Modicon M580

System Planning Guide for Complex Topologies

Original instructions

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to 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.

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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, service, 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.

⚠ WARNING

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 death, serious 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 to facilitate communications between an M580 local rack and remote sub-rings through dual-ring switches (DRSs).

This guide provides detailed information about planning complex M580 architectures, including these:

- implementation of DRSs to support sub-rings
- topology rules and recommendations for choosing a complex network configuration
- 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 EcoStruxure™ Control Expert 14.1 or later.

The technical characteristics of the devices described in the present document also appear online. To access the 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 reference or 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.

Step	Action
5	Depending on the size of your screen, you may need to scroll down to see the datasheet.
6	To save or print a datasheet as a .pdf file, click **Download XXX product datasheet**.

The characteristics that are presented in the present document 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 document and online information, use the online information as your reference.

Related Documents

Title of Documentation	Reference Number
Modicon M580 Standalone System Planning Guide for Frequently Used Architectures	HRB62666 (English), HRB65318 (French), HRB65319 (German), HRB65320 (Italian), HRB65321 (Spanish), HRB65322 (Chinese)
Modicon M580 Hot Standby, System Planning Guide for Frequently Used Architectures	NHA58880 (English), NHA58881 (French), NHA58882 (German), NHA58883 (Italian), NHA58884 (Spanish), NHA58885 (Chinese)
Modicon M580, Hardware, Reference Manual	EIO0000001578 (English), EIO0000001579 (French), EIO0000001580 (German), EIO0000001582 (Italian), EIO0000001581 (Spanish), EIO0000001583 (Chinese)
Modicon M580, RIO Modules, Installation and Configuration Guide	EIO0000001584 (English), EIO0000001585 (French), EIO0000001586 (German), EIO0000001587 (Italian), EIO0000001588 (Spanish), EIO0000001589 (Chinese),
Modicon M580, Change Configuration on the Fly, User Guide	EIO0000001590 (English), EIO0000001591 (French), EIO0000001592 (German), EIO0000001594 (Italian), EIO0000001593 (Spanish), EIO0000001595 (Chinese)

Title of Documentation	Reference Number
Modicon M580 BMENOS0300 Network Option Switch Module Installation and Configuration Guide	NHA89117 (English), NHA89119 (French), NHA89120 (German), NHA89121 (Italian), NHA89122 (Spanish), NHA89123 (Chinese)
Modicon X80, BMXNRP0200/0201 Fiber Converter Modules, User Guide	EIO0000001108 (English), EIO0000001109 (French), EIO0000001110 (German), EIO0000001111 (Spanish), EIO0000001112 (Italian), EIO0000001113 (Chinese)
Modicon eX80, BMEAHI0812 HART Analog Input Module & BMEAHO0412 HART Analog Output Module, User Guide	EAV16400 (English), EAV28404 (French), EAV28384 (German), EAV28413 (Italian), EAV28360 (Spanish), EAV28417 (Chinese)
Modicon X80, Analog Input/Output Modules, User Manual	35011978 (English), 35011979 (German), 35011980 (French), 35011981 (Spanish), 35011982 (Italian), 35011983 (Chinese)
Modicon X80, Discrete Input/Output Modules, User Manual	35012474 (English), 35012475 (German), 35012476 (French), 35012477 (Spanish), 35012478 (Italian), 35012479 (Chinese)
Modicon X80, BMXEHC0200 Counting Module, User Manual	35013355 (English), 35013356 (German), 35013357 (French), 35013358 (Spanish), 35013359 (Italian), 35013360 (Chinese)
Electrical installation guide	EIGED306001EN (English)

Title of Documentation	Reference Number
EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual	35006144 (English), 35006145 (French), 35006146 (German), 35013361 (Italian), 35006147 (Spanish), 35013362 (Chinese)
EcoStruxure™ Control Expert, System Bits and Words, Reference Manual	EIO0000002135 (English), EIO0000002136 (French), EIO0000002137 (German), EIO0000002138 (Italian), EIO0000002139 (Spanish), EIO0000002140 (Chinese)
EcoStruxure™ Control Expert, Operating Modes	33003101 (English), 33003102 (French), 33003103 (German), 33003104 (Spanish), 33003696 (Italian), 33003697 (Chinese)
EcoStruxure™ Control Expert, Installation Manual	35014792 (English), 35014793 (French), 35014794 (German), 35014795 (Spanish), 35014796 (Italian), 35012191 (Chinese)
Modicon Controllers Platform Cyber Security, Reference Manual	EIO0000001999 (English), EIO0000002001 (French), EIO0000002000 (German), EIO0000002002 (Italian), EIO0000002003 (Spanish), EIO0000002004 (Chinese)

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

Part I
Modicon M580 System Introduction

Chapter 1
Hardware in a Complex M580 System

Introduction

This chapter describes modules and switches that are compatible with complex M580 systems.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Modules and Switches in Complex M580 Systems	16
Overview of Complex Topologies	21
Planning a High-Capacity Daisy Chain Loop	23

Modules and Switches in Complex M580 Systems

Dual-Ring Switches (DRSs)

In complex M580 architectures, you can use a DRS to perform these functions:

- integrate fiber cable on the main ring for distances greater than 100 m between two contiguous remote drops. (You may also use BMX NRP 020• *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)* fiber converter modules for this purpose.)
- enable distributed equipment to participate on the RIO network *(see page 157)*
- 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 two DRSs are installed next to each other with specific predefined configuration files *(see page 27)*
- separate primary and standby PACs in a long-haul Hot Standby system *(see Modicon M580 Hot Standby, System Planning Guide for, Frequently Used Architectures)*

NOTE: You can also use a BMENOS0300 module on the local rack or a remote drop to manage distributed equipment in a non-redundant manner.

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 27)* 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 eight copper ports:

ConneXium switch with six copper ports and two 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	8TX1280	• 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.		

You can download these predefined DRS configurations to the switches. These configurations are discussed in the Predefined Configuration Files chapter *(see page 27)*.

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 27)* 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 27)*.

Other System Components

For information on these system components, refer to the Modicon M580 System Planning Guide for Frequently Used Architectures *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)*:

- BMENOC0301 Ethernet communication module
- BMENOC0311 Ethernet communication module with FactoryCast capabilities
- BMENOS0300 network option switch communications module
- BMXCRA31200 X80 standard EIO adapter module
- BMXCRA31210 X80 performance EIO adapter module
- 140CRA31200 drop adapter module

Commissioning

Commission your M580 system:

Stage	Description
1	Set the location of the Ethernet RIO drop.
2	Power up modules without a downloaded application.
3	Download the CPU application(s).
4	Establish transparency between a USB and a device network *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)*.
5	Perform an initial start after an application download.
6	Start and stop an application.

For more information, refer to the commissioning chapter *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)* in the *Modicon M580 Standalone System Planning Guide for Frequently Used Architectures* and the *Modicon M580 Hot Standby System Planning Guide for Frequently Used Architectures*.

Overview of Complex Topologies

Introduction

This topic discusses some of the more common network topologies that use the components of complex M580 network topologies *(see page 16)*.

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 Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)*: distributed equipment that **is not** a physical part of the deterministic RIO network	Each BMENOC0301/11 Ethernet communication module can manage up to 128 isolated distributed devices. The number of BMENOC0301/11 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 Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)* topic for details regarding the number of DIO devices a CPU can manage.
in a **DIO cloud** *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)*: distributed equipment that **is** a physical part of the deterministic RIO network	In addition to a CPU with Ethernet I/O scanner service and BMENOC0301/11 modules on the local rack, you can install one or more BMENOS0300 modules to attach DIO clouds. The distributed equipment cannot be connected directly to the main ring. A CPU with Ethernet I/O scanner service can manage up to 64 or 128 distributed devices, depending on the CPU you are using Refer to the *Selecting a CPU for your System (see Modicon M580, Hardware, Reference Manual)* topic for details regarding the number of DIO devices a CPU can manage.
in an existing (*extended*) network *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)* that you want to communicate with the M580 device network	Confirm that the Ethernet backplane ports of the BMENOC0301/11 and BMENOC0321 modules are enabled. Connect one of the Ethernet ports on the front of one of the BMENOC0301/11 modules to the *Service/Extend* port of the BMENOC0321 module with an interlink cable. Connect the other Ethernet port on the front of the BMENOC0301/11 module to the existing network.

If Distributed Equipment Is ...	Then ...
in an existing (*independent*) network *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)* that you want to communicate with the M580 control network only	Confirm that the Ethernet backplane port of the BMENOC0321 module is enabled. Connect one of the Ethernet ports on the front of one of the BMENOC0301/11 modules to the existing network. Confirm that the Ethernet backplane port of the BMENOC0301/11 module is disabled. Connect the other Ethernet port on the front of the BMENOC0301/11 module to an Ethernet port on the front of the BMENOC0321 module with an interlink cable. **NOTE:** An independent network is essentially an isolated network, but it communicates with an M580 control network. It does not communicate with the M580 device network. You can manage only one independent network in an M580 system.

NOTE: A local rack can have a maximum of *eight* communication modules, depending upon which CPU you choose. Only one of those can be a BMENOC0321 module.

RIO Main Ring 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 communication server service
  - 31: BM•CRA312•0 EIO adapter modules in RIO drops

  NOTE: You can install sixteen BM•CRA312•0 and fifteen 140CRA31200 EIO adapter modules.
- no RIO sub-rings

Design 2:

- a *main ring* with:
  - 1: CPU with Ethernet I/O communication server service
  - 11: BM•CRA312•0 EIO adapter modules in RIO drops
  - 10: DRSs, each supporting an RIO sub-ring (each sub-ring supporting two BM•CRA312•0 EIO adapter modules in RIO drops

Typical Device Network

A *device network* is an Ethernet RIO network where distributed equipment can be installed on the same network as 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, BMENOS0300 network option switch modules, dual-ring switches, adapter class devices, and so on. Devices that are connected to this network follow rules that provide RIO determinism.

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 that use use BMXNRP020• fiber converter modules *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)*

Planning a High-Capacity Daisy Chain Loop

An M580 local rack contains a CPU and supports a maxiumum of eight Ethernet communication modules, including BMENOC0301 or BMENOC0311 modules and BMENOS0300 network option switch modules. Only one of these modules can be a BMENOC0321 network option switch module. The number of communication modules with DIO scanning service depends on your CPU selection *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)*.

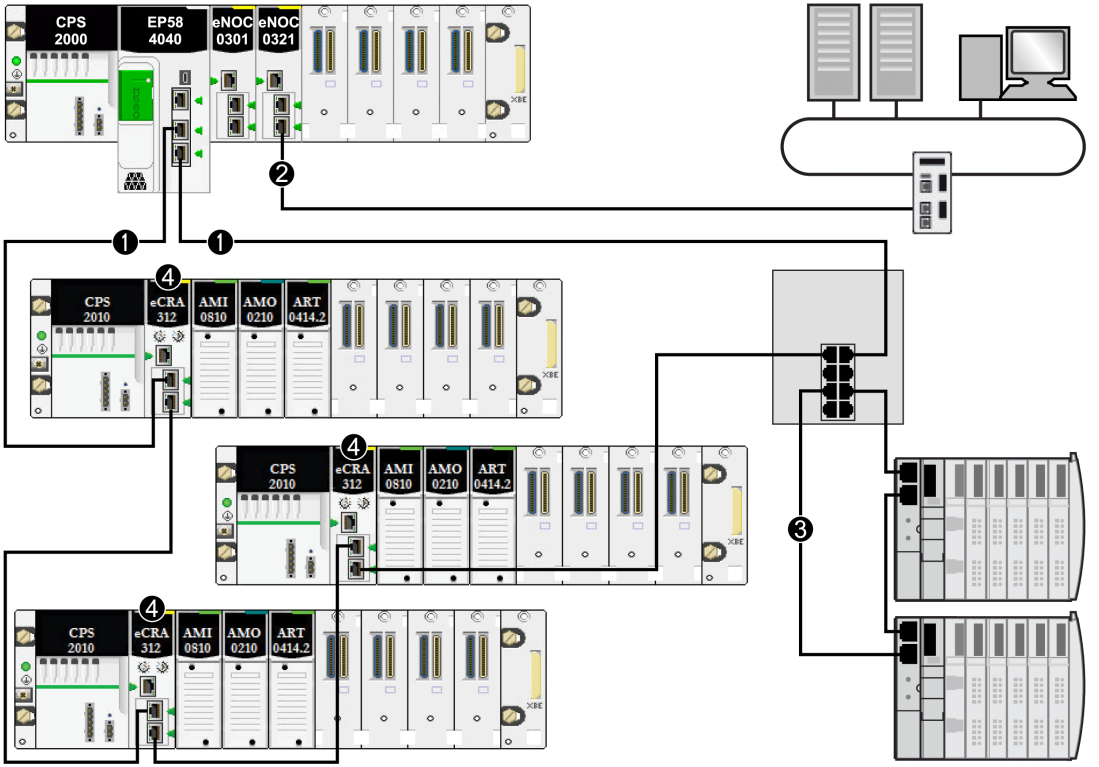
If you use both RIO and distributed equipment in the main ring, use a CPU that supports both RIO and DIO scanning *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)*, referred to in this guide as a CPU with Ethernet I/O communication service. These are the CPUs with commercial references that end in *40*.

NOTE:

- 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 communication server service in the local rack) are allowed on the main ring.
- A maximum of 31 RIO drops (each drop containing a BM•CRA312•0 X80 EIO adapter module) are allowed on the RIO network.
- To diagnose a break in a daisy chain loop, refer to the diagnostics chapter in the BMENOS0300 guide *(see M580 BMENOS0300, Network Option Switch, Installation and Configuration Guide)*.

Connecting Distributed Equipment to the RIO Network

This BMEP58••40 CPU (with Ethernet I/O scanning service) on a local rack supports an RIO main ring with distributed equipment connected to the RIO network:



1 The M580 CPU is connecected to the main ring.
2 The BMENOC0321 control network module is connected to the control network, creating transparency between the device network and the control network.
3 The DIO sub-ring is connected to the main ring through a dual-ring switch (DRS).
4 RIO drops are connected to the main ring through BM•CRA312•0 (e)X80 EIO adapter modules.

Part II
Planning and Designing a Typical 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 a typical RIO network.

What Is in This Part?

This part contains the following chapters:

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Chapter 2
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:

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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	8TX1280	• 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.

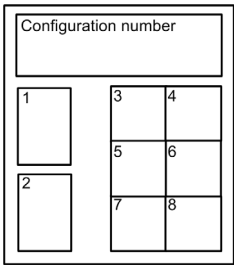
Step	Action
1	Disconnect the cables that form the daisy chain loop in the RIO network. The DRS can remain connected to the loop.
2	Delete the predefined configuration file that you downloaded to the DRS.
3	Download the new predefined configuration file to the DRS.
4	Reconnect the cables to form the daisy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

DRS Labels

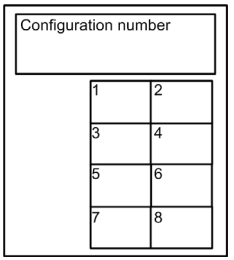
Labels are supplied in the box of the ConneXium extended managed switch. When you determine which predefined configuration you need to download to each DRS, write the respective configuration number on the label and affix to either side of the DRS.

