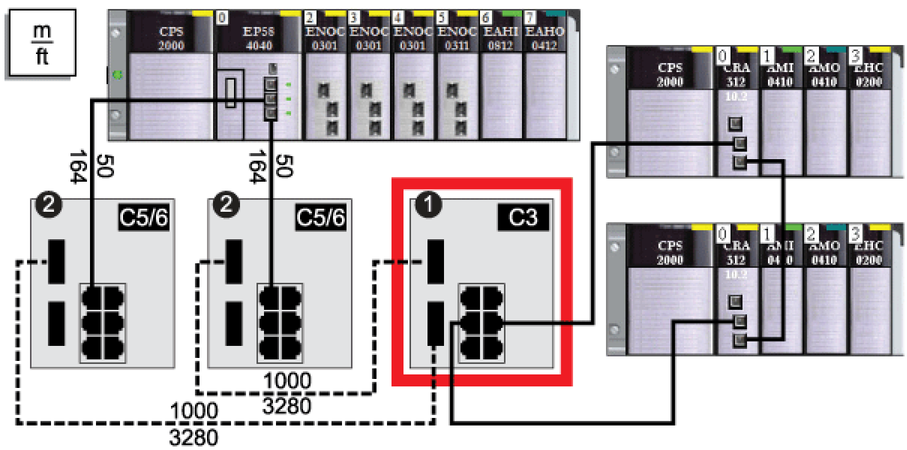
Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Supporting Fiber Links on the Main Ring

RIO devices in the main ring often do not come equipped with fiber connectors. Therefore, some part of the main ring requires copper cable. This predefined configuration is usually implemented with at least 2 other DRSs configured to support 1 fiber and 1 copper connection to the main ring *(see page 116)*.

In this example, the dashed line represents fiber cable and the solid line represents copper wire:



1 A DRS with a C3 predefined configuration file uses 2 fiber ports that support the main ring and 2 copper ports that support an RIO sub-ring.
2 Two DRS with C5 or C6 predefined configuration files use 1 fiber port to support copper-to-fiber and fiber-to-copper transitions. They enable a fiber-based network to connect to the copper ports on the CPU with Ethernet I/O scanner service in the local rack.

The DRS at location (1) uses this predefined configuration. The 2 DRSs at location 2 use a different predefined configuration *(see page 116)*.

NOTE: You can also use BMX NRP 020• fiber converter modules *(see page 88)* instead of the 2 DRSs shown as #2 in the previous illustration.

C4: Fiber RIO Main Ring and Copper DIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C4_RIOMainRingFx_DIOSubRingTx_DIOCloudsVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Predefined Configuration

In some applications, you may need to install distributed equipment a long distance (up to 15 km) from other devices on an M580 network. In other cases, the operating environment may require less susceptibility to electromagnetic interference (EMI) than a copper wire connection can provide. You can meet these needs by using single-mode or multi-mode fiber optic cable on the main ring of your network.

The relationship between the main ring and a DIO sub-ring is essentially the same as with only copper connections *(see page 106)*, with 2 key differences:
- the type of cable used to connect the DRS to the main ring
- the type(s) of DRS you use

Devices Supported by this Predefined Configuration

The predefined configuration described here can be used with a DRS that supports either single-mode or multi-mode fiber cable:
- A TCSESM063F2CU1 ConneXium extended managed switch has 2 ports that support multi-mode fiber cable.
- A TCSESM063F2CS1 ConneXium extended managed switch has 2 ports that support single-mode fiber cable.

Both switches have 6 copper connections. Fiber cable can be used only on the main ring, not on the sub-rings.

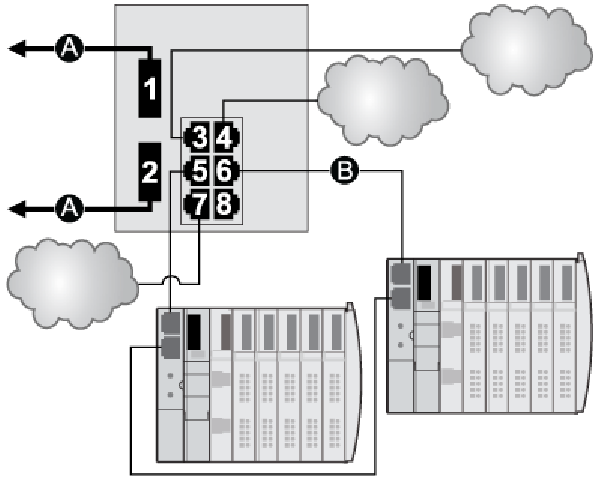
With single-mode fiber cable, you can achieve distances on the main ring up to 15 km. With multi-mode fiber cable, you can achieve distances up to 2 km.

Predefined Port Connections

For this configuration, use the 2 fiber ports (labeled ports 1 and 2) for the main ring (A) connections. Use the 2 middle copper ports (labeled ports 5 and 6) to connect a DIO sub-ring (B) to the main ring.

Ports 3, 4, and 7 on the DRS are available for additional optional connections, and can be used to connect DIO clouds to the M580 system. Port 8 is reserved for port mirroring *(see page 101)*, i.e., for monitoring the status of the ports you previously selected in the switch's port mirror web page.

NOTE: The default configuration of port 8 has port mirroring disabled.



A main ring (with 2 fiber connections)
B DIO sub-ring (with 2 copper connections to some STB islands)

This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	FX	fiber main ring connection
2	FX	fiber main ring connection
3	100Base-TX	DIO cloud connection
4	100Base-TX	DIO cloud connection
5	100Base-TX	copper DIO sub-ring connection
6	100Base-TX	copper DIO sub-ring connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

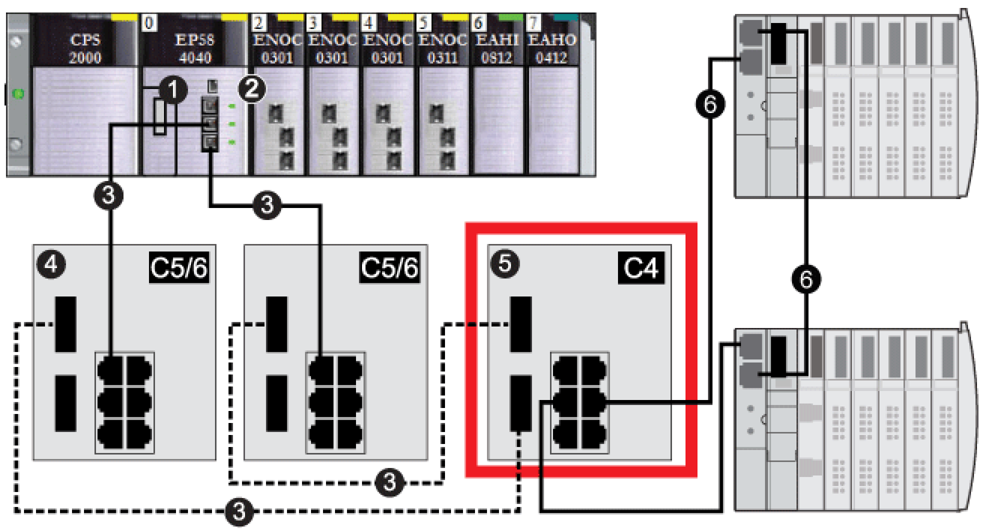
Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Supporting Fiber Links on the Main Ring

RIO devices in the main ring often do not come equipped with fiber connectors. Therefore, some part of the main ring requires copper cable. A switch with an all-fiber main-ring predefined configuration (for example, DRS number 4 in the following diagrams) is usually implemented together with 2 other DRSs (3, below) each of which is configured to support 1 fiber connection and 1 copper connection to the main ring *(see page 121)*.

Connect the DRS directly to the CPU in the local rack:



NOTE: The dashed line represents fiber cable, and the solid line represents copper wire.

1 CPU with Ethernet I/O scanner service on the local rack
2 BME NOC 03•1 Ethernet communication module
3 copper/fiber main ring
4 two DRSs with C5 or C6 predefined configuration files are configured to use only 1 fiber port to support copper-to-fiber or fiber-to-copper transitions.
5 DRS with a C4 predefined configuration file uses 2 fiber ports that support the RIOmain ring and 2 copper ports that support a DIO sub-ring.
6 DIO sub-ring with two STB islands

NOTE: You can also use BMX NRP 020• fiber converter modules *(see page 88)* instead of the two DRSs shown as #4 in the previous illustration.

NOTE: A BME NOC 03•1 module can support distributed equipment via its Ethernet backplane connection to the CPU **and** via its device network port(s) on the front panel, respecting the limitation of 128 devices scanned per BME NOC 03•1 module.

C5: Copper/Fiber Main Ring Connections and RIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C5_RIOMainRingFxTx_RIOSubRingTx_DIOCloudsVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Predefined Configuration

Common uses of this predefined configuration are to transition from a copper cable to a fiber cable on the main ring or to transition back from fiber to copper. An alternative use is to provide a long-haul return path for a basically copper network where the last RIO drop or RIO sub-ring in the daisy chain is far away from the local rack.

In any of the above scenarios, this predefined configuration allows you the opportunity to install an RIO sub-ring and/or some DIO clouds on the DRS you are configuring.

Devices Supported by this Predefined Configuration

The DRS predefined configuration described here can be used with either of 2 switch types:

- A TCSESM063F2CU1 ConneXium extended managed switch, which supports multi-mode fiber cable
- A TCSESM063F2CS1 ConneXium extended managed switch, which supports single-mode fiber cable

Both switches have 2 fiber ports and 6 copper ports.

With single-mode fiber cable, you can achieve distances on the main ring up to 15 km. With multi-mode fiber cable, you can achieve distances up to 2 km.

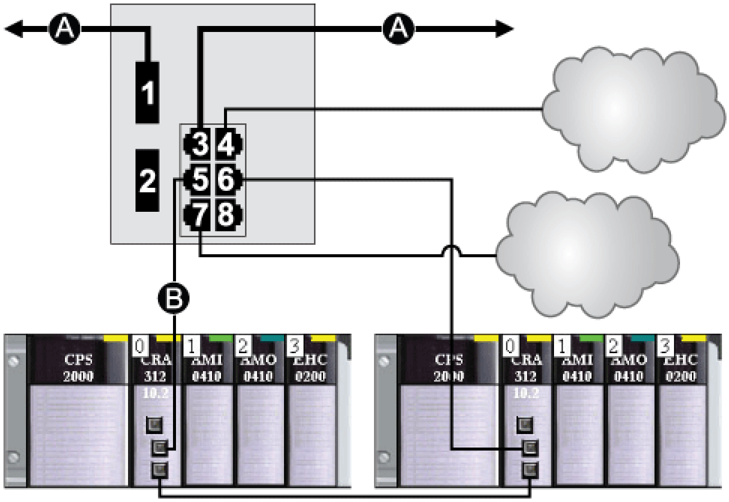
Predefined Port Connections

The top fiber port (labeled 1 in the following figure) makes the connection to the fiber cable on the main ring (A). The other fiber port (port 2) is disabled in this predefined configuration; do not connect to this port.

The top left copper port (port 3) makes the connection to the copper cable on the main ring (A). Copper ports 5 and 6 are used to connect to the RIO sub-ring (B).

Ports 4 and 7 on the DRS are available for additional optional connections, and can be used to connect DIO clouds to the M580 system. Port 8 is reserved for port mirroring *(see page 101)*, i.e., for monitoring the status of the ports you previously selected in the switch's port mirror web page.

NOTE: The default configuration of port 8 has port mirroring disabled.



A main ring (with copper/fiber connections)
B RIO sub-ring

This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	FX	fiber main ring connection
3	100Base-TX	copper main ring connection
2	FX	disabled fiber port; do not use
4	100Base-TX	DIO cloud connection
5	100Base-TX	RIO sub-ring connection
6	100Base-TX	RIO sub-ring connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

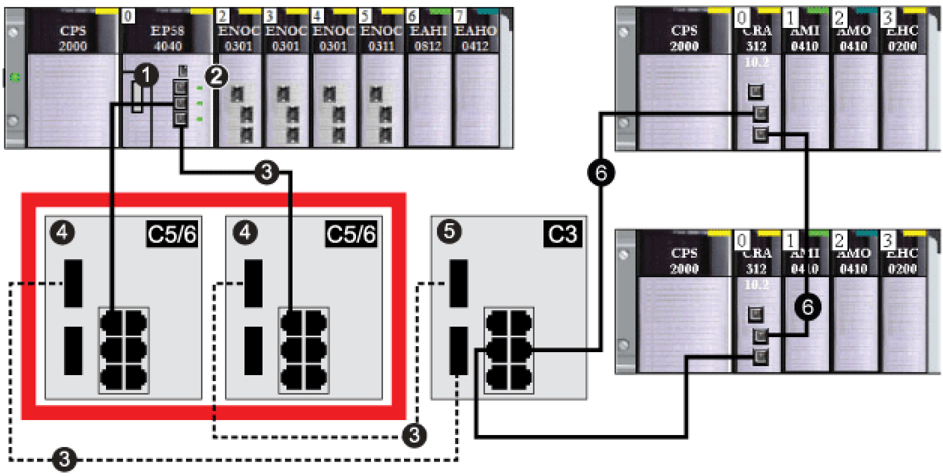
Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Supporting the Fiber-to-Copper Transition on the Main Ring

RIO devices in the main ring often do not come equipped with fiber connectors. Therefore, some part of the main ring requires copper cable. Typically, 2 DRSs are each configured to support 1 fiber and 1 copper connection to the main ring.

Connect the DRS directly to the CPU in the local rack:



1 CPU with Ethernet I/O scanner service on the local rack
2 BME NOC 03•1 Ethernet communication module
3 copper/fiber main ring
4 two DRSs with a C5 or C6 predefined configuration file that use only 1 fiber port to support copper-to-fiber or fiber-to-copper transitions
5 DRS with a C3 predefined configuration file that uses both of the main ring fiber ports and both of the RIO sub-ring copper ports
6 RIO sub-ring

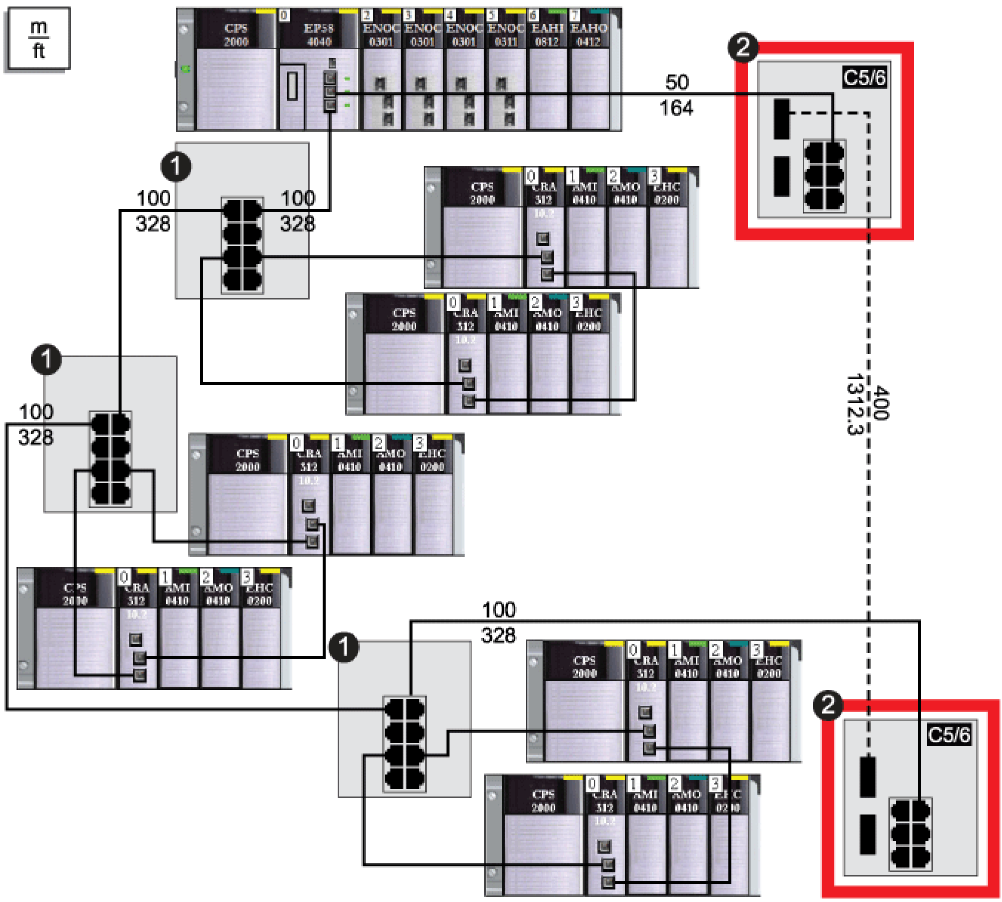
NOTE: You can also use BMX NRP 020• fiber converter modules *(see page 88)* instead of the two DRSs shown as #4 in the previous illustration.

NOTE: A BME NOC 03•1 module can support distributed equipment via its Ethernet backplane connection to the CPU **and** via its device network port(s) on the front panel, respecting the limitation of 128 devices scanned per BME NOC 03•1 module.

A Long-Haul Return Path

Suppose your application calls for several RIO drops. The distance between the first drop and local rack is no more than 100 m, and the distance between consecutive RIO drops is not more than 100 m. The overall distance between the CPU and the last drop, however, is significantly more than 100 m, for example, a distance of 400 m from the local rack.

In this case, you may be able to get the distance you need using less expensive copper connections on the front end of the high capacity daisy chain, and then closing the loop with 1 fiber optic connection:



1 These 3 DRSs are configured for a copper main ring and a copper sub-ring.

2 These 2 DRSs have C5 or C6 predefined configuration files to facilitate a fiber-to-copper transition on the main ring.

NOTE: You can also use BMX NRP 020• fiber converter modules *(see page 88)* instead of the 2 DRSs (2 in the previous figure).

C6: Copper/Fiber Main Ring Connections and DIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C6_RIOMainRingFxTx_DIOSubRingTx_DIOCloudsVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Predefined Configuration

With this predefined configuration downloaded, a DRS can be used to make the transition from copper to fiber or back to copper from fiber on the main ring. The switch can also support a DIO sub-ring.

NOTE: Each DRS applies a lower priority to distributed equipment, and handles packets from an RIO network before handling packets relating to distributed equipment.

Devices Supported by this Predefined Configuration

Distributed equipment includes an embedded dual-port Ethernet switch and supports the RSTP protocol. (In this manual, Modicon STB islands with STB NIP 2311 network interface modules are used for illustration.)

The predefined configuration described here can be used with either of 2 DRS types:

- A TCSESM063F2CU1 ConneXium extended managed switch, which supports multi-mode fiber cable
- A TCSESM063F2CS1 ConneXium extended managed switch, which supports single-mode fiber cable

Both switches have 2 fiber ports and 6 copper ports.

With single-mode fiber cable, you can achieve distances on the main ring up to 15 km. With multi-mode fiber cable, you can achieve distances up to 2 km.

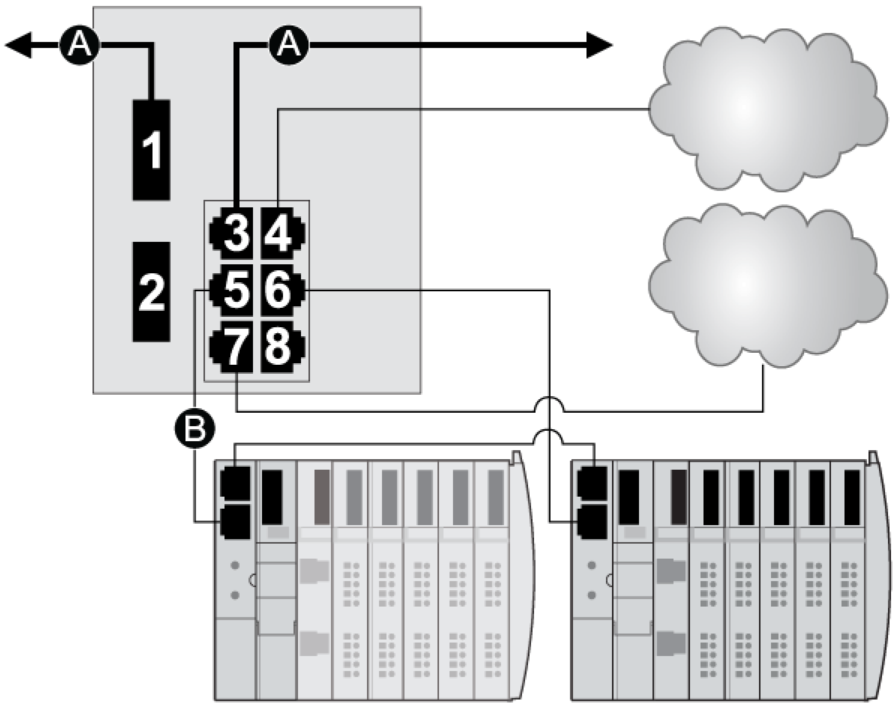
Port Connections

The top fiber port (port 1 in the following graphic) makes the connection to the fiber cable on the main ring (A). The other fiber port (port 2) is disabled; do not connect to this port.

The top left copper port (port 3) makes the connection to the copper cable on the main ring (A). Copper ports 5 and 6 are used to connect to the DIO sub-ring (B).

Ports 4 and 7 can be used for other purposes. Port 8 is reserved for port mirroring *(see page 101)*, i.e., for monitoring the status of the ports you previously selected in the switch's port mirror web page.

NOTE: The default configuration of port 8 has port mirroring disabled.



A main ring (with copper/fiber connections)
B DIO sub-ring

This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	FX	fiber main ring connection
3	100Base-TX	copper main ring connection
2	FX	disabled fiber port; do not use
4	100Base-TX	DIO cloud connection
5	100Base-TX	DIO sub-ring connection
6	100Base-TX	DIO sub-ring connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

C7: Master Copper RIO Main Ring and RIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C7_Master_RIOMainRing_RIOSubRing_DIOCloudsVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Predefined Configuration

One of the many advantages of using the M580 architecture is to put some or all of your RIO drops on sub-rings. The RIO drops on the sub-rings are controlled by the PLC on the main ring the same way as RIO drops connected directly to the main ring. The sub-ring architecture lets you extend the distance between consecutive RIO drops and isolate the devices and cables on a sub-ring from those on the main ring and on other sub-rings.

With this predefined configuration, use 2 DRSs — one installed with this *master* predefined configuration and the other installed with the corresponding *slave* predefined configuration (C8 *(see page 127)*) — to provide a redundant connection between the main ring and the sub-ring. The *master* DRS passes data between the main ring and the RIO sub-ring. If the *master* DRS becomes inoperable, the *slave* DRS takes control and passes data between the main ring and the RIO sub-ring.

NOTE: When a master slave becomes inoperable, a slave DRS assumes the primary role in less than 50 ms. Refer to the *Comparison of Master/Slave Configuration and Auto Configuration* topic to determine what roles the master and slave DRSs resume if the master DRS becomes operational again.

NOTE:

DRS **inner ports** are the 2 ports on the switch that are connected to the main ring. When using 2 DRSs, connect the designated master inner ports to the designated slave inner ports.

- For copper port master and slave DRS redundant configurations, the inner ports (port 2) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.
- For copper/fiber port master and slave DRS redundant configurations, the inner ports (port 3) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.

NOTE: If you are using a single DRS but plan to convert to redundant configurations in the future, record these port configurations to reduce the number of any schematic changes required because of the conversion.

Devices Supported and Restricted in this Predefined Configuration

The DRS predefined configuration described here is for a TCSESM083F23F1 ConneXium extended managed switch, which has 8 copper connection ports and no fiber port connections.

An RIO sub-ring can contain only approved Schneider Electric RIO modules.

Distributed equipment, such as TeSys T motor drives and islands of STB devices, can be connected to switch ports that are not reserved for main ring and RIO sub-ring connections. Each cloud uses only one DRS port connection. You cannot use this predefined configuration to connect distributed equipment directly on the sub-ring.

You cannot use a redundant pair of DRSs to connect a sub-ring to another sub-ring.

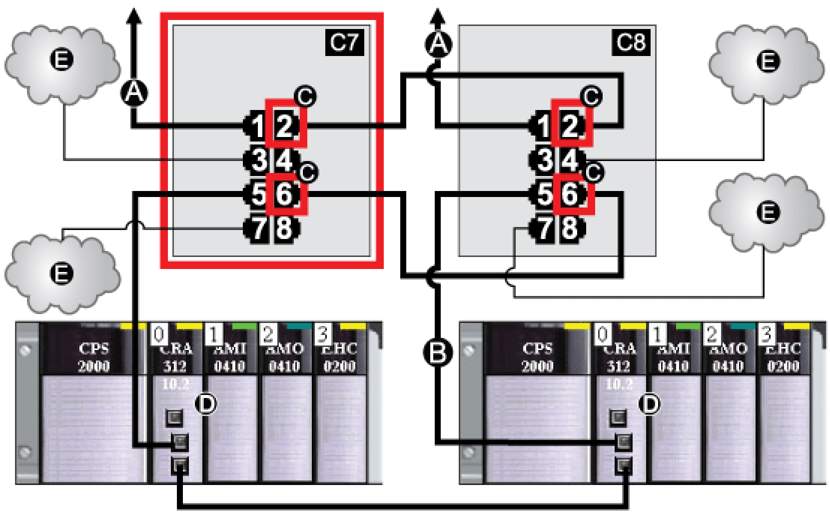
Do not connect any devices between the *master* DRSs and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other — within 100 m.

Predefined Port Connections

Use the 2 top ports (shown as 1 and 2 in the following graphic) for main ring (A) redundant connections. Use ports 5 and 6 for the RIO sub-ring (B) redundant connections.

Ports 3, 4, and 7 are configured for connecting DIO clouds to the network. Port 8 is reserved for port mirroring *(see page 101)* (to monitor the status of the ports you previously selected in the switch's port mirror web page).

NOTE: The default configuration of port 8 has port mirroring disabled.



C7 This master DRS uses a C7 predefined configuration file to act as the primary redundant connection between the main ring and the RIO sub-ring.

C8 This slave DRS uses a C8 predefined configuration file to act as the standby redundant connection between the main ring and the RIO sub-ring.

A DRS connection to the main ring

B DRS connection to the RIO sub-ring

C DRS inner ports (The master and slave DRSs are linked together through ports 2 and 6. Ports 1 are linked to the main ring, and ports 5 are linked to the sub-rinig.)

D These RIO drops have BM• CRA 312 •0 X80 EIO adapter modules.

