Modicon M580 Frequently Used Architectures

System Guide

Original instructions

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Safety Information

Important Information

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 are 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:

(In case of divergence or contradiction between any translation and the English original, the original text in the English language will prevail.)

- 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 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 Document

Document Scope

EcoStruxure™ is a Schneider Electric program designed to address the key challenges of 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 features, using Ethernet as the backbone around the Modicon M580 offer and connecting an M580 *local rack* and M580 *RIO drops*.

This guide provides detailed information about planning frequently used M580 architectures, including the following:

- Ethernet I/O networks (RIO and distributed equipment integrated on the same physical network)
- topology rules and guidelines for choosing a network configuration
- role of network option switch modules
- system commissioning and maintenance
- system performance and limitations
- system diagnostics

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

Validity Note

This document has been updated for the release of EcoStruxure Control Expert 16.4.

The characteristics of the products described in this document are intended to match the characteristics that are available on www.se.com. As part of our corporate strategy for constant improvement, we may revise the content over time to enhance clarity and accuracy. If you see a difference between the characteristics in this document and the characteristics on www.se.com, consider www.se.com to contain the latest information.

General Cybersecurity Information

In recent years, the growing number of networked machines and production plants has seen a corresponding increase in the potential for cyber threats, such as unauthorized access, data breaches, and operational disruptions. You must, therefore, consider all possible cybersecurity measures to help protect assets and systems against such threats.

To help keep your Schneider Electric products secure and protected, it is in your best interest to implement the cybersecurity best practices as described in the Cybersecurity Best Practices document.

Schneider Electric provides additional information and assistance:

- Subscribe to the Schneider Electric security newsletter.
- Visit the Cybersecurity Support Portal web page to:
  - Find Security Notifications.
  - Report vulnerabilities and incidents.
- Visit the Schneider Electric Cybersecurity and Data Protection Posture web page to:
  - Access the cybersecurity posture.
  - Learn more about cybersecurity in the cybersecurity academy.
  - Explore the cybersecurity services from Schneider Electric.

Related Documents

Title of Documentation	Reference Number
Modicon M580 Complex Topologies, System Guide	NHA58892 (English), NHA58893 (French), NHA58894 (German), NHA58895 (Italian), NHA58896 (Spanish), NHA58897 (Chinese)
Modicon M580 Hot Standby Frequently Used Architectures, System Guide	NHA58880 (English), NHA58881 (French), NHA58882 (German), NHA58883 (Italian), NHA58884 (Spanish), NHA58885 (Chinese)
Modicon M580, Open Ethernet Network, System Planning Guide	EIO0000004111 (ENG)
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),

Title of Documentation	Reference Number
Modicon M580, Change Configuration on the Fly, User Guide	EIO0000001590 (English), EIO0000001591 (French), EIO0000001592 (German), EIO0000001594 (Italian), EIO0000001593 (Spanish), EIO0000001595 (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 M580 BMENOS0300 Network Option Switch Module, Installation and Configuration Guide	NHA89117 (English) NHA89119 (French) NHA89120 (German) NHA89121 (Italian) NHA89122 (Spanish) NHA89123 (Chinese)
Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications	EIO0000002726 (English), EIO0000002727 (French), EIO0000002728 (German), EIO0000002730 (Italian), EIO0000002729 (Spanish), EIO0000002731 (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)
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)

Title of Documentation	Reference Number
Modicon Controllers Platform Cyber Security, Reference Manual	EIO0000001999 (English), EIO0000002001 (French), EIO0000002000 (German), EIO0000002002 (Italian), EIO0000002003 (Spanish), EIO0000002004 (Chinese)
Modicon M580 Redundant Communication Adapter Module (PRP) for X80 RIO Drops Installation and Configuration Guide	EIO0000004532 (English), EIO0000004533 (French), EIO0000004534 (German), EIO0000004535 (Italian), EIO0000004536 (Spanish), EIO0000004537 (Chinese)
Modicon Edge I/O NTS, System Planning and Installation Guide	EIO0000004786 (ENG)
Modicon Edge I/O NTS Analog Modules, User Guide	EIO0000005246 (ENG)
Modicon Edge I/O NTS Discrete Modules, User Guide	EIO0000005238 (ENG)
Modicon Edge I/O NTS Network Interface Modules, User Guide	EIO0000004794 (ENG)
Modicon Edge I/O NTS Counting Modules, User Guide	EIO0000005262 (ENG)
Modicon M580 BMENOC0301/11, Ethernet Communication Module, Installation and Configuration Guide	HRB62665 (ENG) HRB65311 (FRE) HRB65313 (GER) HRB65314 (ITA) HRB65315 (SPA) HRB65316 (CHS)
Modicon M580 BMENOC0302 High Performance Ethernet Communication Module, Installation and Configuration Guide	NNZ44174 (ENG)
Modicon Edge I/O, Deployment Guide For EcoStruxure Control Expert Classic	EIO0000004841 (ENG)

You can download these technical publications and other technical information from our website at www.se.com/ww/en/download/ .

Product Related Information

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

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

⚠WARNING

LOSS OF CONTROL

- Perform a Failure Mode and Effects Analysis (FMEA), or equivalent risk analysis, of your application, and apply preventive and detective controls before implementation.
- Provide a fallback state for undesired control events or sequences.
- Provide separate or redundant control paths wherever required.
- Supply appropriate parameters, particularly for limits.
- Review the implications of transmission delays and take actions to mitigate them.
- Review the implications of communication link interruptions and take actions to mitigate them.
- Provide independent paths for control functions (for example, emergency stop, over-limit conditions, and error conditions) according to your risk assessment, and applicable codes and regulations.
- Apply local accident prevention and safety regulations and guidelines.[1]
- Test each implementation of a system for proper operation before placing it into service.

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

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), *Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control* and to NEMA ICS 7.1

(latest edition), *Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems* or their equivalent governing your particular location.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

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

Terminology Derived from Standards

The technical terms, terminology, symbols and the corresponding descriptions in the information contained herein, or that appear in or on the products themselves, are generally derived from the terms or definitions of international standards.

In the area of functional safety systems, drives and general automation, this may include, but is not limited to, terms such as *safety*, *safety function*, *safe state*, *fault*, *fault reset*, *malfunction*, *failure*, *error*, *error message*, *dangerous*, etc.

Among others, these standards include:

Standard	Description
IEC 61131-2:2007	Programmable controllers, part 2: Equipment requirements and tests.
ISO 13849-1:2023	Safety of machinery: Safety related parts of control systems. General principles for design.
EN 61496-1:2013	Safety of machinery: Electro-sensitive protective equipment. Part 1: General requirements and tests.
ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
ISO 14119:2013	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
ISO 13850:2015	Safety of machinery - Emergency stop - Principles for design
IEC 62061:2021	Safety of machinery - Functional safety of safety-related electrical, electronic, and electronic programmable control systems
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: General requirements.
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Requirements for electrical/electronic/programmable electronic safety-related systems.
IEC 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Software requirements.
IEC 61784-3:2021	Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions.
2006/42/EC	Machinery Directive
2014/30/EU	Electromagnetic Compatibility Directive
2014/35/EU	Low Voltage Directive

In addition, terms used in the present document may tangentially be used as they are derived from other standards such as:

Standard	Description
IEC 60034 series	Rotating electrical machines
IEC 61800 series	Adjustable speed electrical power drive systems
IEC 61158 series	Digital data communications for measurement and control – Fieldbus for use in industrial control systems

Finally, the term zone of operation may be used in conjunction with the description of specific hazards, and is defined as it is for a hazard zone or danger zone in the Machinery Directive (2006/42/EC) and ISO 12100:2010.