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

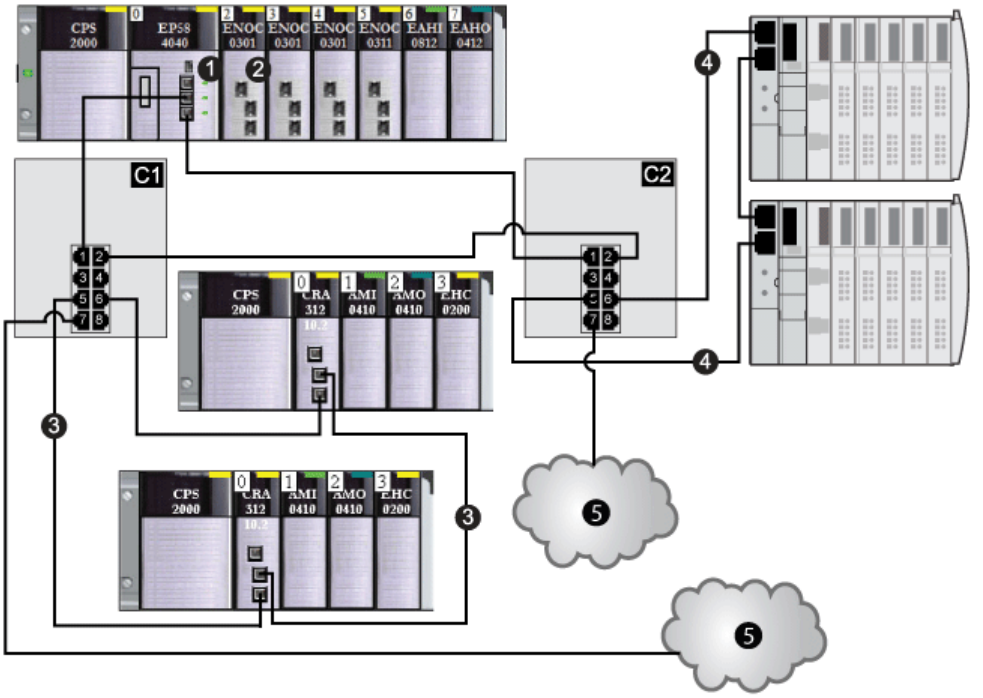


DRS label with copper ports only: TCSESM083F23F1 – 8TX 1280



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:

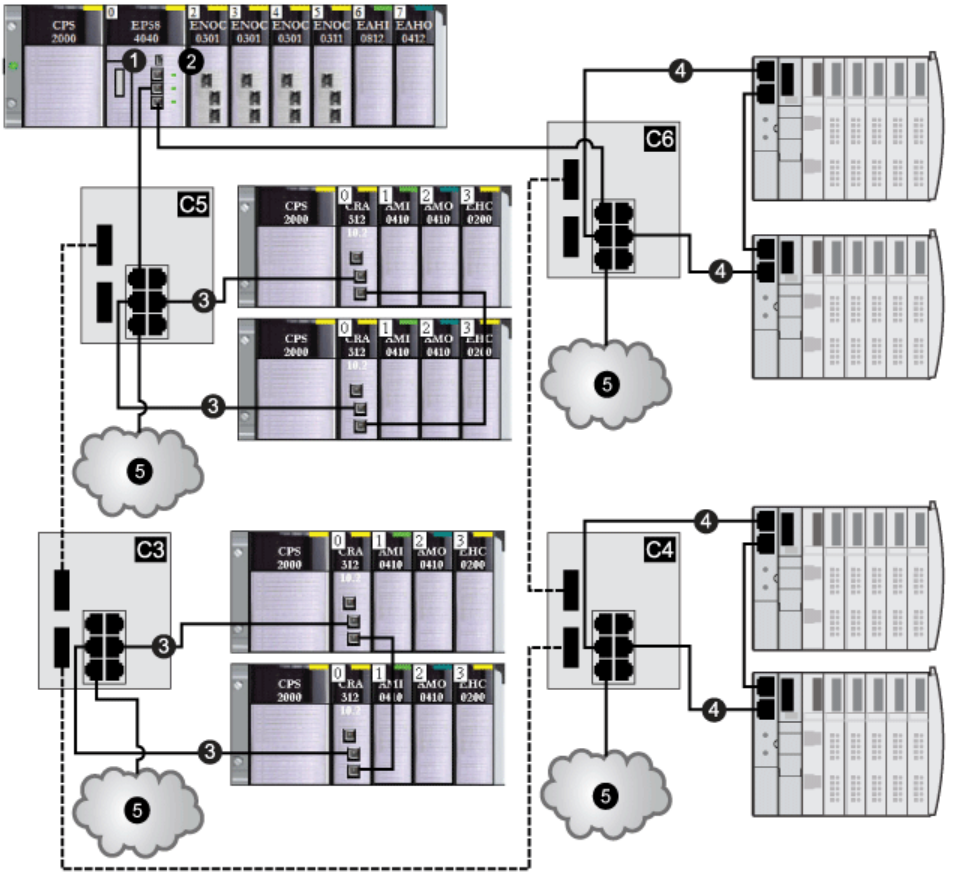


This table describes the switch configurations and the port functionality in the above illustration:

C1	This DRS uses the C1 predefined configuration file for a copper main ring with an RIO sub-ring and DIO clouds *(see page 38)*.
C2	This DRS uses the C2 predefined configuration file for a copper main ring with a DIO sub-ring and DIO clouds *(see page 41)*.
1	CPU with Ethernet I/O scanner service on the local rack
2	BMENOC0301/11 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 44)*.
C4	This DRS uses the C4 predefined configuration file for a fiber main ring and copper DIO sub-ring with DIO clouds *(see page 48)*.
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 52)*.
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 57)*.

1	CPU with Ethernet I/O scanner service on the local rack
2	BMENOC0301/11 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.

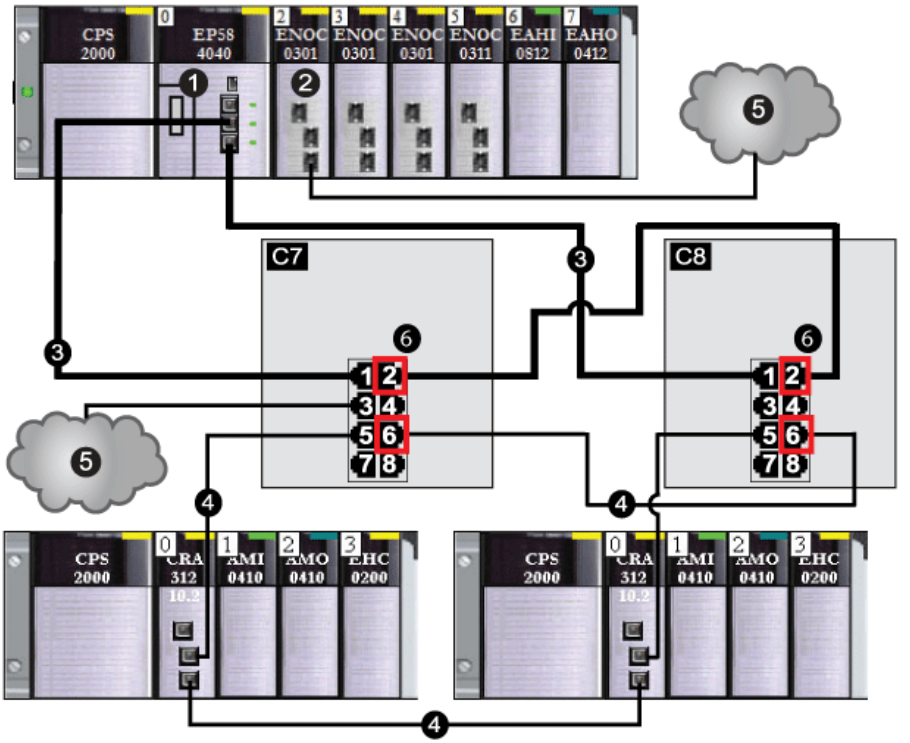
NOTE: Do not connect devices between the master and slave DRS. Connect at least 1 operating link between the master and slave DRS for the redundant connections to function properly.

NOTE:
DRS **inner ports** are the 2 ports on the switch that are connected to the main ring. When using two 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.

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 60)*.
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 63)*.
1	CPU with Ethernet I/O scanner service on the local rack
2	BMENOC0301/11 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 BMENOC0301/11 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 BMENOC0301/11 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.

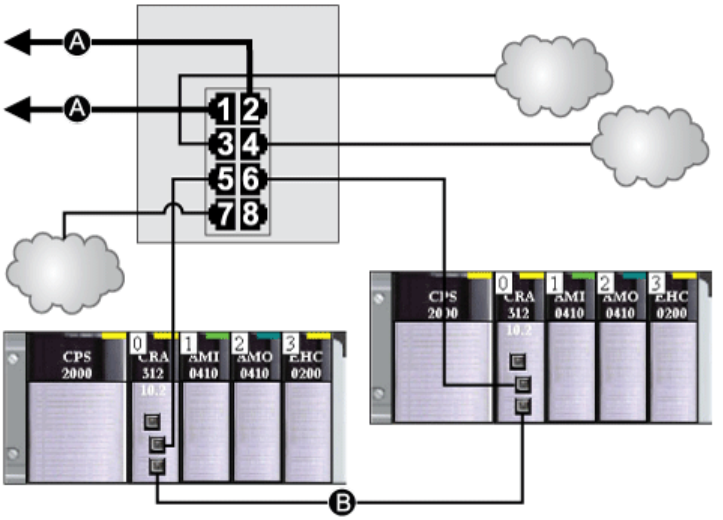
Predefined Port Connections

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 36)* (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.

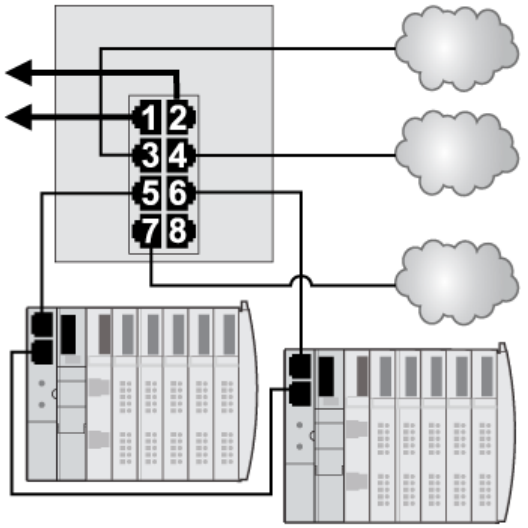
You cannot use RIO modules in a DIO sub-ring. Only distributed equipment with a dual-port embedded Ethernet switch and RSTP protocol support can be used. (In this manual, distributed equipment are represented by Modicon STB islands with STB NIP 2311 network interface modules.)

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 36)*, 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 38)*, 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.

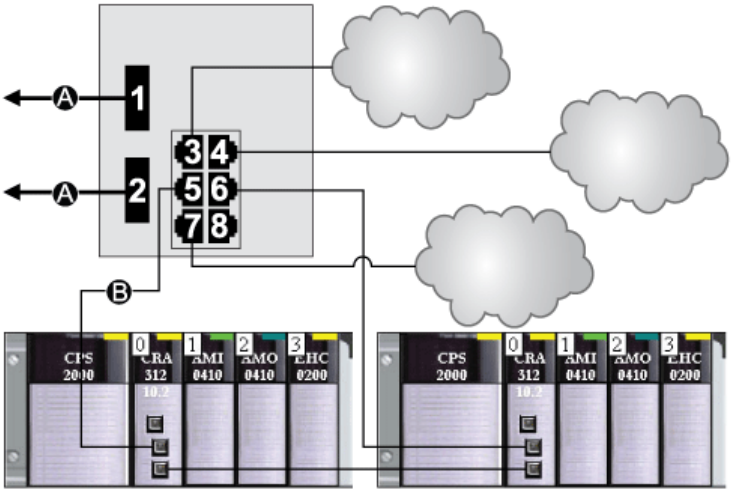
With single-mode fiber cable, you can achieve distances up to 15 km on the main ring. With multi-mode fiber cable, you can achieve distances up to 2 km.

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 36)*, 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

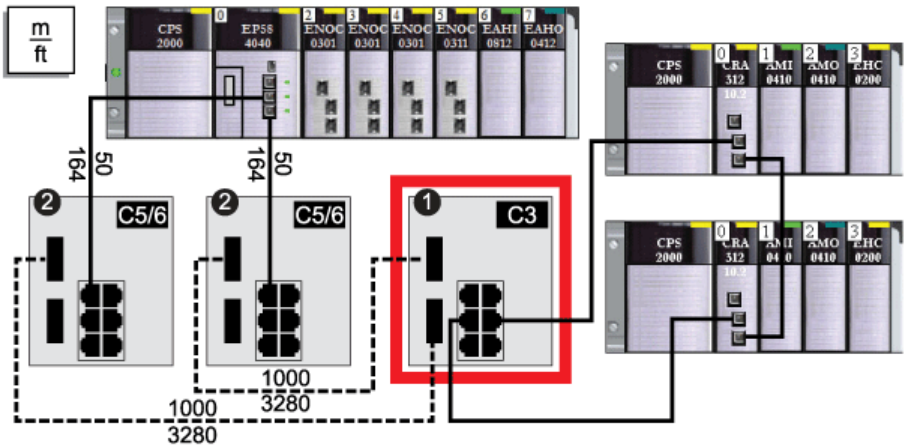
Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

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 52)*.

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 52)*.

NOTE: You can also use BMX NRP 020• fiber converter modules *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)* 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 41)*, 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.

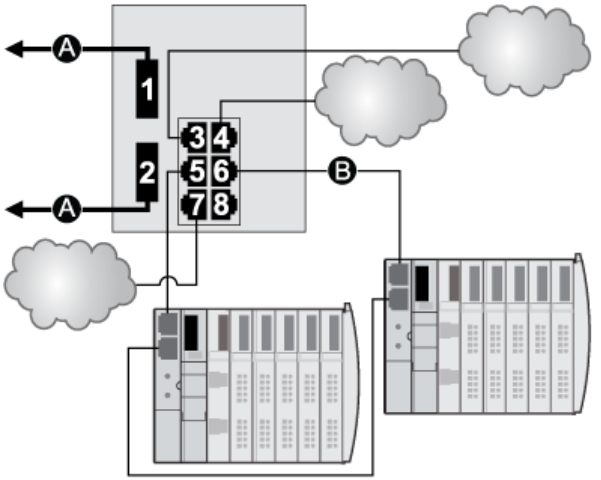
With single-mode fiber cable, you can achieve distances on the main ring up to 15 km. With multi-mode fiber cable, you can achieve distances up to 2 km.

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 36)*, 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

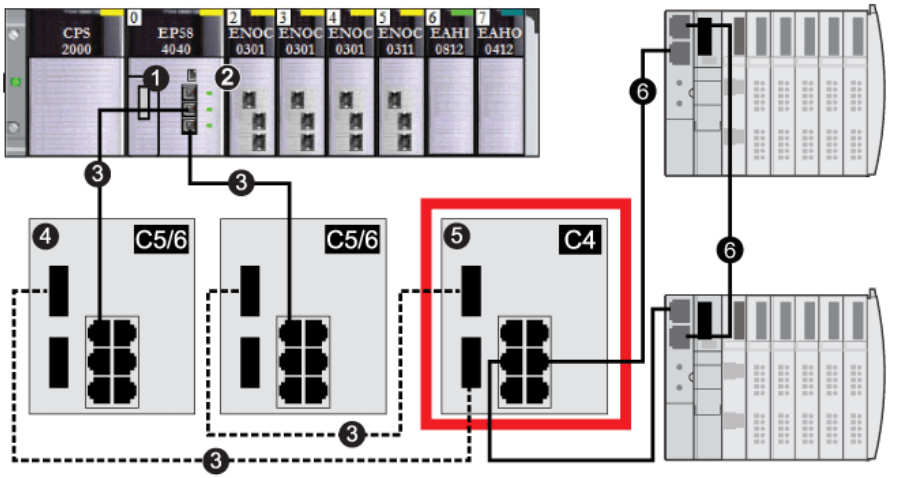
Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

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 57)*.