E DIO clouds

This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	100Base-TX	copper main ring redundant connection
2	100Base-TX	copper main ring redundant connection
3	100Base-TX	DIO cloud connection
4	100Base-TX	DIO cloud connection
5	100Base-TX	copper RIO sub-ring redundant connection
6	100Base-TX	copper RIO sub-ring redundant connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

C8: Slave Copper RIO Main Ring and RIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C8_Slave_RIOMainRing_RIOSubRing_DIOCloudsVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Predefined Configuration

One of the many advantages of using the M580 architecture is to put some or all of your RIO drops on sub-rings. The RIO drops on the sub-rings are controlled by the CPU on the main ring the same way as RIO drops connected directly to the main ring. The sub-ring architecture lets you extend the distance between consecutive RIO drops and isolate the devices and cables on a sub-ring from those on the main ring and on other sub-rings.

With this predefined configuration, use 2 DRSs — one installed with this *slave* predefined configuration and the other installed with the corresponding *master* predefined configuration (C7 *(see page 124)*) — to provide a redundant connection between the main ring and the RIO sub-ring. If the *master* DRS becomes inoperable, the *slave* DRS takes control and passes data between the main ring and the RIO sub-ring.

NOTE: When a master slave becomes inoperable, a slave DRS assumes the primary role in less than 50 ms. Refer to the *Comparison of Master/Slave Configuration and Auto Configuration* topic to determine what roles the master and slave DRSs resume if the master DRS becomes operational again.

NOTE:

DRS **inner ports** are the 2 ports on the switch that are connected to the main ring. When using 2 DRSs, connect the designated master inner ports to the designated slave inner ports.

- For copper port master and slave DRS redundant configurations, the inner ports (port 2) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.
- For copper/fiber port master and slave DRS redundant configurations, the inner ports (port 3) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.

NOTE: If you are using a single DRS but plan to convert to redundant configurations in the future, record these port configurations to reduce the number of any schematic changes required because of the conversion.

Devices Supported and Restricted in this Predefined Configuration

The DRS predefined configuration described here is for a TCSESM083F23F1 ConneXium extended managed switch, which has 8 copper connection ports and no fiber port connections.

An RIO sub-ring can contain only approved Schneider Electric RIO modules.

Distributed equipment, such as TeSys T motor drives and islands of STB devices, can be connected to switch ports that are not reserved for main ring and RIO sub-ring connections. Each cloud uses only one DRS port connection. You cannot use this predefined configuration to connect distributed equipment directly on the sub-ring.

You cannot use a redundant pair of DRSs to connect a sub-ring to another sub-ring.

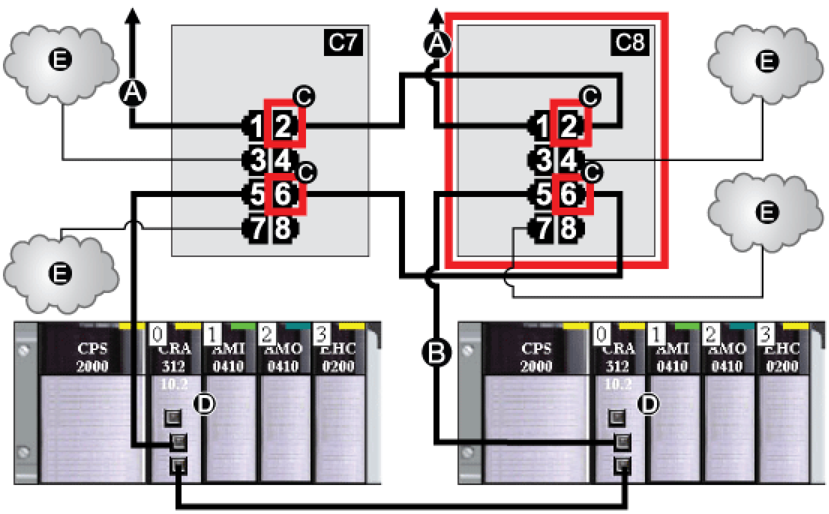
Do not connect any devices between the *master* DRS and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other — within 100 m.

Predefined Port Connections

Use the 2 top ports (shown as 1 and 2 in the following graphic) for main ring (A) redundant connections. Use ports 5 and 6 for the RIO sub-ring (B) redundant connections.

Ports 3, 4, and 7 are configured for connecting DIO clouds to the network. Port 8 is reserved for port mirroring *(see page 101)*: i.e., for monitoring the status of the ports you previously selected in the switch's port mirror web page.

NOTE: The default configuration of port 8 has port mirroring disabled.



C7 This master DRS uses a C7 predefined configuration file to act as the primary redundant connection between the main ring and the RIO sub-ring.
C8 This slave DRS uses a C8 predefined configuration file to act as the standby redundant connection between the main ring and the RIO sub-ring.
A DRS connection to the main ring
B DRS connection to the RIO sub-ring
C DRS inner ports (The master and slave DRSs are linked together through ports 2 and 6. Ports 1 are linked to the main ring, and ports 5 are linked to the sub-ring.)
D These RIO drops have BM• CRA 312 •0 X80 EIO adapter modules.
E DIO clouds

This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	100Base-TX	copper main ring redundant connection
2	100Base-TX	copper main ring redundant connection
3	100Base-TX	DIO cloud connection
4	100Base-TX	DIO cloud connection
5	100Base-TX	copper RIO sub-ring redundant connection
6	100Base-TX	copper RIO sub-ring redundant connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

C9: Master Copper RIO Main Ring and DIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C9_Master_RIOMainRing_DIOSubRing_DIOCloudsVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Predefined Configuration

In some applications, DIO clouds may not provide sufficient cable redundancy. With an M580 network, you can deploy distributed equipment in a way that takes advantage of the redundant cabling architecture. The following DRS predefined configuration enables you to support distributed equipment on sub-rings. A DIO sub-ring restores communications in the event of a broken wire or inoperable device on the sub-ring.

With this predefined configuration, use 2 DRSs — one installed with this *master* predefined configuration and the other installed with the corresponding *slave* predefined configuration (C10 (*see page 133*)) — to provide a redundant connection between the main ring and the DIO sub-ring. The *master* DRS passes data between the main ring and the DIO sub-ring. If the *master* DRS becomes inoperable, the *slave* DRS takes control and passes data between the main ring and the DIO sub-ring.

NOTE: When a master slave becomes inoperable, a slave DRS assumes the primary role in less than 50 ms. Refer to the *Comparison of Master/Slave Configuration and Auto Configuration* topic to determine what roles the master and slave DRSs resume if the master DRS becomes operational again.

NOTE:

DRS **inner ports** are the 2 ports on the switch that are connected to the main ring. When using 2 DRSs, connect the designated master inner ports to the designated slave inner ports.

- For copper port master and slave DRS redundant configurations, the inner ports (port 2) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.
- For copper/fiber port master and slave DRS redundant configurations, the inner ports (port 3) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.

NOTE: If you are using a single DRS but plan to convert to redundant configurations in the future, record these port configurations to reduce the number of any schematic changes required because of the conversion.

NOTE: Each DRS applies a lower priority to distributed equipment, and handles packets from an RIO network before handling packets relating to distributed equipment.

Devices Supported by this Predefined Configuration

The DRS predefined configuration described here is for a TCSESM083F23F1 ConneXium extended managed switch, which has 8 copper connection ports and no fiber ports.

You cannot use RIO modules in a DIO sub-ring. Only distributed equipment with a dual-port embedded Ethernet switch and RSTP protocol support can be used. (In this manual, distributed equipment is represented by STB islands with STB NIP 2311 network interface modules.)

You cannot use a redundant pair of DRSs to connect a sub-ring to another sub-ring.

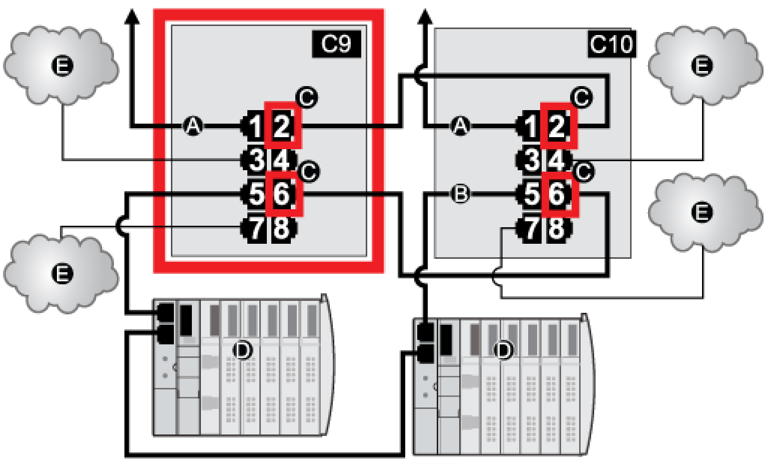
Do not connect any devices between the *master* DRS and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other within 100 m.

Predefined Port Connections

Use the 2 top ports (shown as 1 and 2 in the following graphic) for the main ring redundant connections. Use ports 5 and 6 for the DIO sub-ring redundant connections.

Ports 3, 4, and 7 can be used to connect DIO clouds to the M580 system. Port 8 is reserved for port mirroring *(see page 101)*, i.e., for monitoring the status of the ports you previously selected in the switch's port mirror web page.

NOTE: The default configuration of port 8 has port mirroring disabled.



C9 This master DRS uses a C9 predefined configuration file to act as the primary redundant connection between the main ring and the DIO sub-ring.
C10 This slave DRS uses a C10 predefined configuration file to act as the standby redundant connection between the main ring and the DIO sub-ring.
A DRS connection to the main ring
B DRS connection to the DIO sub-ring
C DRS inner ports (The master and slave DRSs are linked together through ports 2 and 6. Ports 1 are linked to the main ring, and ports 5 are linked to the sub-ring.)
D distributed equipment (STB islands)
E DIO clouds

This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	100Base-TX	copper main ring redundant connection
2	100Base-TX	copper main ring redundant connection
3	100Base-TX	DIO cloud connection
4	100Base-TX	DIO cloud connection
5	100Base-TX	copper DIO sub-ring redundant connection
6	100Base-TX	copper DIO sub-ring redundant connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

C10: Slave Copper RIO Main Ring and DIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C10_Master_RIOMainRing_DIOSubRing_DIOCloudsVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Predefined Configuration

In some applications, DIO clouds may not provide sufficient cable redundancy. With an M580 network, you can deploy distributed equipment in a way that takes advantage of the redundant cabling architecture. The following DRS predefined configuration enables you to support distributed equipment on sub-rings. A DIO sub-ring restores communications in the event of a broken wire or inoperable device on the sub-ring.

With this predfined configuration, use 2 DRSs — one installed with this *slave* predefined configuration and the other installed with the corresponding *master* predefined configuration (C9 *(see page 130)*) — to provide a redundant connection between the main ring and the DIO sub-ring. The *master* DRS passes data between the main ring and the sub-ring. If the *master* DRS becomes inoperable, the *slave* DRS takes control and passes data between the main ring and the DIO sub-ring.

NOTE: When a master slave becomes inoperable, a slave DRS assumes the primary role in less than 50 ms. Refer to the *Comparison of Master/Slave Configuration and Auto Configuration* topic to determine what roles the master and slave DRSs resume if the master DRS becomes operational again.

NOTE:

DRS **inner ports** are the 2 ports on the switch that are connected to the main ring. When using 2 DRSs, connect the designated master inner ports to the designated slave inner ports.

- For copper port master and slave DRS redundant configurations, the inner ports (port 2) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.
- For copper/fiber port master and slave DRS redundant configurations, the inner ports (port 3) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.

NOTE: If you are using a single DRS but plan to convert to redundant configurations in the future, record these port configurations to reduce the number of any schematic changes required because of the conversion.

NOTE: Each DRS applies a lower priority to distributed equipment, and handles packets from an RIO network before handling packets relating to distributed equipment.

Devices Supported by this Predefined Configuration

The DRS predefined configuration described here is for a TCSESM083F23F1 ConneXium extended managed switch, which has 8 copper connection ports and no fiber ports.

You cannot use RIO modules in a DIO sub-ring. Only distributed equipment with a dual-port embedded Ethernet switch and RSTP protocol support can be used. (In this manual, distributed equipment are represented by Modicon STB islands with STB NIP 2311 network interface modules.)

You cannot use a redundant pair of DRSs to connect a sub-ring to another sub-ring.

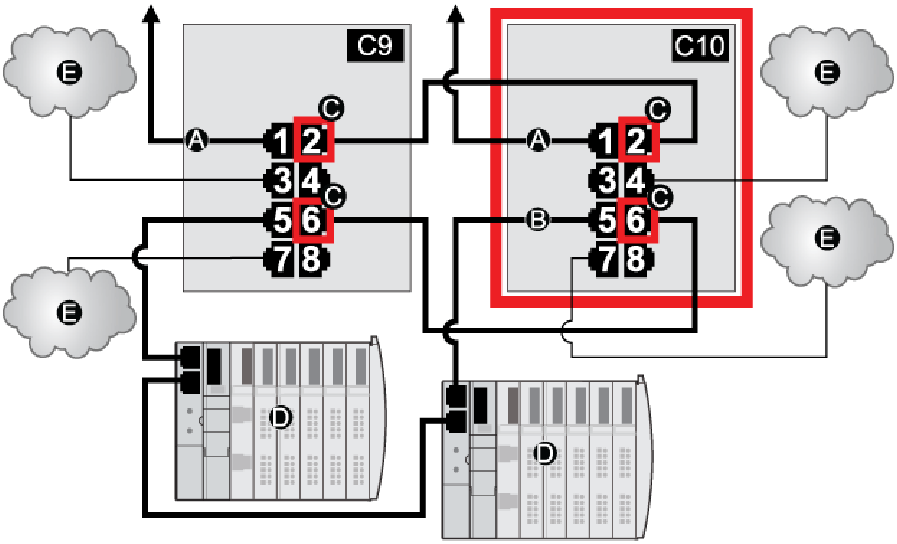
Do not connect any devices between the *master* DRS and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other, within 100 m.

Predefined Port Connections

Use the 2 top ports (shown as 1 and 2 in the following graphic) for the main ring redundant connections. Use ports 5 and 6 for the DIO sub-ring redundant connections.

Ports 3, 4, and 7 can be used to connect DIO clouds to the M580 system. Port 8 is reserved for port mirroring *(see page 101)* (to monitor the status of the ports you previously selected in the switch's port mirror web page).

NOTE: The default configuration of port 8 has port mirroring disabled.



C9 This master DRS uses a C9 predefined configuration file to act as the primary redundant connection between the main ring and the DIO sub-ring.
C10 This slave DRS uses a C10 predefined configuration file to act as the standby redundant connection between the main ring and the DIO sub-ring.
A DRS connection to the main ring
B DRS connection to the DIO sub-ring
C DRS inner ports (The master and slave DRSs are linked together through ports 2 and 6. Ports 1 are linked to the main ring, and ports 5 are linked to the sub-ring.)
D distributed equipment (STB island)
E DIO clouds

This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	100Base-TX	copper main ring redundant connection
2	100Base-TX	copper main ring redundant connection
3	100Base-TX	DIO cloud connection
4	100Base-TX	DIO cloud connection
5	100Base-TX	copper DIO sub-ring redundant connection
6	100Base-TX	copper DIO sub-ring redundant connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

C11: Master Copper/Fiber Main Ring Connections and RIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C11_Master_RIOMainRingFxTx_RIOSubRingTx_DIOCloudsVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Predefined Configuration

Common uses of this predefined configuration are to transition from a copper cable to a fiber cable on the main ring or to transition back from fiber to copper. An alternative use is to provide a long-haul return path for a basically copper network where the last RIO drop or RIO sub-ring in the daisy chain is far away from the local rack.

In any of the above scenarios, this predefined configuration allows you the opportunity to install an RIO sub-ring and/or some DIO clouds on the DRS you are configuring.

With this predefined configuration, use 2 DRSs — one installed with this *master* predefined configuration and the other installed with the corresponding *slave* predefined configuration (C12 *(see page 141)*) — to provide a redundant connection between the main ring and an RIO sub-ring. The *master* DRS passes data between the main ring and the RIO sub-ring. If the *master* DRS becomes inoperable, the *slave* DRS takes control and passes data between the main ring and the RIO sub-ring.

NOTE: When a master slave becomes inoperable, a slave DRS assumes the primary role in less than 50 ms. Refer to the *Comparison of Master/Slave Configuration and Auto Configuration* topic to determine what roles the master and slave DRSs resume if the master DRS becomes operational again.

NOTE:

DRS **inner ports** are the 2 ports on the switch that are connected to the main ring. When using 2 DRSs, connect the designated master inner ports to the designated slave inner ports.

- For copper port master and slave DRS redundant configurations, the inner ports (port 2) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.
- For copper/fiber port master and slave DRS redundant configurations, the inner ports (port 3) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.

NOTE: If you are using a single DRS but plan to convert to redundant configurations in the future, record these port configurations to reduce the number of any schematic changes required because of the conversion.

Devices Supported and Restricted in this Predefined Configuration

The DRS predefined configuration described here can be used with either of 2 switch types:

- A TCSESM063F2CU1 ConneXium extended managed switch, which supports multi-mode fiber cable
- A TCSESM063F2CS1 ConneXium extended managed switch, which supports single-mode fiber cable

Both switches have 2 fiber ports and 6 copper ports.

With single-mode fiber cable, you can achieve distances on the main ring up to 15 km. With multi-mode fiber cable, you can achieve distances up to 2 km.

You cannot use a redundant pair of DRSs to connect a sub-ring to another sub-ring.

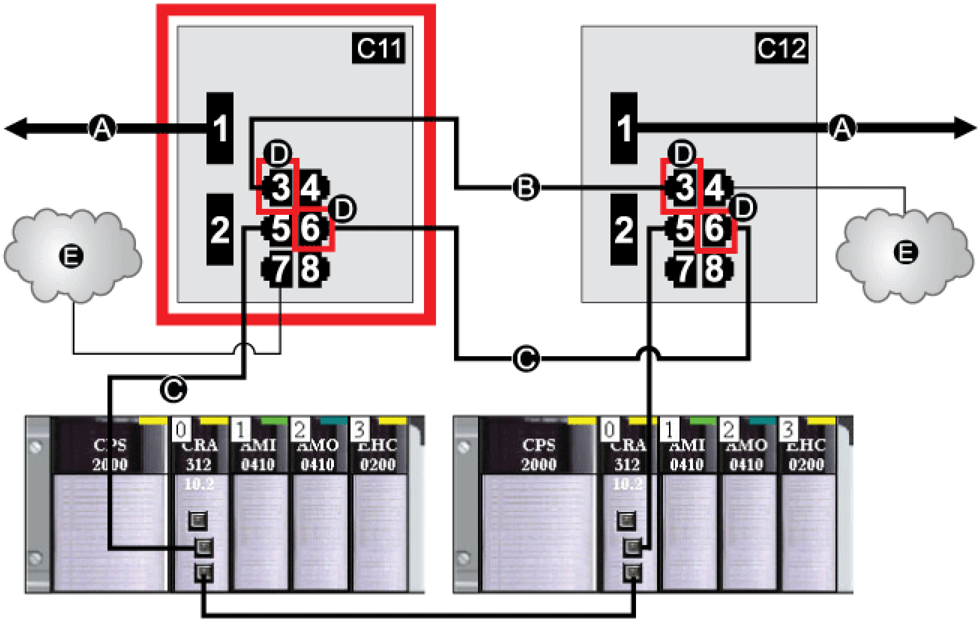
Do not connect any devices between the *master* DRS and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other — within 100 m.

Predefined Port Connections

The top fiber port (labeled 1 in the figure below) makes the redundant connection to the fiber cable on the main ring (A). The other fiber port (port 2) is disabled in this predefined configuration; do not connect to this port.

The top left copper ports (port 3) make the redundant connection to the copper cable on the main ring (B). Copper ports 5 and 6 are used for the RIO sub-ring (C) redundant connections. Ports 4 and 7 are used for DIO cloud connections. Port 8 is reserved for port mirroring *(see page 101)*, i.e., for monitoring the status of the ports you previously selected in the switch's port mirror web page.

NOTE: The default configuration of port 8 has port mirroring disabled.



C11 This master DRS uses a C11 predefined configuration file to act as the primary redundant connection between the main ring and the RIO sub-ring.
C12 This slave DRS uses a C12 predefined configuration file to act as the standby redundant connection between the main ring and the RIO sub-ring.
A DRS connection to the fiber portion of the main ring
B DRS connection to each other on the copper portion of the main ring (with no devices installed between the DRSs)
C DRS connection to the RIO sub-ring
D DRS inner ports (The master and slave DRSs are linked together through ports 3 and 6. Ports 1 are linked to the main ring, and ports 5 are linked to the sub-ring.)
E DIO cloud

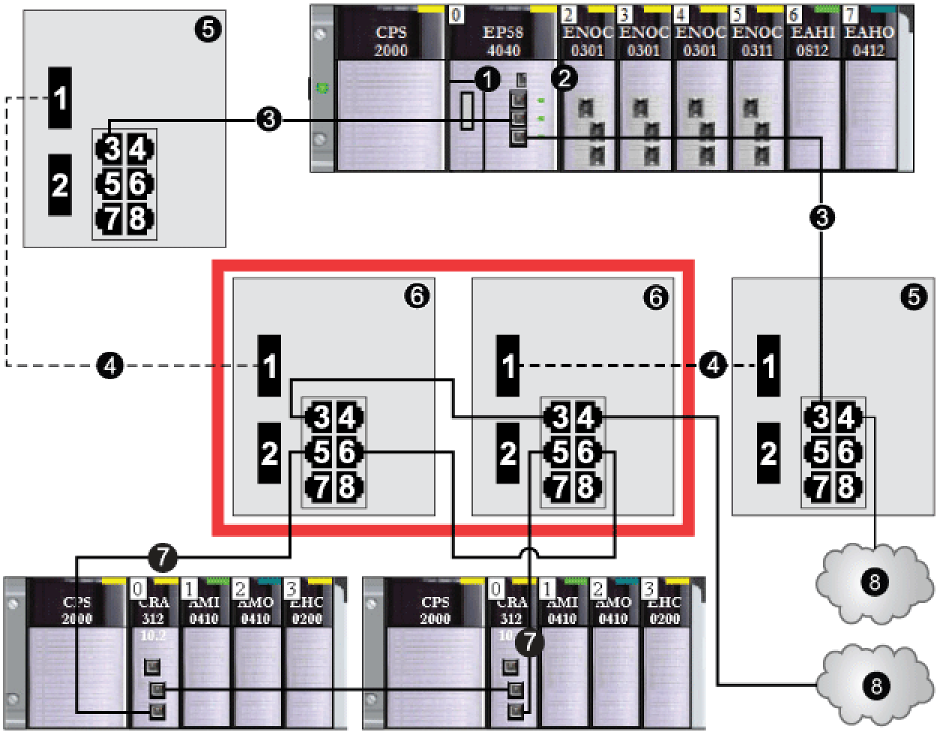
This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	FX	fiber main ring redundant connection
2	FX	disabled fiber port; do not use
3	100Base-TX	copper main ring redundant connection
4	100Base-TX	DIO cloud connection
5	100Base-TX	RIO sub-ring redundant connection
6	100Base-TX	RIO sub-ring redundant connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Supporting the Fiber-to-Copper Transition on the Main Ring

RIO modules in the main ring often do not come equipped with fiber connectors. Therefore, some part of the main ring requires copper cable. Typically, 2 DRSs are each configured to support 1 fiber and 1 copper connection to the main ring.

Connect the DRS to the CPU in the local rack:



1 CPU with Ethernet I/O scanner service on the local rack
2 BME NOC 03•1 Ethernet communication module
3 main ring (copper portion)
4 main ring (fiber portion)
5 DRSs with predefined configuration files that provide copper-to-fiber and fiber-to-copper transitions on the main ring
6 master/slave DRSs that provide a redundant connection between the main ring and the RIO sub-ring (configured to use only 1 fiber port to support copper-to-fiber and fiber-to-copper transitions)
7 RIO sub-ring with 2 RIO drops
8 DIO cloud

NOTE: You can also use BMX NRP 020• fiber converter modules *(see page 88)* instead of the 2 DRSs shown as #5 in the previous illustration.

NOTE: A BME NOC 03•1 module can support distributed equipment via its Ethernet backplane connection to the CPU **and** via its device network port(s) on the front panel, respecting the limitation of 128 devices scanned per BME NOC 03•1 module.

C12: Slave Copper/Fiber Main Ring Connections and RIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C12_Slave_RIOMainRingFxTx_RIOSubRingTx_DIOCloudsVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Predefined Configuration

Common uses of this predefined configuration are to transition from a copper cable to a fiber cable on the main ring or to transition back from fiber to copper. An alternative use is to provide a long-haul return path for a basically copper network where the last RIO drop or RIO sub-ring in the daisy chain is far away from the local rack.

In any of the above scenarios, this predefined configuration allows you the opportunity to install an RIO sub-ring and/or some DIO clouds on the DRS you are configuring.

With this predefined configuration, use 2 DRSs — one installed with this *slave* predefined configuration and the other installed with the corresponding *master* predefined configuration (C11 *(see page 136)*) — to provide a redundant connection between the main ring and an RIO sub-ring. The *master* DRS passes data between the main ring and the RIO sub-ring. If the *master* DRS becomes inoperable, the *slave* DRS takes control and passes data between the main ring and the RIO sub-ring.

NOTE: When a master slave becomes inoperable, a slave DRS assumes the primary role in less than 50 ms. Refer to the *Comparison of Master/Slave Configuration and Auto Configuration* topic to determine what roles the master and slave DRSs resume if the master DRS becomes operational again.

NOTE:

DRS **inner ports** are the 2 ports on the switch that are connected to the main ring. When using 2 DRSs, connect the designated master inner ports to the designated slave inner ports.

- For copper port master and slave DRS redundant configurations, the inner ports (port 2) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.
- For copper/fiber port master and slave DRS redundant configurations, the inner ports (port 3) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.

NOTE: If you are using a single DRS but plan to convert to redundant configurations in the future, record these port configurations to reduce the number of any schematic changes required because of the conversion.

Devices Supported and Restricted in this Predefined Configuration

The DRS predefined configuration described here can be used with either of 2 switch types:

- A TCSESM063F2CU1 ConneXium extended managed switch, which supports multi-mode fiber cable
- A TCSESM063F2CS1 ConneXium extended managed switch, which supports single-mode fiber cable

Both switches have 2 fiber ports and 6 copper ports.

With single-mode fiber cable, you can achieve distances on the main ring up to 15 km. With multi-mode fiber cable, you can achieve distances up to 2 km.

You cannot use a redundant pair of DRSs to connect a sub-ring to another sub-ring.