NOTE: The aforementioned standards may or may not apply to the specific products cited in the present documentation. For more information concerning the individual standards applicable to the products described herein, see the characteristics tables for those product references.

Information on Non-Inclusive or Insensitive Terminology

As a responsible, inclusive company, Schneider Electric is constantly updating its communications and products that contain non-inclusive or insensitive terminology. However, despite these efforts, our content may still contain terms that are deemed inappropriate by some customers.

Modicon M580 System Introduction

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Introduction

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

M580 System

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Introduction

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

Typical System Introduction

Introduction

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

- an Ethernet main local rack, page 24 and the ability to extend to other local racks
- RIO drops, page 26 that support Ethernet and X Bus communications across the backplane
- Ethernet distributed equipment, page 29
- network option switch modules that attach RIO drops and distributed equipment to the M580 system, page 27
- control network module that creates transparency between the device network and the control network, page 34
- RIO and distributed equipment integrated on the same physical network
- RIO and DIO sub-rings that communicate with the RIO main ring
- third-party modules and devices
- daisy-chain ring architectures provided by communication modules with dual Ethernet ports

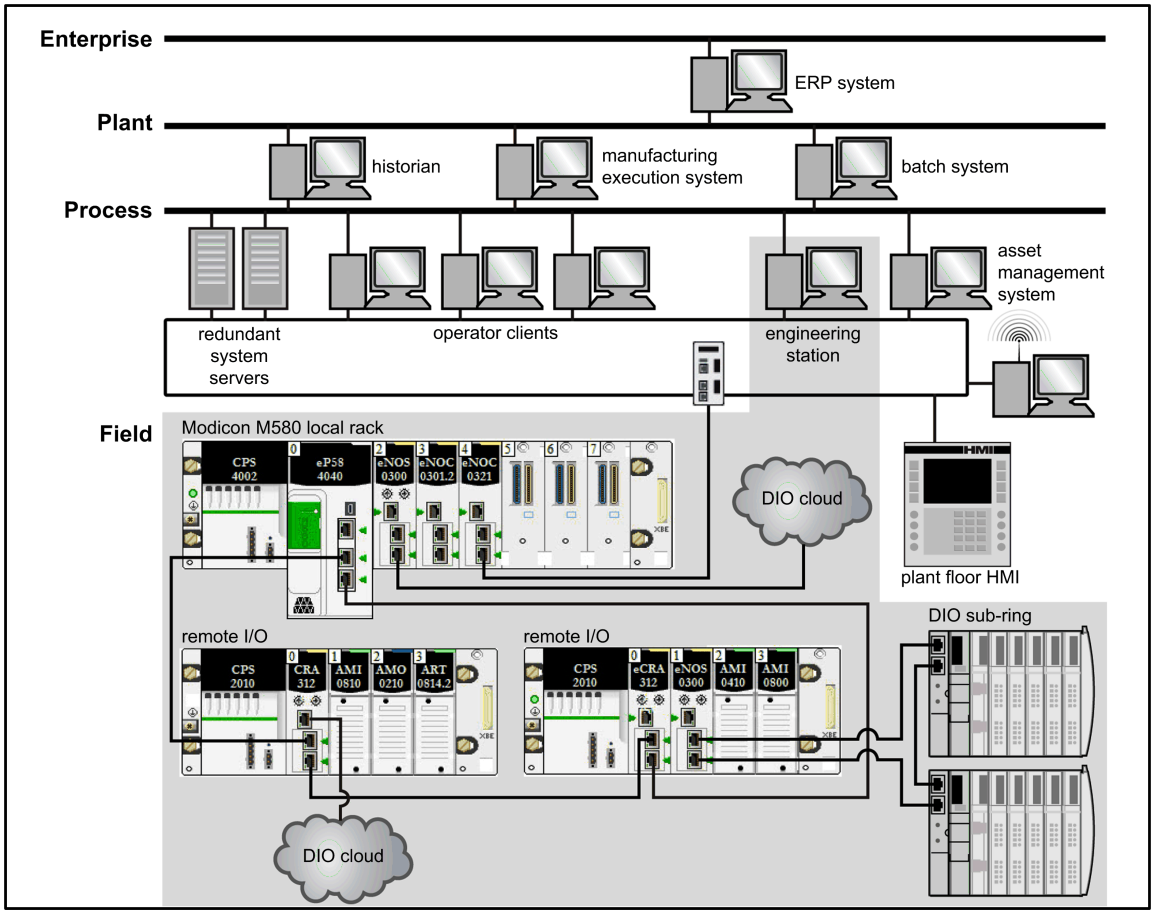
An M580 system provides automatic network recovery of less than 50 ms and *deterministic* RIO performance.

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

NOTE: To use a dual-ring switch (DRS) to connect distributed equipment to the M580 network, refer to the Modicon M580 Complex Topologies System Guide.

Typical M580 Architecture

This is a typical M580 architecture. It includes the enterprise, plant, process, and field levels of a manufacturing plant. An M580 simple RIO system is shown at the field level



⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Do not install more than one standalone controller in an M580 device network.

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

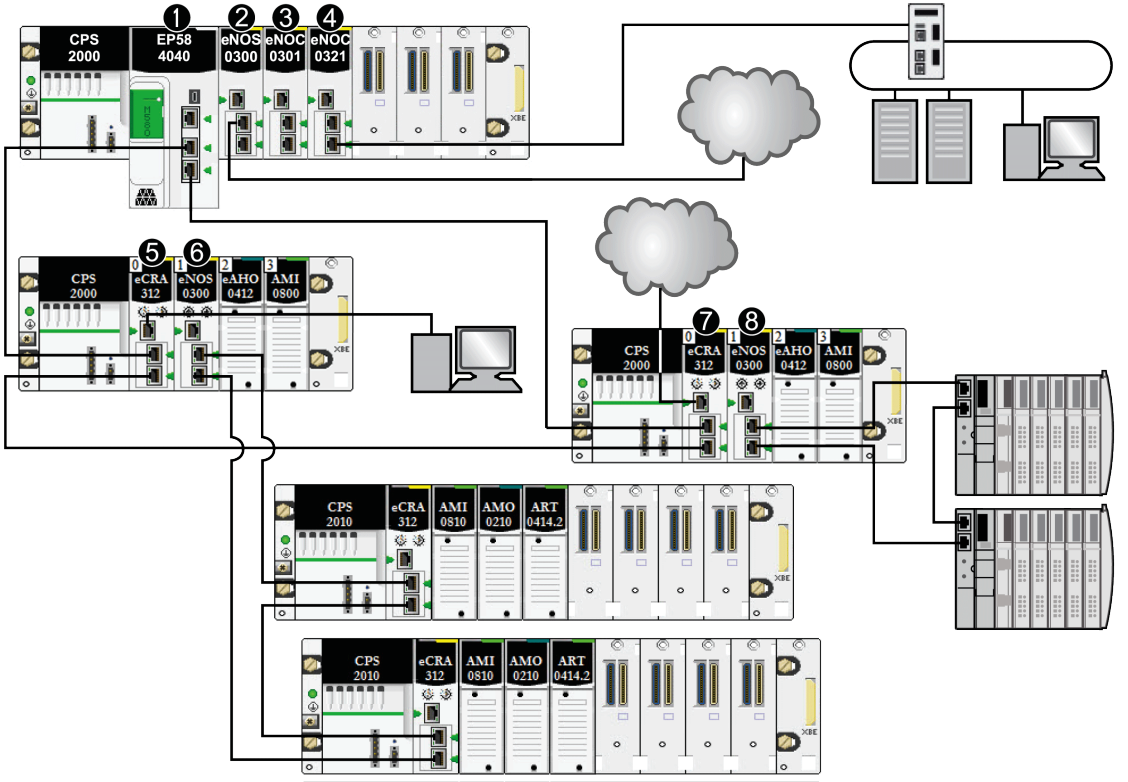
M580 Life Cycle

The life cycle of an M580 network includes these phases:

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

M580 Simple RIO Example

This is an example of a typical M580 system that integrates RIO modules and distributed equipment in one Ethernet I/O device network:



1 An M580 controller with Ethernet I/O scanner service on the local rack is connected to the RIO main ring. (For the Ethernet I/O scanner service, select a controller with a commercial reference that ends in *40*.)