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 BMENOC0301/11 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 Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)* instead of the two DRSs shown as #4 in the previous illustration.

NOTE: A BMENOC0301/11 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 BMENOC0301/11 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.

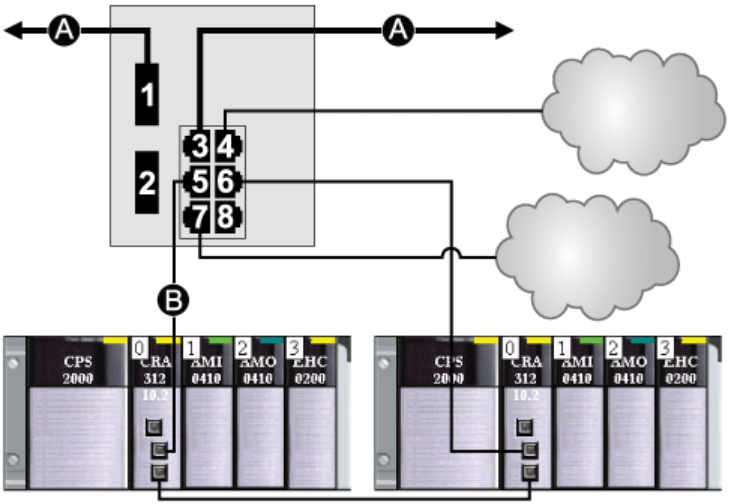
Predefined Port Connections

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 36)*, 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

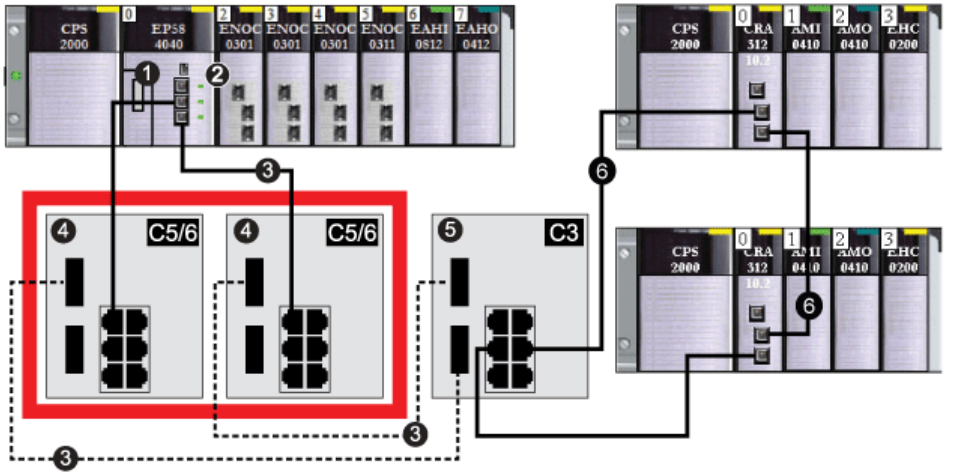
Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

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 BMENOC0301/11 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

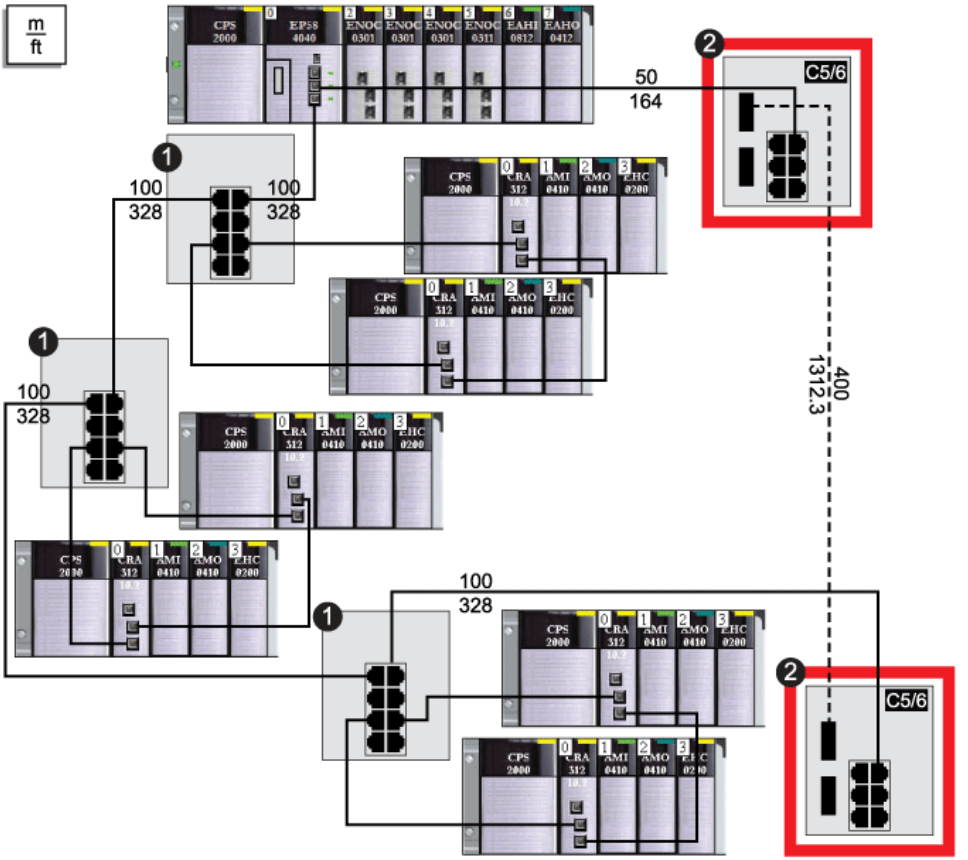
NOTE: You can also use BMX NRP 020• fiber converter modules *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)* instead of the two DRSs shown as #4 in the previous illustration.

NOTE: A BMENOC0301/11 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 BMENOC0301/11 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 Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)* 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.

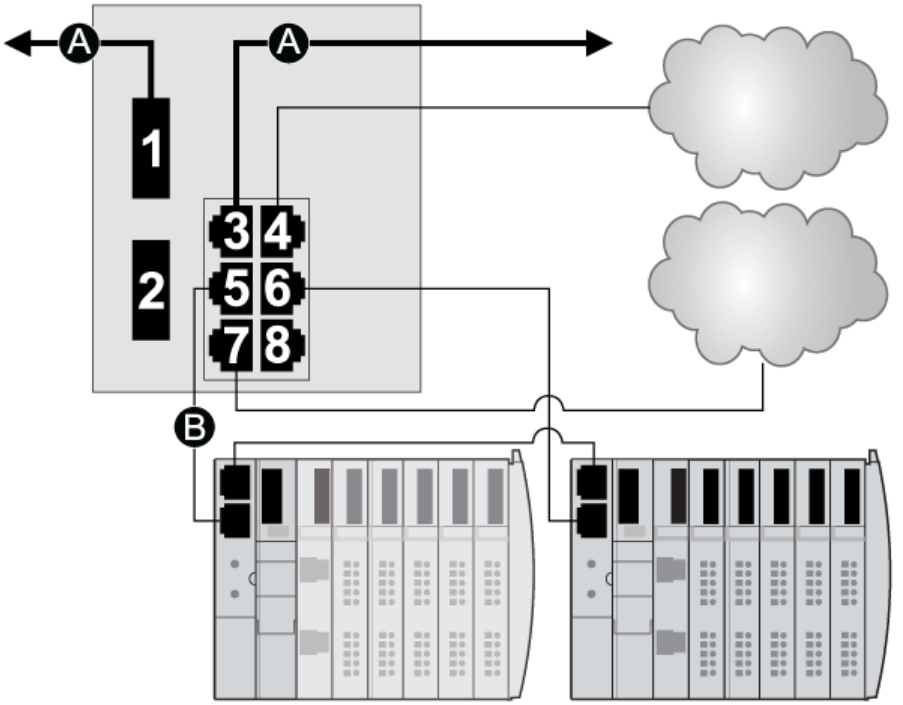
Port Connections

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 36)*, 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 63)*) — 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 two 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.

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.

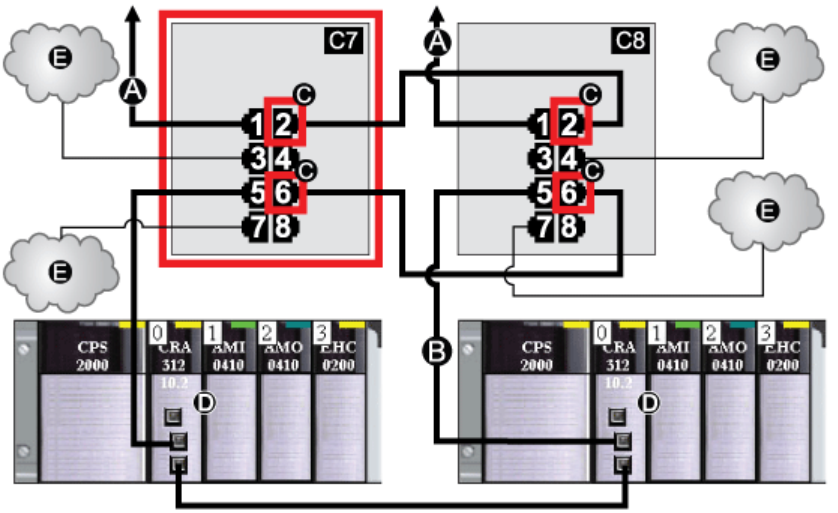
Do not connect any devices between the *master* DRSs and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other — within 100 m.

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 36)* (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•CRA312•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 60)*) — 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 two 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.

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.

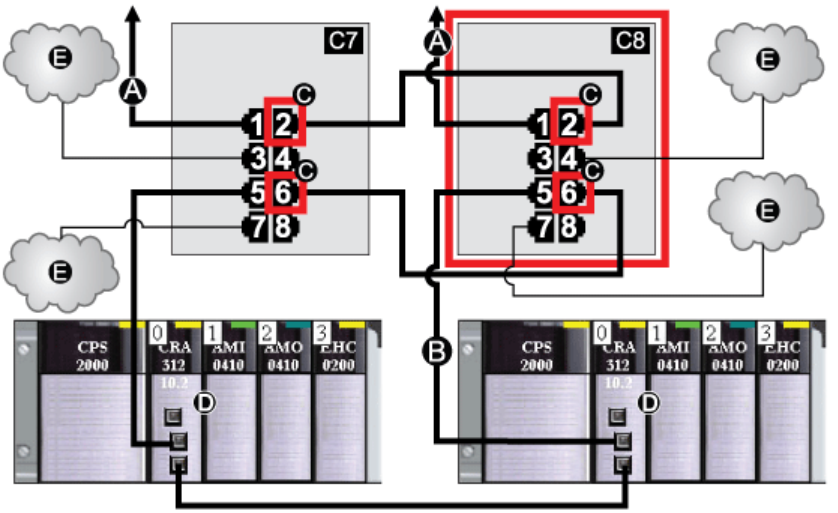
Do not connect any devices between the *master* DRS and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other — within 100 m.

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 36)*: 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•CRA312•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 69)*) — 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 two 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.

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.

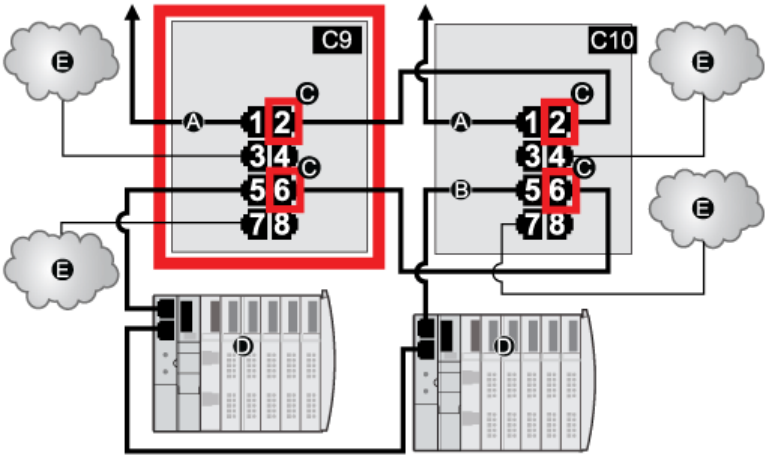
Do not connect any devices between the *master* DRS and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other within 100 m.

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 36)*, 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 66)*) — 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 two 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.

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.

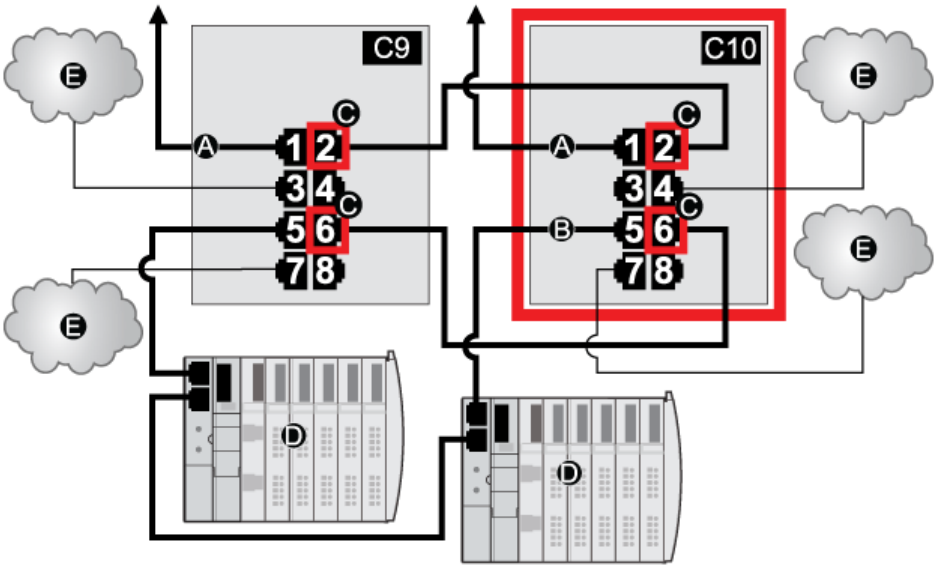
Do not connect any devices between the *master* DRS and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other, within 100 m.

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 36)* (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 77)*) — 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 two 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.

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.