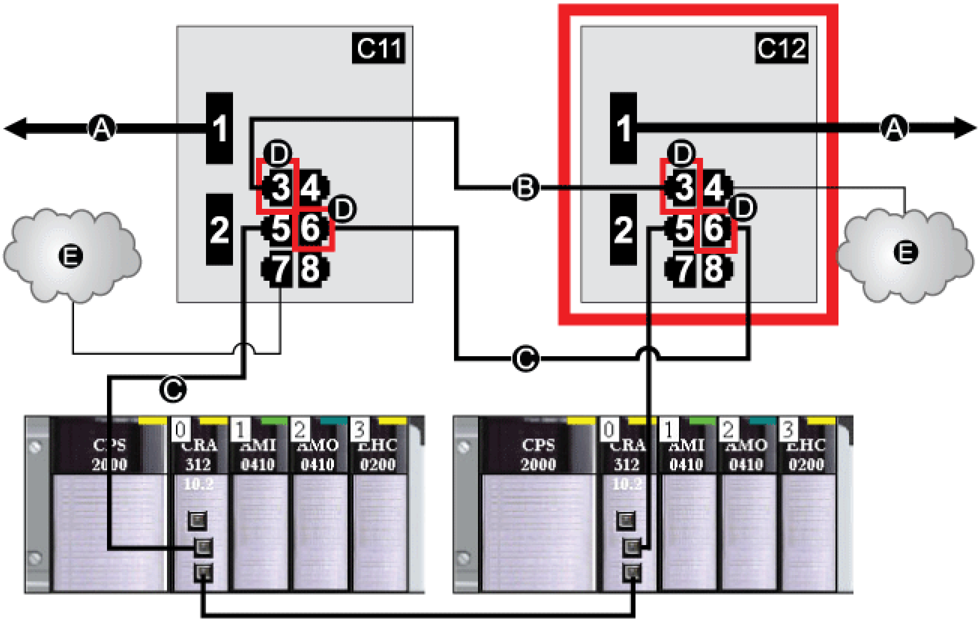
Do not connect any devices between the *master* DRS and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other within 100 m.

Predefined Port Connections

The top fiber port (labeled 1 in the figure below) makes the redundant connection to the fiber cable on the main ring (A). The other fiber port (port 2) is disabled in this predefined configuration; do not connect to this port.

The top left copper port (port 3) makes the redundant connection to the copper cable on the main ring (B). Copper ports 5 and 6 are used for the RIO sub-ring (C) redundant connections. Ports 4 and 7 are used for DIO cloud connections. Port 8 is reserved for port mirroring *(see page 101)*, i.e., for monitoring the status of the ports you previously selected in the switch's port mirror web page.

NOTE: The default configuration of port 8 has port mirroring disabled.



C11 master DRS using a C11 predefined configuration file acting as the primary redundant connection between the main ring and the RIO sub-ring
C12 slave DRS using a C12 predefined configuration file acting as the standby redundant connection between the main ring and the RIO sub-ring
A DRS connections to the fiber portion of the main ring
B DRS connections to each other on the copper portion of the main ring (with no devices installed between the 2 DRSs)
C DRS connections to the RIO sub-ring
D DRS inner ports (The master and slave DRSs are linked together via ports 3 and 6. Ports 1 are linked to the main ring, and ports 5 are linked to the sub-ring.)
E DIO clouds

This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	FX	fiber main ring redundant connection
2	FX	disabled fiber port; do not use
3	100Base-TX	copper main ring redundant connection
4	100Base-TX	DIO cloud connection
5	100Base-TX	RIO sub-ring redundant connection
6	100Base-TX	RIO sub-ring redundant connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

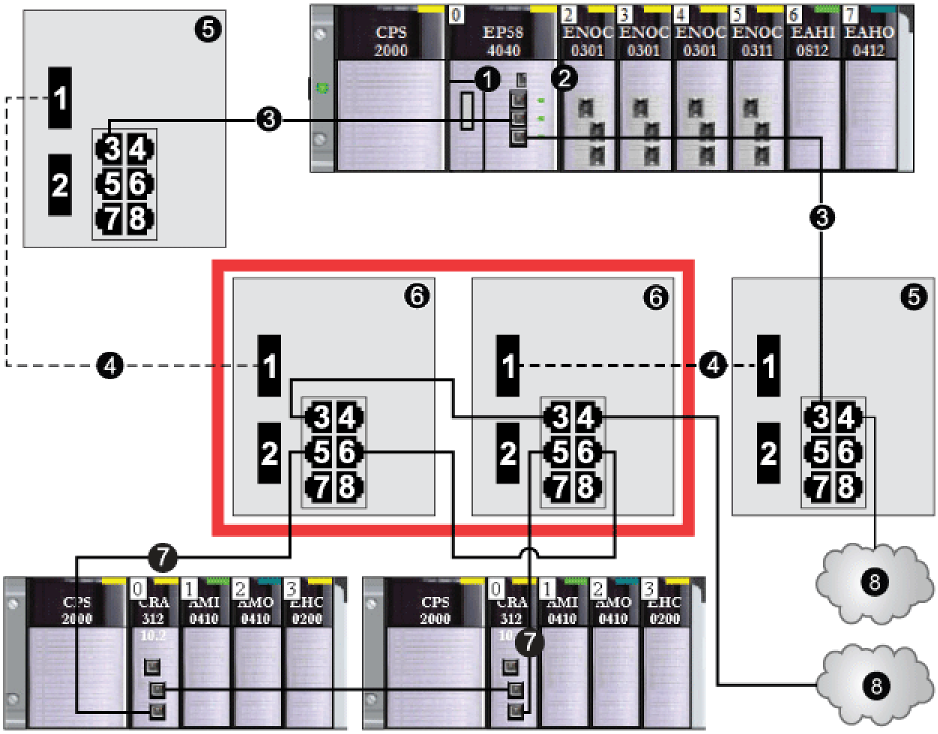
Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Supporting the Fiber-to-Copper Transition on the Main Ring

RIO modules in the main ring often do not come equipped with fiber connectors. Therefore, some part of the main ring requires copper cable. Typically, 2 DRSs are each configured to support 1 fiber and 1 copper connection to the main ring.

Connect the DRS to the CPU in the local rack:



1 CPU with Ethernet I/O scanner service on the local rack
2 BME NOC 03•1 Ethernet communication module
3 copper portion of the main ring
4 fiber portion of the main ring
5 DRSs with predefined configuration file that provide copper-to-fiber and fiber-to-copper transitions on the main ring
6 Master/slave DRSs that provide a redundant connection between the main ring and the RIO sub-ring. They are configured to use only 1 fiber port. They support a copper-to-fiber and fiber-to-copper transition.
7 RIO sub-ring with 2 RIO drops
8 DIO cloud

NOTE: You can also use BMX NRP 020• fiber converter modules *(see page 88)* instead of the 2 DRSs shown as #6 in the previous illustration.

NOTE: A BME NOC 03•1 module can support distributed equipment via its Ethernet backplane connection to the CPU **and** via its device network port(s) on the front panel, respecting the limitation of 128 devices scanned per BME NOC 03•1 module.

C13: Master Copper/Fiber Main Ring Connections and DIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C13_Master_RIOMainRingFxTx_DIOSubRingTx_DIOCloudsVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Predefined Configuration

With this predefined configuration downloaded, a DRS can be used to make the transition from copper to fiber or back to copper from fiber on the main ring. The switch can also support a DIO sub-ring.

With this predefined configuration, use 2 DRSs — one installed with this *master* predefined configuration and the other installed with the corresponding *slave* predefined configuration (C14 (*see page 150*)) — to provide a redundant connection between the main ring and a DIO sub-ring. The *master* DRS passes data between the main ring and the DIO sub-ring. If the *master* DRS becomes inoperable, the *slave* DRS takes control and passes data between the main ring and the RIO sub-ring.

NOTE: When a master slave becomes inoperable, a slave DRS assumes the primary role in less than 50 ms. Refer to the *Comparison of Master/Slave Configuration and Auto Configuration* topic to determine what roles the master and slave DRSs resume if the master DRS becomes operational again.

NOTE:

DRS **inner ports** are the 2 ports on the switch that are connected to the main ring. When using 2 DRSs, connect the designated master inner ports to the designated slave inner ports.

- For copper port master and slave DRS redundant configurations, the inner ports (port 2) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.
- For copper/fiber port master and slave DRS redundant configurations, the inner ports (port 3) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.

NOTE: If you are using a single DRS but plan to convert to redundant configurations in the future, record these port configurations to reduce the number of any schematic changes required because of the conversion.

NOTE: Each DRS applies a lower priority to distributed equipment, and handles packets from an RIO network before handling packets relating to distributed equipment.

Devices Supported by this Predefined Configuration

Distributed equipment includes an embedded dual-port Ethernet switch and supports the RSTP protocol. (In this manual, Modicon STB islands with STB NIP 2311 network interface modules are used for illustration.)

The predefined configuration described here can be used with either of 2 DRS types:

- A TCSESM063F2CU1 ConneXium extended managed switch, which supports multi-mode fiber cable
- A TCSESM063F2CS1 ConneXium extended managed switch, which supports single-mode fiber cable

Both switches have 2 fiber ports and 6 copper ports.

With single-mode fiber cable, you can achieve distances on the main ring up to 15 km. With multi-mode fiber cable, you can achieve distances up to 2 km.

You cannot use a redundant pair of DRSs to connect a sub-ring to another sub-ring.

Do not connect any devices between the *master* DRS and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other within 100 m.

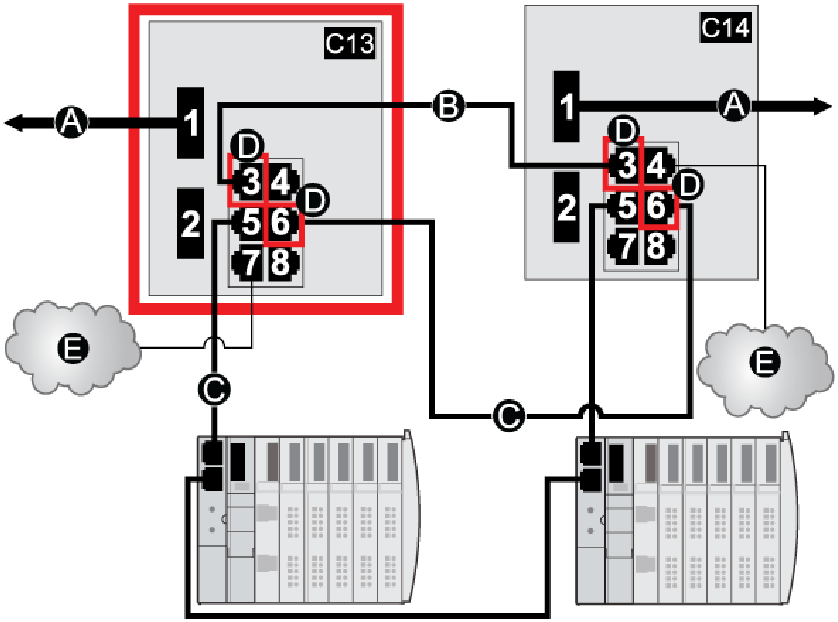
Port Connections

The top fiber port (port 1) makes the redundant connection to the fiber cable on the main ring (A). The other fiber port (port 2) is disabled; do not connect to this port.

The top left copper port (port 3) makes the redundant connection to the copper cable on the main ring (B). Copper ports 5 and 6 are used to connect to the DIO sub-ring (C).

Ports 4 and 7 can be used for other purposes. Port 8 is reserved for port mirroring *(see page 101)*, i.e., for monitoring the status of the ports you previously selected in the switch's port mirror web page.

NOTE: The default configuration of port 8 has port mirroring disabled.



C13 This master DRS uses a C13 predefined configuration file to act as the primary redundant connection between the main ring and the DIO sub-ring.
C14 This slave DRS uses a C14 predefined configuration file to act as the standby redundant connection between the main ring and the DIO sub-ring.
A DRS connection to the fiber portion of the main ring
B DRS connection to each other on the copper portion of the main ring (with no other devices installed between the 2 DRSs)
C DRS connection to the DIO sub-ring
D DRS inner ports (The master and slave DRSs are linked together through ports 3 and 5. Ports 1 are linked to the main ring, and ports 5 are linked to the sub-ring.)
E DIO clouds

This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	FX	fiber main ring redundant connection
2	FX	disabled fiber port; do not use
3	100Base-TX	copper main ring redundant connection
4	100Base-TX	DIO cloud connection
5	100Base-TX	DIO sub-ring redundant connection
6	100Base-TX	DIO sub-ring redundant connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING
UNEXPECTED EQUIPMENT BEHAVIOR Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

C14: Slave Copper/Fiber Main Ring Connections and DIO Sub-ring with DIO Clouds

Predefined Configuration File Name

`C14_Slave_RIOMainRingFxTx_DIOSubRingTx_DIOCloudsVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Predefined Configuration

With this predefined configuration downloaded, a DRS can be used to make the transition from copper to fiber or back to copper from fiber on the main ring. The switch can also support a DIO sub-ring.

With this predefined configuration, use 2 DRSs — one installed with this *slave* predefined configuration and the other installed with the corresponding *master* predefined configuration (C13 (*see page 146*)) — to provide a redundant connection between the main ring and a DIO sub-ring. The *master* DRS passes data between the main ring and the DIO sub-ring. If the *master* DRS becomes inoperable, the *slave* DRS takes control and passes data between the main ring and the RIO sub-ring.

NOTE: When a master slave becomes inoperable, a slave DRS assumes the primary role in less than 50 ms. Refer to the *Comparison of Master/Slave Configuration and Auto Configuration* topic to determine what roles the master and slave DRSs resume if the master DRS becomes operational again.

NOTE:

DRS **inner ports** are the 2 ports on the switch that are connected to the main ring. When using 2 DRSs, connect the designated master inner ports to the designated slave inner ports.

- For copper port master and slave DRS redundant configurations, the inner ports (port 2) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.
- For copper/fiber port master and slave DRS redundant configurations, the inner ports (port 3) connect to each other for the main ring, and port 6 on both DRSs connect to each other for a sub-ring.

NOTE: If you are using a single DRS but plan to convert to redundant configurations in the future, record these port configurations to reduce the number of any schematic changes required because of the conversion.

NOTE: Each DRS applies a lower priority to distributed equipment, and handles packets from an RIO network before handling packets relating to distributed equipment.

Devices Supported by this Predefined Configuration

Distributed equipment includes an embedded dual-port Ethernet switch and supports the RSTP protocol. (In this manual, Modicon STB islands with STB NIP 2311 network interface modules are used for illustration.)

The predefined configuration described here can be used with either of 2 DRS types:

- A TCSESM063F2CU1 ConneXium extended managed switch, which supports multi-mode fiber cable
- A TCSESM063F2CS1 ConneXium extended managed switch, which supports single-mode fiber cable

Both switches have 2 fiber ports and 6 copper ports.

With single-mode fiber cable, you can achieve distances on the main ring up to 15 km. With multi-mode fiber cable, you can achieve distances up to 2 km.

You cannot use a redundant pair of DRSs to connect a sub-ring to another sub-ring.

Do not connect any devices between the *master* DRS and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other within 100 m.

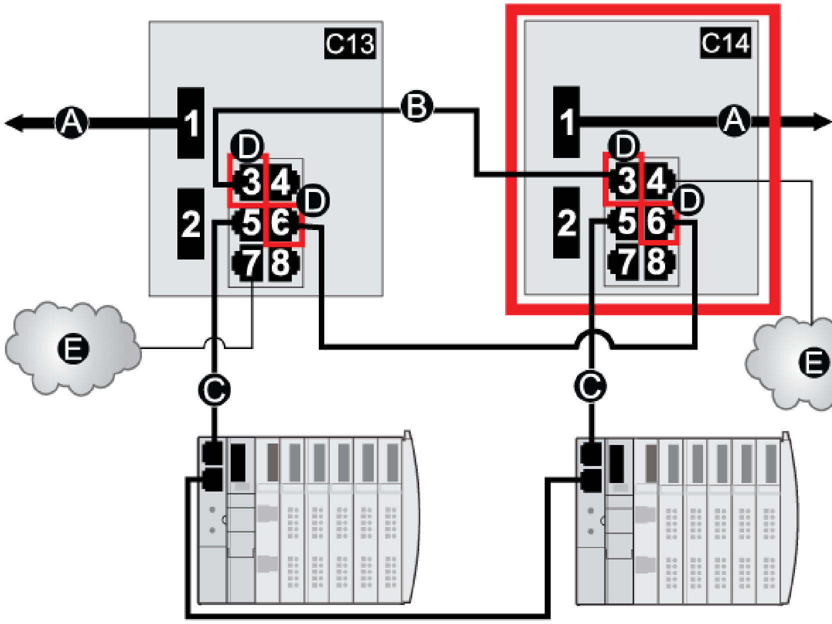
Port Connections

The top fiber port (port 1) makes the redundant connection to the fiber cable on the main ring (A). The other fiber port (port 2) is disabled; do not connect to this port.

The top left copper port (port 3) makes the redundant connection to the copper cable on the main ring (B). Copper ports 5 and 6 are used to connect to the DIO sub-ring (C).

Ports 4 and 7 can be used for other purposes. Port 8 is reserved for port mirroring *(see page 101)*, i.e., for monitoring the status of the ports you previously selected in the switch's port mirror web page.

NOTE: The default configuration of port 8 has port mirroring disabled.



C13 This master DRS uses a C13 predefined configuration file to act as the primary redundant connection between the main ring and the DIO sub-ring.
C14 This slave DRS uses a C14 predefined configuration file to act as the primary redundant connection between the main ring and the DIO sub-ring.
A Port 1 on the DRS is connected to the fiber portion of the main ring.
B The DRSs are connected on the copper portion of the main ring through port 3. (No devices are installed between the 2 DRSs.)
C The DRSs are connected to the DIO sub-ring through port 6.
D DRS inner ports (The master and slave DRSs are linked together through ports 3 and 6. Ports 1 are linked to the main ring, and ports 6 are linked to the sub-ring.)
E DIO clouds

This table describes the functionality of the ports in the above illustration:

Port	Type	Description
1	FX	fiber main ring redundant connection
2	FX	disabled fiber port; do not use
3	100Base-TX	copper main ring redundant connection
4	100Base-TX	DIO cloud connection
5	100Base-TX	DIO sub-ring redundant connection
6	100Base-TX	DIO sub-ring redundant connection
7	100Base-TX	DIO cloud connection
8	100Base-TX	port mirroring connection

Except when enabling or disabling ports that are not connected to either a main ring or a sub-ring, do not adjust the configuration parameters or alter the port usage in the predefined configuration file. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch, as well as the performance of the RIO network.

Port mirroring is disabled by default. If you enable port mirroring, you can select the ports on which you want to analyze traffic as the source ports. Ports 1-7 can be selected as source ports. Port 8 is the destination port, and it cannot be changed.

⚠ WARNING

UNEXPECTED EQUIPMENT BEHAVIOR

Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Obtaining and Installing Predefined Configuration Files

Obtaining Predefined Configuration Files

The Unity Pro V9.0 installation CD contains the predefined configuration files (**UPV9 DVD Folders →Goodies →Config DRS**).

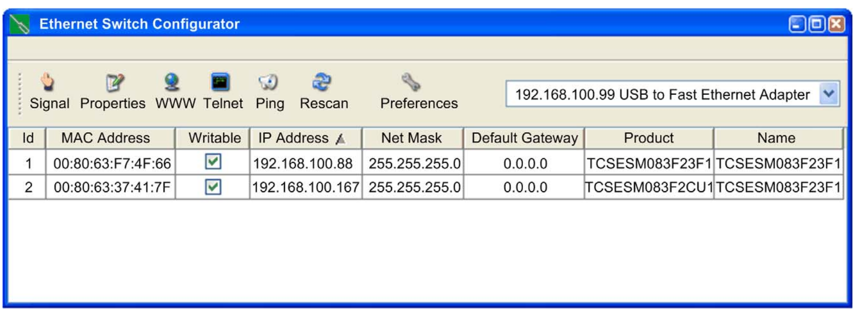
If you have already installed Unity Pro V9.0, the predefined configuration files are also your PC's hard drive (**Shared Documents →Schneider Electric →Unity Pro →Extras →Config DRS**).

Loading a Predefined Configuration onto a DRS

The process for loading a predefined configuration onto a DRS involves the use of 2 tools, including:

- the Ethernet switch configuration tool, which you can load on your PC from the ConneXium Resource CD that came with your DRS
- a web browser, such as Internet Explorer, that you can use to navigate to the DRS's embedded web pages and install the predefined configuration file

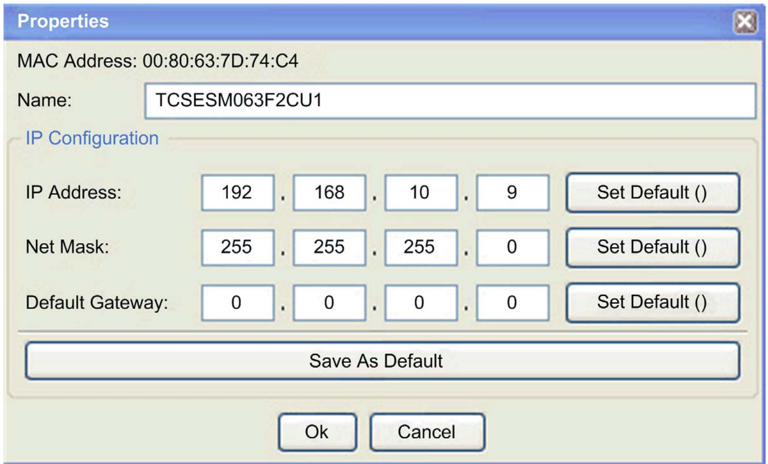
Use these steps to load a predefined configuration file on your DRS:

Step	Action
1	Connect your PC to the network that includes the switch or switches you want to configure. Set the IP parameters for your PC.
2	Place the ConneXium Resource CD into the disk drive of your PC. **Result**: The ConneXium Resource CD navigation screen opens.
3	Click the link that reads **Install ConneXium Configuration Software**. **Result**: The CD automatically installs the Ethernet switch configuration tool onto your PC. The tool should automatically open. **NOTE:** If the Ethernet switch configuration tool does not automatically open, manually start it by selecting **Start →Programs →Schneider Electric →ConneXium → Ethernet Switch Configurator**.
4	On start-up, the tool searches your network for TCSESM-E DRSs, and displays a list of the devices it finds: 

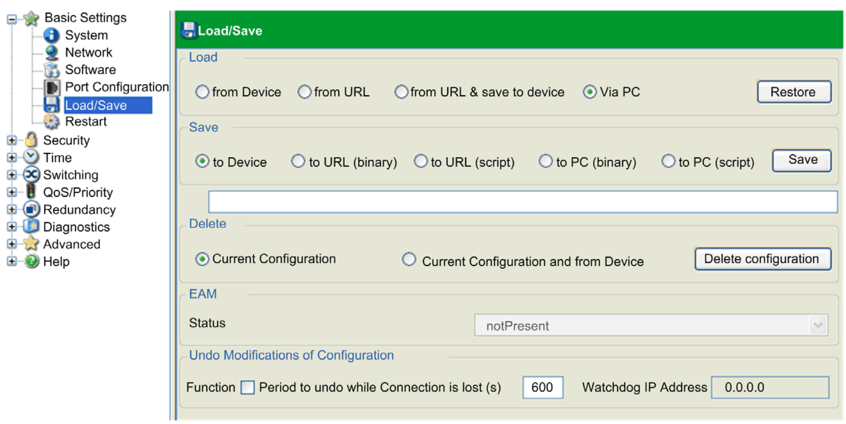
<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>5</td><td>To change or assign an IP address to the desired switch (from the list displayed in the previous step), perform one of the following:

Double-click the switch.
Select the switch, and click Edit →Change Device Properties.
Select the switch, and click the Properties toolbar icon.
Result: The Properties dialog box opens, as shown in the following illustration.

Edit the fields as necessary, and press Ok to accept your changes.



</td></tr>
<tr><td>6</td><td>Select the switch you want to configure, and click the WWW button to open the embedded web pages for the selected switch.</td></tr>
<tr><td>7</td><td>Use the tree control on the left side of the web page and select Basic Settings →Load/Save:



</td></tr>
</table>

Step	Action
8	In the **Delete** section of the page, select **Current Configuration**, then select **Delete configuration**. **Result**: The existing configuration is deleted from RAM. **NOTE:** Do not select **Current Configuration and from Device** before deleting the configuration. If you do, the configured IP address may be lost, and you may have to begin again the process of loading the predefined configuration.
9	In the **Load** section of the page, select **via PC**, then select **Restore**. **Result**: The **Open** dialog opens.
10	Use the **Open** dialog to navigate to and select the predefined configuration file you want to load onto the selected DRS, then click **OK**.
11	After a short wait, the message *Configuration updated completed successfully* displays, indicating the predefined configuration file has been loaded onto the DRS. Close this message dialog. **NOTE:** When you close the dialog, the icon next to the **Load/Save** node changes to the  icon, indicating that the configuration has been written to the DRS RAM, but not yet stored in flash memory.
12	In the **Save** section of the web page, select **to Device**, then click **Save**. **Result**: This writes your predefined configuration settings to DRS flash memory. **NOTE:** When you click **Save**, the icon next to the **Load/Save** node changes back to the , indicating that the configuration has been stored in flash memory.
13	For your changes to take effect, perform either a cold or a warm restart of the DRS. Do one of the following: ● Open the **Basic Settings** →**Restart** web page. ● Click either **Cold start** or **Warm start**. **NOTE:** Refresh the web pages in your browser before viewing the DRS configuration settings.

Chapter 5
Verifying the Network Configuration

Using the Network Inspector

Introduction

In Unity Pro, click **Tools** →**Network Inspector** to visualize and verify a complex network configuration. The tool can:

- verify network addresses
- provide a global view of your network
- configure network topologies

NOTE: The Network Inspector tool is available on all M580 PACs . Only devices enabled in the address server (DHCP) are controlled.

Creating a Complex Network

Follow these steps to use the **Network Inspector** tool in Unity Pro:

Step	Action	Comment
1	Click **Tools** →**Network Inspector**.	A global view of your network displays.
2	Add distributed equipment and/or RIO modules to the **EIO Bus**.	**NOTE:** Only devices enabled in the address server (DHCP) are controlled.
3	Configure all scanners.	**NOTE:** The tool does not control the scanners.
4	Click **Tools** →**Network Inspector** again to verify the IP addresses.	If the tool displays a detected error, go to the specific device editor and change the IP configuration. Then, run the **Network Inspector** again.

Topology Network Configuration

Use the **Network Inspector** window to configure network topologies within an application.

NOTE: Table cells are read only.