2 A BMENOS0300 network option switch module on the local rack connects a DIO cloud to the RIO main ring.

3 A BMENOC0301(C) Ethernet communication module, connected to the controller through the Ethernet backplane, manages distributed equipment on the device network.

4 A BMENOC0321(C) control network module on the local rack creates transparency between the device network and the control network.

5 A PC for port mirroring is connected to the service port of a BMECRA312•0 (e)X80 EIO adapter module.

6 A BMENOS0300 network option switch module on an RIO drop manages an RIO sub-ring.

7 A DIO cloud is connected to the service port of a BMECRA31210 eX80 performance EIO adapter module.

8 A BMENOS0300 network option switch module on an RIO drop connects a DIO sub-ring to the RIO main ring.

> **NOTE:** A BMENOC0301(C)/BMENOC0311/BMENOC0302(H) module supports distributed equipment through its Ethernet backplane connection to the controller and through its device network port(s) on the front panel, respecting the limitation of 128 devices scanned per BMENOC0301(C)/BMENOC0311/BMENOC0302(H) module.

Typical System Components

Introduction

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

These are the available physical components for an RIO main ring:

- *local rack*: An M580 local rack contains the controller and a power supply. The local rack consists of a main rack and optionally an extended rack.
- *RIO drops*: RIO drops are M580 racks that include I/O modules that are connected to an Ethernet RIO network. The drops are managed by an Ethernet RIO adapter module. A drop can include a single rack or a main rack plus an (optional) extended rack.
- BMENOS0300 network option switch modules.

A typical M580 system also allows you to perform these tasks:

- Connect RIO sub-rings to the main ring via BMENOS0300 modules.
- Create transparency between the RIO network and the control network via a BMENOC0321(C) control network module on the local rack.

NOTE: Some M580 controller references do not support RIO scanning. Controllers with commercial references ending in *20* support only local I/O and distributed equipment (DIO scanning). Controllers with commercial references ending in *40* support RIO scanning as well as local I/O modules and distributed equipment. M580 Hot Standby controllers (see Modicon M580 Hot Standby Frequently Used Architectures, System Guide) that end in ***40*** do not support local I/O modules.

Connect distributed equipment to the M580 network with these devices:

- service port of the controller
- BMENOC0301(C)/BMENOC0311/BMENOC0302(H) Ethernet communication module
- BMENOS0300 network option switch module

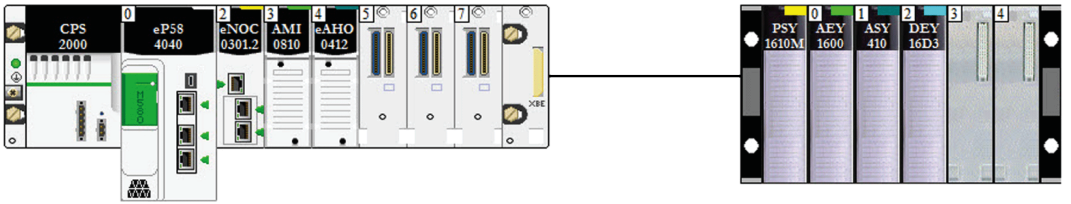
Refer to the *Modicon M580 Complex Topologies, System Guide* to connect distributed equipment with dual-ring switches.

Local Rack

Within the *main ring* in a typical M580 system, a *local rack* contains the controller, a power supply, and a maximum of four BMENOC0301(C)/BMENOC0311 Ethernet communication modules, or a maximum of six BMENOC0302(H) High performance Ethernet communication modules, and a BMENOS0300 network option switch modules, and a maximum of two BMENOC0321(C) control network modules.

A local rack consists of one main rack and up to seven full extended racks (up to 14 Premium half racks, page 98), depending on the controller you use. The main rack is required in the M580 architecture; extended racks are optional, and when present, are considered part of the local rack.

This graphic shows an M580 main local rack with an extended local rack:



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

Module/backplane compatibility:

- You can install Modicon X80 I/O modules on BMEXBP••00 Ethernet or BMXXBP0•00 X Bus backplanes.
- You can install Modicon eX80 (example: PMESWT0100 and BMEAH•0•12 modules) on BMEXBP••00 Ethernet backplanes only.
- You can install Modicon eX80 *and* Modicon X80 modules on BMEXBP••02 backplanes, which support both Ethernet and X Bus communications.
- You can install Premium I/O modules on TSXRKY•EX Premium backplanes only.

Backplane compatibility:

	Local Racks		**Remote Racks**	
	Main Rack	**Extended Rack**	**Main Rack**	**Extended Rack**
BMEXBP••00 Ethernet	X	—	X	—
BMXXBP0•00 X Bus	X[1]	X	X[2]	X
TSXRKY•EX Premium	—	X	—	—
BMEXBP0602(H) Ethernet/X Bus	X	—	X	—
BMEXBP1002(H) Ethernet/X Bus	X	—	X	—

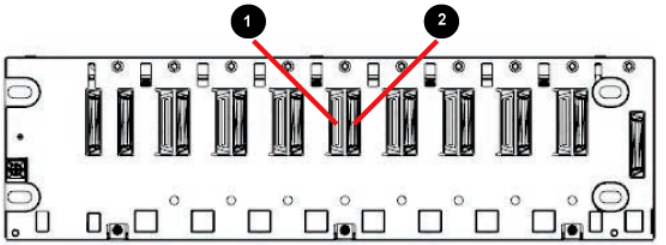
X: allowed

—: not allowed

[1] Requires a hardware revision of PV:02 or later.

[2] Requires a hardware revision PV:02 or later f you use a BMECRA31210 eX80 performance EIO adapter module.

BMEXBP••0• backplanes also provide X Bus connections across the backplane, and are therefore compatible with Modicon X80 modules supported by the M580 system. BMXXBP••00 X Bus backplanes, on the other hand, do not have the connections required to support eX80 modules.



1 Ethernet connector

2 X Bus connector

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

RIO Drops

An *RIO drop* is connected to an RIO ring. These drops consist of one or two racks of (e)X80 I/O modules and/or third-party modules. An RIO drop is connected to the daisy-chain ring on which the Ethernet RIO network resides. Each remote drop contains one BM•CRA312•0 (e) X80 EIO adapter module. Each rack in a remote drop contains its own power supply module.

NOTE: You can also install Quantum RIO (see Quantum EIO, System Planning Guide) drops in an M580 RIO main ring. Refer to the *Quantum Ethernet I/O System Planning Guide* for details.

RIO drops provide deterministic communication on the main ring and the RIO sub-rings so that RIO modules synchronize with controller tasks (MAST, FAST, AUX0, AUX1); whereas distributed equipment is not deterministic.

Remote eX80 EIO adapter modules are available as Ethernet (BME) and X Bus (BMX) communicators. If you plan to use X80 I/O modules that require Ethernet, then choose a *BME X80 EIO adapter module*. If your X80 I/O uses only X Bus for backplane communication, then you can use a *BMX X80 EIO adapter module* or a *BME X80 EIO adapter module*.

RIO drops are connected to the main ring via copper cable to the controller with Ethernet I/O scanner service, page 75 on the *local rack* or to another RIO drop (which may be connected to another RIO drop or the controller).