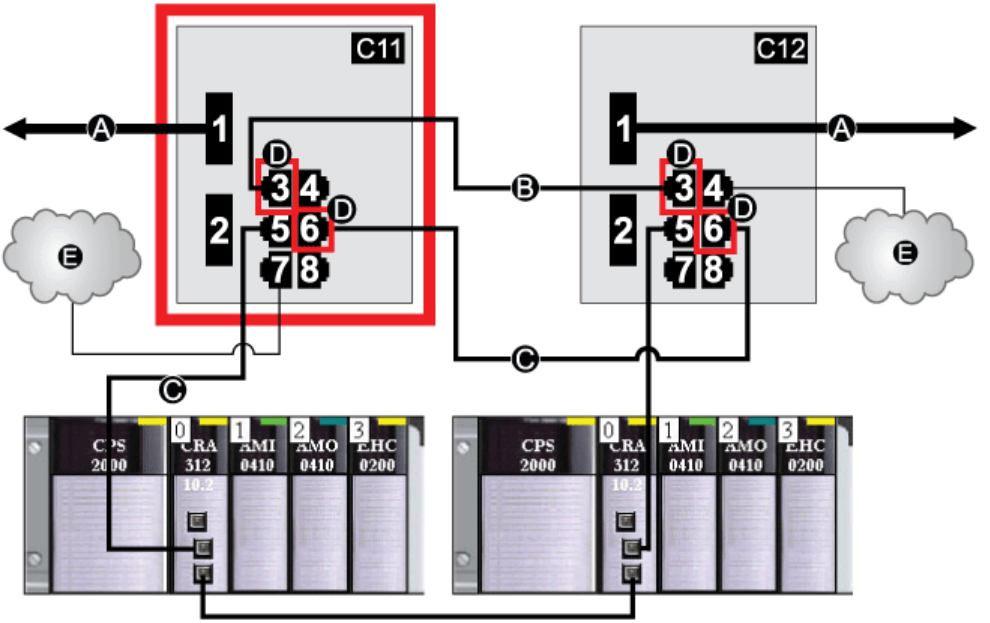
Do not connect any devices between the *master* DRS and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other — within 100 m.

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 36)*, 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

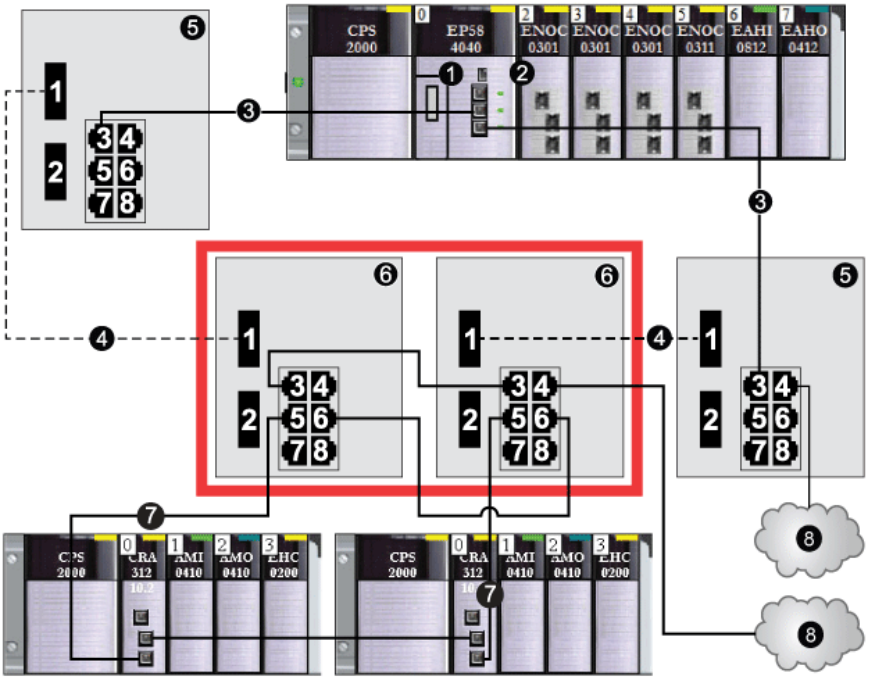
This table describes the functionality of the ports in the above illustration:

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 BMENOC0301/11 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 Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)* instead of the 2 DRSs shown as #5 in the previous illustration.

NOTE: A BMENOC0301/11 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 BMENOC0301/11 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 72)*) — 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 two 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.

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.

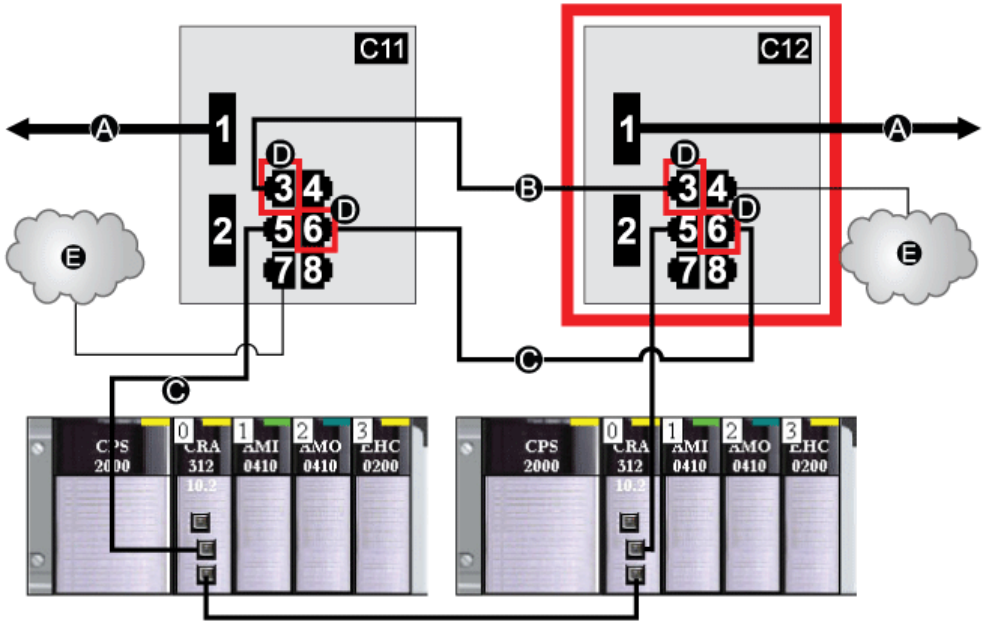
Do not connect any devices between the *master* DRS and the *slave* DRS on the main ring or the sub-ring. Install the DRSs next to each other within 100 m.

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 36)*, 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

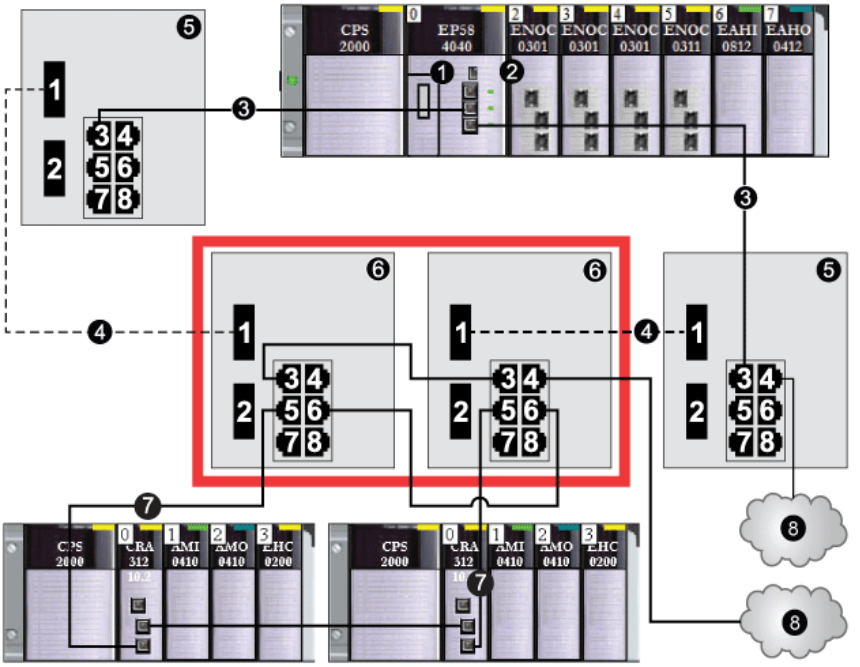
Do not modify any parameter in the DRS predefined configuration you download to the switch, except enabling or disabling port mirroring on Ethernet ports.

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 BMENOC0301/11 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 Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)* instead of the 2 DRSs shown as #6 in the previous illustration.

NOTE: A BMENOC0301/11 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 BMENOC0301/11 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 86)*) — 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 two 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.

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.

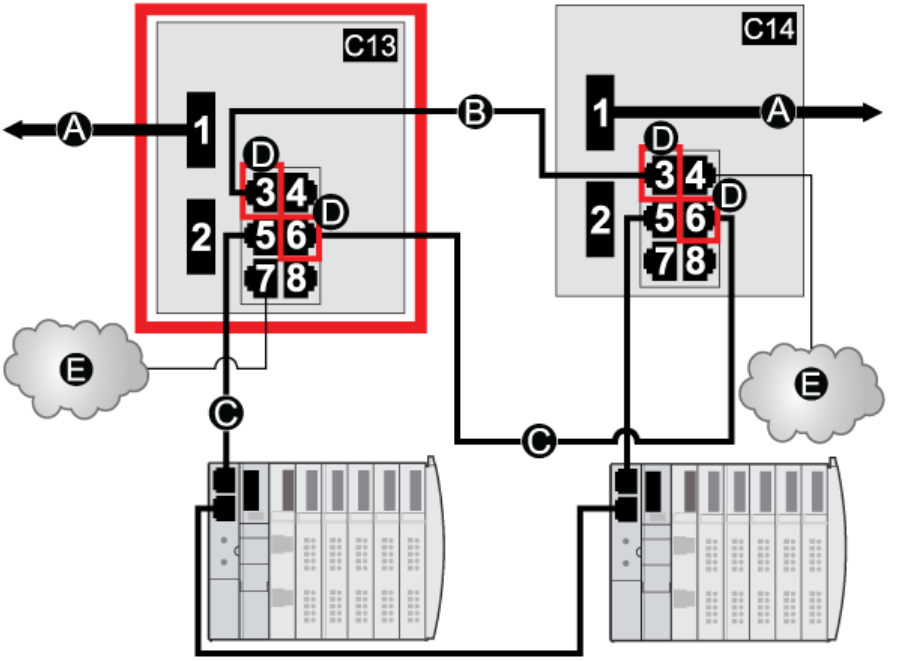
Port Connections

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 36)*, 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 82)*) — 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 two 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.

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.

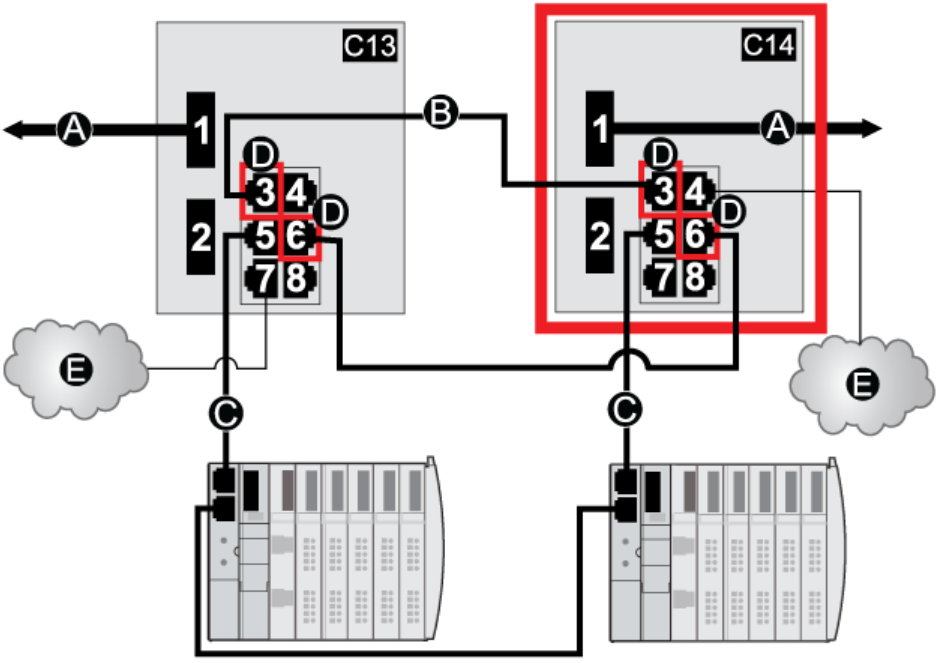
Port Connections

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 36)*, 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.

C15: Copper/Fiber Connection for a Long-haul Hot Standby Link

Preconfiguration File Name

`C15_CRPLinkHotStandbyLDVx.xx.cfg`, where *`Vx.xx`* references the version number of the file.

Use of this Preconfiguration

In some Hot Standby applications, you may want to separate the primary controller from the standby controller by a long distance. In a tunnel application, for example, you may want to install the two PLCs at opposite ends of the tunnel to lessen the likelihood that environmental damage to one affects the other.

A fiber-optic link connects the 140CRP93200 heads in each local rack. Because the 140CRP93200 modules do not have fiber ports, the initial connections are made with copper cable. Two DRSs, each with this preconfiguration downloaded, are used to transition from copper to fiber then back to copper.

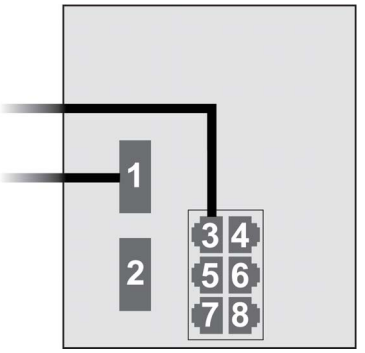
Devices Supported by this Preconfiguration

The C16 file supports the TCSESM063F2CU1 and TCSESM063F2CS1 ConneXium extended DRSs. Each DRS has six ports that support copper connections and two ports that support fiber-optic connections. Choose a DRS according to the fiber cable distances in your hardware configuration:

Dual-Ring Switch	Fiber Ports	Mode	Distance
TCSESM063F2CU1	2	multi-mode	2 km
TCSESM063F2CS1	2	single-mode	15 km

Predefined Port Connections

This is a graphical view of the supported connections:



These connections are available when you use the C15 file:

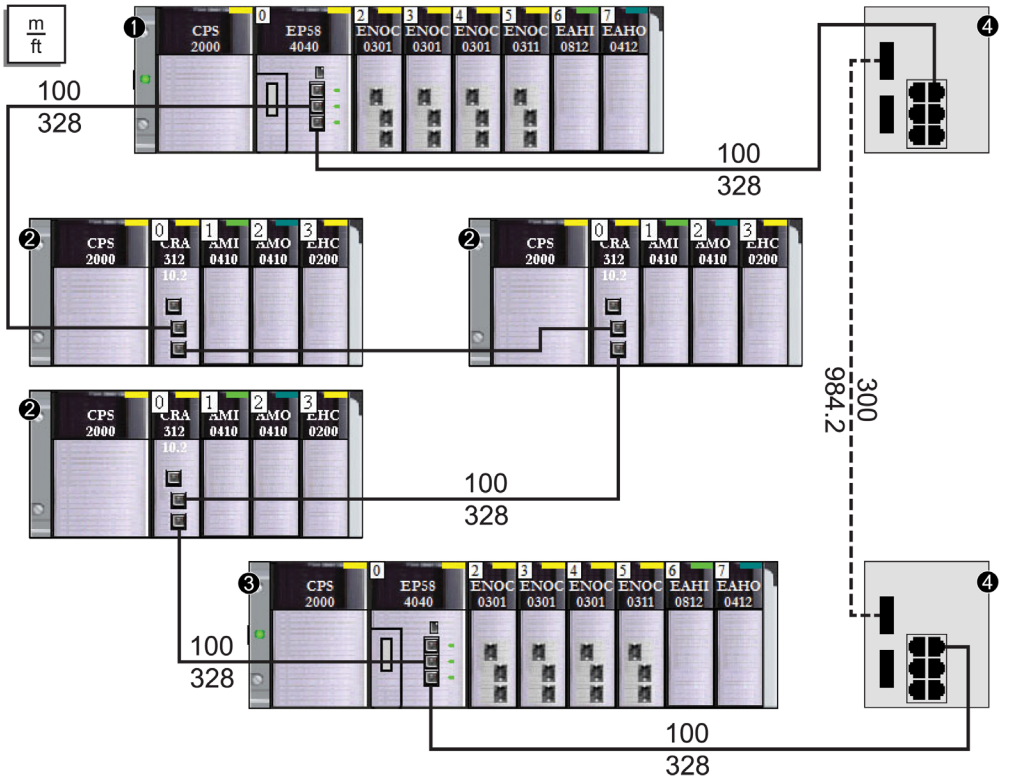
Port	Type	Description
1	FX	fiber connection to the main ring
3	100Base-TX	copper connection from the 140CRP93200 to the main ring
2	FX	disabled fiber port; do not use
4	100Base-TX	disabled copper port; do not use
5	100Base-TX	disabled copper port; do not use
6	100Base-TX	disabled copper port; do not use
7	100Base-TX	disabled copper port; do not use
8	100Base-TX	port mirroring connection (disabled by default)

NOTE: This predefined configuration does not support the use of a sub-ring or any distributed I/O clouds.