Parameters in the **Network Inspector**:

Parameter	Description
Device	Ethernet communication device name
Topo @	topological address (if the device exists)
Eth. Port	port number of the Ethernet device
Object Type	control network, device network, extended network, distributed equipment, RIO module, isolated network

Parameter	Description
IPA @	IP address
IPB @	
Subnet Mask	
Gateway	
SNMP IP1 @	
SNMP IP2 @	
NTP Primary	
NTP Secondary	

Buttons in the **Network Inspector**:

Button	Description
OK	Apply modifications and exit.
Apply	Apply modifications and refresh.
Cancel	Cancel modifications and exit.
IP details >>	Show the list of all IP addresses of the configuration. (This button changes to **<<IP summary** when pressed.)
<<IP summary	Hide the list of all IP addresses in the configuration. (This button changes to **IP details >>** when pressed.)

NOTE:

- The red cells indicate detected errors (defined by network management rules).
- IP address cells are read-only. These values are modified in a dedicated device screen.
- Use the **Eth. Port** column to set cables between the module of the configuration.

Network IP Address List

If you press the **IP details** button, Unity Pro displays 7 additional columns that identify each IP address used with other network attributes.

NOTE: IP address cells are read-only. Modify these values in a dedicated device screen.

Network Manager Services

The network manager starts automatically when an application is analyzed. The global network management system (GNMS) is responsible for global network consistency. These checks are performed:

- GNMS verifies that all IP addresses are unique for the modules in the application.
- Each gateway that exists on your network is displayed in the network manager. By default, Unity Pro notifies you if one of the gateways is missing an IP address. You can change this notification by clicking **Tools** →**Project Settings** →**General** →**Management of build messages** → **Missing gateway IP @ generates**. The options are a `detected warning` (default value) or nothing.
- Only a single RSTP can be configured as a root for a given network.
- The range of IP addresses is 1.0.0.0 … 126.255.255.255 or 128.0.0.0 … 223.255.255.255. Otherwise, an error is detected. Addresses 224.0.0.0 and up are multicast or experimental addresses. Addresses starting at 127 are loopback addresses. Addresses 169.254/16 are reserved for automatic private IP addressing (APIPA).
- The tool verifies that the network address of the IP address is valid.
- The tool verifies that the host address of the IP address is valid, including that broadcast IP addresses are blocked.
- While an M580 CPU uses *classless inter-domain routing* (CIDR), some IP addresses are not allowed to maintain compatibility:
  - in a class A network, IP addresses that end in 255.255.255
  - in a class B network, IP addresses that end in 255.255
  - in a class C network, IP addresses that end in 255
- The IP address is configured to access the gateway address. Therefore, the gateway address is within the subnetwork defined by the mask. The gateway is not accessible when it is not on the same subnetwork as the IP address.

Network Bandwidth Considerations

Unity Pro alerts you when there are possible bandwidth considerations.

Ethernet RIO bandwidth:

- Unity Pro displays an error message in the log window if the RIO bandwidth (originator -> target) or (target->originator) is greater than 8%.
- Unity Pro displays a **warning** in the log window if the RIO bandwidth (originator -> target) or (target->originator) is greater than 6%.

Device network bandwidth (DIO and RIO combined):

- Unity Pro displays an **error** in the log window if total Modbus and EIP bandwidth (originator -> target) or (target->originator) is greater than 40%.
- Unity Pro displays a **warning** in the log window if total Modbus and EIP bandwidth (originator -> target) or (target->originator) is greater than 30%.

Chapter 6
Performance

Introduction

This chapter discusses system performance considerations, including typical system recovery times, improving system performance, application response time, and communication loss detection times.

What Is in This Chapter?

This chapter contains the following sections:

Section 6.1
System Performance

Introduction

Creating a deterministic RIO system requires the use of network components and designs that support switched Ethernet communication including:

- full duplex transmissions
- 100 Mbps transmission speed
- QoS prioritization of RIO packets

This chapter introduces you to devices that meet these performance considerations. It also presents typical system recovery times and describes methods to help improve system performance.

What Is in This Section?

This section contains the following topics:

System Performance

Memory Consumption

Input and output memory specification:

Scope	Type	Maximum Value per Task*
M580 CPU	input bytes per network	up to 32,768, depending on CPU model
	output bytes per network	up to 24,576, depending on CPU model
Ethernet RIO	input words per drop	1400
	output words per drop	1400
Ethernet DIO	input bytes per device	up to 1,400, depending on EtherNet/IP or Modbus/Modbus function code.
	output bytes per device	1,400
Total DIO scanning capability	input Kbytes	up to 4, depending on CPU model
	output Kbytes	up to 4, depending on CPU model
** You can use all 4 tasks (MAST, FAST, AUX0, AUX1) simultaneously.*		

Displaying I/O Memory Consumption

You can monitor the I/O memory consumption in Unity Pro . Use one of these methods:

- In the **Project Browser**, expand **Project** →**Configuration** →**EIO Bus**. Right-click **Properties**.
  — or —
- In the background of the **EIO Bus** window, right-click **Bus properties**.
  — or —
- In the **Edit** menu, select **Bus properties**.

Exceeding RIO Drop Limitations

Unity Pro displays an **error** in the log window if one of these events occurs:

- The size of the **RIO drop** memory for the MAST task exceeds 1,400 input bytes or 1,400 output bytes.
- The size of the **RIO drop** memory for the FAST task exceeds 1,400 input bytes or 1,400 output bytes.
- The size of the **RIO drop** memory for the AUX0 task exceeds 1,400 input bytes or 1,400 output bytes.
- The size of the **RIO drop** memory for the AUX1 task exceeds 1,400 input bytes or 1,400 output bytes.
- The size of the M580 network exceeds 80% of the maximum drop limitation for the CPU chosen.

Minimum / Maximum System Channels

The minimum and maximum number of channels that a global M580 configuration can manage is a function of the M580 CPU model that you are using. For detailed information on configuring channels, refer to the *Modicon M580 Hardware Reference Manual*

System Throughput Considerations

Introduction

System throughput describes the quantity of data in bytes that the CPU can process in a single scan. Design your M580 system so that the CPU can scan the data produced by the system in a single scan. If the quantity of data produced by the system is excessive, and scan time is configured to be:

- periodic: There is a data overrun. (Not all data is included in a single scan.)
- cyclic: The time required by the CPU to complete the scan may be undesirably long.

This topic presents throughput data for devices on an RIO local rack, which you can use to calculate the throughput of your own application.

Local Rack Throughput Device Capacities

A local rack can contain the following maximum numbers of devices:

Device	Maximum per Rack
M580 CPU with Ethernet I/O scanner service	1
BME NOC 03•1 Ethernet communication module	4(1)
BMX EIA 0100 AS-interface module	4(1)
BMX NOR 0200 Ethernet communication module	4(1)
BMX NOM 0200 Modbus communication module	4(1) (see note below)
(1) A local rack contains an M580 CPU with Ethernet I/O scanner service and a maximum of four communication modules, depending upon the CPU you choose *(see page 75)*. While the M580 CPUs and BME NOC 03•1 modules are designed specifically for a M580 system, you can use BMX EIA 0100, BMX NOR 0200, and BMX NOM 0200 modules.	

Each CPU with Ethernet I/O scanner service can contribute the following maximum capacity:

Data Type	Maximum Capacity
input data	24,000 bytes
output data	24,000 bytes
explicit exchange function block data	up to 8,192 bytes (8 blocks, each with 1,024 bytes), depending on CPU model

Each CPU with Ethernet DIO scanner service can contribute the following maximum capacity:

Data Type	Maximum Capacity
input data	up to 4,000 bytes, depnding on CPU model
output data	4,000 bytes
explicit exchange function block data	6,144 bytes (6 explicit exchange function blocks, 1,024 bytes per block)

Sample Architecture

For example, a local rack could include a CPU with Ethernet I/O scanner service managing an RIO network with 10 drops and only one MAST task, and a DIO network with 20 distributed devices.

In this example, the I/O exchange requires 15 ms on each scan. Determine a CPU scan time that is compatible with this processing time.

Calculating the Minimum MAST Cycle Time

Introduction

By configuring a sufficiently large MAST cycle time, the CPU in your M580 system can process the data processed by the system in a single scan. If the configured MAST cycle time is smaller than the required processing time, the CPU will force MAST to over-run.

By using the formulas (set forth below) to compute a minimum MAST time for your system, you can avoid a MAST overrun situation.

Calculating a Minimum MAST Cycle

Assuming that only the MAST task is configured, the minimum MAST cycle time (in ms) can be calculated as follows:

- (# of drops using MAST task) / 1.5

The minimum cycle time for other tasks can similarly be estimated:

- *FAST task*: (# of drops using FAST task) / 1.5
- *AUX0 task*: (# of drops using AUX0 task) / 1.5
- *AUX1 task*: (# of drops using AUX1 task) / 1.5

If multiple tasks need to be configured, satisfy the following conditions (where all cycle times are measured in ms):

(# of drops using MAST task) / (MAST cycle time) + (# of drops using FAST task) / (FAST cycle time) + (# of drops using AUX0 task) / (AUX0 cycle time) + (# of drops using AUX1 task) / (AUX1 cycle time) < 1.5

If DIO devices are configured, the minimum cycle time needs to be increased.

Example

In this example, the configuration consists of:

- a local rack with a CPU with Ethernet I/O scanner service, using only MAST task
- 10 RIO drops

The minimum MAST cycle time equals:

10 / 1.5 = 6.7 ms

Section 6.2
Application Response Time

Introduction

Application response time (ART) is the time a CPU application takes to react to an input,starting when the input signal triggers a write command from the CPU and ending when the corresponding output module changes state.

What Is in This Section?

This section contains the following topics:

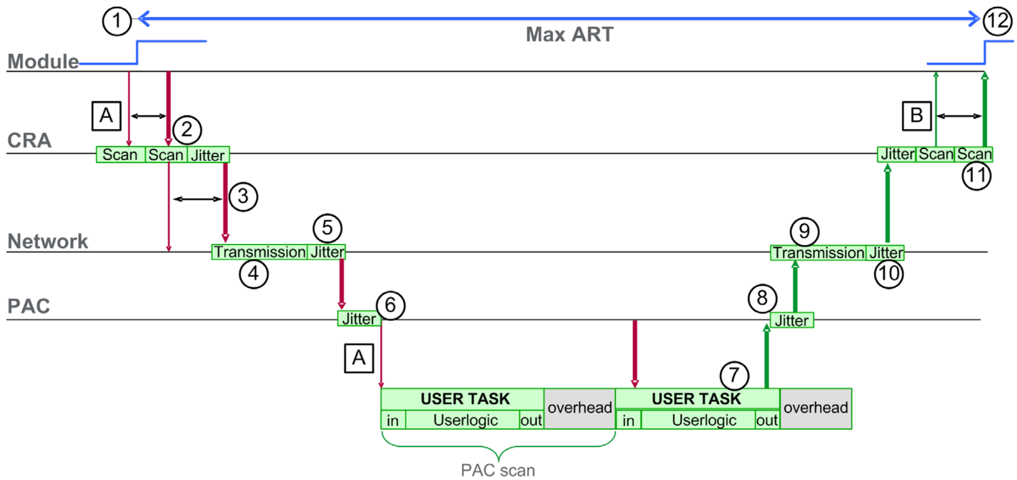
Simplified Presentation of Application Response Time

Introduction

Each Ethernet RIO input signal packet travels from an RIO drop to the CPU , and the CPU sends an output signal back to the RIO drop. The time it takes for theCPU to receive the input signal and effect achange in the output module based on the input is called application response time(ART). In an M580 system, the ART is deterministic, which means you can calculate the maximum time the CPU uses to resolve an RIO logic scan.

Overview: ART Computation Parameters

The following diagram displays ART-related events and computation parameters. Refer to the *Design Principles of M580 Networks* appendix *(see page 243)* for details.



NOTE: Overhead in the previous illustration refers to the time period between the end of USER TASK processing (noted by the end of **out**) and the start of the next period (based on CPU USER TASK cycle time).

A: missed input scan	6: CPU input jitter
B: missed output scan	7: operation of application logic (1 scan)
1: input turns ON	8: CPU output jitter
2: CRA drop processing time	9: network delay
3: CRA input Request Packet Interval (RPI) rate	10: network jitter
4: network delay	11: CRA drop processing time
5: network jitter	12: output applied

Quick Estimation of ART

To estimate the maximum ART based on the maximum number of RIO modules and distributed equipment for an application, sum these values:

- CRA->Scanner RPI
- 2 * CPU_Scan (for the task)
- 8.8. ms (a constant value representing the maximum CRA processing time)

NOTE: This calculation is valid for each task. However, in a multitasking situation, the CPU_Scan time may be increased due to higher-priority tasks.

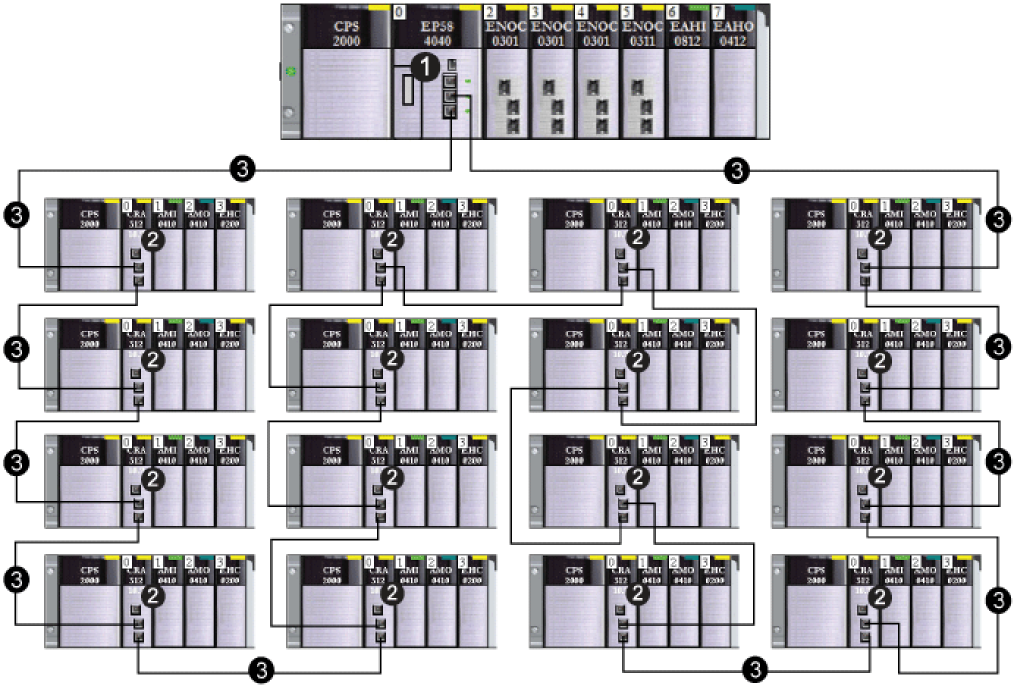
NOTE: If the MAST task is combined with the FAST task (multitasking), the CPU_Scan for the MAST task may be increased significantly. The result of multitasking can be a much longer ART for the MAST task.

NOTE: Because the FAST task has highest priority, the ART for the FAST task is not impacted by other tasks.

NOTE: If a cable break occurs or a cable is reconnected on the network, add an additional time period to the above ART calculation to allow for RSTP recovery. The additional time to be added equals: 50 ms + CRA->Scanner RPI.

Simplified Computation of ART for Simple Daisy Chain Loop of BM• CRA 312 •0 Adapter Modules in a Main Ring

This example calculates the ART from the perspective of the BM• CRA 312 •0 X80 EIO adapter module:



1 CPU on the local rack
2 RIO drop with a BM• CRA 312 •0 X80 EIO adapter module
3 main ring

Recall that the formula to estimate the maximum ART is:

ART= CRA->Scanner RPI + CPU_Scan/2 + (2*CPU_Scan) + 8.8

Thus, for a task with a scan time of 40 ms and a CRA->Scanner RPI of 25 ms, maximum ART is:

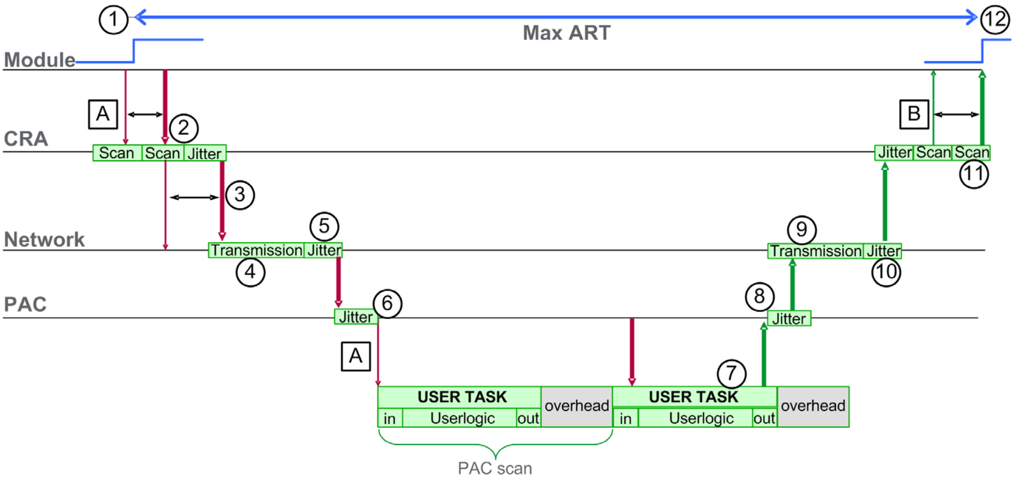
max ART = 25 + (2*40) + 8.8 = 113.8 ms

NOTE: If a cable break exists on the network, add an additional time period equal to 50 ms + CRA->Scanner RPI to the above ART calculation. The added time allows for RSTP recovery from the cable break.

Application Response Time

Overview: ART Computation Parameters

The following diagram displays ART-related events and computation parameters. Refer to the *Design Principles of M580 Networks* appendix *(see page 243)* for details.



A: missed input scan	6: CPU input jitter
B: missed output scan	7: operation of application logic (1 scan)
1: input turns ON	8: CPU output jitter
2: CRA drop processing time	9: network delay
3: CRA input request packet interval (RPI) rate	10: network jitter
4: network delay	11: CRA drop processing time
5: network jitter	12: output applied

The ART computation parameters and their maximum values (in milliseconds) are described below:

<table>
<tr><th>ID</th><th>Parameter</th><th>Max (ms)</th><th colspan="2">Description</th></tr>
<tr><td>2</td><td>CRA drop process time (CRA_Drop_Process)</td><td>4.4</td><td colspan="2">The sum of CRA input scan time and queue delay</td></tr>
<tr><td>3</td><td>CRA input RPI (RPI)</td><td>–</td><td colspan="2">User defined. Default = 0.5 * CPU period if MAST is in periodic mode. If MAST is in cyclic mode, the default value is watchdog/4).</td></tr>
<tr><td rowspan="8">4</td><td rowspan="8">network input time[2] (Network_In_Time)</td><td rowspan="8">2.496
(0.078 * 32)
NOTE: The value 2.496 ms is based upon a packet size of 800 bytes and 32 hops[1].</td><td colspan="2">The product of (network delay based on I/O packet size) * (the number of hops[1] the packet travels). The network delay component can be estimated as follows:</td></tr>
<tr><td>I/O packet size (bytes):</td><td>Estimated network delay (μs):</td></tr>
<tr><td>128</td><td>26</td></tr>
<tr><td>256</td><td>35</td></tr>
<tr><td>400</td><td>46</td></tr>
<tr><td>800</td><td>78</td></tr>
<tr><td>1200</td><td>110</td></tr>
<tr><td>1400</td><td>127</td></tr>
<tr><td>5</td><td>network input jitter (Network_In_Jitter)</td><td>6.436
((30 * 0.078) + (32 * 0.128))
NOTE: The value 6.436 is based upon a packet size of 800 bytes.</td><td colspan="2">The formula is: ((number of RIO drops) * (network delay)) + ((number of distributed equipment hops[1]) * (0.128))</td></tr>
<tr><td>6</td><td>CPU input jitter (CPU_In_Jitter)</td><td>2.12
(1 + (0.07 * 16))</td><td colspan="2">CPU input queue delay.</td></tr>
<tr><td>7/8</td><td>CPU scan time (CPU_Scan)</td><td>–</td><td colspan="2">This is the user defined Unity Pro scan time, which can be either fixed or cyclic.</td></tr>
<tr><td>9</td><td>CPU output jitter (CPU_Out_Jitter)</td><td>2.2</td><td colspan="2">CPU output queue delay.</td></tr>
<tr><td>10</td><td>network output time[2] (Network_Out_Time)</td><td>2.496</td><td colspan="2">Computed in the same manner as network input time, above.</td></tr>
<tr><td>11</td><td>network output jitter (Network_Out_Jitter)</td><td>3.968
(16 * 0.128)</td><td colspan="2">Computed in the same manner as network output jitter.</td></tr>
<tr><td colspan="5">1. A hop is a switch that a packet passes through on the path from a source (transmitting) device to a destination (receiving) device. The total number of hops is the number of passthrough switches along the path.
2. Network input and output times may be increased when optical fiber is used.
increase = total length of fiber cables * 0.0034 ms/km</td></tr>
</table>

ID	Parameter	Max (ms)	Description
12	CRA drop process time (CRA_Drop_Process)	4.4	The sum of CRA queue delay and output scan time.
1. A *hop* is a switch that a packet passes through on the path from a source (transmitting) device to a destination (receiving) device. The total number of *hops* is the number of passthrough switches along the path. 2. Network input and output times may be increased when optical fiber is used. *increase* = total length of fiber cables * 0.0034 ms/km			

Estimating ART

Using the parameters described in the preceding table, you can compute the maximum estimated ART, based on the maximum number of RIO modules and distributed equipment, for an application, as follows:

ART = (2 * CRA_Drop_Process) + (RPI) + (Network_In_Time) + (Network_In_Jitter) + (CPU_In_Jitter) + (1 * CPU_Scan) + (CPU_Out_Jitter) + (Network_Out_Time) + (Network_Out_Jitter)

NOTE: If a cable break occurs or a cable is reconnected on the network, add an additional time period to the above ART calculation to allow for RSTP recovery. The additional time to be added equals: 50 ms + CPU_Scan/2.

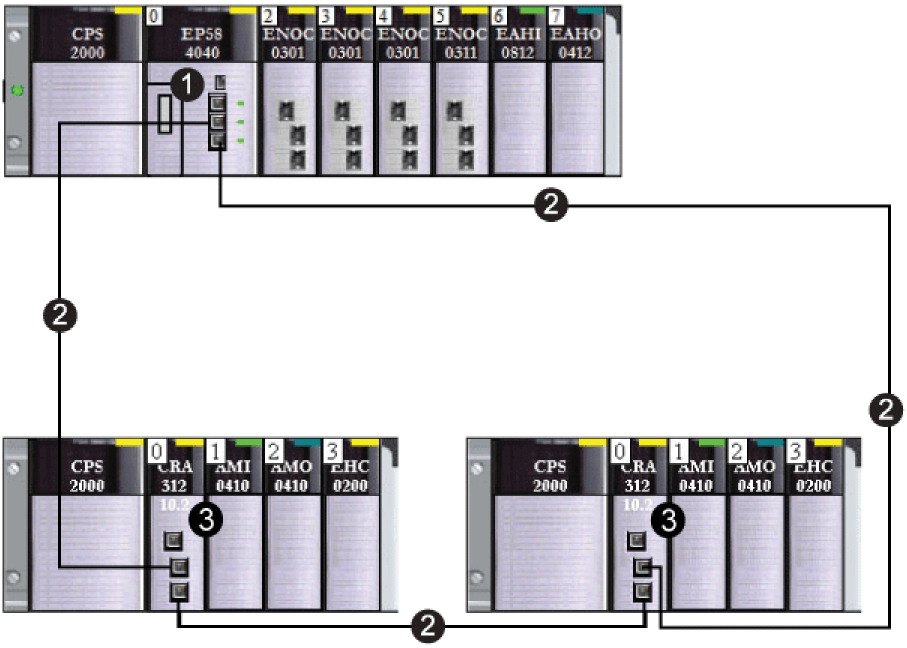
Application Response Time Examples

Introduction

The following examples are designed to help you calculate the application response time (ART) for an application.

Example 1: CPU with Ethernet I/O Scanner Service in a Main Ring

This example calculates ART from the perspective of the BM• CRA 312 •0 X80 EIO adapter module associated with the MAST task in an RIO main ring:



1 CPU with Ethernet I/O scanner service
2 main ring
3 RIO drop

In this example, ART is calculated from the perspective of the adapter module in the one of the RIO drops (devices 3 in this figure). Consider the following application-specific elements when calculating ART:

- The maximum potential hop count, that is, the maximum number of switches a packet might need to pass through from the adapter module (3) to the CPU with Ethernet I/O scanner service in the local rack (2), is 3.
  NOTE: The hop count includes all switches located along the route between the source input module and the CPU, including the switches embedded in the BM• CRA 312 •0 X80 EIO adapter module.
- Jitter is introduced into the system only from the 2 main ring drops.

Given these factors, ART computation parameters include:

Parameter	Maximum value (ms)	Comments
BM• CRA 312 •0 process time (CRA_Drop_Process)	4.4	The sum of BM• CRA 312 •0 input scan time and queue delay.
BM• CRA 312 •0 input RPI (RPI)	–	User defined. Default = 0.5 * CPU period.
network input time (Network_In_Time)	(0.078 * 3) = 0.234	Hop-count is 3 from the BM• CRA 312 •0 X80 EIO adapter module in the RIO drop (3) to the CPU with Ethernet I/O scanner service in the local rack (1), which includes the switches in both the BM• CRA 312 •0 X80 EIO adapter module and the CPU with Ethernet I/O scanner service.
network input jitter (Network_In_Jitter)	(0.078 * 2) = 0.156	For delay occasioned by devices (2) and (3).
CPU Ethernet I/O scanner service input jitter (CPU_In_Jitter)	(1 + (0.07 * 2)) = 1.14	To read packet
CPU scan time (CPU_Scan)	–	User defined, based on application.
CPU Ethernet I/O scanner service output jitter (CPU_Out_Jitter)	1.21	CPU Ethernet I/O scanner service internal queue delay
network output time (Network_Out_Time)	(0.078 * 3) = 0.234	Hop-count is 3 from the BM• CRA 312 •0 X80 EIO adapter module in the RIO drop (4) to the CPU with Ethernet I/O scanner service in local rack (2), which includes the switches in both the BM• CRA 312 •0 X80 EIO adapter module and the CPU with Ethernet I/O scanner service.
network output jitter (Network_Out_Jitter)	0	Does not apply. No distributed equipment is connected to the RIO network.
For an explanation of each parameter, refer to the ART Computation Parameters topic *(see page 172)*.		

Parameter	Maximum value (ms)	Comments
BM• CRA 312 •0 process time (CRA_Drop_Process)	4.4	The sum of the BM• CRA 312 •0 X80 EIO adapter module output scan time and queue delay
For an explanation of each parameter, refer to the ART Computation Parameters topic (*see page 172*).		