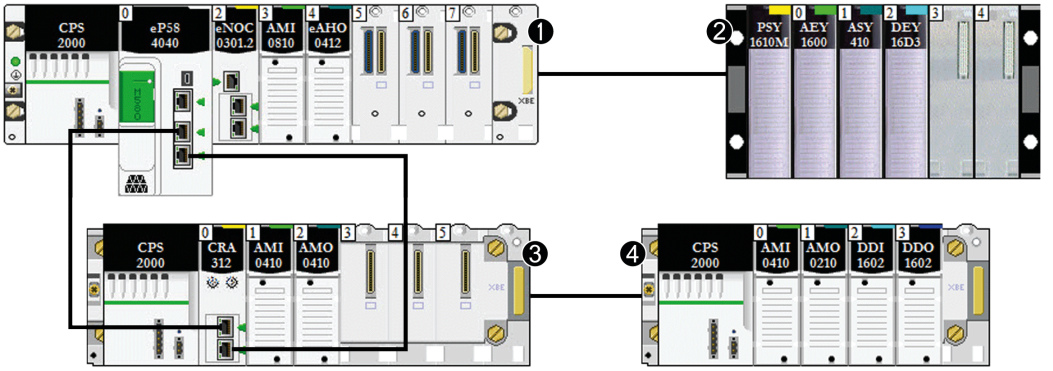
An RIO drop contains a main remote rack and an optional extended remote rack, depending on the (e)X80 EIO adapter module that is on the RIO drop:

- If you install a BM•CRA31200 *(e)X80 standard EIO adapter module*, extended remote racks are not supported.
- If you install a BM•CRA31210 *(e)X80 performance EIO adapter module*, one extended remote rack is supported.

The adapter module is installed in slot 00 (directly to the right of the power supply) in the main rack of the drop.

A maximum of 31 RIO drops can be supported in an M580 network.

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



1 local main rack

2 local extended rack

3 remote main rack

4 remote extended rack

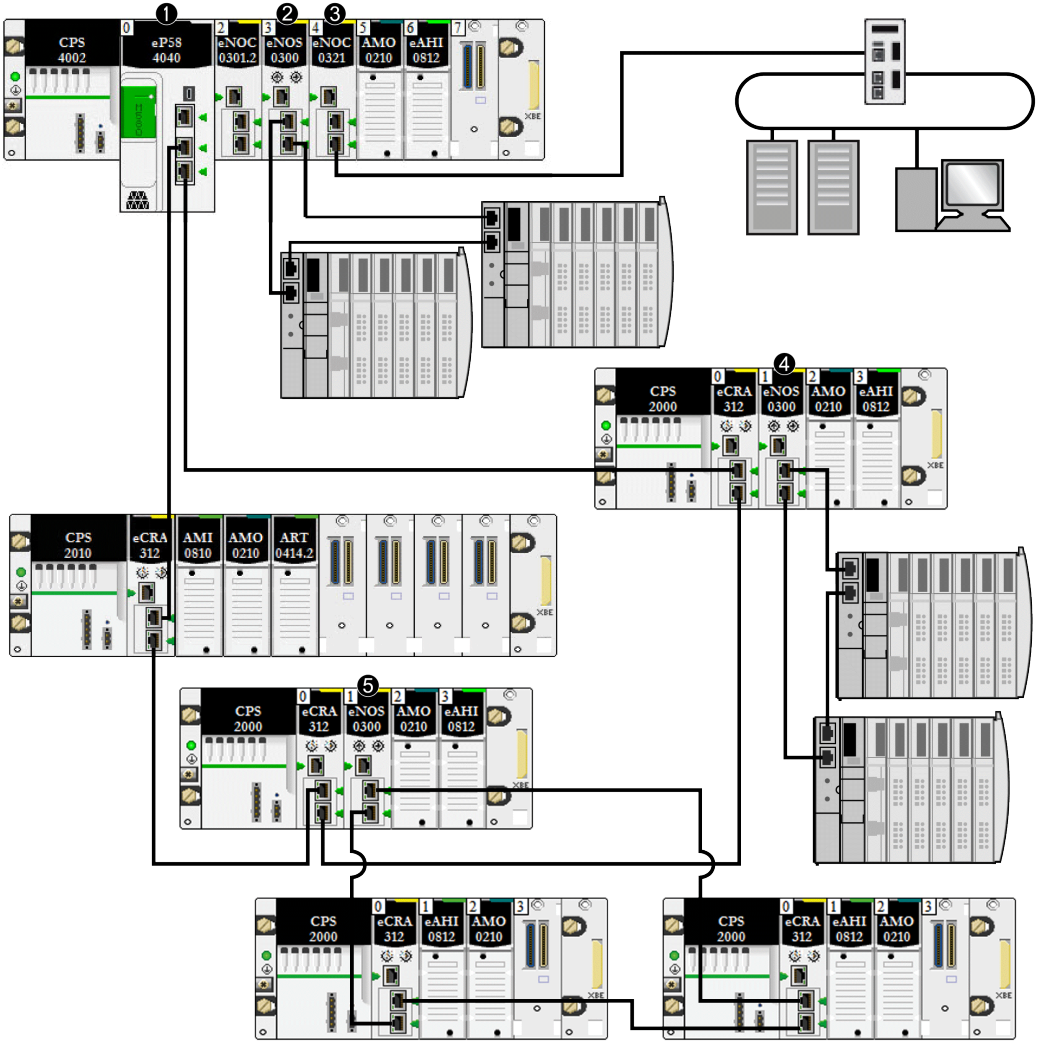
Network Option Switch Modules

A BMENOS0300 network option switch module in an M580 network can connect RIO and DIO sub-rings as well as DIO clouds to the RIO main ring. A network option switch module is considered a communication module when you calculate the maximum number of communication modules allowed on a local rack.

Use a BMENOS0300 module for these purposes:

- Reduce system costs by using a BMENOS0300 module instead of a dual-ring switch (DRS) to connect RIO and DIO sub-rings to the Ethernet I/O network and instead of a BMENOC0301(C)/BMENOC0311/BMENOC0302(H) to connect distributed equipment to the network.
- Enable *RSTP* recovery support for devices and cables on RIO and DIO sub-rings.
- Isolate the RIO and DIO sub-rings from one another and from the main ring to improve system robustness.

In this simple device network, a BMENOS0300 network option switch module is installed on the local rack and one of the RIO drops. The BMENOS0300 modules connect DIO sub-rings to the RIO main ring:



1 A controller with Ethernet I/O scanner service on the local rack is connected to the main ring.

2 A BMENOS0300 module on the local rack connects a DIO sub-ring to the main ring.

3 A BMENOC0321 module on the local rack provides transparency between the device network and the control network.

4 A BMENOS0300 module on an RIO drop connects a DIO sub-ring to the RIO main ring.

5 A BMENOS0300 module on an RIO drop connects an RIO sub-ring to the RIO main ring.

BMENOS0300 modules and BMENOC0301(C)/BMENOC0311/BMENOC0302(H) modules differ in these ways:

Service	BMENOC0301 / BMENOC0311/ BMENOC0302(H)	BMENOS0300
Ethernet communication module	X	X
DIO scanner service	X	—
Local rack installation	X	X
RIO drop installation	—	X
FDR service	X	—

Fiber Converter Modules

You can install a BMX NRP 020• fiber converter module, page 101 on a Modicon X80 rack and Modicon X80 Ethernet RIO drops to convert copper cable to fiber for distances greater than 100 m.