NOTE: When you download this DRS 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.
Do not adjust the configuration parameters or alter the port usage from what is shown above. Changing the configuration parameters or the port assignments can compromise the effectiveness and accuracy of the switch and the performance of the RIO network.
You can enable/disable port mirroring and change the selection of the source ports that you want mirrored. Port mirroring is disabled by default. The destination port is set to port 8, and ports 1-7 are selected as source ports. Do not change the destination port. When using port mirroring, select the ports, for which you want to analyze the traffic, as the source ports. When you finish troubleshooting, disable port mirroring.

A Long-haul Hot Standby Link

This sample network includes a primary local rack and a secondary Hot Standby rack. Multiple RIO drops are connected to the main ring. Two copper-to-fiber DRSs provide a long-haul fiber connection that supports the Hot Standby functionality:



1 The CPU in the primary rack is connected to (e)X80 EIO adapter modules.
2 RIO drops are connected to the main ring through BM•CRA312•0 (e)X80 EIO adapter modules.
3 The CPU in the standby rack is connected to (e)X80 EIO adapter modules.
4 DRSs are configured for long-haul Hot Standby support and connected by a fiber cable greater than 100 m long.

Obtaining and Installing Predefined Configuration Files

Obtaining Predefined Configuration Files

The Control Expert installation CD contains the predefined configuration files (**UPVx.x DVD Folders → Goodies → Config DRS**).

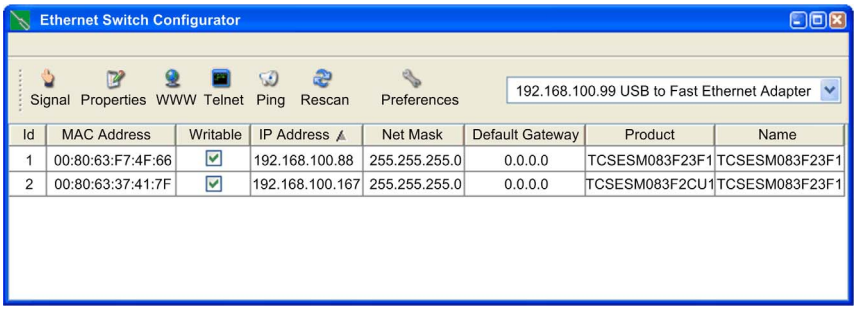
If you have already installed Control Expert, the predefined configuration files are also your PC's hard drive (**Shared Documents → Schneider Electric → Unity Pro → Extras → Config DRS**).

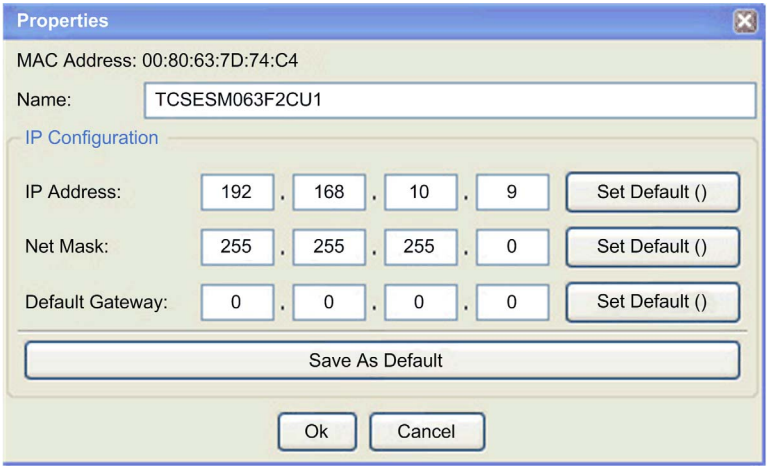
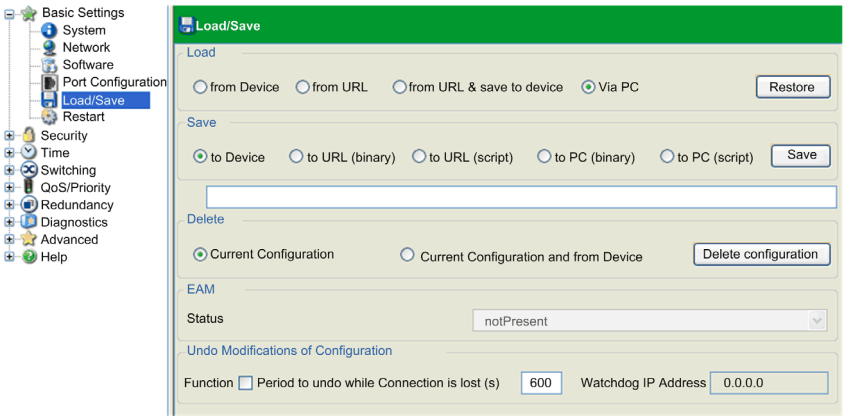
Loading a Predefined Configuration onto a DRS

The process for loading a predefined configuration onto a DRS involves the use of two 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: 

Step	Action
5	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. 
6	Select the switch you want to configure, and click the **WWW** button to open the embedded web pages for the selected switch.
7	Use the tree control on the left side of the web page and select **Basic Settings → Load/Save**: 

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 3
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	Topic	Page
3.1	System Performance	98
3.2	Verifying the Network Configuration	104
3.3	Application Response Time	107

Section 3.1
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:

Topic	Page
System Performance	99
System Throughput Considerations	101
Calculating the Minimum MAST Cycle Time	103

System Performance

Memory Consumption

Input and output memory specification:

Scope	Type	Maximum Value per Task*
M580 CPU	input bytes per device	up to 32,768, depending on CPU model
	output bytes per device	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 four tasks (MAST, FAST, AUX0, AUX1) simultaneously.*		

Displaying I/O Memory Consumption

You can monitor the I/O memory consumption in Control Expert . 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

Control Expert 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 an M580 configuration can manage is a function of the *Modicon M580* CPU model that you are using. For detailed information on configuring channels, refer to the *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

This table shows the maximum number of devices per local rack:

Device	Maximum per Rack
M580 CPU with Ethernet I/O scanner service	1
BMENOC0301/BMENOC0311 Ethernet communication module	3(1)
BMENOS0300 network option switch module	4(1)
BMENOC0321 control network module	1
BMXEIA0100 AS-interface module	4(2)
BMXNOR0200 Ethernet communication module	3(1, 2)
BMXNOM0200 Modbus communication module	4(1, 2) (see note below)

(1) A local rack contains an M580 CPU with Ethernet I/O scanner service and a maximum of six communication modules, depending upon the CPU you choose *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)*. (Only three of these communication modules can be BMENOC0301/311 modules.)
While the M580 CPUs and BMENOC0301/11 modules are designed specifically for a M580 system, you can use BMXEIA0100, BMXNOR0200, and BMXNOM0200 modules.
For the number of devices per rack supported by BME•585040 and BME•586040 CPUs, refer to the CPU selection table *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)*.
(2) Not supported in local racks in M580 Hot Standby systems.

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 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.

NOTE:
If you add a BME CXM 0100 module to the rack in Control Expert, you choose either **Remote** or **Distributed**.

- If you choose **Remote** , then the BME CXM 0100 module acts like a drop in the statement (**# of drops using MAST task) / 1.5**) in the way that MAST cycle is affected.
- If you choose **Distributed**, then the BME CXM 0100 module acts like a distributed device in the statement (**If DIO devices are configured, the minimum cycle time needs to be increased.**)

Unlike an actual drop, the BME CXM 0100 module can be mapped only to the MAST task.

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 3.2
Verifying the Network Configuration

Using the Ethernet Network Manager

Introduction

In Control Expert, click **Tools → Ethernet Network Manager** to visualize and verify a complex network configuration. The tool can:

- provide a global view of your network
- edit IP addresses and device identifiers for (e)X80 EIO adapter modules

Use either method to access the **Ethernet Network Manager**:

- Select **Tools → Ethernet Network Manager**.
- Select **Ethernet Network Manager** in the **Project Browser**.

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

Network Topology Configuration

The **Ethernet Network Manager** tool provides a snapshot of IP address settings for devices included in network topologies that are part of your application. If the tool detects an addressing error, it displays the detected error against a red background. If the tool detects an error, you can re-configure the affected setting in Control Expert.

Parameters in the **Ethernet Network Manager**:

Parameter	Description
Name	Ethernet communication device name
Type	The device type: ● Scanner ● Module
Subtype	The device sub-type: ● RIO/DIO ● CRA
Profiles	The kind of control network communications: ● Remote (RIO) ● Distributed (DIO)
Topo address	The topological address of the device, in the sequence: bus, drop, rack, slot.
DHCP Enable	Indicates if the device is a DHCP client and receives its IP address(es) from a DHCP server (yes/no).

Parameter	Description
IP Address	The IP address, or addresses, assigned to the device. **NOTE:** Editable for scanned modules.
Subnet Mask	The subnet mask related to each assigned IP address.
Gateway Address	The IP address of the default gateway, to which messages for other networks are transmitted.
Identified By	For scanned devices, the type of network identifier - the device Name,
Identifier	The string used to identify a scanned device. The default value is the device Name. **NOTE:** Editable for scanned modules.
SNMP	For scanning devices, the IP address of up to two SNMP network manager devices.
NTP State	The state of the NTP client: ● Enabled ● Disabled
NTP Configuration	The IP addresses of up to two NTP servers that send updates to the NTP client resident in the device.

NOTE:
- The red cells indicate detected errors (defined by network management rules).
- After editing a scanned module **IP Address** or **Identifier** setting, click the validate button to save your edits.

Verifying a Hot Standby Network

Follow these steps to use the **Ethernet Network Manager** tool while building your network in Control Expert:

Step	Action
1	In Control Expert, click **Tools → Ethernet Network Manager**. A preliminary, read-only global view of your network displays.
2	Check for settings with a red background, indicating the tool has detected a configuration error.
3	Click **OK** to close the **Network Inspector** tool.
4	If the tool displayed a detected error: ● in a scanning device, go to the specific device editor and change the IP configuration settings. ● in a scanned device, you can edit the **IP address** and **Identifier** settings in the **Ethernet Network Manager**, or go to the specific device editor and change the IP configuration settings. When you finish your edits, run the **Ethernet Network Manager** again.
5	Add distributed equipment and/or RIO modules to the **EIO Bus**. **NOTE:** Only devices enabled in the address server (DHCP) are controlled.
6	Configure all scanners.
7	Repeat steps 1, 2, 3, and 4 until the **Ethernet Network Manager** no longer detects any errors.

Network Manager Services

The network manager starts automatically when you open the **Network Inspector** tool. The global network management system (GNMS) is responsible for global network consistency. The following 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, Control Expert 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 switch 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

Control Expert alerts you when there are possible bandwidth considerations.

Ethernet RIO bandwidth:

- Control Expert displays a detected error message in the log window if the RIO bandwidth (originator -> target) or (target->originator) is greater than 8%.
- Control Expert 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):

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

Section 3.3
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?

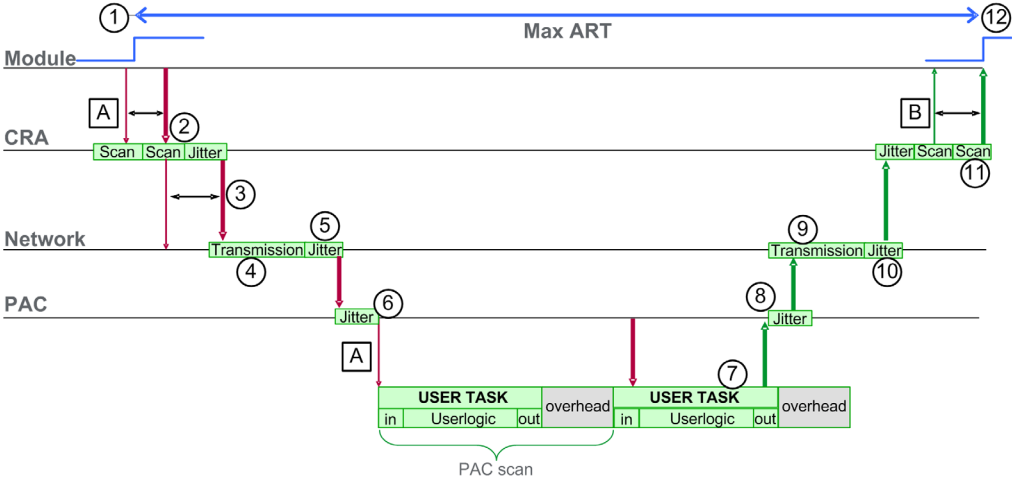
This section contains the following topics:

Topic	Page
Application Response Time	108
Application Response Time Example	111
Communication Loss Detection Times	114
Optimizing Application Response Time	116

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 Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)* 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:

ID	Parameter	Maximum value (ms)	Description	
2	CRA drop process time (CRA_Drop_Process)	4.4	The sum of CRA input scan time and queue delay	
3	CRA input RPI (RPI)	–	CPU task. Default = 0.5 * CPU period if MAST is in periodic mode. If MAST is in cyclic mode, the default value is watchdog/4).	
4	network input time[2] (Network_In_Time)	2.496 (0.078 * 32) **NOTE:** The value 2.496 ms is based upon a packet size of 800 bytes and 32 hops[1].	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:	
			I/O packet size (bytes):	Estimated network delay (µs):
			128	26
			256	35
			400	46
			800	78
			1200	110
			1400	127
5	network input jitter (Network_In_Jitter)	6.436 ((30 * 0.078) + (32 * 0.128)) **NOTE:** This value is based on a packet size of 800 bytes for RIO drops and 1500 bytes for DIO traffic.	formula: ((number of RIO drops) * (network delay)) + ((number of distributed equipment hops[1]) * network delay)	
6	CPU input jitter (CPU_In_Jitter)	5.41 (1 + (.07 * 63))	CPU input queue delay (owing to RIO drops and DIO traffic)	
7/ 8	CPU scan time (CPU_Scan)	–	This is the user defined Control Expert scan time, which can be either fixed or cyclic.	
9	CPU output jitter (CPU_Out_Jitter)	2.17 (1 + (0.07 * 31))	CPU output queue delay.	
10	network output time[2] (Network_Out_Time)	2.496	See calculation above for Network_In_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

ID	Parameter	Maximum value (ms)	Description
11	network output jitter (Network_Out_Jitter)	4.096 (32 * 0.128)	Calculate in the same manner as Network_In_Jitter without I/O frames from RIO drops.
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.