Recall that the ART formula is:

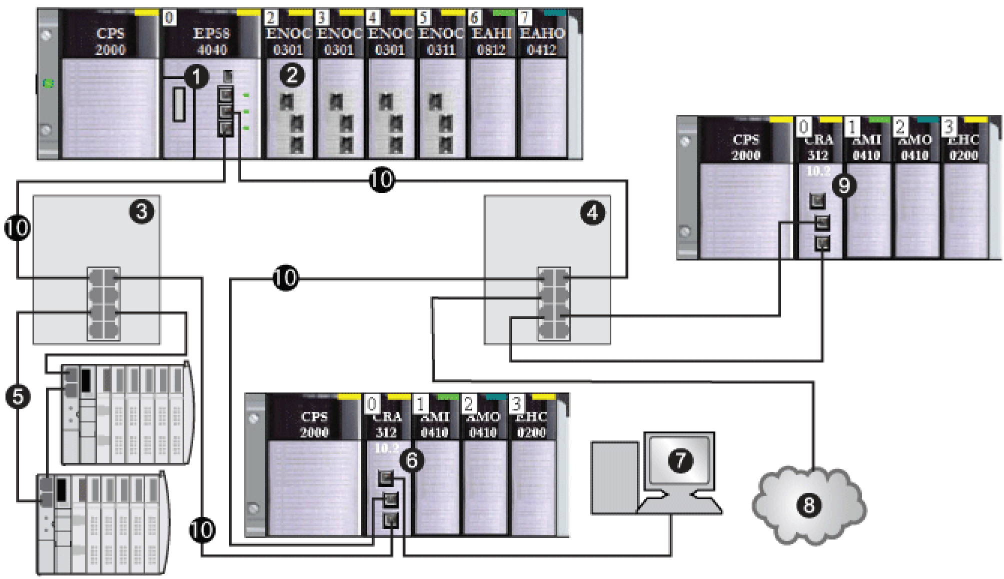
ART= (2*CRA_Drop_Process) + (RPI) + (Network_In_Time) + (Network_In_Jitter) + (CPU_In_Jitter) + (2*CPU_Scan) + (CPU_Out_Jitter) + (Network_Out_Time) + Network_Out_Jitter)

Thus, for a CPU scan time of 50 ms and RPI of 25 ms, maximum ART is:

max ART = (2*4.4) + 25 + 0.234 + 0.156 + 1.14 + (2*50) + 1.21 + 0.234 = 136.774 ms

Example 2: BM• CRA 312 •0 in an RIO Sub-ring

This example calculates the maximum ART, representing the longest packet path from a BM• CRA 312 •0 X80 EIO adapter module in an RIO sub-ring to the CPU with Ethernet I/O scanner service in the local rack. The calculation is performed from the perspective of the BM• CRA 312 •0 X80 EIO adapter module (9) in the following M580 network design:



1 CPU with Ethernet I/O scanner service on the local rack
2 BME NOC 03•1 Ethernet communication module (with the Ethernet backplane connection enabled), managing the distributed equipment on the device network
3 DRS on the main ring supporting a DIO sub-ring
4 DRS on the main ring supporting an RIO sub-ring and a DIO cloud

5 DIO sub-ring
6 RIO drop (with a BM• CRA 312 •0 X80 EIO adapter module) on the main ring
7 HMI device connected to the RIO drop (6)
8 DIO cloud
9 RIO drop in a sub-ring (with a BM• CRA 312 •0 X80 EIO adapter module)
10 main ring

In this example, ART is calculated from the perspective of the adapter module in the RIO drop (device 9 in this figure). Consider the following application-specific elements when calculating ART:

- The maximum potential hop count, that is, the maximum number of switches a packet might need to pass through from the RIO adapter module (9) to the CPU with Ethernet I/O scanner service in the local rack (1), is 8. This would be the case if a packet follows the path from the RIO drop (9), through a DRS (4), through the BM• CRA 312 •0 X80 EIO adapter module in an RIO drop (6), through a second DRS (3) to the local rack (1).
  NOTE: The hop count includes all switches located along the route between the source input module and the CPU, including the switches embedded in the BM• CRA 312 •0 X80 EIO adapter module.
- Jitter, also known as packet queue delay, is introduced into the system by the following design elements:
  - DIO sub-ring (5)
  - RIO sub-ring, on which the BM• CRA 312 •0 X80 EIO adapter module (9) is located
  - RIO drop (6)
  - HMI (7)
  - DIO cloud (8)

Given these factors, ART computation parameters include:

Parameter	Maximum value (ms)	Comments
CRA drop process time (CRA_Drop_Process)	4.4	The sum of CRA input scan time and queue delay.
CRA input RPI (RPI)	–	User defined. Default = 0.5 * CPU period.
network input time (Network_In_Time)	(0.078 * 7) = 0.546	Hop count is 7 from the BM• CRA 312 •0 X80 EIO adapter module in the RIO drop (8) to the CPU with Ethernet I/O scanner service in the local rack (1), which includes the switches in both the BM• CRA 312 •0 X80 EIO adapter module and the CPU.
network input jitter (Network_In_Jitter)	((0.078 * 3) + (0.128 * 4)) = 0.746	3 RIO packets from devices (1), (6), and (9) plus 4 DIO packets from distributed equipment (1), (5), (7) and (8)
CPU input jitter (CPU_In_Jitter)	(1 + (0.07 * 2)) = 1.14	To read packets from devices (9) and (7).
For an explanation of each parameter, refer to the topic ART Computation Parameters *(see page 172)*.		

Parameter	Maximum value (ms)	Comments
CPU scan time (CPU_Scan)	–	User defined, based on application.
CPU output jitter (CPU_Out_Jitter)	1.21	CPU Ethernet I/O service internal queue delay
network output time (Network_Out_Time)	(0.078 * 7) = 0.546	Hop-count is 8 from the BM• CRA 312 •0 X80 EIO adapter module in the RIO drop (9) to the CPU Ethernet I/O scanner service in the local rack (1), which includes the switches in both the BM• CRA 312 •0 X80 EIO adapter module and the CPU.
network output jitter (Network_Out_Jitter)	(0.128 * 4) = 0.512	Worst case, for devices (9), (4), (6), (3), and (1).
BM• CRA 312 •0 drop process time (CRA_Drop_Process)	4.4	The sum of the BM• CRA 312 •0 X80 EIO adapter module output scan time and queue delay.
For an explanation of each parameter, refer to the topic ART Computation Parameters *(see page 172)*.		

Recall that the ART formula is:

ART= (2*CRA_Drop_Process) + (RPI) + (Network_In_Time) + (Network_In_Jitter) + (CPU_In_Jitter) + (2*CPU_Scan) + (CPU_Out_Jitter) + (Network_Out_Time) + Network_Out_Jitter)

Thus, for a CPU scan time of 50 ms and RPI of 25 ms, maximum ART is:

max ART = (2*4.4) + 25 + 0.546 + 0.746 + 1.14 + (2*50) + 1.21 + 0.546 + 0.512 = 138.5 ms

NOTE: If a cable break exists on the network, add an additional time period, equal to 50 ms + RPI, to the above ART calculation. The added time allows for RSTP recovery from the cable break.

Optimizing Application Response Time

Overview

You can reduce the maximum application response time (ART) for your system, by employing these network design tips:

- use only the minimally required number of RIO drops (BM• CRA 312 •0 X80 EIO adapter modules)
- use only the minimally required number of RIO input and output modules
- place the RIO drops with the fastest communications capacity nearest to the local rack containing the CPU with Ethernet I/O scanner service

In addition, you can further reduce ART by using the FAST task in your Unity Pro logic.

Reducing the Number of RIO Drops

When you reduce the number of RIO drops in your system, you also reduce:

- the number of hops that a packet passes through from an RIO drop to the CPU with Ethernet I/O scanner service in the local rack
- the number of packets received by the CPU with Ethernet I/O scanner service

By reducing these values, you also reduce the following elements of ART:

- network input/output times
- network input/output jitter
- CPU with Ethernet I/O scanner service
- CPU scan time (the greatest savings)

Reducing the Number of Remote Input and Output Modules

When you reduce the number of RIO input and output modules, you also reduce the size of the packet, which in turn reduces the following elements of ART:

- network input/output time
- network input/output jitter
- BM• CRA 312 •0 module drop process time

Placing the Fastest RIO Drops Nearest to the Local Rack

When you place the fastest RIO drops nearest to the local rack, you reduce the number of hops that a packet passes through from the RIO drop to the local rack. You also reduce the following elements of ART:

- network input/output time
- network input/output jitter

Using the FAST Task to Optimize ART

Using the FAST task can result in smaller ART because the I/O data associated with the FAST task can be executed at a higher priority. ART when using FAST task is not degraded because of the task's priority.

NOTE: These efficiencies of the FAST task are not realized during end-of-scan delays.

	Scan Type	Period (ms) / Default Value	Watchdog (ms) / Default Value	Usage (I/O)
MAST[1]	cyclic[2] or periodic	1...255 / 20	10...1500 by 10 / 250	local and remote racks
FAST	periodic	1...255 / 5	10...500 by 10 / 100	local and remote racks[3]
AUX0	periodic	10...2550 by 10 / 100	100...5000 by 100 / 2000	local and remote racks[3]
AUX1	periodic	10...2550 by 10 / 200	100...5000 by 100 / 2000	local and remote racks[3]
I/O Event	event (128 maximum devices from 0 to 127)			local rack[4]

[1] The MAST task is mandatory.

[2] When set to cyclic mode, the minimum cycle time is 4 ms if there is an RIO network and 1 ms if there is no RIO network in the system.

[3] FAST and AUX tasks are supported for the BM• CRA 312 10 X80 EIO adapter modules only.

[4] DDDT syntax is not supported in the I/O event task.

The Unity Pro help pages further describe the multiple tasks.

Section 6.3
Communication Loss Detection Times

Communication Loss Detection Times

Overview

An M580 system can detect the existence of communication loss in the following ways:

- a broken cable is detected by a CPU with Ethernet I/O scanner service and a BM• CRA 312 •0 (e)X80 EIO adapter module
- a CPU with Ethernet I/O scanner service detects that a BM• CRA 312 •0 module has stopped communicating.
- a BM• CRA 312 •0 module detects that a CPU with Ethernet I/O scanner service has stopped communicating

The time required by the system to detect each type of communication loss is described below.

Broken Cable Detection Time

A CPU and a BM• CRA 312 •0 module can detect a broken or detached cable within 5 ms of the occurrence.

NOTE: A network that includes up to 16 drops and a CPU with RIO scanner service can recover communications within 50 ms from the time the cable break is detected.

NOTE: When a broken cable is connected to an RIO port and other cables on the ring are healthy, wait for the LINK LED (the status of the port) to appear before removing another cable in the system. If all links are broken simultaneously, the device goes into fallback state.

RIO Drop Loss Detection Time

A CPU with Ethernet I/O scanner service can detect and report the communication loss of a BM• CRA 312 •0 module within the time defined by the following formula:

Detection time = (xMultiplier * MAST period) + (CPU scan time), where:

- MAST period / 2 = RPI for the MAST task
- RPI = the input refresh rate from the BM• CRA 312 •0 module to the CPU
- xMultiplier is a value in the range 4...64. The value xMultiplier is determined by the following table:

MAST period / 2 (ms)	xMultiplier
2	64
3...4	32
5...9	16

MAST period / 2 (ms)	xMultiplier
10...21	8
≥ 22	4

For RPI details, refer to the *Connection Parameters* topic in the *Modicon M580 Remote I/O Modules Installation and Configuration Guide*.

CPU with Ethernet I/O Scanner Service Loss Detection Time

A BM• CRA 312 •0 module in an RIO drop can detect the communication loss of a CPU with Ethernet I/O scanner service within the time defined by the following formula:

Detection time = (xMultiplier x MAST period / 2) + (CPU scan time), where:

- MAST period / 2 = the output refresh rate from the CPU with Ethernet I/O scanner service to the BM• CRA 312 •0 module
- xMultiplier is a value in the range 4...64. The value xMultiplier is determined by the following table:

RPI (ms)	xMultiplier
2	64
3...4	32
5...9	16
10...21	8
≥ 22	4

Part III
M580 System Commissioning and Diagnostics

Introduction

This part describes M580 system commissioning and diagnostics.

What Is in This Part?

This part contains the following chapters:

Chapter 7
Commissioning

Overview

This chapter describes the commissioning process in an M580 system.

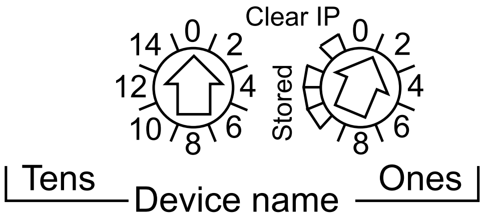
What Is in This Chapter?

This chapter contains the following topics:

Setting the Location of the Ethernet RIO Drop

Setting Rotary Switches

Set the location of the Ethernet RIO drop on the network with the rotary switches on the front of the BM• CRA 312 •0 X80 EIO adapter module before you apply power to the module and before you download the application:



The values you set are applied during a power cycle. If you change the switch settings after the module has powered up, the Mod Status LED is activated and a mismatch message is logged in the module diagnostic.

Because new values on the rotary switches are implemented only at the next power cycle, we recommend that you set the value before starting the module. (Valid values: 00 ... 159)

The values on the rotary switches combine with the device prefix (for example, BMECRA_*xxx* or BMXCRA_*xxx*) to create the device name (where *xxx* represents the value of the rotary switches). The preceding figure shows the Tens switch set to 0 and the Ones switch set to 01, for a device name of BMECRA_001.

NOTE:
- The rotary switches can be manipulated with a small flat-tipped screwdriver.
- No software is required to configure or enable the rotary switches.
- Do not use the Stored and Clear IP settings on the Ones rotary switch. (The functionality of these settings does not apply to RIO installations.)

Powering Up Modules Without a Downloaded Application

BME P58 •040 IP Address

In the absence of a valid application, a CPU with Ethernet I/O scanner service uses the IP address that is based on the MAC address printed on the front of the module. You can configure the IP address in Unity Pro as detailed in the *Modicon M580 Remote I/O Modules Installation and Configuration Guide* when you have downloaded an application.

BM• CRA 312 •0 IP Address

In the absence of an application, the BM• CRA 312 •0 X80 EIO adapter module unsuccessfully requests an IP address from a CPU with Ethernet I/O scanner service. The adapter module then derives an IP address from the MAC address printed on the front of the module. The module continues in this cycle because it does not have a valid configuration. This `Not Configured` state is indicated by the LED display on the front of the module. There are no exchanges with the CPU. Physical outputs of I/O modules in the RIO drops are in the fallback state (output forced at 0).

Downloading CPU Applications

Connecting to Unity Pro

To download the CPU application if your system **is not** configured, connect Unity Pro to one of the following:

- the USB port on the CPU
- the service port on the CPU

To download the CPU application if your system **is** configured, connect Unity Pro to one of the following:

- the USB port on the CPU
- the service port (configured as an access port) on the CPU or any network module
- the service port of a BM• CRA 312 •0 X80 EIO adapter module on an RIO drop on the main ring or a sub-ring
- to a DRS, which is needed when a sub-ring is used

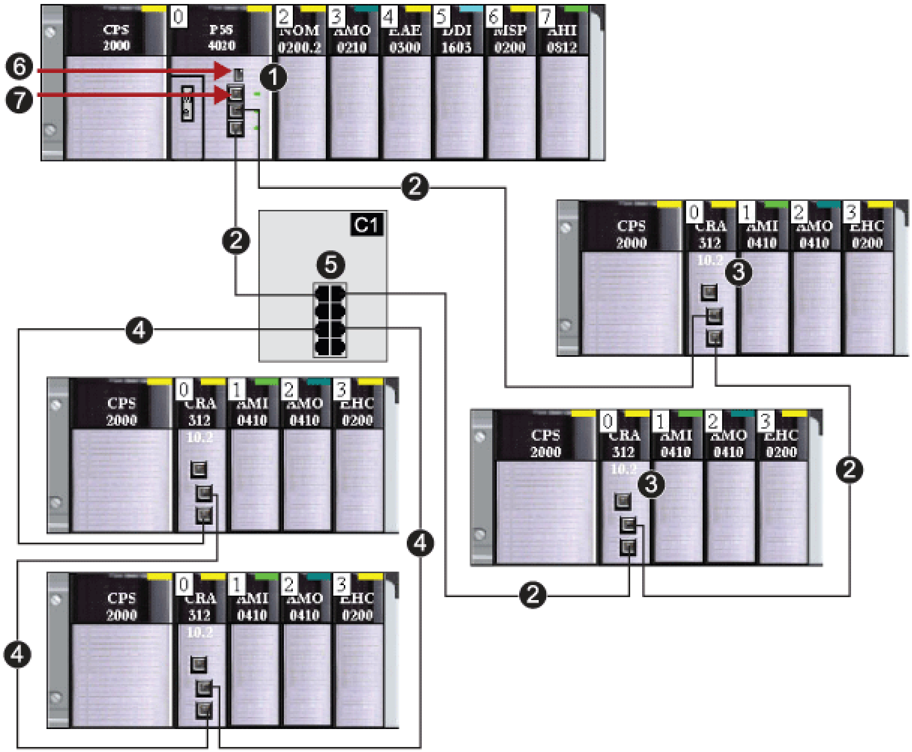
NOTE: Connecting to other ports requires QoS to be configured on the PC.

NOTE:

- Unity Pro is the only tool that can download the CPU application.
- If Unity Pro is connected to a CPU that has no configuration, the default IP address of the CPU is used.

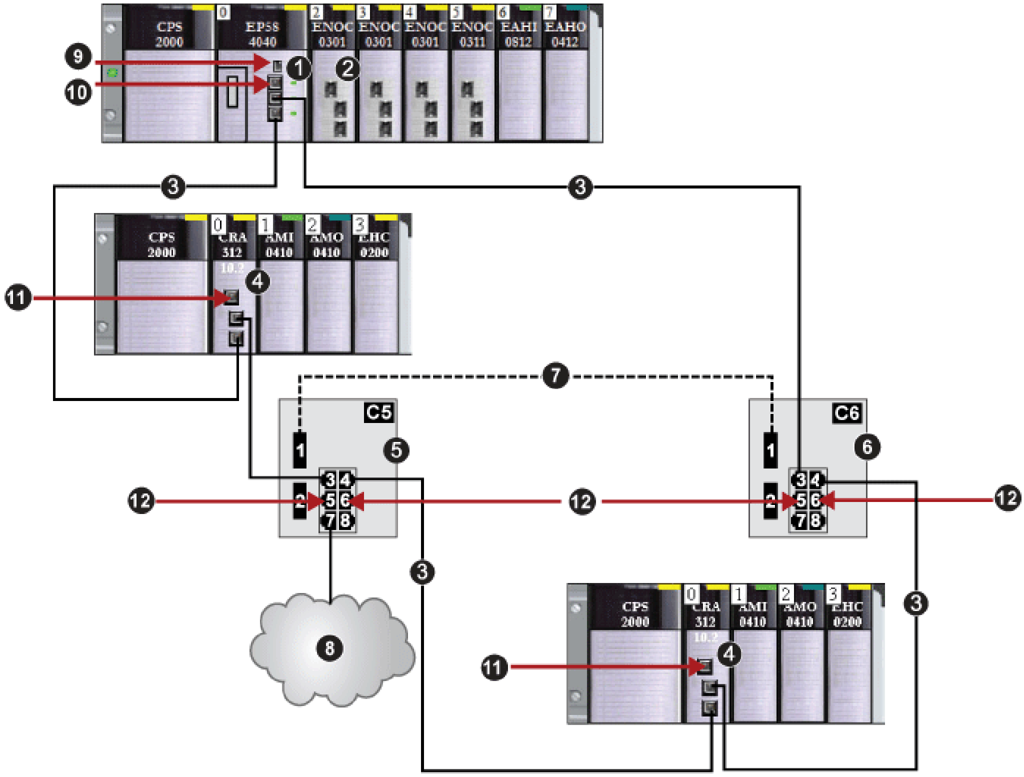
Examples

This figure shows the possible connections to Unity Pro when your system **is not** configured:



1 CPU with Ethernet I/O scanner service on the local rack
2 main ring
3 RIO drop (including the BM• CRA 312 •0 X80 EIO adapter module)
4 RIO sub-ring
5 DRS with a C1 predefined configuration file connecting the RIO sub-ring to the main ring
6 Unity Pro connection using the USB port on the CPU
7 Unity Pro connection using the service port on the CPU

This figure shows the possible connections to Unity Pro when your system **is** configured:



1 CPU with Ethernet I/O scanner service on the local rack

2 BME NOC 03•1 Ethernet communication module (with the Ethernet backplane connection enabled), managing the DIO cloud (8)

3 copper portion of the main ring

4 RIO drop (including the BM• CRA 312 10 X80 EIO adapter module)

5 DRS with a C5 predefined configuration file for a copper-to-fiber conversion

6 DRS with a C6 predefined configuration file for a fiber-to-copper conversion)

7 fiber portion of the main ring (to extend distance beyond 100 m)

8 DIO cloud

9 Unity Pro connection using the USB port on the CPU

10 Unity Pro connection using the service port on the CPU

11 Unity Pro connection using the service port on a BM• CRA 312 10 module

12 Unity Pro connection using a DIO port on a DRS

Establishing Transparency between a USB and Device Network

If your M580 system requires transparency between the PC connected to the PAC’s USB port and the device network, add a persistent static route in the PC routing table.

Example of a command to address a device network with the IP address `x.x.0.0` (for Windows):

```
route add x.x.0.0 mask 255.255.0.0 90.0.0.1 -p
```

Initial Start After Application Download

Reading the Configuration

At the end of the application download, the CPU configures all modules on the local rack. The CPU's Ethernet I/O scanner service reads from the CPU memory to get the configuration of the RIO drops declared in the Unity Pro configuration. The configuration of the RIO drops is used to configure the FDR server in the CPU.

At power up, each BM• CRA 312 •0 X80 EIO adapter module gets an IP address from the CPU's DHCP server. Then it reads its configuration from the FDR server in the CPU. Finally, the CPU's Ethernet I/O scanner service initializes the configured I/O modules in the rack.

NOTE: Verify that the IP address on each piece of distributed equipment is correct and unique before initial start.

NOTE: If the BM• CRA 312 •0 module is powered up first, the IP address is derived from the MAC address printed on the front of the module. The adapter module then performs checks to see if a DHCP server becomes available to distribute an IP address.

The RUN Command

Before receiving a RUN command from the CPU, all RIO drops are configured and connected to the CPU with Ethernet I/O scanner service. The RUN LEDs on the BM• CRA 312 •0 modules blink to indicate that the CPU is in the STOP state. In the RIO drops, the physical outputs remain in the fallback state (output forced to 0). Input values in the CPU memory image are interpreted as 0.

When the CPU is in RUN state, RIO drops change from the STOP to the RUN state. The LEDs on the BM• CRA 312 •0 module indicate this change. Output data received from the CPU are applied to physical outputs. Input images in the CPU are updated with physical inputs.

NOTE: For local I/O in the CPU or extended rack and for Premium I/O, there is no change in the comparison with previous versions of CPUs.

Powering Down/Powering Up Modules

Warm Restart

In a power-up sequence, the BM• CRA 312 •0 X80 EIO adapter module performs a complete reconfiguration. (There is no backup memory in the BM• CRA 312 •0 module for saving the configuration.)

A warm start occurs when, after a condition-generated shutdown, the system resumes and the programs running on that system continue at the point they were at when the shutdown occurred. No data is lost in a warm start as long as the CPU contains a valid configuration. When a warm start occurs in RUN mode, there is no requirement to re-execute the application program, even if there are detected errors on the RIO system (the CPU with Ethernet I/O scanner service, the BM• CRA 312 •0 module, or I/O modules are absent or inoperable).

After the CPU's Ethernet I/O scanner service restarts, it reads from the CPU memory to get the configuration of RIO drops declared in the Unity Pro configuration. The BM• CRA 312 •0 modules get the latest configuration.

Starting and Stopping an Application

CPU Transitions

CPU commands that change states:

Command	Description
`STOP CPU`	CPU tasks go to the STOP state.
`RUN CPU`	CPU tasks go to the RUN state.
`RUN Task`	The relevant tasks and the CPU go to the RUN state.
`STOP Task`	The relevant task goes to the STOP state. The CPU goes to the STOP state if this task was the last task in the RUN state.

NOTE:

- When the CPU switches from RUN to STOP, the output modules in RIO drops associated with this task go to the configured fallback state. Input values associated with this task in the CPU memory image are interpreted as 0.
- When the CPU switches from STOP to RUN, data received from the CPU are applied to the physical outputs associated with this task. Input images in the CPU are updated with physical inputs associated with this task.
- Refer to the *Modicon M580 Hardware Reference Manual* for CPU configuration options that help prevent remote commands from accessing the Run/Stop modes.

Chapter 8
System Diagnostics

Overview

This chapter describes system diagnostics in an M580 system.

NOTE:

For diagnostics at the module level, refer to the respective module user guide.

- For the CPU with Ethernet I/O scanner service, refer to the *Modicon M580 Hardware Reference Manual*.
- For the BM• CRA 312 •0 X80 EIO adapter module, refer to the *Modicon M580 Remote I/O Modules Installation and Configuration Guide*.
- For the BME NOC 03•1 Ethernet communication module, refer to the *Modicon M580 BME NOC 03•1 Ethernet Communication Module Installation and Configuration Guide*.

What Is in This Chapter?

This chapter contains the following topics:

System Diagnostics

Introduction

The following tables describe the various causes for communication interruption and where to detect these causes.

NOTE:

For detailed module diagnostic data, refer to the respective module user guide.

- For the CPU with Ethernet I/O scanner service, refer to the *Modicon M580 Hardware Reference Manual*.
- For the BM• CRA 312 •0 X80 EIO adapter modules, refer to the *Modicon M580 Remote I/O Modules Installation and Configuration Guide*.
- For the BME NOC 03•1 Ethernet communication module, refer to the *Modicon M580 BME NOC 03•1 Ethernet Communication Module Installation and Configuration Guide*.

NOTE: Refer to the *Unity Pro Program Languages and Structure Reference Manual* for a detailed explanation of system bits and words.