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

Distributed Equipment

In an M580 system, distributed equipment can communicate with an M580 Ethernet RIO network, or it can be isolated from the network:

- **Integrating distributed equipment into an Ethernet RIO network**: Distributed equipment is connected to the RIO main ring through the service port of a controller, an Ethernet communication module, or a BM•CRA31210 (e)X80 EIO adapter module on the main ring or sub-ring. (The maximum load the network can process through the connection to the BM•CRA31210 module is 5 Mbps per second.) Special types of distributed equipment that have two Ethernet ports and support *RSTP* may be connected to the main ring as a DIO *sub-ring*. Many types of distributed equipment may be connected as DIO clouds.

  NOTE: *Refer to the DIO clouds topic, page 32 to see how DIO clouds can be connected to the device network.*

  A BMENOC0301(C)/BMENOC0311/BMENOC0302(H) Ethernet communication module scans DIO networks in the M580 *device network* when its Ethernet backplane connection is enabled, allowing it to communicate with the controller. Enabling the Ethernet backplane connection links the BMENOC0301(C)/BMENOC0311/BMENOC0302(H) module and the controller network port connections together, allowing either device to manage the distributed equipment.

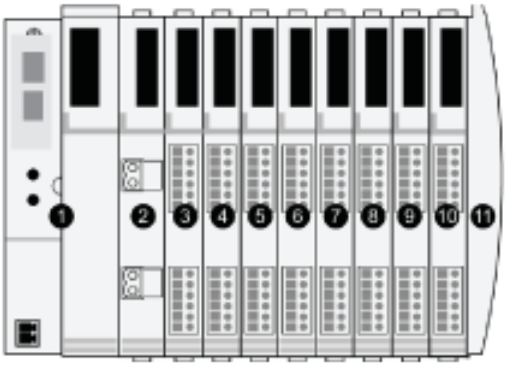
  You can also connect distributed equipment of an existing DIO network as an extended DIO network in an M580 system. Connect a BMENOC0301(C)/BMENOC0311/BMENOC0302(H) module to the existing DIO network as well as the *extend port* of a BMENOC0321(C) module so that the distributed equipment can communicate with the M580 control network.

- **Isolating distributed equipment from an Ethernet RIO network**: Distributed equipment in DIO clouds can be managed by either a controller (independent of any RIO network), a BMENOC0301(C)/BMENOC0311/BMENOC0302(H) module, or a BMENOS0300 module whose Ethernet backplane connection is disabled, thus not allowing communication between the DIO cloud and the RIO network. These DIO clouds may contain equipment such as TeSys T motor drives, islands of STB or Modicon Edge I/O NTS devices, SCADA and HMI devices, and PCs. If you use a device that has two Ethernet ports and supports RSTP, you can connect the device in a star or a daisy chain loop. In this instance, the distributed equipment is isolated and is not a physical or logical part of the Ethernet RIO network.

  You can also connect distributed equipment that is part of an existing DIO network to the M580 control network only (not the M580 device network). To connect an *independent DIO network*, connect a BMENOC0301(C)/BMENOC0311/BMENOC0302(H) module (with its Ethernet backplane port disabled) to the existing DIO network as well as a BMENOC0321(C) module. The distributed equipment are not a physical or logical part of the device network, but they do communicate with the M580 *control network*.

Distributed equipment can be connected to the M580 network via the controller, BMENOC0301(C)/BMENOC0311/BMENOC0302(H), or BMENOS0300 modules on the local rack. Equipment can also be connected to the service port of a BM•CRA31210 X80 performance EIO adapter module. Distributed equipment cannot be connected directly to the RIO main ring. To use a dual-ring switch (DRS) to connect distributed equipment to the M580 network, refer to the Modicon M580 Complex Topologies, System Guide.

Example 1: Advantys STB islands are used as examples of distributed equipment in this document. When an STB island is used with an STB NIP 2311 EtherNet/IP network interface module (NIM), the island can be connected directly to an Ethernet port of a BMENOC0301 (C)/BMENOC0311/BMENOC0302(H) communication module, the service port of a BM•CRA312•0 eX80 EIO adapter module, a BMENOS0300 network option switch module, or the service port of an M580 controller in a daisy chain formation. The STB NIP 2311 NIM has two Ethernet ports and it supports RSTP, enabling it to operate as a ring connected to the two Ethernet ports on a communication module:



1 STBNIP2311 NIM

2 STBPDT3100 (24 Vdc power distribution module)

3 STBDDI3230 24 Vdc (2-channel digital input module)

4 STBDDO3200 24 Vdc (2-channel digital output module)

5 STBDDI3420 24 Vdc (4-channel digital input module)

6 STBDDO3410 24 Vdc (4-channel digital output module)

7 STBDDI3610 24 Vdc (6-channel digital input module)

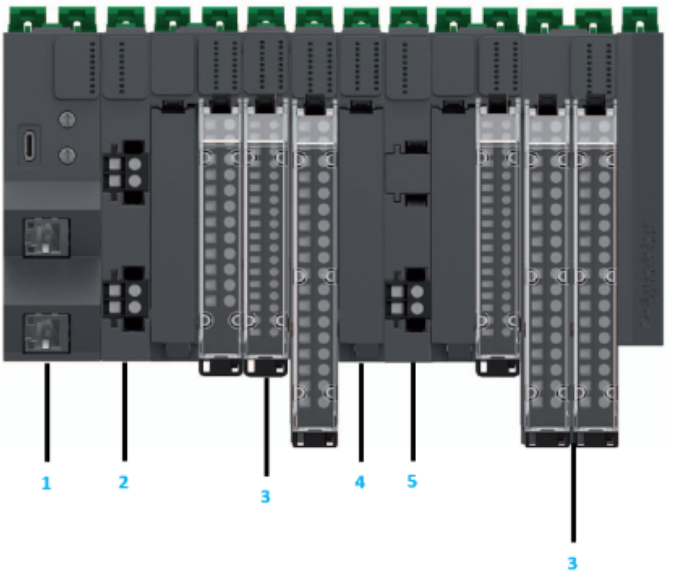
8 STBDDO3600 24 Vdc (6-channel digital output module)

9 STBAVI1270 +/-10 Vdc (2-channel analog input module)

10 STBAVO1250 +/-10 Vdc (2-channel analog output module)

11 STBXMP1100 (island bus termination plate)

Example 2: The following illustration presents an example of the Modicon Edge I/O NTS cluster in a distributed I/O structure, including the following elements:



1 Network Interface Module (mandatory)

2 Power supply Field and Bus module (mandatory)

3 Modicon Edge I/O NTS I/O modules

4 Accessories

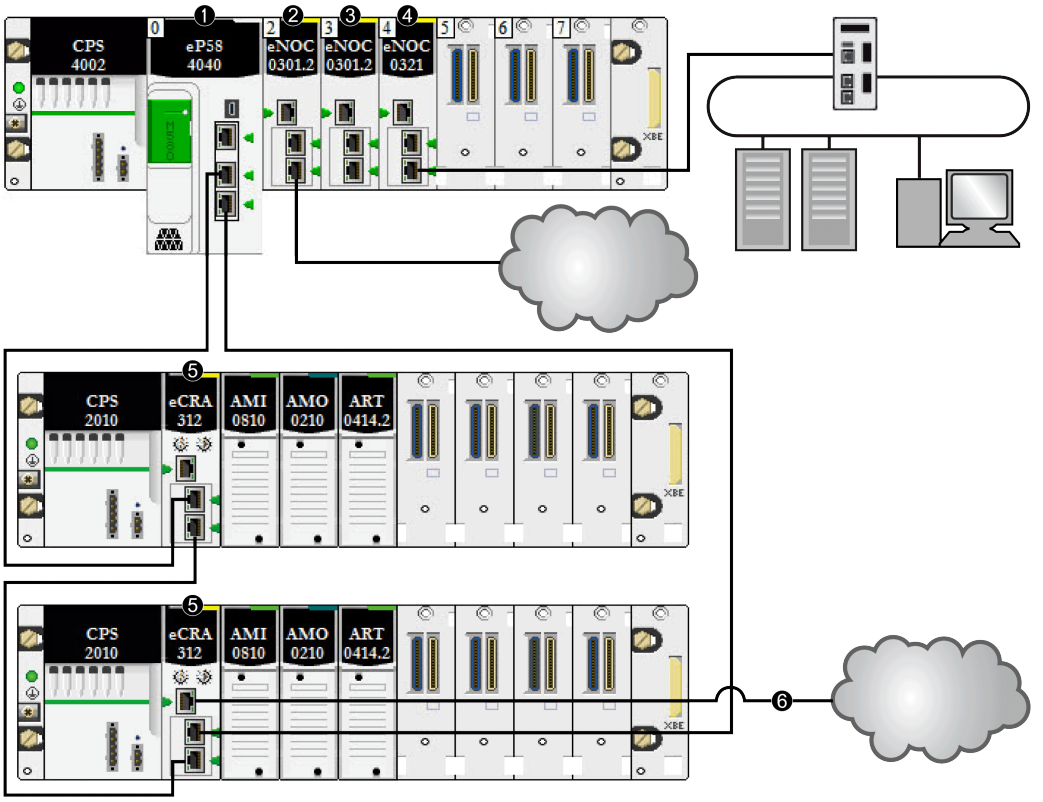
5 Power supply Field Distribution module

DIO Clouds

A *DIO cloud* contains distributed equipment that may support *RSTP*. DIO clouds require only a single (non-ring) copper wire connection. Connect a DIO cloud directly to one of these:

- BMENOS0300 network option switch module
- BMENOC0301(C)/BMENOC0311/BMENOC0302(H) Ethernet communication module
- service port of the controller
- service port of a BM•CRA312•0 eX80 EIO adapter module on an RIO drop

Distributed equipment in a DIO cloud communicates with the M580 network through a connection to the main ring:



1 A controller on the main rack runs the Ethernet I/O scanner service.

2 A DIO cloud is connected to a BMENOC0301(C) Ethernet communication module (Ethernet backplane connection disabled).

3 A BMENOC0301(C) Ethernet communication module (Ethernet backplane connection enabled) manages distributed equipment on the device network.

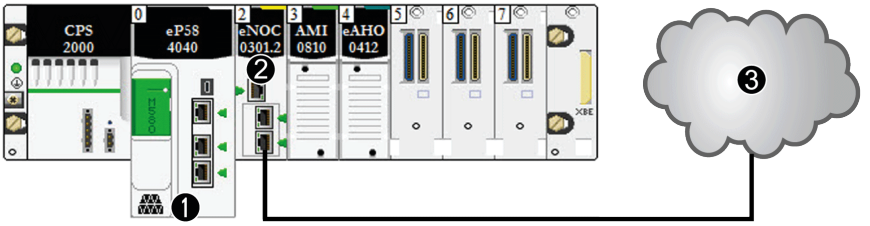
4 A BMENOC0321 module on the local rack provides transparency between the device network and the control network.

5 An X80 performance EIO adapter module connects an RIO drop to the main ring.

6 A DIO cloud is connected to a BM•CRA31210 X80 performance EIO adapter module.

NOTE: A BMENOC0301(C) module (3) supports distributed equipment through its Ethernet backplane connection to the controller respecting the limitation of 128 devices scanned per BMENOC0301(C) module. When distributed equipment is scanned by a BMENOC0301(C) module with Ethernet backplane connection disabled (2), the data is passed to the controller via X Bus.

When a DIO cloud is connected directly to a BMENOC0301(C) or a BMENOS0300 module (with the Ethernet backplane port disabled), distributed equipment is isolated from the RIO network because it does not communicate with the controller Ethernet I/O scanner service:



1 controller with DIO scanner service

2 BMENOC0301(C) Ethernet communication module (Ethernet backplane connection disabled)

3 DIO *isolated* cloud

Device Network

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

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

The device network contains a local rack, RIO drops, distributed equipment, network option switch modules, adapter class devices, etc. Devices connected to this network follow certain rules to provide RIO *determinism*. Details about determinism are provided in the section application response time, page 114.

Control Network

A *control network* is an Ethernet-based network that contains controllers, SCADA systems, an NTP server, PCs, AMS system, switches, etc. Two kinds of topologies are supported:

- *flat*: All devices in this network belong to the same subnet.

- *2 levels*: The network is split into an operation network and an inter-controller network. These two networks can be physically independent, but are generally linked by a routing device.

The BMENOC0321(C) control network module is installed on the local rack of an M580 system. The module provides the interfaces to communicate with a control network and client applications on an Ethernet RIO network.

The main purpose of the BMENOC0321(C) module is to provide transparency between the control network, the device network, and an extended DIO network, while preserving device network determinism. In addition, the BMENOC0321(C) module provides services to communicate with controller applications running on the control network.

Only one BMENOC0321(C) module can be configured on the local rack. To communicate with modules in an M580 device network, confirm that the Ethernet backplane ports of the controller, BMENOC0301(C)/BMENOC0311/BMENOC0302(H) modules, and the BMENOC0321(C) module are enabled.

Copper and Fiber Cables

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

Calculating Maximum Devices in a Typical M580 Main RIO Ring

The main ring in a typical M580 system supports up to 32 devices. These are the valid types of devices:

1. a local rack, page 24 (containing the controller, communication modules and I/O modules)
2. a maximum of 31 RIO drops, page 26 (each drop containing a BM•CRA312•0 EIO adapter module)

NOTE:

- Do not count BMXNRP020• modules in your calculation.
- The maximum number of BM•CRA312•0 EIO adapter modules in an RIO network is 31.
- For the maximum number of modules supported in an M580 system, refer to the Communication Capability table in Selecting a Controller for your M580 System, page 75 and the System Throughput Considerations, page 111.