The maximum ART value is equal to the sum of values in the **Maximum value** column. Therefore, the ART calculation for a CPU scan time (CPU_Scan) of 50 ms and an RPI value of 25 ms looks like this:

4.4 + 25 + 2.496 + 6.436 + 5.41 + (2 * 50) + 2.17 + 2.496 + 4.096 + 4.4 = **156.904** ms ART

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.

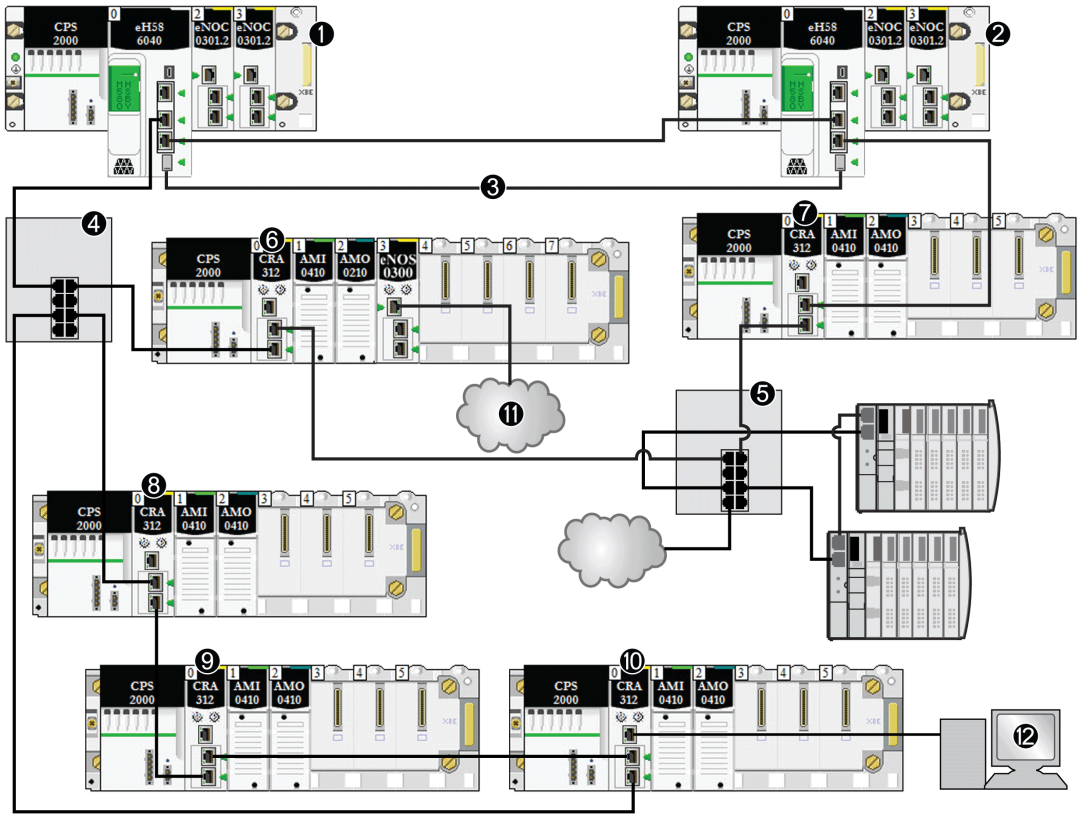
Application Response Time Example

Introduction

This sample Modicon M580 application is designed to help you calculate the ART, or application response time *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)*.

Example of a BM•CRA312•0 Module in an RIO Sub-ring

This example calculates the maximum ART, representing the longest packet path from a BM•CRA312•0 X80 EIO adapter module in an RIO sub-ring (8, in the following graphic) to the CPU with Ethernet I/O scanner service in the local rack (1). The calculation is performed from the perspective of the BM•CRA312•0 X80 EIO adapter modules in this M580 network design:



1 The primary rack includes an M580 CPU.
2 The secondary rack includes an M580 CPU.
3 The Hot Standby ports on the primary and standby CPUs are linked.

4 A DRS on the main ring supports an RIO sub-ring.
5 A DRS on the main ring supports a DIO sub-ring and a DIO cloud.
6, 7 RIO drops on the main ring include BM•CRA312•0 X80 EIO adapter modules.
8, 9, 10 An RIO drop on an RIO sub-ring includes a BM•CRA312•0 X80 EIO adapter module.
11 A DIO cloud is connected to a BMENOS0300 network option switch module in an RIO drop.
12 An HMI device is connected to a BM•CRA312•0 X80 EIO adapter module in an RIO drop.

Calculation

In this example, assume there are breaks in two cables:

- **main ring:** There is a cable break between the CPU with Ethernet I/O scanner service in the local rack (1) and the DRS (4).
- **RIO sub-ring:** There is a cable break between the DRS (4) and the BM•CRA312•0 X80 EIO adapter module in an RIO drop (8).

In this example, ART is calculated from the perspective of the adapter module in the RIO drop. Consider these application-specific elements when you calculate the ART:

- In this example, the maximum potential hop count is 10. That is, 10 is the maximum number of switches a packet can potentially pass through between RIO adapter module 8 and the CPU with Ethernet I/O scanner service in the local rack (1). This is the case when a packet follows this path from RIO adapter module 8 and the local rack (1): 8, 9, 10, 4 (x2), 6, 5 (x2), 7, 2, 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•CRA312•0 X80 EIO adapter module. Count each DRS as two devices when you calculate the hop count.
- Jitter (packet queue delay) is introduced into the system by these design elements:
  - DIO sub-ring
  - RIO sub-ring, on which the BM•CRA312•0 X80 EIO adapter module is located
  - RIO drop
  - HMI
  - DIO cloud

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)	—	Default = 0.5 * CPU period.
network input time (Network_In_Time)	(0.078 * 10) = 0.780	The hop count is 10 from the CPU with Ethernet I/O scanner service in the local rack (1) to the BM•CRA312•0 X80 EIO adapter module in the RIO drop (8). hop sequence: 8, 9, 10, 4 (x2), 6, 5 (x2), 7, 2, 1 (Count each DRS [4, 5] as two devices when you calculate the capacity of your main-ring.)
For an explanation of each parameter, refer to the topic ART Computation Parameters *(see page 108)*.		

Parameter	Maximum value (ms)	Comments
network input jitter (Network_In_Jitter)	((0.078 * 5) +	RIO: The value 5 represents the number of BM•CRA312•0 modules plus the number of CPUs based on a packet size of 800 bytes.
	(0.128 * 2))	DIO: The value 2 represents the number of packets from distributed equipment based on a packet size of 1500 bytes.
	= 0.646	
CPU input jitter (CPU_In_Jitter)	(1 + (0.07 * 5)) = 1.35	Read packets from the distributed devices attached to DRS 5 and the BM•CRA312•0 modules (6, 7, 9, 10).
CPU scan time (CPU_Scan)	2 * CPU_Scan	User defined, based on application.
CPU output jitter (CPU_Out_Jitter)	(1 + (0.07 * 5)) = 1.35	CPU Ethernet I/O service internal queue delay (owing to BM•CRA312•0 modules)
network output time (Network_Out_Time)	(0.078 * 10) = 0.780	See comment above for Network_In_Time.
network output jitter (Network_Out_Jitter)	(0.128 * 1) = .128	Owing to distributed devices.
BM•CRA312•0 drop process time (CRA_Drop_Process)	4.4	The sum of the BM•CRA312•0 X80 EIO adapter module (6) output scan time and queue delay.
For an explanation of each parameter, refer to the topic ART Computation Parameters *(see page 108)*.		

The maximum ART value is equal to the sum of values in the **Maximum value** column. Therefore, the ART calculation for a CPU scan time (CPU_Scan) of 50 ms and an RPI value of 25 ms looks like this:

4.4 + 25 + 0.780 + 0.646 + 1.35 + (2*50) + 1.35 + 0.780 + 0.128 + 4.4 = **138.834** ms ART

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.

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•CRA312•0 (e)X80 EIO adapter module
- a CPU with Ethernet I/O scanner service detects that a BM•CRA312•0 module has stopped communicating.
- a BM•CRA312•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•CRA312•0 module can detect a broken or detached cable within 5 ms of the occurrence.

NOTE: A network that includes up to 31 drops and a CPU with Ethernet I/O 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•CRA312•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•CRA312•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
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•CRA312•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•CRA312•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

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•CRA312•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 Control Expert logic.

NOTE: In an M580 Hot Standby *(see Modicon M580 Hot Standby, System Planning Guide for, Frequently Used Architectures)*system, plan your topology accordingly so the amount of data exchanged is reduced.

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•CRA312•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[5]	periodic	10...2550 by 10 / 100	100...5000 by 100 / 2000	local and remote racks[3]
AUX1[5]	periodic	10...2550 by 10 / 200	100...5000 by 100 / 2000	local and remote racks[3]
I/O Event[5]	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•CRA31210 X80 EIO adapter modules only.

[4] DDDT syntax is not supported in the I/O event task.

[5] Not supported by Hot Standby systems.

The Control Expert help pages further describe the multiple tasks *(see EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual)*.

Part III
Diagnosing Complex M580 Sytems

Chapter 4
System Diagnostics

Overview

This chapter describes the system diagnostics for complex M580 systems.

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 (see Modicon M580, Hardware, Reference Manual)*.
- For the BM•CRA312•0 X80 EIO adapter module, refer to the *Modicon M580 Remote I/O Modules Installation and Configuration Guide (see Modicon M580, RIO Modules, Installation and Configuration Guide)*.
- For the BMENOC0301/11 Ethernet communication module, refer to the *Modicon M580 BMENOC0301/11 Ethernet Communication Module Installation and Configuration Guide (see Modicon M580, BMENOC0301/0311 Ethernet Communications Module, Installation and Configuration Guide)*.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
System Diagnostics	122
Main Ring Diagnostics	128
Sub-Ring Diagnostics	129

System Diagnostics

Introduction

These tables describe the various causes for communication interruptions in complex M580 system architectures.

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 (see Modicon M580, Hardware, Reference Manual)*.
- For the BM•CRA312•0 X80 EIO adapter modules, refer to the *Modicon M580 Remote I/O Modules Installation and Configuration Guide (see Modicon M580, RIO Modules, Installation and Configuration Guide)*.
- For the BMENOC0301/11 Ethernet communication module, refer to the *Modicon M580 BMENOC0301/11 Ethernet Communication Module Installation and Configuration Guide (see Modicon M580, BMENOC0301/0311 Ethernet Communications Module, Installation and Configuration Guide)*.
- For the BMENOS0300 network option switch module, refer to the *Modicon M580 BMEN0S0300 Network Option Switch Module Installation and Configuration Guide*.
- For the BMENOC0321 control network switch module, refer to the *Modicon M580 BMENOC0321 Control Network Module Installation and Configuration Guide*.

NOTE: Refer to the *EcoStruxure™ Control Expert, System Bits and Words, Reference Manual* for a detailed explanation of system bits and words.

Ethernet Communication Modules in the Local Rack

Monitor diagnostics for Ethernet Communication Modules in the Local Rack:

Status of...	Module [1]	User Application [2]	Control Expert [3]	Rack Viewer [5]	Ethernet Management Tool [6]
BMENOC0301/11 Ethernet backplane connection broken	BMENOC0301/11 active LED				
BMENOC0301/11 reset	BMENOC0301/11 LED	BMENOC0301/11 health bit (in CPU system word) I/O scanner connection status	DTM online diagnostic inoperable	yes	yes
BMENOC0301/11 inoperable	BMENOC0301/11 LED	BMENOC0301/11 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 Control Expert to detect whether a BMENOC0301/11 is inoperable or has been reset.
4. Not applicable.
5. Use the FactoryCast rack viewer to detect if a BMENOC0301/11 is inoperable or has been reset.
6. Use ConneXium Network Manager, HiVision, or other Ethernet network management tool to detect if a BMENOC0301/11 is inoperable or has been reset.

Ethernet RIO Network

NOTICE
UNINTENTIONAL EQUIPMENT BEHAVIOR Confirm that each module has a unique IP address. Duplicate IP addresses can cause unpredictable module/network behavior. **Failure to follow these instructions can result in equipment damage.**

Monitor diagnostics for the Ethernet RIO network:

Status of...	Module [1]	User Application [2]	Rack Viewer [5]	Ethernet Management Tool [6]
duplicate IP address in CPU or BMXCRA312•0	BMEP58•0•0 LED BM•CRA312•0 LED			
CPU (single) cable pulled out	BMEP58•0•0 active LED	CPU status byte CPU DDDT	yes	yes
BM•CRA312•0 (single) cable pulled out	BM•CRA312•0 ACT LED	drop connection status (in CRA DDDT)		yes
BMENOS0300 diagnostic	ACT LED		web page	yes
DRS powered off	DRS power LED	DATA_EXCH block: monitor DRS (ports 5 and 6)		yes
DRS cable pulled out	DRS ACT LED	DATA_EXCH block: monitor DRS (ports 5 and 6)	DRS web	yes
main ring cable broken *(see page 128)*		EIO system bit (part of CPU DDT)	DRS web (only if cable on DRS port is broken)	
single ring cable broken *(see page 129)*		DATA_EXCH block: monitor DRS (ports 5 and 6)	DRS web	

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•CRA312•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]	Rack Viewer [5]	Ethernet Management Tool [6]
RIO traffic too slow (due to bad configuration or cabling)		DATA_EXCH block: monitor DRS (port 5 and 6) Also possible via CRA DDDT		
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•CRA312•0 X80 EIO adapter module, or DRS. Also use this tool to detect DRS power state and slow DIO traffic.

Ethernet RIO Drops

Monitor diagnostics for Ethernet RIO drops:

Status of...	Module [1]	User Application [2]	Rack Viewer [5]	ConneXium Network Manager [6]
BM•CRA312•0 powered off or disconnected	BM•CRA312•0 LED	drop connection status (in CPU DDDT) detected drop error status (in CPU DDDT)		yes
BM•CRA312•0 not configured	BM•CRA312•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•CRA312•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•CRA312•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•CRA312•0 X80 EIO adapter module.

RIO Modules

Monitor diagnostics for RIO modules:

Status of...	Module [1]	User Application [2]	Rack Viewer [5]
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
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.

Distributed Equipment

Monitor diagnostics for distributed equipment:

Status of...	User Application [2]	Rack Viewer [5]	ConneXium Network Manager [6]
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 = A cable is broken or a device has stopped.
- 1 = loop is present and healthy.

NOTE: Refer to the M580 RIO guide *(see Modicon M580, RIO Modules, Installation and Configuration Guide)* for a list of diagnostic status bits.