Web Page Diagnostics

The embedded web server in the M580 CPU displays data in standard HTML web pages. Access the embedded web pages on a PC, iPad, or Android tablet with these browsers:

- Internet Explorer (v8 or later)
- Google Chrome (v11 or later)
- Mozilla Firefox (v4 or later)
- Safari (v5.1.7 or later)

Diagnosing the CPU

Status of...	Module [1]	User Application [2]	Unity Pro [3]	Rack Viewer [5]	Ethernet Management Tool [6]
CPU reset	BME P58 •0•0	in CPU DDDT		yes	yes
CPU inoperable	BME P58 •0•0	in CPU DDDT		yes	yes

1. Refer to the module LED to detect a pulled cable, an inoperable module, or reset module (LED on, off, or flashing to display status or detected error pattern).
2. Refer to your application to detect the module status (link Ethernet port, EIP scanner status, DDDT, system words).
3. Use the DTM browser in Unity Pro to detect whether a CPU is inoperable or has been reset.
4. Not applicable.
5. Use the rack viewer to detect if a CPU is inoperable or has been reset.
6. Use ConneXium Network Manager, HiVision, or other Ethernet network management tool to detect if a CPU is inoperable or has been reset.

Diagnosing Ethernet Communication Modules in the Local Rack

Status of...	Module [1]	User Application [2]	Unity Pro [3]	Rack Viewer [5]	Ethernet Management Tool [6]
BME NOC 03•1 Ethernet backplane connection broken	BME NOC 03•1 active LED				
BME NOC 03•1 reset	BME NOC 03•1 LED	BME NOC 03•1 health bit (in CPU system word) I/O scanner connection status	DTM online diagnostic inoperable	yes	yes
BME NOC 03•1 inoperable	BME NOC 03•1 LED	BME NOC 03•1 health bit (in CPU system word) I/O scanner connection status	DTM online diagnostic inoperable	yes	yes

1. Refer to the module LED to detect a pulled cable, an inoperable module, or reset module (LED on, off, or flashing to display status or detected error pattern).
2. Refer to your application to detect the module status (link Ethernet port, EIP scanner status, DDDT, system words).
3. Use the DTM browser in Unity Pro to detect whether a BME NOC 03•1 is inoperable or has been reset.
4. Not applicable.
5. Use the FactoryCast rack viewer to detect if a BME NOC 03•1 is inoperable or has been reset.
6. Use ConneXium Network Manager, HiVision, or other Ethernet network management tool to detect if a BME NOC 03•1 is inoperable or has been reset.

Diagnosing the Ethernet RIO Network

Status of...	Module [1]	User Application [2]	Embedded Web Page [4]	Rack Viewer [5]	Ethernet Management Tool [6]
Ethernet RIO Network					

1. Refer to the module LED to detect a pulled cable or a powered-off device (LED on, off, or flashing to display status or detected error pattern).
2. Refer to your application (via system word, CPU DDDT, or DATA_EXCH block) to detect a pulled cable, a powered-off device, a break in the main ring or sub-ring, or slow network traffic.
3. Not applicable.
4. Use the DRS web pages to detect a pulled cable or a break in the main ring.
5. Use the rack viewer to detect if a CPU is inoperable or has been reset.
6. Use ConneXium Network Manager, HiVision, or other Ethernet network management tool to detect a pulled cable in a CPU, BM• CRA 312 •0 X80 EIO adapter module, or DRS. Also use this tool to detect DRS power state and slow DIO traffic.

Status of...	Module [1]	User Application [2]	Embedded Web Page [4]	Rack Viewer [5]	Ethernet Management Tool [6]
duplicate IP address in CPU or BMX CRA 312 •0	BME P58 •0•0 LED BM• CRA 312 •0 LED				
CPU (single) cable pulled out	BME P58 •0•0 active LED	CPU status byte CPU DDDT		yes	yes
BM• CRA 312 •0 (single) cable pulled out	BM• CRA 312 •0 ACT LED	drop connection status (in CRA DDDT)			yes
dual-ring switch (DRS) powered off	DRS power LED	DATA_EXCH block: monitor DRS (port 5 and 6)			yes
dual-ring switch (DRS) cable pulled out	DRS ACT LED	DATA_EXCH block: monitor DRS (port 5 and 6)	DRS web		yes
main ring cable broken *(see page 203)*		EIO system bit (part of CPU DDT)	DRS web (only if cable on DRS port is broken)		
sub-ring cable broken *(see page 204)*		DATA_EXCH block: monitor DRS (port 5 and 6)	DRS web		
RIO traffic too slow (due to bad configuration or cabling)		DATA_EXCH block: monitor DRS (port 5 and 6) Also possible via CRA DDDT	DRS web		
DIO traffic too slow (generate too much traffic)		DATA_EXCH block: monitor DRS (port 5 and 6)	DRS web		MIB

1. Refer to the module LED to detect a pulled cable or a powered-off device (LED on, off, or flashing to display status or detected error pattern).
2. Refer to your application (via system word, CPU DDDT, or DATA_EXCH block) to detect a pulled cable, a powered-off device, a break in the main ring or sub-ring, or slow network traffic.
3. Not applicable.
4. Use the DRS web pages to detect a pulled cable or a break in the main ring.
5. Use the rack viewer to detect if a CPU is inoperable or has been reset.
6. Use ConneXium Network Manager, HiVision, or other Ethernet network management tool to detect a pulled cable in a CPU, BM• CRA 312 •0 X80 EIO adapter module, or DRS. Also use this tool to detect DRS power state and slow DIO traffic.

Diagnosing Ethernet RIO Drops

Status of...	**Module [1]**	**User Application [2]**	**Rack Viewer [5]**	**ConneXium Network Manager [6]**
Ethernet RIO Drops				
BM• CRA 312 •0 powered off or disconnected	BM• CRA 312 •0 LED	drop connection status (in CPU DDDT) detected drop error status (in CPU DDDT)		yes
BM• CRA 312 •0 not configured	BM• CRA 312 •0 LED CPU LED	drop connection status (in CPU DDDT) detected drop error status (in CPU DDDT)		yes (It does not appear on the screen.)
extended rack inoperable (detected fault in BM• XBE 100 00 or cable)	module PWR LED	remote module health bits (in device DDDT)	yes	

1. Refer to the module LED to detect a powered-off, disconnected or unconfigured BM• CRA 312 •0 X80 EIO adapter module or to detect an inoperable extended rack (LED on, off, or flashing to display status or detected error pattern).
2. Refer to your application (via system word) to detect a powered-off, disconnected or unconfigured BM• CRA 312 •0 X80 EIO adapter module or to detect an inoperable extended rack.
3. Not applicable.
4. Not applicable.
5. Use the FactoryCast rack viewer to detect a powered-off, disconnected or unconfigured BM• XBE 100 00 module.
6. Use ConneXium Network Manager, HiVision, or other Ethernet network management tool to detect a a powered-off, disconnected or unconfigured BM• CRA 312 •0 X80 EIO adapter module.

Diagnosing RIO Modules

Status of...	**Module [1]**	**User Application [2]**	**Rack Viewer [5]**
RIO Modules			
module absent, inoperable, or misplaced	May be possible via LEDs	remote module health bit (in CPU DDDT and in Device DDT (for Modicon X80 modules))	yes

1. Refer to the module LED to detect status (LED on, off, or flashing to display status or detected error pattern).
2. Refer to your application (via system word or status byte) to detect module status, including absent, inoperable, or misplaced module.
3. Not applicable.
4. Not applicable.
5. Use the FactoryCast rack viewer to detect module status, including absent, inoperable, or misplaced module.
6. Not applicable.

Status of...	Module [1]	User Application [2]	Rack Viewer [5]
module status	module LED (depends on module)	module's status byte	yes

1. Refer to the module LED to detect status (LED on, off, or flashing to display status or detected error pattern).
2. Refer to your application (via system word or status byte) to detect module status, including absent, inoperable, or misplaced module.
3. Not applicable.
4. Not applicable.
5. Use the FactoryCast rack viewer to detect module status, including absent, inoperable, or misplaced module.
6. Not applicable.

Diagnosing Distributed Equipment

Status of...	User Application [2]	Rack Viewer [5]	ConneXium Network Manager [6]
Distributed Equipment			
disconnected	CPU connection status	yes	yes

1. Not applicable.
2. Refer to your application (via CPU connection status) to detect disconnected distributed equipment.
3. Not applicable.
4. Not applicable.
5. Use the FactoryCast rack viewer to detect module status, including absent, inoperable, or misplaced module.
6. Not applicable.

Main Ring Diagnostics

Diagnosing the RIO Main Ring

You can monitor breaks in the main ring by diagnosing the `REDUNDANCY_STATUS` bits in the CPU with Ethernet I/O scanner service on the local rack DDT. The system detects and reports in this bit a main ring cable break that persists for at least 5 seconds.

Within the `REDUNDANCY_STATUS` bit:
- 0 = Cable is broken or device has stopped.
- 1 = Loop is present and healthy.

NOTE: Refer to the *Modicon M580 Remote I/O Modules Installation and Configuration Guide* for a list of diagnostic status bits.

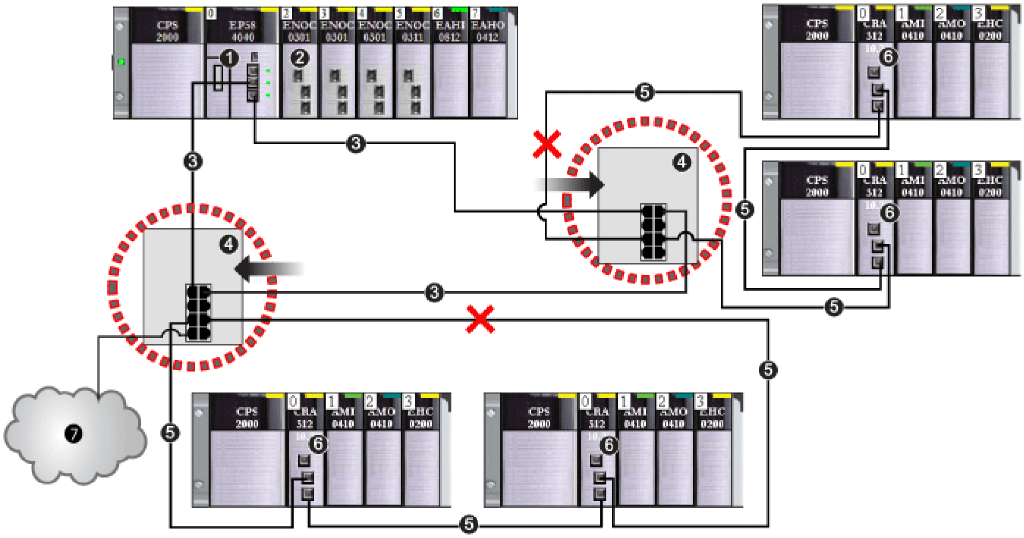
Sub-Ring Diagnostics

Detecting a Sub-ring Break via DRS

This topic describes how to detect a cable break in a sub-ring on the RIO network by diagnosing a DRS.

Step	Action
1	Write a `DATA_EXCH` block to the DRS managing the sub-ring of interest. **NOTE:** Use the CPU with Ethernet I/O scanner service to send `DATA_EXCH` commands to diagnose the status of sub-rings. For other operations (get remote statistics, read data, etc.), we recommend that you send a `DATA_EXCH` command from a communication module on the local rack.
2	Read the states of ports 5 and 6 on the DRS. The possible port state values are: **1** disabled **2** blocking **3** listening **4** learning **5** forwarding **6** broken
3	● If either port 5 or 6 is in a blocking state (2), then the loop is present and healthy (no cable break.) ● If both ports 5 and 6 are in any other state besides blocking state (2), then there is a cable break on the sub-ring.

This graphic shows breaks in 2 sub-rings connected by DRSs on the main ring. The arrows point to the DRSs, on which you monitor ports 5 and 6 in your application using a DATA_EXCH block:

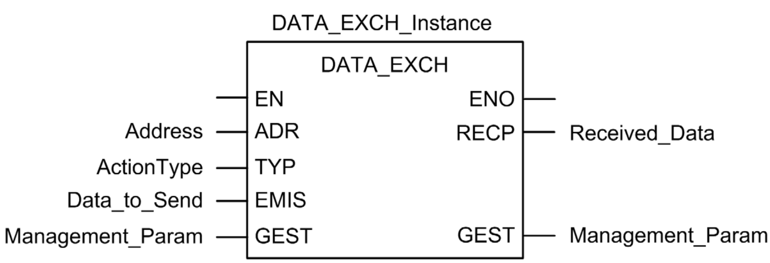


1 CPU with Ethernet I/O scanner service on the local rack
2 BME NOC 03•1 Ethernet communication module (with the Ethernet backplane connection enabled), managing the DIO cloud (7)
3 main ring
4 DRS connected to the main ring and RIO sub-rings
5 RIO sub-ring with a communication break (indicated by an **X**)
6 RIO drop (including a BM• CRA 312 •0 X80 EIO adapter module)
7 DIO cloud connected to a DRS

NOTE: When you add or remove devices from your network configuration, modify the sub-ring cable break logic in your application.

Writing a DATA_EXCH Block to Diagnose a Sub-ring Break

This is an example of a DATA_EXCH block created in a Unity Pro application to read the DRS ports 5 and 6 state.



In the Unity Pro application, write a DATA_EXCH block to send an EIP explicit message to the DRS that is managing the sub-ring. This EIP explicit message can be sent via the BM• CRA 312 •0 module or other communication module that is managing devices in the device network.

NOTE: Use a CPU with Ethernet I/O scanner service to send DATA_EXCH commands to diagnose the status of sub-rings.

To create the DATA_EXCH block, create and assign variables, and connect the block to an AND block. The logic continuously sends an explicit message when it receives confirmation of success or detected error.

Refer to the Explicit Messaging topic in the *Modicon M340 BMX NOC 0401 Ethernet Communication Module User Manual* for details on using the DATA_EXCH block.

Input Parameters

Create variables and assign input pins. In this example, variables have been created (and named) as described below. (You can use different variable names in your explicit messaging configurations.)

Parameter	Data Type	Description
Address	Array [0...7] of INT	The path to the DRS. Use the ADDM function.
ActionType	INT	The type of action to perform. The setting = 1 (transmission followed by await reception).
Data_to_Send	Array [n...m] of INT	

Input/Output Parameters

Create variables and assign input pins. In this example, variables have been created (and named) as described below. (You can use different variable names in your explicit messaging configurations.)

Parameter	Data Type	Description
Management_Param	Array [0...3] of INT	consists of 4 words

Output Parameters

Create variables and assign output pins. In this example, variables have been created (and named) as described below. (You can use different variable names in your explicit messaging configurations.)

Parameter	Data Type	Description
Received_Data	Array [n...m] of INT	the EtherNet/IP (CIP) response

Part IV

Cyber Security

Chapter 9
Cyber Security

Introduction

Cyber security is a branch of network administration that addresses attacks on or by computer systems and through computer networks that can result in accidental or intentional disruptions. The objective of cyber security is to help provide increased levels of protection for information and physical assets from theft, corruption, misuse, or accidents while maintaining access for their intended users.

No single cyber security approach is adequate. Schneider Electric recommends a defense-in-depth approach. Conceived by the National Security Agency (NSA), this approach layers the network with security features, appliances, and processes. The basic components of this approach are:

- risk assessment
- a security plan built on the results of the risk assessment
- a multi-phase training campaign
- physical separation of the industrial networks from enterprise networks using a demilitarized zone (DMZ) and the use of firewalls and routing to establish other security zones
- system access control
- device hardening
- network monitoring and maintenance

This chapter defines the elements that help you configure a system that is less susceptible to cyber attacks. For detailed information on the defense-in-depth approach, refer to the *TVDA: How Can I Reduce Vulnerability to Cyber Attacks in the Control Room* on the Schneider Electric website.

What Is in This Chapter?

This chapter contains the following topics:

What is Cyber Security?

Introduction

Cyber threats are deliberate actions or accidents that can disrupt the normal operations of computer systems and networks. These actions can be initiated from within the physical facility or from an external location. Security challenges for the control environment include:

- diverse physical and logical boundaries
- multiple sites and large geographic spans
- adverse effects of security implementation on process availability
- increased exposure to worms and viruses migrating from business systems to control systems as business-control communications become more open
- increased exposure to malicious software from USB devices, vendor and service technician laptops, and the enterprise network
- direct impact of control systems on physical and mechanical systems

Sources of Cyber Attacks

Implement a cyber security plan that accounts for various potential sources of cyber attacks and accidents, including:

Source	Description
internal	• inappropriate employee or contractor behavior • disgruntled employee or contractor
external opportunistic (non-directed)	• script kiddies* • recreational hackers • virus writers
external deliberate (directed)	• criminal groups • activists • terrorists • agencies of foreign states
accidental	
* slang term for hackers who use malicious scripts written by others without necessarily possessing a comprehensive understanding of how the script works or its potential impact on a system	

A deliberate cyber attack on a control system may be launched to achieve a number of malicious results, including:

- disrupt the production process by blocking or delaying the flow of information
- damage, disable, or shut down equipment to negatively impact production or the environment
- modify or disable safety systems to cause intentional harm

How Attackers Gain Access

A cyber attacker bypasses the perimeter defenses to gain access to the control system network. Common points of access include:

- dial-up access to remote terminal unit (RTU) devices
- supplier access points (such as technical support access points)
- IT-controlled network products
- corporate virtual private network (VPN)
- database links
- poorly configured firewalls
- peer utilities

Cyber Security Certifications

Schneider Electric developed cyber security guidelines based on the following recommendations:

- Achilles
- ISA Secure

Questions?

To submit a cyber security question, report security issues, or get the latest news from Schneider Electric, visit our *website*.

Schneider Electric Guidelines

Introduction

Your PC system can run a variety of applications to enhance security in your control environment. The system has factory default settings that require reconfiguration to align with Schneider Electric's device hardening recommendations of the defense-in-depth approach.

The following guidelines describe procedures in a Windows 7 operating system. They are provided as examples only. Your operating system and application may have different requirements or procedures.

Disabling Unused Network Interface Cards

Verify that network interface cards not required by the application are disabled. For example, if your system has 2 cards and the application uses only one, verify that the other network card (Local Area Connection 2) is disabled.

To disable a network card in Windows 7:

Step	Action
1	Open **Control Panel** →**Network and Internet** →**Network and Sharing Center** →**Change Adapter Settings**.
2	Right-click the unused connection. Select **Disable**.

Configuring the Local Area Connection

Various Windows network settings provide enhanced security aligned with the defense-in-depth approach that Schneider Electric recommends.

In Windows 7 systems, access these settings by opening **Control Panel** →**Network and Internet** →**Network and Sharing Center** →**Change Adapter Settings** →**Local Area Connection (x).**

This list is an example of the configuration changes you might make to your system on the **Local Area Connection Properties** screen:

- Disable all IPv6 stacks on their respective network cards. (This system example does not require the IPv6 address range and disabling the IPv6 stacks limits vulnerability to potential IPv6 security risks.
- Deselect all **Local Area Connection Properties** items except for **QoS Packet Scheduler** and **Internet Protocol Version 4**.
- Under the **Wins** tab on **Advanced TCP/IP Settings**, deselect the **Enable LMHOSTS** and **Disable NetBIOS over TCP/IP** check boxes.
- Enable **File and Print Sharing for Microsoft Network**.

Schneider Electric's defense-in-depth recommendations also include the following:

- Define only static IPv4 addresses, subnet masks, and gateways.
- Do not use DHCP or DNS in the control room.

Managing Windows Firewall

Schneider Electric’s defense-in-depth approach recommendations include enabling the Windows host firewall on all system PCs. Enable the firewalls for any public or private profile listed.

Managing the Network Time Server

NOTE: The following information is applicable only if the network time server in your system is implemented on a host PC.

Each PC and system in your system receives its time updates from the firewall bounding its security zone. Configure your network time server (NTP), start the service, configure the W32time service settings, and configure the NTP server’s host firewall ports, as follows:

Configuring the NTP Server	
1	In a command window, execute `gpedit.msc` to open the Group Policy tool.
2	Open **Administrative Templates** →**System** →**Windows Time Service** →**Time Providers**.
3	Double-click **Enable Windows NTP Server**.
4	On the **Enable Windows NTP Client Properties** page, select **Enabled** →**OK**.
5	On the **Time Providers** page, double-click **Configure Windows NTP Client**.
6	On the **Configure Windows NTP Client Properties page**, set the following values: ● **Configure Windows NTP Client**: enabled ● **NtpServer**: Time-b.nist.gov ● **Type**: NTP
7	Click **OK**.
Starting the Service	
1	In a command window, execute `services.msc` to open the Services tool.
2	Double-click **Windows Time**.
3	On the **Windows Time Properties** screen, change **Startup Type** to **Automatic**.
4	Click **Start** to start the service.
Configuring W32time	
1	In a command window, execute `w32tm /config /sychfromflags:manual /manualpeerlist:time-b.nist.gov /update` **NOTE:** This command configures the windows time service (w32tm) to synchronize with the time-b.nist.gov /update time.
2	I a command window, execute `sc triggerinfor w32time start/networkon stop/networkoff` **NOTE:** Rebooting the server does not automatically start the w32tm service if the system is not in a domain. The `sc triggerinfo` command configures the w32time to start on the first IP address and stop on zero IP address.
Configuring the NTP Server’s Host Firewall Ports **NOTE:** NTP servers receive packets over port 123. The following steps open port 123 for inbound connections.	

1	Open **Control Panel** →**Windows Firewall** →**Advanced Settings** →**Inbound Rules**.
2	Click **New Rule**.
3	On the **Rule Type** page, select **Port**. Click **Next**.
4	On the **Protocol and Ports** page: ● Select **UDP** in the **Protocol type** field. ● Select **Specific Ports**. ● Enter **123** in the **Specific Local Ports** field. ● Click **Next**.
5	On the **Action** page, select **Allow this Connection**. Click **Next**.
6	On the **Profile** page, select **Domain**, **Public**, and **Private**. Click **Next**.
7	On the **Name** page, enter **NTP Server** in the **Name** field.
8	Return to the **Inbound Rules** page, and verify that the new rule is present with the following parameter values: ● **Name**: NTP Server ● **Profile**: All ● **Enabled**: Yes ● **Action**: Allow ● **Override**: No ● **Program**: Any ● **Local Address**: Any ● **Remote Address**: Any ● **Protocol**: UPD ● **Local Port**: 123 ● **Remote Port**: Any ● **Allowed Users**: Any ● **Allowed Computers**: Any

Disabling the Remote Desktop Protocol

Schneider Electric's defense-in-depth approach recommendations include disabling remote desktop protocol (RDP) unless your application requires the RDP. The following steps describe how to disable the protocol:

Step	Action
1	In Windows 2008R2 or Windows 7, disable RDP via **Computer** →**System Properties** → **Advanced System Settings**.
2	On the **Remote** tab, deselect the **Allow Remote Assistance Connections to this Computer** check box.
3	Select the **Don't Allow Connection to this Computer** check box.

Updating Security Policies

Update the security policies on the PCs in your system by `gpupdate` in a command window. For more information, refer to the Microsoft documentation on `gpupdate`.

Disabling LANMAN and NTLM

The Microsoft LAN Manager protocol (LANMAN or LM) and its successor NT LAN Manager (NTLM) have vulnerabilities that make their use in control applications inadvisable.

The following steps describe how to disable LM and NTLM in a Windows 7 or Windows 2008R2 system:

Step	Action
1	In a command window, execute `secpol.msc` to open the **Local Security Policy** window.
2	Open **Security Settings** →**Local Policies** →**Security Options**.
3	Select **Send NTLMv2 response only. Refuse LM & NTLM** in the **Network Security: LAN Manger authentication level** field.
4	Select the **Network Security: Do not store LAN Manager hash value on next password change** check box.
5	In a command window, enter `gpupdate` to commit the changed security policy.

Managing Updates

Before deployment, update all PC operating systems using the utilities on Microsoft's **Windows Update** Web page. To access this tool in Windows 2008R2, Windows 7, or Windows XP, select **Start** →**All Programs** →**Windows Update**.

Managing Enhanced Write Filter

Enhanced write filter (EWF) is a feature of Windows XP Embedded and Windows Embedded Standard 7 machines, which filters writes to another volume.

Step	Action
1	Before you load any software on Windows XP Embedded machines, disable the enhanced write filter (EWF) function by executing `ewfmgr c: -commitanddisable -live` in a command window and rebooting the machine.
2	After you install updates or software, enable EWF by executing `ewfmgr c: -enable` in a command window and rebooting the machine.

NOTE: Schneider Electric recommends running the *Microsoft Threat Analyzer* after each application installation and the *Microsoft Baseline Security Analyzer* (MBSA) prior to installing updates or software and after installation. Follow the security remediation suggestions offered by the MBSA, which will record a history of the security changes you make in your system. You can download this program at http://www.microsoft.com.

Managing Accounts

Introduction

Schneider Electric recommends the following regarding account management:

- Create a standard user account with no administrative privileges.
- Use the standard user account to launch applications. Use more privileged accounts to launch an application only if the application requires higher privilege levels to perform its role in the system.
- Use an administrative level account to install applications.

Managing User Account Controls (UAC) (Windows 7)

To block unauthorized attempts to make system changes, Windows 7 grants applications the permission levels of a normal user, with no administrative privileges. At this level, applications cannot make changes to the system. UAC prompts the user to grant or deny additional permissions to an application. Set UAC to its maximum level. At the maximum level, UAC prompts the user before allow an application to make any changes that require administrative permissions.

To access UAC settings in Windows 7, open **Control Panel** →**User Accounts and Family Safety** →**User Accounts** →**Change User Account Control Settings**. Or enter **UAC** in the Windows 7 **Start Menu** search field.

Managing Passwords

Introduction

Password management is one of the fundamental tools of device hardening, which is the process of configuring a device against communication-based threats. Schneider Electric recommends the following password management guidelines:

- Enable password authentication on all email and Web servers, CPUs, and Ethernet interface modules.
- Change all default passwords immediately after installation, including those for:
  - user and application accounts on Windows, SCADA, HMI, and other systems
  - scripts and source code
  - network control equipment
  - devices with user accounts
  - FTP servers
- Grant passwords only to people who require access. Prohibit password sharing.
- Do not display passwords during password entry.
  - Require passwords that are difficult to guess. They should contain at least 8 characters and should combine upper and lower case letters, digits, and special characters when permitted.
- Require users and applications to change passwords on a scheduled interval.
- Remove employee access accounts when employment has terminated.
- Require different passwords for different accounts, systems, and applications.
- Maintain a secure master list of administrator account passwords so they can be quickly accessed in the event of an emergency.
- Implement password management so that it does not interfere with the ability of an operator to respond to an event such as an emergency shutdown.
- Do not transmit passwords via email or other manner over the insecure Internet.

Managing Passwords in Unity Pro

When you create an application in Unity Pro, create a password.

- Choose a password that contains alphanumeric characters, and is case-sensitive. Unity Pro encrypts the password, and stores it in the application.
- Choose a password that contains a minimum of 8 characters.
- Choose a password that is difficult to guess.
  - The password should combine upper and lower case letters, digits, and special characters.

When you open an existing application, the **Application Password** dialog box opens. Type your password, and click **OK**.