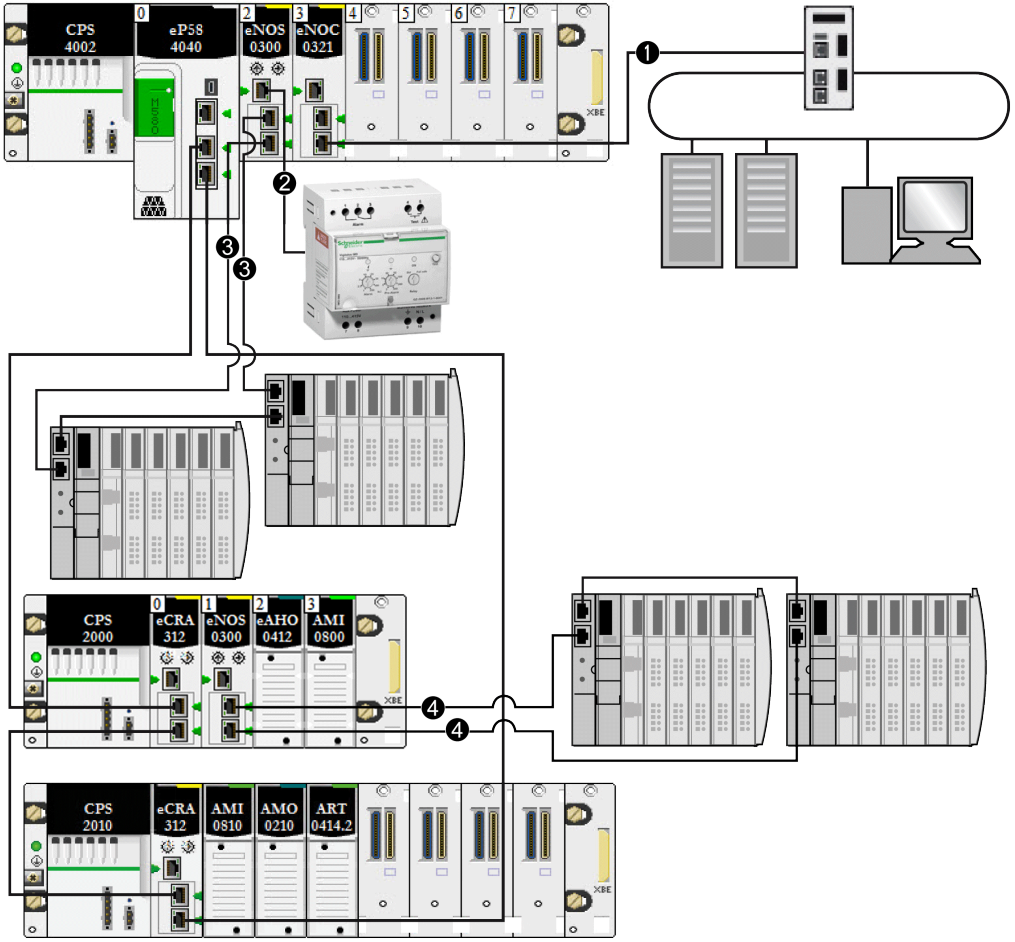
Typical RIO/DIO Network Topologies

Introduction

This topic discusses some of the more common DIO and RIO network topologies that use typical system components, page 23.

DIO Daisy Chain and DIO Daisy Chain Loop

BMENOS0300 network option switch modules support distributed equipment as shown:



1 A BMENOC0321 module on the local rack provides transparency between the device network and the control network.

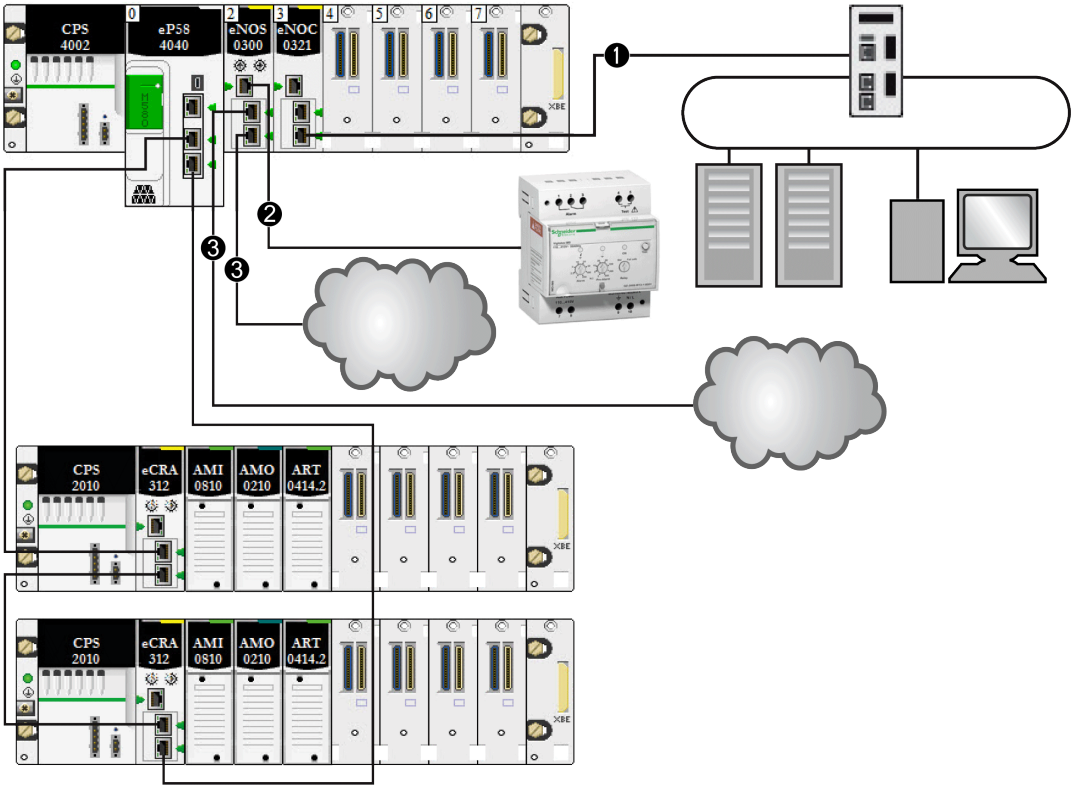
2 A BMENOS0300 module on the local rack is connected to a DIO daisy chain.

3 The same BMENOS0300 module on the local rack is connected to a DIO daisy chain loop.

4 A BMENOS0300 module on an (e)X80 drop is connected to a DIO sub-ring.

DIO Daisy Chain and DIO Clouds

BMENOS0300 network option switch modules support distributed equipment as shown:



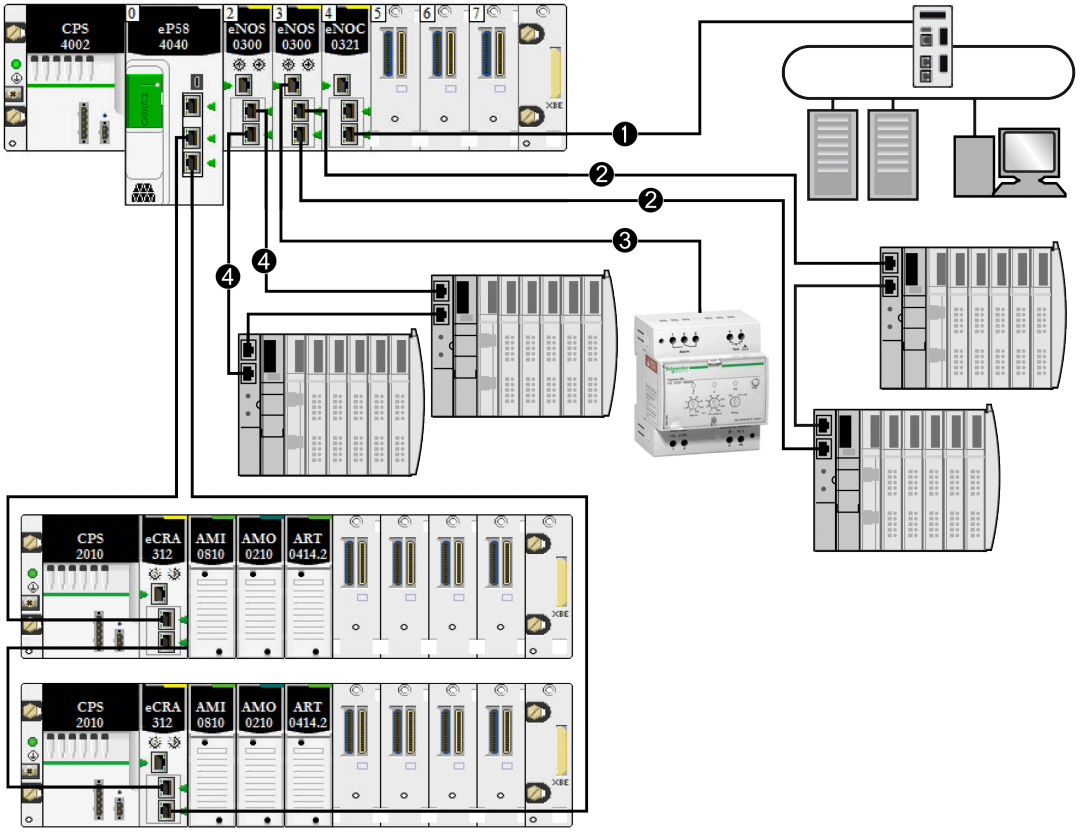
1 A BMENOC0321 module on the local rack provides transparency between the device network and the control network.