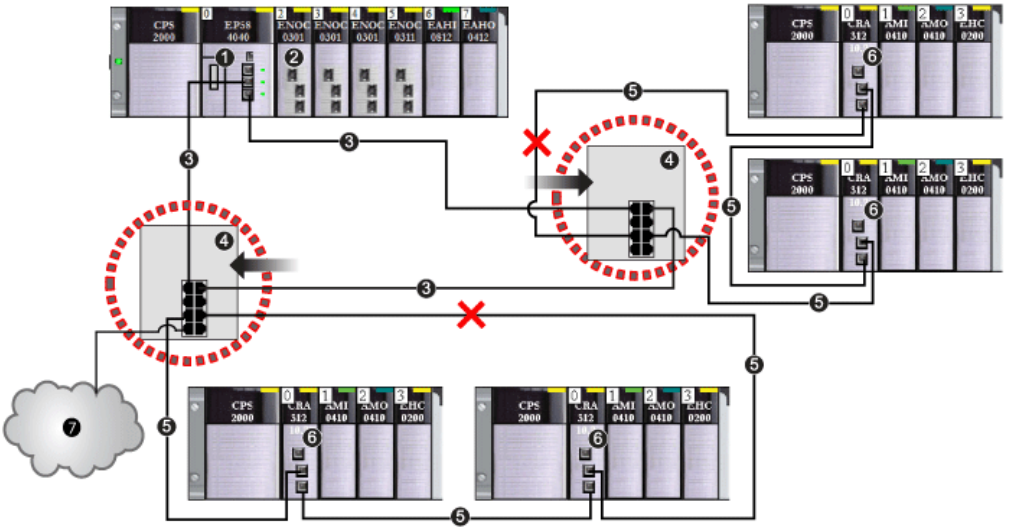
Sub-Ring Diagnostics

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:

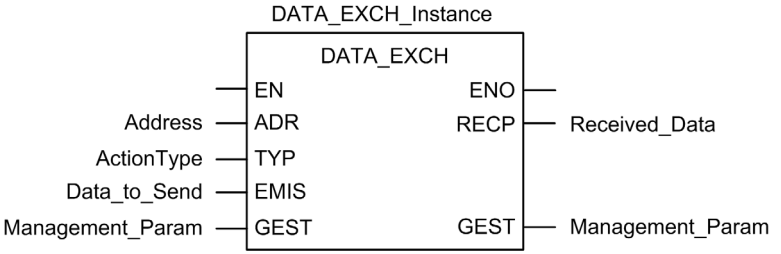


1 CPU with Ethernet I/O scanner service on the local rack
2 BMENOC0301/11 Ethernet communication module (with the Ethernet backplane connection enabled), managing the DIO cloud (7)
3 main ring
4 DRS connected to the main ring and RIO sub-rings
5 RIO sub-ring with a communication break (indicated by an **X**)
6 RIO drop (including a BM•CRA312•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 Control Expert application to read the DRS ports 5 and 6 state.



In the Control Expert 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•CRA312•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 *(see Modicon M340, BMX NOC 0401 Ethernet Communication Module, User Manual)* 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 *(see Modicon M580, BMENOC0301/0311 Ethernet Communications Module, Installation and Configuration Guide)*	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 *(see Modicon M580, BMENOC0301/0311 Ethernet Communications Module, Installation and Configuration Guide)*	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` *(see Modicon M580, BMENOC0301/0311 Ethernet Communications Module, Installation and Configuration Guide)*	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` *(see Modicon M580, BMENOC0301/0311 Ethernet Communications Module, Installation and Configuration Guide)*	Array [n...m] of `INT`	the EtherNet/IP (CIP) response

Appendices

What Is in This Appendix?

The appendix contains the following chapters:

Chapter	Chapter Name	Page
A	Frequently Asked Questions (FAQ)	135
B	Complex Network Design Principles	137

Appendix A
Frequently Asked Questions (FAQ)

FAQs

Topologies

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 27)*.

NOTE:

- DRSs **are not** used in a simple daisy chain loop topology *(see Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)*.
- DRSs **are** used in a high capacity daisy chain loop topology *(see page 23)* to support distributed equipment and sub-rings.

Appendix B
Complex Network Design Principles

Introduction

This chapter describes the design principles for M580 network topologies that consist of a main ring with optional RIO/DIO sub-rings.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
RIO with DIO Network Design Principles	138
Defined Architecture: Topologies	139
Defined Architecture: Junctions	141

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
- BMENOS0300 network option switch module
- **Implementation of Defined Architectures**: An M580 network supports the addition of DIO data traffic only in specific network designs, including one of these:
  - a main ring joined by a BMENOS0300 network option switch module to a DIO cloud
  - a main ring with one or more RIO drops

  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

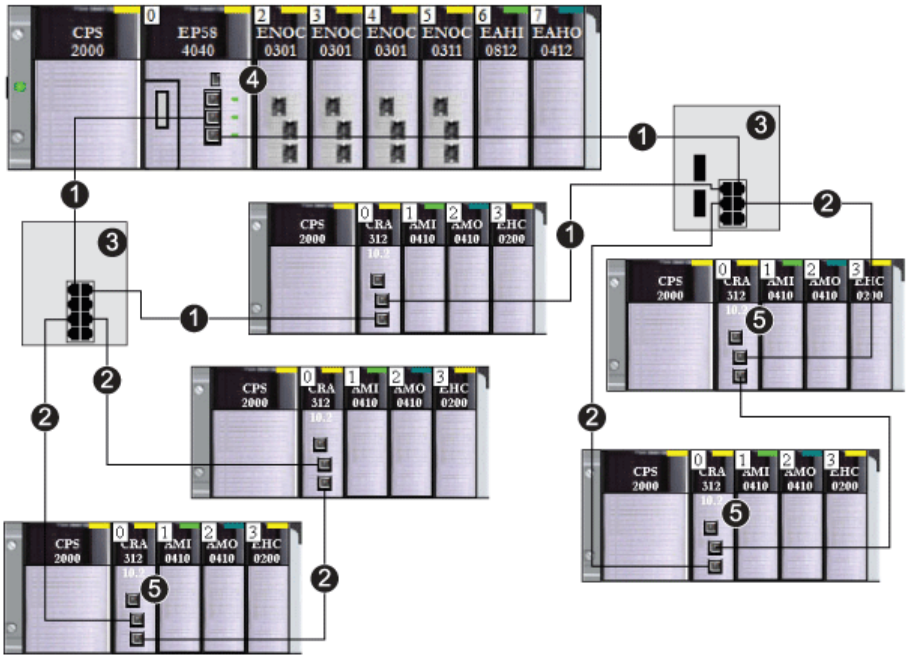
Introduction

The defined architecture restricts the 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 Modicon M580 Standalone, System Planning Guide for, Frequently Used Architectures)*. To determine the hop count from the perspective of an RIO drop, count the number of switches from the remote drop 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•CRA312•0 X80 EIO adapter module

In this 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•CRA312•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.

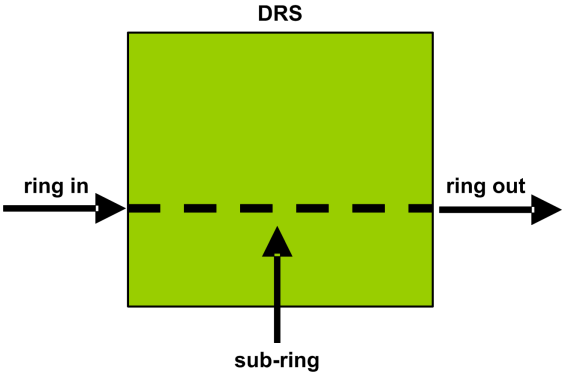
Each junction presents the queueing point, which can add delay — or jitter — to the system. If two packets simultaneously arrive at a junction, only one can be immediately transmitted. The other waits for a period referred to as “one delay time” before it is transmitted.

Because RIO packets are granted priority by the M580 network, the longest an RIO packet can wait at a junction is one delay time before it is transmitted by the module or DRS.

The following scenarios depict how DRSs handle packets that arrive simultaneously.

DRS

In this example, a DRS receives a steady flow of packets from both the main ring and an RIO sub-ring:

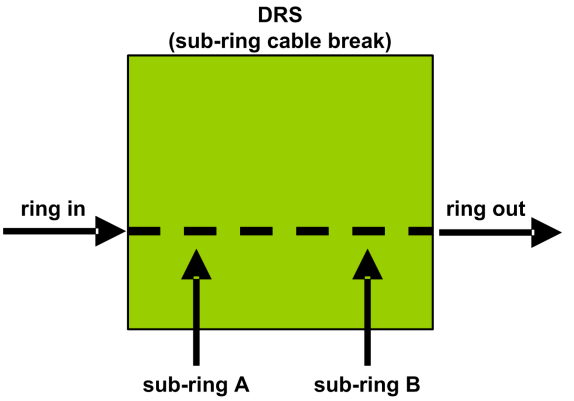


The DRS handles RIO packets in this sequence:

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 this 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 this 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.

Glossary

!

%I

According to the CEI standard, %I indicates a language object of type discrete IN.

%IW

According to the CEI standard, %IW indicates a language object of type analog IN.

%M

According to the CEI standard, %M indicates a language object of type memory bit.

%MW

According to the CEI standard, %MW indicates a language object of type memory word.

%Q

According to the CEI standard, %Q indicates a language object of type discrete OUT.

%QW

According to the CEI standard, %QW indicates a language object of type analog OUT.

%SW

According to the CEI standard, %SW indicates a language object of type system word.

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.

advanced mode

In Control Expert, advanced mode is a selection that displays expert-level configuration properties that help define Ethernet connections. Because these properties should be edited only by people with a good understanding of EtherNet/IP communication protocols, they can be hidden or displayed, depending upon the qualifications of the specific user.

applicative time stamping

Use the applicative time stamping solution to access time stamp event buffers with a SCADA system that does not support the OPC DA interface. In this case, function blocks in the Control Expert PLC application read events in the buffer and formats them to be sent to the SCADA system.

architecture

Architecture describes a framework for the specification of a network that is constructed of these components:

- physical components and their functional organization and configuration
- operational principles and procedures
- data formats used in its operation

ARRAY

An `ARRAY` is a table containing elements of a single type. This is the syntax: `ARRAY [<limits>] OF <Type>`

Example: `ARRAY [1..2] OF BOOL` is a one-dimensional table with two elements of type `BOOL`.

`ARRAY [1..10, 1..20] OF INT` is a two-dimensional table with 10x20 elements of type `INT`.

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.

B

BCD

(*binary-coded decimal*) Binary encoding of decimal numbers.

BOOL

(*boolean type*) This is the basic data type in computing. A `BOOL` variable can have either of these values: 0 (`FALSE`) or 1 (`TRUE`).

A bit extracted from a word is of type `BOOL`, for example: `%MW10.4`.

BOOTP

(*bootstrap protocol*) A UDP network protocol that can be used by a network client to automatically obtain an IP address from a server. The client identifies itself to the server using its MAC address. The server, which maintains a pre-configured table of client device MAC addresses and associated IP addresses, sends the client its defined IP address. The BOOTP service utilizes UDP ports 67 and 68.

broadcast

A message sent to all devices in a broadcast domain.

C

CCOTF

(*change configuration on the fly*) A feature of Control Expert that allows a module hardware change in the system configuration while the system is operating. This change does not impact active operations.

CIP™

(*common industrial protocol*) A comprehensive suite of messages and services for the collection of manufacturing automation applications (control, safety, synchronization, motion, configuration and information). CIP allows users to integrate these manufacturing applications with enterprise-level Ethernet networks and the internet. CIP is the core protocol of EtherNet/IP.

class 1 connection

A CIP transport class 1 connection used for I/O data transmission via implicit messaging between EtherNet/IP devices.

class 3 connection

A CIP transport class 3 connection used for explicit messaging between EtherNet/IP devices.

connected messaging

In EtherNet/IP, connected messaging uses a CIP connection for communication. A connected message is a logical relationship between two or more application objects on different nodes. The connection establishes a virtual circuit in advance for a particular purpose, such as frequent explicit messages or real-time I/O data transfers.

connection

A virtual circuit between two or more network devices, created prior to the transmission of data. After a connection is established, a series of data is transmitted over the same communication path, without the need to include routing information, including source and destination address, with each piece of data.

connection originator

The EtherNet/IP network node that initiates a connection request for I/O data transfer or explicit messaging.

connectionless

Describes communication between two network devices, whereby data is sent without prior arrangement between the two devices. Each piece of transmitted data also includes routing information, including source and destination address.

control network

An Ethernet-based network containing PACs, SCADA systems, an NTP server, PCs, AMS, switches, etc. Two kinds of topologies are supported:

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

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 an industrial environment.

D

DDT

(*derived data type*) A derived data type is a set of elements with the same type (`ARRAY`) or with different types (structure).

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 DDT (DDDT)

A Device DDT is a DDT predefined by the manufacturer and not modifiable by user. It contains the I/O language elements of an I/O module.

device network

An Ethernet-based network within a remote I/O network that contains both remote I/O and distributed I/O devices. Devices connected on this network follow specific rules to allow remote I/O determinism.

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.

DFB

(*derived function block*) DFB types are function blocks that can be defined by the user in ST, IL, LD or FBD language.

Using these DFB types in an application makes it possible to:

- simplify the design and entry of the program
- make the program easier to read
- make it easier to debug
- reduce the amount of code generated

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

(*distributed I/O*) Also known as distributed equipment. DRSs use DIO ports to connect distributed equipment.

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 I/O scanner service.

DNS

(*domain name server/service*) A service that translates an alpha-numeric domain name into an IP address, the unique identifier of a device on the network.

domain name

An alpha-numeric string that identifies a device on the internet, and which appears as the primary component of a web site's uniform resource locator (URL). For example, the domain name *schneider-electric.com* is the primary component of the URL *www.schneider-electric.com*.

Each domain name is assigned as part of the domain name system, and is associated with an IP address.

Also called a host name.

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.

DSCP

(*differentiated service code points*) This 6-bit field is in the header of an IP packet to classify and prioritize traffic.

DST

(*daylight saving time*) DST is also called *summer time* and is a practice consisting of adjusting forward the clock near the start of spring and adjusting it backward near the start of autumn.

DT

(*date and time*) The DT type, encoded in BCD in a 64-bit format, contains this information:

- the year encoded in a 16-bit field
- the month encoded in an 8-bit field
- the day encoded in an 8-bit field
- the time encoded in an 8-bit field
- the minutes encoded in an 8-bit field
- the seconds encoded in an 8-bit field

NOTE: The eight least significant bits are not used.

The DT type is entered in this format:

DT#<Year>**-**<Month>**-**<Day>**-**<Hour>**:**<Minutes>**:**<Seconds>

This table shows the upper/lower limits of each field:

Field	Limits	Comment
Year	[1990,2099]	Year
Month	[01,12]	The leading 0 is displayed; it can be omitted during data entry.
Day	[01,31]	For months 01/03/05/07/08/10/12
	[01,30]	For months 04/06/09/11
	[01,29]	For month 02 (leap years)
	[01,28]	For month 02 (non-leap years)
Hour	[00,23]	The leading 0 is displayed; it can be omitted during data entry.
Minute	[00,59]	The leading 0 is displayed; it can be omitted during data entry.
Second	[00,59]	The leading 0 is displayed; it can be omitted during data entry.

DTM

(*device type manager*) A DTM is a device driver running on the host PC. It provides a unified structure for accessing device parameters, configuring and operating the devices, and troubleshooting devices. DTMs can range from a simple graphical user interface (GUI) for setting device parameters to a highly sophisticated application capable of performing complex real-time calculations for diagnosis and maintenance purposes. In the context of a DTM, a device can be a communications module or a remote device on the network.

See FDT.

E

EDS

(*electronic data sheet*) EDS are simple text files that describe the configuration capabilities of a device. EDS files are generated and maintained by the manufacturer of the device.

EF

(*elementary function*) This is a block used in a program which performs a predefined logical function.

A function does not have any information on the internal state. Several calls to the same function using the same input parameters will return the same output values. You will find information on the graphic form of the function call in the [*functional block (instance)*]. Unlike a call to a function block, function calls include only an output which is not named and whose name is identical to that of the function. In FBD, each call is indicated by a unique [number] via the graphic block. This number is managed automatically and cannot be modified.

Position and configure these functions in your program to execute your application.

You can also develop other functions using the SDKC development kit.

EFB

(*elementary function block*) This is a block used in a program which performs a predefined logical function.

EFBs have states and internal parameters. Even if the inputs are identical, the output values may differ. For example, a counter has an output indicating that the preselection value has been reached. This output is set to 1 when the current value is equal to the preselection value.