Creating / Changing Application Passwords

To create or change your Unity Pro application password, follow these steps:

Step	Action
1	Right-click **your project name** →**Properties** in the **Project Browser**. **Result**: The **Properties of Project** dialog box opens.
2	Click the **Protection** tab.
3	In the **Application** field, click **Change password**. **Result**: The **Modify Password** dialog box opens.
4	• To enter a ***new*** password, type the password in the **Entry** field. Retype the password in the **Confirmation** field, and click **OK**. • To change an ***existing*** password, type the current password in the **Old password** field. Type the new password in the **Entry** field. Retype the new password in the **Confirmation** field, and click **OK**.
5	In the **Properties of Project** dialog box, click **Apply** to save the changes, or click **OK** to save and close.

Removing Application Passwords

To remove your Unity Pro application password, follow these steps:

Step	Action
1	Right-click **your project name** →**Properties** in the **Project Browser**. **Result**: The **Properties of Project** dialog box opens.
2	Click the **Protection** tab.
3	In the **Application** field, click **Clear password**. **Result**: The **Access Control** dialog box opens.
4	Type the password in the **Password** field, and click **OK**.
5	In the **Properties of Project** dialog box, click **Apply** to save the changes, or click **OK** to save and close.

Managing the Auto Lock Feature

Follow these steps to establish the amount of time that a password is required to activate a locked application.

Step	Action
1	Right-click **your project name** →**Properties** in the **Project Browser**. **Result**: The **Properties of Project** dialog box opens.
2	Click the **Protection** tab.
3	In the **Application** field, select the **Auto-lock** check box.
4	Click the up / down arrows to select the desired number of minutes before a password is required to unlock a locked application.
5	In the **Properties of Project** dialog box, click **Apply** to save the changes, or click **OK** to save and close.

Resetting a Forgotten Password

You have 3 attempts to enter your Unity Pro or CPU application password correctly. If you forget your password, follow these steps to reset it.

Step	Action
1	When the **Application Password** dialog box opens, press **Shift + F2**. **Result**: A grayed number (ex: 57833) appears in the dialog box.
2	Contact your local Schneider Electric customer support. Give this grayed number to the support representative.
3	Type the temporary password in the **Application Password** dialog box that customer support gives you.
4	Modify the temporary password *(see page 218)*.
5	Click **Build** →**Rebuild All Project**.
6	Click Save.

Managing the Data Storage Password

Introduction

By default, the data storage password is **datadownload**.

Unity Pro only allows you to **change** or **reset** the password.

NOTE: When importing a ZEF file, the application data storage password is set to its default value: **datadownload**.

How to Change the Data Storage Password

To change the data storage password:

Step	Action
1	Right-click **your project name** →**Properties** in the **Project Browser**. **Result**: The **Properties of Project** dialog box opens.
2	Click the **Protection** tab.
3	In the **Data Storage** area, click the **Change password ...** button.
4	Enter the old password in the **Old password** field.
5	Type the new password in the **Entry** field.
6	Confirm the new password in the **Confirmation** field.
7	Click **OK** to save the changes. **NOTE:** If you enter an incorrect old password, the message **Wrong Password!** is displayed.

How to Reset the Data Storage Password

To reset the data storage password:

Step	Action
1	Right-click **your project name** →**Properties** in the **Project Browser**. **Result**: The **Properties of Project** dialog box opens.
2	Click the **Protection** tab.
3	In the **Data Storage** area, click the **Reset password ...** button.
4	Enter the old password in the **Password** field.
5	Click **OK** to reset the password to its default value:**datadownload**. **NOTE:** If you enter an incorrect old password, the message **Wrong Password!** is displayed.

Managing Integrity Checks

Introduction

You can use an integrity check feature in Unity Pro on an authorized PC to help prevent Unity Pro files from being changed via a virus / malware through the Internet.

The integrity check feature concerns the following components:
- DLLs
- Unity Pro hardware catalog
- libset and object files of EFBs
- DTMs

Performing an Integrity Check

Unity Pro automatically performs an integrity check when you first open an application. Thereafter, the check automatically runs periodically. To perform a manual integrity check in Unity Pro, follow these steps:

Step	Action
1	Click **Help** →**About Unity Pro XXX**.
2	In the **Integrity check** field, click **Perform self-test**. **Result**: The integrity check runs in the background and does not impact your application performance. Unity Pro creates a log of the successful and unsuccessful component logins. The log file contains the IP address, the date and hour, and the result of the login. **NOTE:** If an integrity check displays an unsuccessful component login, the **Event Viewer** displays a message. Click **OK**. Manually fix the items in the log.

Managing Logging Functions

Introduction

Your cyber security system is greatly enhanced by collecting and analyzing system notifications to identify intrusion attempts or problematic routes. Examples of logging methods are *syslog* and *Windows Event Management*.

A syslog server manages the network and security event messages produced by servers and devices. You can configure all firewalls and switches in your system to log data to the syslog server.

Additionally, you can configure Windows servers and work stations to generate security messages that are not collected by the syslog server.

Many devices trigger email messages, particularly on alerts. Firewalls allow the passage of these messages. You can configure Windows servers to act as SMTP server relays to forward mail messages.

Configuring the Syslog Server

To add the server manager feature:

Step	Action
1	Select **Start** →**All Programs** →**Administrative Tools** →**Server Manager**.
2	On the **Features** page, click **Add Features**.
3	Select **Subsystem for UNIX-based Applications** →**Next**.
4	Select **Install**.

To edit the syslog file:

Step	Action
1	Select **Start** →**Korn Shell**.

2	At the **$** prompt in the **Korn Shell** window, enter the following commands:
	`cd/etc/init.d`
	`vi syslog`

3	Remove the `#` symbol from the line that contains `${SYSLOGD}`. (Use the arrow keys to position the cursor under the `#` and type `x`.)
4	To save the file and exit the vi editor, type `:wq!`
5	At the `$` prompt in the **Korn Shell** window, enter the following command to start the server: `/etc/init.d/syslog start.`

Managing Syslog Firewall Rules

The following firewall rules are an example of what values to create on the syslog server's Windows host firewall to allow incoming syslog connections:

Parameter	Value
name	syslog
profile	all
enabled	yes
action	allow
override	no
program	any
local address	any
remote address	any
protocol	UDP
local port	514
remote port	any
allowed users	any
allowed computers	any

The following parameters are an example of what values to create on the ConneXium industrial firewalls to allow syslog server connections:

	Firewall 1	Firewall 2	Firewall 3	Firewall 4
description	outgoing allow syslog	outgoing allow syslog	incoming allow syslog	outgoing allow syslog
active	yes	yes	yes	yes
src IP	$Control	$Control	$DMZ	$DMZ
src port	any	any	any	any
dst IP	$Operation network	$Operation network	$Operation network	$Operation network
dst port	514	514	514	514
protocol	UDP	UDP	UDP	UDP
action	accept	accept	accept	accept

Managing Security Services

Introduction

You can enable/disable the following Ethernet services using the **Security** tab in Unity Pro:

Field	Parameter	Value	Comment
FTP	–	**Disabled**(default value)	Disables firmware upgrade, SD memory card data remote access, data storage remote access, and device configuration management using the FDR service. **NOTE:** Data storage is operational.
		Enabled	–
TFTP	–	**Disabled** (default value)	Disables the ability to read RIO drop configuration and device configuration management using the FDR service.
		Enabled	–
HTTP	–	**Disabled** (default value)	Disables the web access service.
		Enabled	–
Access Control	–	**Enabled** (default value)	DenIES Ethernet access to the Modbus and EIP server from unauthorized network devices.
		Disabled	–
Enforce Security and **Unlock Security**	–	–	See the following paragraph *(see page 225)* for details.
Authorized addresses (1)	**IP Address**	0.0.0.0 ... 255.255.255.255	See the following paragraph *(see page 225)* for details.
	Subnet	**Yes**/**No**	
	Subnet mask	0.0.0.0 ... 255.255.255.255	
1. You can modify this field when you set **Access Control** to **Enabled**.			

Schneider Electric recommends disabling services that are not being used.

NOTE: Set the **Security** tab parameters before you download the application to the CPU. The default settings (maximum security level) reduce the communication capacities and port access.

Enforce Security and Unlock Security Fields

- To set previous fields to the **maximum** security level, click **Enforce Security**. This is the **Security** tab default setting.
  Result: **FTP**, **TFTP**, and **HTTP** are set to **Disabled**.
- To set previous fields to the **minimum** security level, click **Unlock Security**.

Result: **FTP**, **TFTP**, and **HTTP** are set to **Enabled**.

NOTE: You can set each field individually once the global setting is applied.

Defining the List of Authorized Addresses

The list of authorized addresses applies to the only devices that can communicate with the M580 CPU via the port 502 server or the EtherNet/IP server. The list also applies to CPU firmware downloads.

When access control is enabled, add the IP addresses of the authorized addresses. Devices can only communicate with authorized addresses. To define the list of authorized addresses, you can enter one of the following:

- an IP address in the **IP Address** table column with **NO** selected in the **Subnet** column
- a subnet address in the **IP Address** table column with **YES** selected in the **Subnet** column and a **Subnet Mask** entered in the **Subnet Mask** column.
  NOTE: The subnet in the **IP Address** column can be the subnet itself or any IP address of the subnet. If you enter a subnet without a subnet mask, a detected error displays stating that the screen cannot be validated.

You can enter up to 128 authorized IP addresses.

Modifying Services in Online Mode

Possible online (STOP or RUN) modifications are:

- add or remove one line (subnet or IP address)
- modify a parameter of a line (IP address and/or subnet and/or subnet mask)

Managing FTP and TFTP

Schneider Electric Ethernet devices use *file transfer protocol* (FTP) for various tasks including firmware loading, displaying custom Web pages, and retrieving error logs.

FTP and *trivial file transfer protocol* (TFTP) may be vulnerable to various cyber security attacks. Therefore, Schneider Electric recommends disabling FTP and TFTP they are not needed.

Managing HTTP

Hypertext transfer protocol (HTTP) is the underlying protocol used by the Web. It is used in control systems to support embedded Web servers in control products. Schneider Electric Web servers use HTTP communications to display data and send commands via Web pages.

If the HTTP server is not required, disable it. Otherwise, use *hypertext transfer protocol secure* (HTTPS), which is a combination of HTTP and a cryptographic protocol, instead of HTTP if possible. Only allow traffic to specific devices, by implementing access control mechanisms such as a firewall rule that restricts access from specific devices to specific devices.

You can configure HTTPS as the default Web server on the products that support this feature.

Managing SNMP

Simple network management protocol (SNMP) provides network management services between a central management console and network devices such as routers, printers, and PACs. The protocol consists of 3 parts:

- manager: an application that manages SNMP agents on a network by issuing requests, getting responses, and listening for and processing agent-issued traps
- agent: a network-management software module that resides in a managed device. The agent allows configuration parameters to be changed by managers. Managed devices can be any type of device: routers, access servers, switches, bridges, hubs, PACs, drives.
- network management system (NMS): the terminal through which administrators can conduct administrative tasks

Schneider Electric Ethernet devices have SNMP service capability for network management.

Often SNMP is automatically installed with **public** as the read string and **private** as the write string. This type of installation allows an attacker to perform reconnaissance on a system to create a denial of service.

To help reduce the risk of an attack via SNMP:

- When possible, deactivate SNMP v1 and v2 and use SNMP v3, which encrypts passwords and messages.
- If SNMP v1 or v2 is required, use access settings to limit the devices (IP addresses) that can access the switch. Assign different read and read/write passwords to devices.
- Change the default passwords of all devices that support SNMP.
- Block all inbound and outbound SNMP traffic at the boundary of the enterprise network and operations network of the control room.
- Filter SNMP v1 and v2 commands between the control network and operations network to specific hosts or communicate them over a separate, secured management network.
- Control access by identifying which IP address has privilege to query an SNMP device.

Managing Remote Run/Stop Access

Refer to the *Modicon M580 Hardware Reference Manual* for CPU configuration options that help prevent remote commands from accessing the Run/Stop modes.

Managing Backup Functionality

Windows Server Backup

Schneider Electric recommends backing up up data, programs, and settings routinely so that a system can be recovered back to its state that existed prior to any disruption. Additionally, test backup/restoration processes to confirm proper functionality as a best practice.

Step	Action
1	Select **Start** →**All Programs** →**Administrative Tools** →**Server Manager**.
2	On the **Features** page, click **Add Features**.
3	Click **Windows Server Backup Features** →**Windows Server Backup** →**Next**.
4	On the **Confirm Installation Selections** page, click **Install**.

Appendices

What Is in This Appendix?

The appendix contains the following chapters:

Appendix A
Frequently Asked Questions (FAQ)

Frequently Asked Questions (FAQ)

Topologies

Do we have to follow the topology rules given in the user guide?

Yes, the system has been tested with the topology rules provided *(see page 65)*. The level of determinism and the operating characteristics of the network described in this document are based on a system designed according to these rules.

Do I have to use DRSs in the M580 system?

Yes, if you use a switch in the M580 system, use a DRS and download the appropriate predefined configuration for it. There are several DRS models available, based on the network topology *(see page 93)*.

NOTE:

- DRSs **are not** used in a simple daisy chain loop topology *(see page 77)*.
- DRSs **are** used in a high capacity daisy chain loop topology *(see page 79)* to support distributed equipment and sub-rings.

Can I connect DIO scanner devices (M340, Premium) to DIO ports or clouds or in a DIO network?

We recommend that you do not add these devices to DIO ports. Each DIO port on DRSs / BM• CRA 312 •0 X80 EIO adapter modules has a bandwidth that determines how much traffic is allowed on the M580 main ring. This bandwidth limitation can cause DIO scanner performance to decrease, which may be unacceptable in your network.

What type of distributed equipment can I connect to DIO ports or clouds?

You can connect devices that do not support 802.1D/Q tagging.

Example: Advantys, TeSyS-T, Momentum, and non-Schneider devices

Can I access devices (via ping, PC tools) in an M580 **network via the `SERVICE` port (ETH1) when it is configured in `port mirror mode`?**

No. When the `SERVICE` port is configured in `port mirror mode`, you cannot access devices, that is, you cannot ping other devices by connecting a PC to ETH1 in port mirror mode. When the `SERVICE` port is configured in access mode, then you can access devices in an M580 network via any tool.

IP Addressing / FDR

Can I use the stored and clear IP rotary switch positions on the BM• CRA 312 •0 X80 EIO adapter modules?

We recommend that you do not use these switch positions *(see page 188)* on the rotary switches because they do not support I/O module management. The only way to manage I/O modules is to use the `ones` and `tens` positions.

Ethernet Ports / Cables / Networks (Loops)

Can I connect a PC to an RIO module port?

Yes, but PCs will not be able to communicate with any modules. We recommend you connect PCs (or any other non-RIO device) to the following:
- a DRS — `DIO Cloud` or `DIO Sub Ring` port
- a CPU: `SERVICE` port configured as an access port
- a BM• CRA 312 •0 X80 EIO adapter module: `SERVICE` port configured as an access port

Can I change the bandwidth limitation on the DIO portsof a DRS?

We recommend that you do not change the bandwidth because it may affect performance in the M580 network.

ConneXium Network Manager

Why can't I discover IMPRs? I installed the ConneXium Network Manager tool, but the IMPRs are shown as Modbus devices.

Possible cause:
- You may not have the latest version of ConneXium Network Manager.
- You may not have specified the `GET` community name while discovering the network.

Possible solution:
- Install the latest version of ConneXium Network Manager or contact Schneider Electric support to get the Ethernet IMPR device types.
- Add the `GET` community name of the IMPR before discovering the network. You can retrieve the `GET` community name by reading the configuration using PowerSuite. By default, the IMPR `GET` community name is `public_1`.

Why is ConneXium Network Manager taking such a long time to discover the network?

Possible cause:
- The parameters you selected before discovering the network may be slowing down the process.

Possible solution:
- You can speed up the network discovery by adjusting the tool discovery parameters. Please read the *ConneXium Network Manager Ethernet Diagnostic Tool Reference Guide*.
  NOTE: If you increase the network discovery speed, you will also increase network traffic.

Why does ConneXium Network Manager display the IMPRs in a star topology when I have the IMPRs connected in a daisy chain or daisy chain loop topology?

Possible cause:

- ConneXium Network Manager does not currently support daisy chain and daisy chain loop topologies. Please contact ConneXium Network Manager support to find out when these topologies will be supported.

Possible solution:

- Manually edit the network topology that ConneXium Network Manager displays to create your own topology.

Why does ConneXium Network Manager say that my IP address has an invalid gateway?

Possible cause:

When you enter a gateway address, ConneXium Network Manager does 2 things:

- validates that the gateway address is in the same subnet as the IP address
- contacts the gateway address
  - If a response is received from the gateway address, ConneXium Network Manager discovers if the address is actually a gateway/router address. If the address is not an actual gateway/router address, ConneXium Network Manager displays a detected error message.
  - If no response is received from the gateway address, ConneXium Network Manager takes no action.

Possible solution:

- Enter a valid gateway address.
  — or —
- Enter a gateway address that is in the same subnet as the IP address. Check that the gateway address is not assigned to any other device on the subnet.

Appendix B
Detected Error Codes

Overview

This chapter contains a list of codes that describe the status of Ethernet communication module messages.

What Is in This Chapter?

This chapter contains the following topics:

EtherNet/IP Implicit or Explicit Messaging Detected Error Codes

Introduction

If a DATA_EXCH function block does not execute an EtherNet/IP explicit message, Unity Pro returns a hexadecimal detected error code. The code can describe an EtherNet/IP detected error.

EtherNet/IP Detected Error Codes

EtherNet/IP hexadecimal detected error codes include:

Detected Error Code	Description
16#800D	Timeout on the explicit message request
16#8012	Bad device
16#8015	Either: ● Nor resources to handle the message, or ● Internal detected error: no buffer available, no link available, impossible to send to the TCP task
16#8018	Either: ● Another explicit message for this device is in progress, or ● TCP connection or encapsulation session in progress
16#8030	Timeout on the Forward_Open request
Note: The following 16#81xx detected errors are Forward_Open response detected errors that originate at the remote target and are received via the CIP connection.	
16#8100	Connection in use or duplicate Forward_Open
16#8103	Transport class and trigger combination not supported
16#8106	Ownership conflict
16#8107	Target connection not found
16#8108	Invalid network connection parameter
16#8109	Invalid connection size
16#8110	Target for connection not configured
16#8111	RPI not supported
16#8113	Out of connections
16#8114	Vendor ID or product code mismatch
16#8115	Product type mismatch
16#8116	Revision mismatch
16#8117	Invalid produced or consumed application path
16#8118	Invalid or inconsistent configuration application path
16#8119	Non-Listen Only connection not opened

Detected Error Code	Description
16#811A	Target object out of connections
16#811B	RPI is smaller than the production inhibit time
16#8123	Connection timed out
16#8124	Unconnected request timed out
16#8125	Parameter detected error in unconnected request and service
16#8126	Message too large for unconnected_send service
16#8127	Unconnected acknowledge without reply
16#8131	No buffer memory available
16#8132	Network bandwidth not available for data
16#8133	No consumed connection ID filter available
16#8134	Not configured to send scheduled priority data
16#8135	Schedule signature mismatch
16#8136	Schedule signature validation not possible
16#8141	Port not available
16#8142	Link address not valid
16#8145	Invalid segment in connection path
16#8146	Detected error in Forward_Close service connection path
16#8147	Scheduling not specified
16#8148	Link address to self invalid
16#8149	Secondary resources unavailable
16#814A	Rack connection already established
16#814B	Module connection already established
16#814C	Miscellaneous
16#814D	Redundant connection mismatch
16#814E	No more user-configurable link consumer resources: the configured number of resources for a producing application has reached the limit
16#814F	No more user-configurable link consumer resources: there are no consumers configured for a producing application to use
16#8160	Vendor specific
16#8170	No target application data available
16#8171	No originator application data available
16#8173	Not configured for off-subnet multicast
16#81A0	Detected error in data assignment
16#81B0	Optional object state detected error

Detected Error Code	Description
16#81C0	Optional device state detected error
Note: All 16#82xx detected errors are register session response detected errors.	
16#8200	Target device does not have sufficient resources
16#8208	Target device does not recognize message encapsulation header
16#820F	Reserved or unknown detected error from target

Explicit Messaging: Communication and Operation Reports

Overview

Communication and operation reports are part of the management parameters.

NOTE: It is recommended that communication function reports be tested at the end of their execution and before the next activation. On cold start-up, confirm that all communication function management parameters are checked and reset to 0.

NOTE: It may be helpful to use the %S21 to examine the first cycle after a cold or warm start. For more information, refer to Unity Pro online help for %S21.

Communication Report

This report is common to every explicit messaging function. It is significant when the value of the activity bit switches from 1 to 0. The reports with a value between 16#01 and 16#FE concern errors detected by the processor that executed the function.

The different values of this report are indicated in the following table:

Value	Communication report (least significant byte)
16#00	Correct exchange
16#01	Exchange stop on timeout
16#02	Exchange stop on user request (`CANCEL`)
16#03	Incorrect address format
16#04	Incorrect destination address
16#05	Incorrect management parameter format
16#06	Incorrect specific parameters
16#07	Error detected in sending to the destination
16#08	Reserved
16#09	Insufficient receive buffer size
16#0A	Insufficient send buffer size
16#0B	No system resources: the number of simultaneous communication EFs exceeds the maximum that can be managed by the processor
16#0C	Incorrect exchange number
16#0D	No telegram received
16#0E	Incorrect length
16#0F	Telegram service not configured
16#10	Network module missing
16#11	Request missing
16#12	Application server already active

Value	Communication report (least significant byte)
16#13	UNI-TE V2 transaction number incorrect
16#FF	Message refused

NOTE: The function can detect a parameter error before activating the exchange. In this case the activity bit remains at 0, and the report is initialized with values corresponding to the detected error.

Operation Report

This report byte is specific to each function, and specifies the result of the operation on the remote application:

Value	Operation report (most significant byte)
16#05	Length mismatch (CIP)
16#07	Bad IP address
16#08	Application error
16#09	Network is down
16#0A	Connection reset by peer
16#0C	Communication function not active
16#0D	• Modbus TCP: transaction timed out • EtherNet/IP: request timeout
16#0F	No route to remote host
16#13	Connection refused
16#15	• Modbus TCP: no resources • EtherNet/IP: no resources to handle the message; or an internal detected error; or no buffer available; or no link available; or cannot send message
16#16	Remote address not allowed
16#18	• Modbus TCP: concurrent connections or transactions limit reached • EtherNet/IP: TCP connection or encapsulation session in progress
16#19	Connection timed out
16#22	Modbus TCP: invalid response
16#23	Modbus TCP: invalid device ID response
16#30	• Modbus TCP: remote host is down • EtherNet/IP: connection open timed out
16#80...16#87: Forward_Open response detected errors:	
16#80	Internal detected error
16#81	Configuration detected error: the length of the explicit message, or the RPI rate, needs to be adjusted
16#82	Device detected error: target device does not support this service
16#83	Device resource detected error: no resource is available to open the connection

Value	Operation report (most significant byte)
16#84	System resource evebt: unable to reach the device
16#85	Data sheet detected error: incorrect EDS file
16#86	Invalid connection size
16#90...16#9F: Register session response detected errors:	
16#90	Target device does not have sufficient resources
16#98	Target device does not recognize message encapsulation header
16#9F	Unknown detected error from target

Appendix C
Design Principles of M580 Networks

Overview

This chapter describes the design principles for the following types of M580 network topologies:

- a main ring, with RIO sub-rings
- a main ring, with both RIO and DIO sub-rings

What Is in This Chapter?

This chapter contains the following sections:

Section C.1
Network Determinism Parameters

Network Determinism Parameters

Introduction

Determinism refers to the ability to calculate and predict application response time (ART), which is the time required for an M580 network system to detect and respond to a single input. When you calculate ART for your application, consider the following:

- An M580 architecture features a dedicated module for RIO communications.
- Each remote packet travels from an input module in the remote drop to the controller, then back to an output module in the remote drop.
- Hop count is defined as the number of switches (including switches embedded in RIO devices) that a packet passes through to reach its destination.
- Packet path impacts jitter calculations, because of potential queue delays along its path.
- For RIO ART calculations:
  - Consider the worst case, i.e., the longest path a packet may need to travel in case of a broken network cable.
  - RIO only provides recovery from a single break in the system. This remains true even if a packet is able to arrive at its destination when multiple breaks exist in the system.
  - Only count hops and jitter delays along the network path, i.e., from the perspective of the specific RIO adapter module transmitting the packet. Do not include hops and jitter for other devices in the system that are not on the network path.

Section C.2
RIO Network Design Principles

Overview

This section describes the design principles for M580 network topologies that consist exclusively of main rings and optional RIO sub-rings.

What Is in This Section?

This section contains the following topics:

RIO Network Design Principles

Overview

M580 Ethernet RIO networks provide deterministic operation when the following principles are incorporated in the network design:

- **Defined Architectures:** A network topology that consists of simple daisy chain loops, or main rings with sub-rings, provides the following design advantages:
  - Hop counts between the remote adapter device and the controller are limited. The smaller number of hops along the transmission path reduces the opportunity for network delays.
  - Junctions between devices in the topology also are limited, which in turn limits packet queuing delays, known as jitter.
- **Traffic Prioritization:** Jitter that is inherent in RIO traffic is further limited by using QoS to prioritize packets. When RIO packets and other traffic (e.g., DIO packets, programming commands, web inquiries, diagnostics) simultaneously enter a transmission queue, Ethernet RIO traffic is transmitted first, based on its higher priority.
- **Switched Ethernet:** Switched Ethernet reduces jitter by helping data packets avoid collisions. Switched Ethernet is implemented when you use switches with the following features:
  - Store and forward: The switch receives the entire packet before forwarding it, which lets the switch prioritize packet transmissions and check for corrupted packets before re-transmission.
  - Full duplex: The switch supports the simultaneous bi-directional transmission of packets, without collisions.
  - 100 Mbps transmission speeds, which limits delay times per hop, as set forth below.

Switched Ethernet Delay Times

Switched Ethernet topologies can provide for the following transmission delay times per hop:

I/O Data Size (bytes)	Estimated Delay Time (μs)[1]
128	26
256	35
400	46
800	78
1200	110
1400	127
1. Delay times include 100 bytes of Ethernet overhead.	

Defined Architecture: Topologies

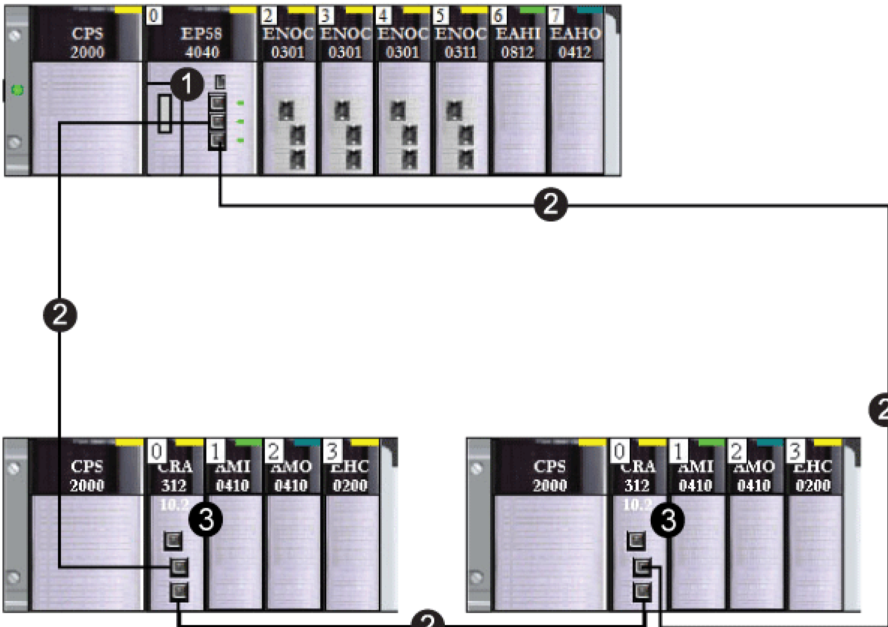
Introduction

In the following examples, the defined architectures restrict the number of hops a packet takes from an RIO drop to the CPU. By restricting the number of hops, the application response time (ART) for the system can be calculated.

In any M580 network topology, the hop count is used as a factor in calculating network delay *(see page 246)*. To determine the hop count from the perspective of an RIO drop, count the number of switches from the remote drop to the CPU.

Simple Daisy Chain Loop

The following is an example of a simple daisy chain loop topology:



1 CPU with Ethernet I/O scanner service on the local rack
2 main ring
3 BM• CRA 312 •0 X80 EIO adapter module on an X80 Ethernet RIO drop

In this M580 simple daisy-chain loop topology (which consists of only the local rack and RIO drops), the following restrictions apply:
- the maximum hop count = 17
- the maximum number of RIO modules:

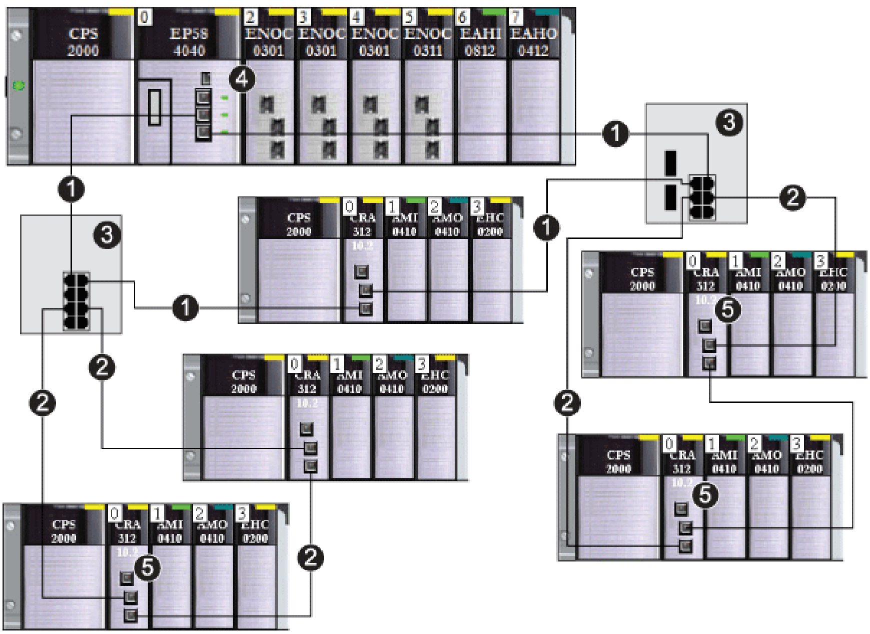
- one (1) CPU with Ethernet I/O scanner service on the local rack
- up to sixteen X80 EIO adapter modules (BM• CRA 312 •0)

NOTE: The maximum number of RIO drops depends on the particular CPU in your system. For more information, refer to the M580 CPU selection table *(see page 75)*.

In this design, the traffic is transmitted through the port with the shortest path to the CPU.

High Capacity Sub-System

The following is an example of a high capacity M580 system, consisting of a main ring, with multiple sub-rings:



1 main ring
2 RIO sub-ring
3 DRSs connecting the main ring to the sub-rings
4 CPU with Ethernet I/O scanner service on the local rack
5 RIO drop with a BM• CRA 312 •0 X80 EIO adapter module

In this more complex M580 network topology (with a single main ring and multiple sub-rings), these restrictions apply:

The maximum number of...	...is...
hops in a network path	17
RIO modules	16
devices in any sub-ring	16

Defined Architecture: Junctions

Introduction

An M580 network can support both RIO modules (including BM• CRA 312 •0 X80 EIO adapter modules) and dual-ring switches (DRSs).

Both RIO modules and DRSs constitute a network junction, as follows:

- An RIO module joins ring traffic with RIO module traffic.
- A DRS joins sub-ring traffic with main ring traffic.

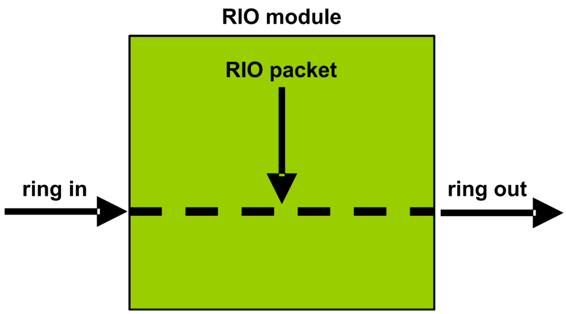
Each junction presents the queueing point, which can add delay — or jitter — to the system. If 2 packets simultaneously arrive at a junction, only 1 can be immediately transmitted. The other waits for a period referred to as “one delay time” before it is transmitted.

Because RIO packets are granted priority by the M580 network, the longest an RIO packet can wait at a junction is 1 delay time before it is transmitted by the module or DRS.

The following scenarios depict how different junction types handle packets that arrive simultaneously.

RIO Module

In the following example, an RIO module originates packets for transmission and forwards packets it receives on the ring:

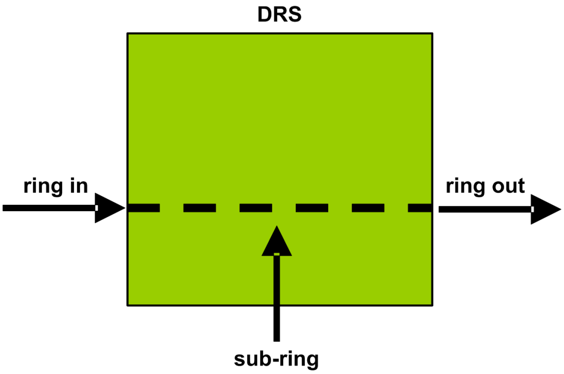


The RIO module handles RIO packets in the following sequence:

Time	Ring In	RIO Packet	Ring Out	Comment
T0	1 (started)	a	–	Packet “a” arrived after transmission of packet “1” begins.
T1	2	–	1	Packet “2” arrived after packet “a.”
T2	3	–	a	Packet “3” arrived after packet “2.”
T3	4	–	2	Packet “4” arrived after packet “3.”
T4	5	–	3	Packet “5” arrived after packet “4.”

DRS

In the following example, a DRS receives a steady flow of packets from both the main ring and an RIO sub-ring:

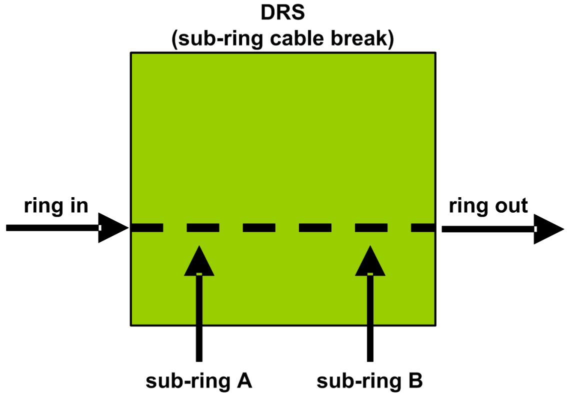


The DRS handles RIO packets in the following sequence:

Time	Ring In	Sub-ring	Ring Out	Comment
T0	1 (started)	a	–	Packet “a” arrived after transmission of packet “1” begins.
T1	2	b	1	Packets “2” and “b” arrive simultaneously.
T2	3	c	a	Packets “3” and “c” arrive simultaneously.
T3	4	d	2	Packets “4” and “d” arrive simultaneously.
T4	5	e	b	Packets “5” and “e” arrive simultaneously.

DRS with Sub-ring Cable Break

In the following example, a DRS receives a steady flow of packets from the main ring and also from both segments of an RIO sub-ring with a cable break:



The DRS handles RIO packets in the following sequence:

Time	Ring In	Sub-ring A	Sub-ring B	Ring Out	Comment
T0	1 (started)	a	p	–	Packets “a” and “p” arrive after transmission of packet “1” begins.
T1	2	b	q	1	Packets “2” , “b,” and “q” arrive simultaneously.
T2	3	c	r	a	Packets “3”, “c,” and “r” arrive simultaneously.
T3	4	d	s	p	Packets “4”, “d,” and “s” arrive simultaneously.
T4	5	e	t	2	Packets “5”, “e,” and “t” arrive simultaneously.

Section C.3
RIO with DIO Network Design Principles

Overview

This section describes the design principles for M580 network topologies that consist of a main ring with optional RIO *and* DIO sub-rings.

What Is in This Section?

This section contains the following topics:

RIO with DIO Network Design Principles

Overview

An M580 network can transmit data from distributed equipment. This is accomplished by using equipment that is configured to implement the following network design principles:

- **CPU**: CPU with Ethernet I/O scanner service on the local rack
- **Use of dual-ring switches (DRSs)**: DIO data enters the M580 network from distributed equipment, which is attached to a Schneider Electric DRS. Schneider Electric provides predefined configuration files *(see page 93)* for each DRS, depending upon its role in the network.
- **Implementation of Defined Architectures**: An M580 network supports the addition of DIO data traffic only in specific network designs, including:
  - a main ring joined by DRSs to one or more DIO sub-rings
    — or —
  - a main ring joined to one or more RIO sub-rings, with distributed equipment connected to DRS ports on the main ring or a sub-ring

  These designs provide a limited number and type of junctions between network segments and a limited hop count from any device to the CPU.
- **QoS Traffic Prioritization**: DIO packets are assigned the lower priority. They wait in a queue until a device finishes transmitting all RIO data packets. This limits RIO jitter to 128 μs, which represents the time required to complete the transmission of one DIO packet that has already begun.
- **DIO data is not delivered in real-time**: DIO packets wait in a queue until all RIO packets are transmitted. DIO data transmissions use the network bandwidth that remains after RIO data has been delivered.

Defined Architecture: Topologies

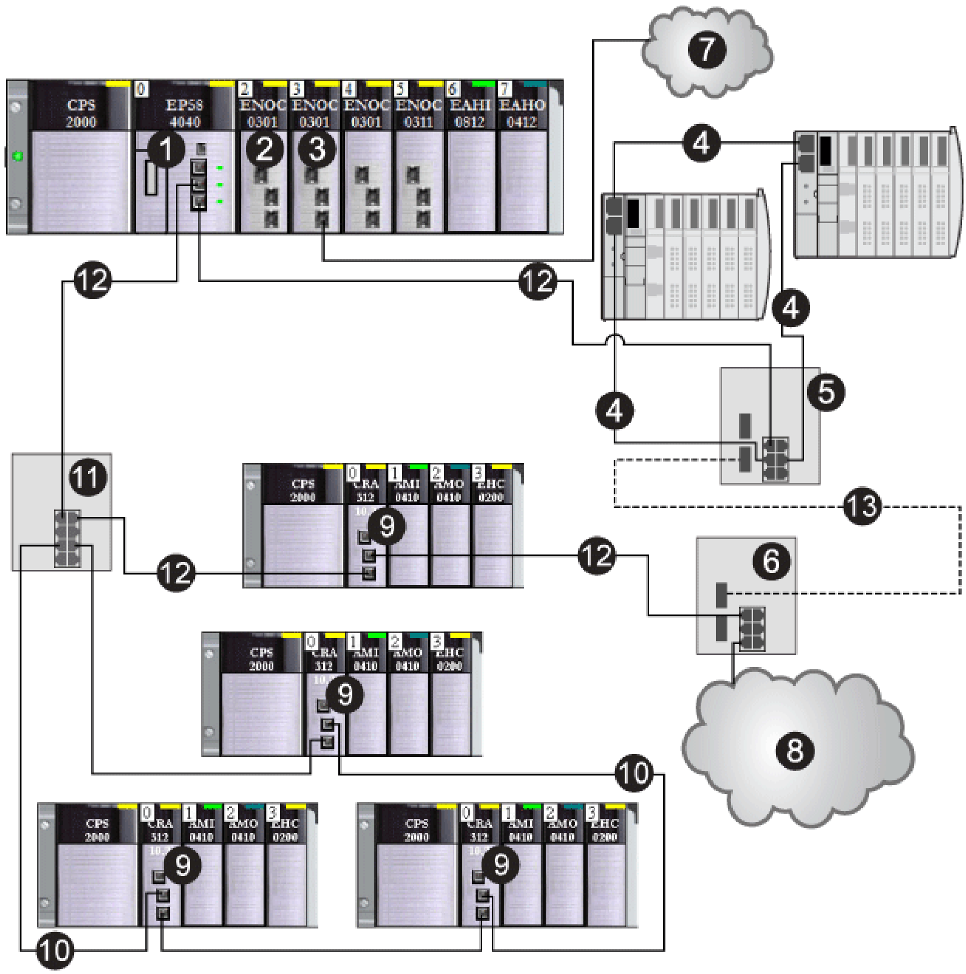
Introduction

The defined architecture restricts the addition of DIO data to the system by means of either:

- a DIO sub-ring attached to a DRS
  – or –
- distributed equipment, known as a DIO cloud, attached to DRS ports

High Capacity Subsystem Example

This figure shows a sample high-capacity daisy chain loop network configuration:



1 CPU with Ethernet I/O scanner service on the local rack
2 BME NOC 03•1 Ethernet communication module (Ethernet backplane connection enabled) managing distributed equipment on the network
3 BME NOC 03•1 module (Ethernet backplane connection disabled) managing an isolated DIO cloud (7)
4 DIO sub-ring
5 DRS used to convert copper cable to fiber (also connects the DIO sub-ring to the main ring)
6 DRS used to convert copper cable to fiber (also connects the DIO cloud to the main ring)
7 isolated DIO cloud
8 DIO cloud
9 RIO drop (including a BM• CRA 312 •0 X80 EIO adapter module)

10 RIO sub-ring
11 DRS (connecting the RIO sub-ring to the main ring)
12 copper portion of the main ring
13 fiber portion of the main ring

NOTE: A module can support distributed equipment via its Ethernet backplane connection to the CPU and via its device network port(s) on the front panel, respecting the limitation of 128 devices scanned per module.

In this complex M580 network topology (which consists of a main ring and multiple sub-rings), the following restrictions apply:

The maximum number of...	...is...
hops in a network path	17
RIO modules in any sub-ring	16
RIO modules in the main ring	16
devices in any sub-ring	16
distributed equipment on the network	128 per scanner; ther may be several BME NOCs in the system with the CPU

RIO and DIO Defined Architecture: Junctions

Introduction

An M580 network can accept the addition of DIO traffic through a DRS. The DRS can accept DIO data form either of the following 2 sources:

- a DIO sub-ring connected to the DRS sub-ring ports
- a DIO cloud connected to a DRS port that does not support the main ring, a sub-ring, or port mirroring

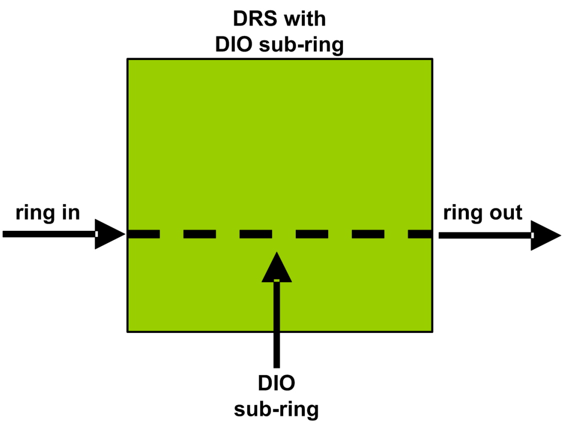
Each junction presents the queueing point, which can add delay or jitter to the system. If 2 packets simultaneously arrive at a junction, only 1 can be immediately transmitted. The other waits for a period referred to as *1 delay time* until it can be transmitted.

Because RIO packets are granted priority by the M580 network, the longest an RIO packet can wait at a junction is 1 delay time before it is transmitted by the device or DRS.

The following scenarios depict how different junction types handle DIO packets that arrive simultaneously with RIO packets.

DRS

In the following example, a DRS receives a steady flow of packets from both the main ring and a DIO sub-ring:



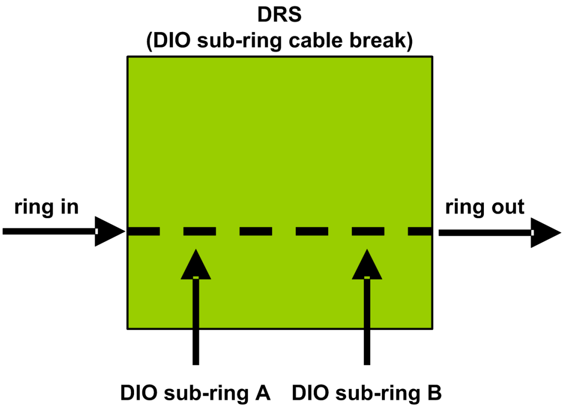
The DRS handles RIO packets in the following sequence:

Time	Main Ring In	DIO Sub-ring	Main Ring Out	Comment
T0	1	a (started)	–	Packet “1” arrived after transmission of packet “a” begins.
T1	2	b	a	Packets “2” and “b” arrive simultaneously.

Time	Main Ring In	DIO Sub-ring	Main Ring Out	Comment
T2	3	c	1	Packets “3” and “c” arrive simultaneously.
T3	4	d	2	Packets “4” and “d” arrive simultaneously.
T4	5	e	3	Packets “5” and “e” arrive simultaneously.

DRS with Sub-ring Cable Break

In the following example, a DRS receives a steady flow of packets from the main ring and also from both segments of a DIO sub-ring with a cable break:



The DRS handles RIO packets in the following sequence:

Time	Main Ring In	DIO Sub-ring A	DIO Sub-ring B	Main Ring Out	Comment
T0	1 (started)	a	p	–	Packets “a” and “p” arrive after transmission of packet “1” begins.
T1	2	b	q	1	Packets “2” , “b” and “q” arrive simultaneously.
T2	3	c	r	2	Packets “3”, “c” and “r” arrive simultaneously.
T3	4	d	s	3	Packets “4”, “d” and “s” arrive simultaneously.
T4	5	e	t	4	Packets “5”, “e” and “t” arrive simultaneously.

Glossary

A

adapter

An adapter is the target of real-time I/O data connection requests from scanners. It cannot send or receive real-time I/O data unless it is configured to do so by a scanner, and it does not store or originate the data communications parameters necessary to establish the connection. An adapter accepts explicit message requests (connected and unconnected) from other devices.

ART

(*application response time*) The time a CPU application takes to react to a given input. ART is measured from the time a physical signal in the CPU turns on and triggers a write command until the remote output turns on to signify that the data has been received.

AUX

An (AUX) task is an optional, periodic processor task that is run through its programming software. The AUX task is used to execute a part of the application requiring a low priority. This task is executed only if the MAST and FAST tasks have nothing to execute. The AUX task has two sections:

- IN: Inputs are copied to the IN section before execution of the AUX task.
- OUT: Outputs are copied to the OUT section after execution of the AUX task.

C

CCOTF

(*change configuration on the fly*) A feature of Unity Pro that allows a CPU hardware change in the system configuration while the system is operating and not impacting other active operations.

CPU

(*central processing unit*) The CPU, also known as the processor or controller, is the brain of an industrial manufacturing process. It automates a process as opposed to relay control systems. CPUs are computers suited to survive the harsh conditions of the industrial environment.

D

determinism

For a defined application and architecture, you can predict that the delay between an event (change of value of an input) and the corresponding change of a controller output is a finite time *t*, smaller than the deadline required by your process.

device network

An Ethernet-based network within an RIO network that contains both RIO and distributed equipment. Devices connected on this network follow specific rules to allow RIO determinism.

DHCP

(*dynamic host configuration protocol*) An extension of the BOOTP communications protocol that provides for the automatic assignment of IP addressing settings, including IP address, subnet mask, gateway IP address, and DNS server names. DHCP does not require the maintenance of a table identifying each network device. The client identifies itself to the DHCP server using either its MAC address, or a uniquely assigned device identifier. The DHCP service utilizes UDP ports 67 and 68.

DIO cloud

A group of distributed equipment that is not required to support RSTP. DIO clouds require only a single (non-ring) copper wire connection. They can be connected to some of the copper ports on DRSs, or they can be connected directly to the CPU or Ethernet communications modules in the *local rack*. DIO clouds **cannot** be connected to *sub-rings*.

DIO network

A network containing distributed equipment, in which I/O scanning is performed by a CPU with DIO scanner service on the local rack. DIO network traffic is delivered after RIO traffic, which takes priority in an RIO network.

distributed equipment

Any Ethernet device (Schneider Electric device, PC, servers, or third-party devices) that supports exchange with a CPU or other Ethernet communication service.

DRS

(*dual-ring switch*) A ConneXium extended managed switch that has been configured to operate on an Ethernet network. Predefined configuration files are provided by Schneider Electric to downloaded to a DRS to support the special features of the main ring / sub-ring architecture.

E

Ethernet DIO scanner service

an embedded scanner service of M580 CPUs (BME P58 1020, BME P58 2020, BME P58 3020, BME P58 4020) that manages distributed equipment only on an M580 device network

Ethernet I/O scanner service

an embedded scanner service of M580 CPUs (BME P58 2040, BME P58 3040, BME P58 4040) that manages distributed equipment **and** RIO drops on an M580 device network

EtherNet/IP™

A network communication protocol for industrial automation applications that combines the standard internet transmission protocols of TCP/IP and UDP with the application layer common industrial protocol (CIP) to support both high speed data exchange and industrial control. EtherNet/IP employs electronic data sheets (EDS) to classify each network device and its functionality.

F

FAST

An event-triggered (FAST) task is an optional, periodic processor task that identifies high priority, multiple scan requests, which is run through its programming software. A FAST task can schedule selected I/O modules to have their logic solved more than once per scan. The FAST task has two sections:

- IN: Inputs are copied to the IN section before execution of the FAST task.
- OUT: Outputs are copied to the OUT section after execution of the FAST task.

FDR

(*fast device replacement*) A service that uses configuration software to replace an inoperable product.

FTP

(*file transfer protocol*) A protocol that copies a file from one host to another over a TCP/IP-based network, such as the internet. FTP uses a client-server architecture as well as separate control and data connections between the client and server.

H

HMI

(*human machine interface*) System that allows interaction between a human and a machine.

HTTP

(*hypertext transfer protocol*) A networking protocol for distributed and collaborative information systems. HTTP is the basis of data communication for the web.

I

IP address

The 32-bit identifier, consisting of both a network address and a host address assigned to a device connected to a TCP/IP network.

isolated DIO network

An Ethernet-based network containing distributed equipment that does not participate in an RIO network.

L

local rack

An M580 rack containing the CPU and a power supply. A local rack consists of one or two racks: the main rack and the extended rack, which belongs to the same family as the main rack. The extended rack is optional.

M

main ring

The main ring of an Ethernet RIO network. The ring contains RIO modules and a local rack (containing a CPU with Ethernet I/O scanner service) and a power supply module.

MAST

A master (MAST) task is a deterministic processor task that is run through its programming software. The MAST task schedules the RIO module logic to be solved in every I/O scan. The MAST task has two sections:
- IN: Inputs are copied to the IN section before execution of the MAST task.
- OUT: Outputs are copied to the OUT section after execution of the MAST task.

Modbus

Modbus is an application layer messaging protocol. Modbus provides client and server communications between devices connected on different types of buses or networks. Modbus offers many services specified by function codes.

P

PAC

programmable automation controller. The PAC is the brain of an industrial manufacturing process. It automates a process as opposed to relay control systems. PACs are computers suited to survive the harsh conditions of the industrial environment.

Q

QoS

(*quality of service*) The practice of assigning different priorities to traffic types for the purpose of regulating data flow on the network. In an industrial network, QoS is used to provide a predictable level of network performance.

R

RIO drop

One of the three types of RIO modules in an Ethernet RIO network. A RIO drop is an M580 rack of I/O modules that are connected to an Ethernet RIO network and managed by an Ethernet RIO adapter module. A drop can be a single rack or a main rack with an extended rack.

RIO network

An Ethernet-based network that contains 3 types of RIO devices: a local rack, an RIO drop, and a ConneXium extended dual-ring switch (DRS). Distributed equipment may also participate in an RIO network via connection to DRSs.

RPI

(requested packet interval) The time period between cyclic data transmissions requested by the scanner. EtherNet/IP devices publish data at the rate specified by the RPI assigned to them by the scanner, and they receive message requests from the scanner at each RPI.

RSTP

(*rapid spanning tree protocol*) Allows a network design to include spare (redundant) links to provide automatic backup paths if an active link stops working, without the need for loops or manual enabling/disabling of backup links.

S

service port

A dedicated Ethernet port on the M580 RIO modules. The port may support the following major functions (depending on the module type):
- port mirroring: for diagnostic use
- access: for connecting HMI/Unity Pro/ConneXview to the CPU
- extended: to extend the device network to another subnet
- disabled: disables the port, no traffic is forwarded in this mode

SNMP

(*simple network management protocol*) Protocol used in network management systems to monitor network-attached devices. The protocol is part of the internet protocol suite (IP) as defined by the internet engineering task force (IETF), which consists of network management guidelines, including an application layer protocol, a database schema, and a set of data objects.

SNTP

(*simple network time protocol*) See NTP.

sub-ring

An Ethernet-based network with a loop attached to the main ring, via a dual-ring switch (DRS) on the main ring. This network contains RIO or distributed equipment.

T

TFTP

(*trivial file transfer protocol*) A simplified version of *file transfer protocol* (FTP), TFTP uses a client-server architecture to make connections between two devices. From a TFTP client, individual files can be uploaded to or downloaded from the server, using the user datagram protocol (UDP) for transporting data.

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