EIO network

(Ethernet I/O) An Ethernet-based network that contains three types of devices:

- local rack
- X80 remote drop (using a BM•CRA312•0 adapter module), or a BMENOS0300 network option switch module
- ConneXium extended dual-ring switch (DRS)

NOTE: Distributed equipment may also participate in an Ethernet I/O network via connection to DRSs or the service port of X80 remote modules.

EN

`EN` stands for **EN**able; it is an optional block input. When the `EN` input is enabled, an `ENO` output is set automatically.

If `EN` = 0, the block is not enabled; its internal program is not executed, and `ENO` is set to 0.

If `EN` = 1, the block's internal program is run and `ENO` is set to 1. If a runtime error is detected, `ENO` is set to 0.

If the `EN` input is not connected, it is set automatically to 1.

ENO

`ENO` stands for **E**rror **NO**tification; this is the output associated with the optional input `EN`.

If `ENO` is set to 0 (either because `EN` = 0 or if a runtime error is detected):

- The status of the function block outputs remains the same as it was during the previous scanning cycle that executed correctly.
- The output(s) of the function, as well as the procedures, are set to 0.

Ethernet

A 10 Mb/s, 100 Mb/s, or 1 Gb/s, CSMA/CD, frame-based LAN that can run over copper twisted pair or fiber optic cable, or wireless. The IEEE standard 802.3 defines the rules for configuring a wired Ethernet network; the IEEE standard 802.11 defines the rules for configuring a wireless Ethernet network. Common forms include 10BASE-T, 100BASE-TX, and 1000BASE-T, which can utilize category 5e copper twisted pair cables and RJ45 modular connectors.

Ethernet DIO scanner service

This embedded DIO scanner service of M580 CPUs manages distributed equipment on an M580 device network.

Ethernet I/O scanner service

This embedded Ethernet I/O scanner service of M580 CPUs 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.

explicit messaging

TCP/IP-based messaging for Modbus TCP and EtherNet/IP. It is used for point-to-point, client/server messages that include both data, typically unscheduled information between a client and a server, and routing information. In EtherNet/IP, explicit messaging is considered class 3 type messaging, and can be connection-based or connectionless.

explicit messaging client

(*explicit messaging client class*) The device class defined by the ODVA for EtherNet/IP nodes that only support explicit messaging as a client. HMI and SCADA systems are common examples of this device class.

F

FAST

A 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.

FBD

(*function block diagram*) An IEC 61131-3 graphical programming language that works like a flowchart. By adding simple logical blocks (`AND`, `OR`, etc.), each function or function block in the program is represented in this graphical format. For each block, the inputs are on the left and the outputs on the right. Block outputs can be linked to inputs of other blocks to create complex expressions.

FDR

(*fast device replacement*) A service that uses configuration software to replace an inoperable product.

FDT

(*field device tool*) The technology that harmonizes communication between field devices and the system host.

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.

full duplex

The ability of two networked devices to independently and simultaneously communicate with each other in both directions.

function block diagram

See FBD.

G

gateway

A gateway device interconnects two different networks, sometimes through different network protocols. When it connects networks based on different protocols, a gateway converts a datagram from one protocol stack into the other. When used to connect two IP-based networks, a gateway (also called a router) has two separate IP addresses, one on each network.

GPS

(*global positioning system*) The GPS standard consists of a space-based positioning, navigation, and timing signals delivered worldwide for civil and military use. Standard positioning service performance depends on satellite broadcast signal parameters, GPS constellation design, the number of satellites in sight, and various environmental parameters.

H

harsh environment

Resistance to hydrocarbons, industrial oils, detergents and solder chips. Relative humidity up to 100%, saline atmosphere, significant temperature variations, operating temperature between -10°C and + 70°C, or in mobile installations. For hardened (H) devices, the relative humidity is up to 95% and the operating temperature is between -25°C and + 70°C.

HART

(*highway addressable remote transducer*) A bi-directional communication protocol for sending and receiving digital information across analog wires between a control or monitoring system and smart devices.

HART is the global standard for providing data access between host systems and intelligent field instruments. A host can be any software application from a technician's hand-held device or laptop to a plant's process control, asset management, or other system using any control platform.

high-capacity daisy chain loop

Often referred to as HCDL, a high-capacity daisy chain loop uses dual-ring switches (DRSs) to connect device sub-rings (containing RIO drops or distributed equipment) and/or DIO clouds to the Ethernet RIO network.

HMI

(*human machine interface*) System that allows interaction between a human and a machine.

Hot Standby

A Hot Standby system uses a primary PAC (PLC) and a standby PAC. The two PAC racks have identical hardware and software configurations. The standby PAC monitors the current system status of the primary PAC. If the primary PAC becomes inoperable, high-availability control is maintained when the standby PAC takes control of the system.

HTTP

(*hypertext transfer protocol*) A networking protocol for distributed and collaborative information systems. HTTP is the basis of data communication for the web.

I

I/O scanner

An Ethernet service that continuously polls I/O modules to collect data, status, event, and diagnostics information. This process monitors inputs and controls outputs. This service supports both RIO and DIO logic scanning.

IEC 61131-3

International standard: programmable logic controllers

Part 3: programming languages

IGMP

(internet group management protocol) This internet standard for multicasting allows a host to subscribe to a particular multicast group.

IL

(*instruction list*) An IEC 61131-3 programming language that contains a series of basic instructions. It is very close to assembly language used to program processors. Each instruction is made up of an instruction code and an operand.

implicit messaging

UDP/IP-based class 1 connected messaging for EtherNet/IP. Implicit messaging maintains an open connection for the scheduled transfer of control data between a producer and consumer. Because an open connection is maintained, each message contains primarily data, without the overhead of object information, plus a connection identifier.

INT

(*INTeger*) (encoded in 16 bits) The upper/lower limits are as follows: -(2 to the power of 15) to (2 to the power of 15) - 1.

Example: `-32768`, `32767`, `2#1111110001001001`, `16#9FA4`.

inter-controller network

An Ethernet-based network that is part of the control network, and provides data exchange between controllers and engineering tools (programming, asset management system (AMS)).

IODDT

(*input/output derived data type*) A structured data type representing a module, or a channel of a CPU. Each application expert module possesses its own IODDTs.

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.

IPsec

(*internet protocol security*) An open set of protocol standards that make IP communication sessions private and secure for traffic between modules using IPsec, developed by the internet engineering task force (IETF). The IPsec authentication and encryption algorithms require user-defined cryptographic keys that process each communications packet in an IPsec session.

isolated DIO network

An Ethernet-based network containing distributed equipment that does not participate in an RIO network.

L

LD

(*ladder diagram*) An IEC 61131-3 programming language that represents instructions to be executed as graphical diagrams very similar to electrical diagrams (contacts, coils, etc.).

literal value of an integer

A literal value of an integer is used to enter integer values in the decimal system. Values may be preceded by the "+" and "-" signs. Underscore signs (_) separating numbers are not significant.

Example:

```
-12, 0, 123_456, +986
```

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.

local slave

The functionality offered by Schneider Electric EtherNet/IP communication modules that allows a scanner to take the role of an adapter. The local slave enables the module to publish data via implicit messaging connections. Local slave is typically used in peer-to-peer exchanges between PACs.

M

M580 Ethernet I/O device

An Ethernet device that provides automatic network recovery and deterministic RIO performance. The time it takes to resolve an RIO logic scan can be calculated, and the system can recover quickly from a communication disruption. M580 Ethernet I/O devices include:

- local rack (including a CPU with Ethernet I/O scanner service)
- RIO drop (including an X80 adapter module)
- DRS switch with a predefined configuraton

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.

MB/TCP

(*Modbus over TCP protocol*) This is a Modbus variant used for communications over TCP/IP networks.

MIB

(*management information base*) A virtual database used for managing the objects in a communications network. See SNMP.

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.

multicast

A special form of broadcast where copies of the packet are delivered to only a specified subset of network destinations. Implicit messaging typically uses multicast format for communications in an EtherNet/IP network.

N

network

There are two meanings:

- In a ladder diagram:
  A network is a set of interconnected graphic elements. The scope of a network is local, concerning the organizational unit (section) of the program containing the network.
- With expert communication modules:
  A network is a set of stations that intercommunicate. The term *network* is also used to define a group interconnected graphic elements. This group then makes up part of a program that may comprise a group of networks.

network time service

Use this service to synchronize computer clocks over the Internet to record events (sequence events), synchronize events (trigger simultaneous events), or synchronize alarms and I/O (time stamp alarms).

NIM

(*network interface module*) A NIM resides in the first position on an STB island (leftmost on the physical setup). The NIM provides the interface between the I/O modules and the fieldbus master. It is the only module on the island that is fieldbus-dependent — a different NIM is available for each fieldbus.

NTP

(*network time protocol*) Protocol for synchronizing computer system clocks. The protocol uses a jitter buffer to resist the effects of variable latency.

O

O->T

(*originator to target*) See originator and target.

ODVA

(*Open DeviceNet Vendors Association*) The ODVA supports network technologies that are based on CIP.

OFS

(*OPC Factory Server*) OFS enables real-time SCADA communications with the Control Expert family of PLCs. OFS utilizes the standard OPC data access protocol.

OPC DA

(*OLE for Process Control Data Access*) The Data Access Specification is the most commonly implemented of the OPC standards that provide specifications for real-time data communications between clients and servers.

operation network

An Ethernet-based network containing operator tools (SCADA, client PC, printers, batch tools, EMS, etc.). Controllers are connected directly or through routing of the inter-controller network. This network is part of the control network.

originator

In EtherNet/IP, a device is considered the originator when it initiates a CIP connection for implicit or explicit messaging communications or when it initiates a message request for un-connected explicit messaging.

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 an industrial environment.

port 502

Port 502 of the TCP/IP stack is the well-known port that is reserved for Modbus TCP communications.

port mirroring

In this mode, data traffic that is related to the source port on a network switch is copied to another destination port. This allows a connected management tool to monitor and analyze the traffic.

PTP

(*precision time protocol*) Use this protocol to synchronize clocks throughout a computer network. On a local area network, PDP achieves clock accuracy in the sub-microsecond range, making it suitable for measurement and control systems.

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

rack optimized connection

Data from multiple I/O modules are consolidated in a single data packet to be presented to the scanner in an implicit message in an EtherNet/IP network.

ready device

Ethernet ready device that provides additional services to the EtherNet/IP or Modbus module, such as: single parameter entry, bus editor declaration, system transfer, deterministic scanning capacity, alert message for modifications, and shared user rights between Control Expert and the device DTM.

RIO drop

One of the three types of RIO modules in an Ethernet RIO network. An 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 or BMENOS0300 network option switch modules.

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

S908 RIO

A Quantum RIO system using coaxial cabling and terminators.

SCADA

(*supervisory control and data acquisition*) SCADA systems are computer systems that control and monitor industrial, infrastructure, or facility-based processes (examples: transmitting electricity, transporting gas and oil in pipelines, and distributing water).

scanner

A scanner acts as the originator of I/O connection requests for implicit messaging in EtherNet/IP, and message requests for Modbus TCP.

scanner class device

A scanner class device is defined by the ODVA as an EtherNet/IP node capable of originating exchanges of I/O with other nodes in the network.

service port

A dedicated Ethernet port on the M580 RIO modules. The port may support these major functions (depending on the module type):

- port mirroring: for diagnostic use
- access: for connecting HMI/Control Expert/ConneXview to the CPU
- extended: to extend the device network to another subnet
- disabled: disables the port, no traffic is forwarded in this mode

SFC

(*sequential function chart*) An IEC 61131-3 programming language that is used to graphically represent in a structured manner the operation of a sequential CPU. This graphical description of the CPU's sequential behavior and of the various resulting situations is created using simple graphic symbols.

SFP

(*small form-factor pluggable*). The SFP transceiver acts as an interface between a module and fiber optic cables.

simple daisy chain loop

Often referred to as SDCL, a simple daisy chain loop contains RIO modules only (no distributed equipment). This topology consists of a local rack (containing a CPU with Ethernet I/O scanner service), and one or more RIO drops (each drop containing an RIO adapter module).

SMTP

(*simple mail transfer protocol*) An email notification service that allows controller-based projects to report alarms or events. The controller monitors the system and can automatically create an email message alert with data, alarms, and/or events. Mail recipients can be either local or remote.

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.

SOE

(*sequence of events*) The process of determining the order of events in an industrial system and correlating those events to a real-time clock.

ST

(*structured text*) An IEC 61131-3 programming language that presents structured literal language and is a developed language similar to computer programming languages. It can be used to organize a series of instructions.

sub-ring

An Ethernet-based network with a loop attached to the main ring, via a dual-ring switch (DRS) or BMENOS0300 network option switch module on the main ring. This network contains RIO or distributed equipment.

subnet mask

The 32-bit value used to hide (or mask) the network portion of the IP address and thereby reveal the host address of a device on a network using the IP protocol.

switch

A multi-port device used to segment the network and limit the likelihood of collisions. Packets are filtered or forwarded based upon their source and destination addresses. Switches are capable of full-duplex operation and provide full network bandwidth to each port. A switch can have different input/output speeds (for example, 10, 100 or 1000Mbps). Switches are considered OSI layer 2 (data link layer) devices.

system time stamping

xxxx

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.

TIME_OF_DAY

See `TOD`.

TOD

(*time of day*) The `TOD` type, encoded in BCD in a 32-bit format, contains this information:

- the hour encoded in an 8-bit field
- the minutes encoded in an 8-bit field
- the seconds encoded in an 8-bit field

NOTE: The eight least significant bits are not used.

The TOD type is entered in this format: xxxxxxxx: **`TOD#`**`<Hour>:<Minutes>:<Seconds>`

This table shows the upper/lower limits of each field:

Field	Limits	Comment
Hour	[00,23]	The leading 0 is displayed; it can be omitted during data entry.
Minute	[00,59]	The leading 0 is displayed; it can be omitted during data entry.
Second	[00,59]	The leading 0 is displayed; it can be omitted during data entry.

Example: `TOD#23:59:45`.

TR

(*transparent ready*) Web-enabled power distribution equipment, including medium- and low-voltage switch gear, switchboards, panel boards, motor control centers, and unit substations. Transparent Ready equipment allows you to access metering and equipment status from any PC on the network, using a standard web browser.

trap

A trap is an event directed by an SNMP agent that indicates one of these events:

- A change has occurred in the status of an agent.
- An unauthorized SNMP manager device has attempted to get data from (or change data on) an SNMP agent.

U

UDP

(*user datagram protocol*) A transport layer protocol that supports connectionless communications. Applications running on networked nodes can use UDP to send datagrams to one another. Unlike TCP, UDP does not include preliminary communication to establish data paths or provide data ordering and checking. However, by avoiding the overhead required to provide these features, UDP is faster than TCP. UDP may be the preferred protocol for time-sensitive applications, where dropped datagrams are preferable to delayed datagrams. UDP is the primary transport for implicit messaging in EtherNet/IP.

UMAS

(*Unified Messaging Application Services*) UMAS is a proprietary system protocol that manages communications between Control Expert and a controller.

UTC

(*coordinated universal time*) Primary time standard used to regulate clocks and time worldwide (close to former GMT time standard).

V

variable

Memory entity of type `BOOL`, `WORD`, `DWORD`, etc., whose contents can be modified by the program currently running.

VLAN

(*virtual local area network*) A local area network (LAN) that extends beyond a single LAN to a group of LAN segments. A VLAN is a logical entity that is created and configured uniquely using applicable software.

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