2 The BMENOS0300 module on the local rack is connected to a DIO daisy chain.

3 The same BMENOS0300 module on the local rack is connected to two DIO clouds.

DIO Daisy Chain and DIO Multiple Daisy Chain Loops

A BMENOS0300 network option switch module on a local rack supports a DIO daisy chain and a DIO daisy chain loop. A different BMENOS0300 module on the same rack supports another DIO daisy chain loop:



1 A BMENOC0321 module on the local rack provides transparency between the device network and the control network.

2 The BMENOS0300 module on the local rack is connected to a DIO daisy chain.

3 The same BMENOS0300 module on the local rack is connected to a DIO daisy chain loop.

4 Another BMENOS0300 module on the local rack is connected to another DIO daisy chain loop.

NOTE: This architecture applies only to Modicon M580 standalone systems. It is **not** supported in Hot Standby systems.

Typical RIO/DIO Network Topologies with Edge I/O

Introduction

This topic presents the Modicon Edge I/O NTS system and how it integrates into an M580 control system. Consult the user guides for the Modicon Edge I/O NTS devices, page 11.

The Edge I/O NTS device is a distributed I/O (DIO) device that can be used in topologies described in this document — in DIO clouds or in topologies that integrate STB modules.

The Edge I/O NTS device has a special feature compared to other DIO devices. With the correct parameterization, it can be integrated into M580 topologies in places where DIO devices are otherwise not allowed, such as the RIO main ring.

RIO Network Compatibility

The RIO network operates as a controlled Ethernet-based network. Compliance with the RIO network rules helps ensure deterministic-like behavior of the M580 system.

The RIO network contains the following devices:

- ConneXium extended dual-ring switch – TCSESM-E (Connexium DRS)
- Modicon extended dual-ring switch – MCSESM-E (Modicon DRS)
- X-bus
  RIO EIO drops (BM•CRA3•••• or Quantum 140CRA31200 adapter modules)
- Modicon BMENOS0300 network option switch module
- Modicon BMXNRP0200 fiber converter module
- Altivar Process ATV9••
- NTSNEC1200(H) network interface module (NIM)

These RIO-compatible devices can be physically connected to the RIO ring and coexist on the RIO network.

These devices can be configured and scanned using M580 I/O scanners that target the NTSNEC1200(H) network interface module. The NTSNEC1200(H) is a DIO-type device compatible with the RIO network.

However, RIO network-compatible devices cannot be considered RIO adapter modules; their communication with M580 is not synchronized with the controller cycle, nor deterministic.

For the NTSNEC1200(H) device to be RIO-compatible, it is necessary to configure it with the following settings:

- NTSNEC1200(H) with firmware version 1.0.0.505 or later
- RSTP enabled
- RSTP bridge identifier = 32768
- VLAN QoS for RIO network enabled

Standalone Topology

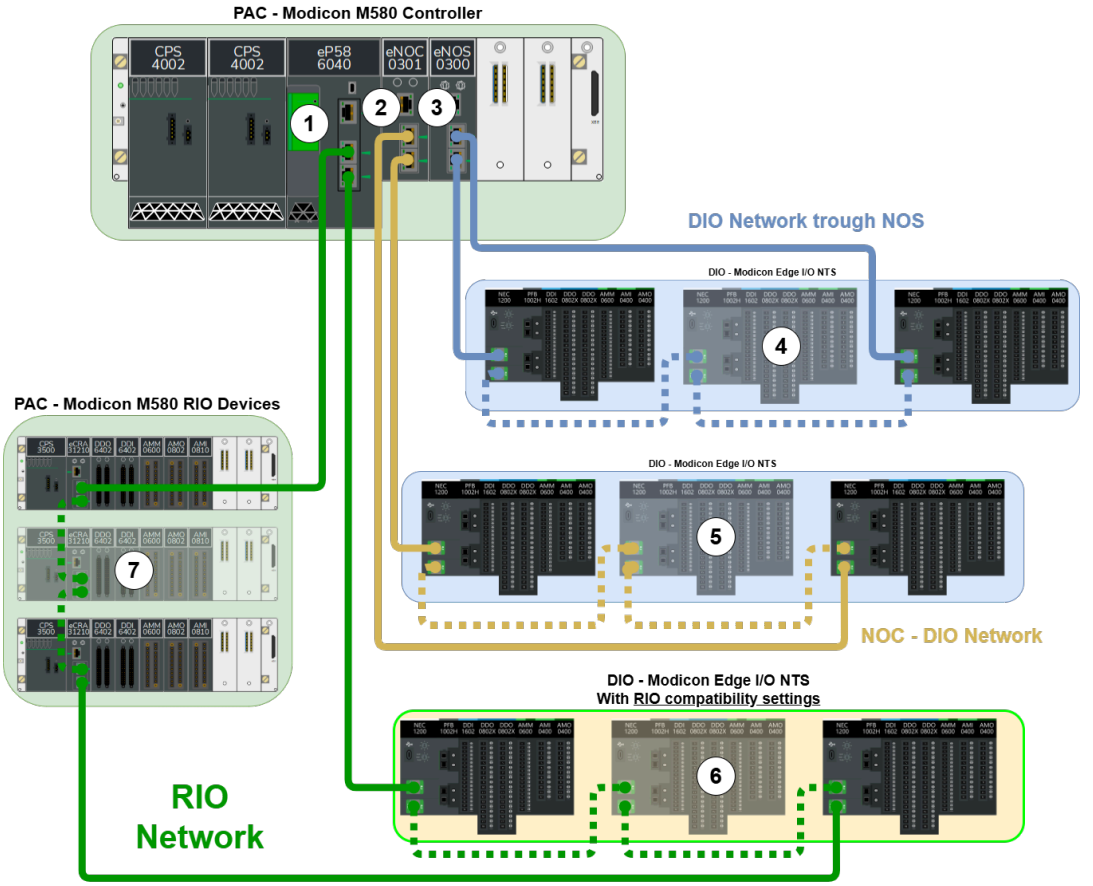
When configured with RIO network compatibility, the NTSNEC1200(H) device can be used in the following standalone topologies without affecting the RIO network or X80 determinism.

Standalone controllers (BMEP58•0•0) support the following topologies:

- Edge I/O NTS devices in a DIO ring/cloud connected to or scanned by the M580 controller
- Edge I/O NTS devices in a DIO ring/cloud connected to or scanned by a BMENOC•••• (C) communication module
- Edge I/O NTS devices in a DIO ring/cloud connected to or scanned by a BMENOS•••• network option switch module

For information on how to structure an M580 topology with Edge I/O NTS devices and DRSs integrated, refer to the Modicon M580 Complex Topologies System Guide.

Example


PAC - Modicon M580 Controller
CPS 4002
CPS 4002
eP58 6040
eNOC 0301
eNOS 0300
1
2
3
DIO Network trough NOS
DIO - Modicon Edge I/O NTS
4
PAC - Modicon M580 RIO Devices
7
DIO - Modicon Edge I/O NTS
5
NOC - DIO Network
DIO - Modicon Edge I/O NTS
With RIO compatibility settings
6
RIO
Network

1M580 controller scans RIO and DIO devices

2 BMENOC0301 communication module (scans up to 128 DIO devices).

3 BMENOS0300 network option switch module allows the controller to extend its control network.

4 Edge I/O NTS islands scanned by the controller through the BMENOS300 module.

5 Edge I/O NTS islands scanned by the BMENOC0301 module.

6 Edge I/O NTS islands scanned by the controller inside the RIO network. In this case, the Edge I/O NTS device must be configured with RIO-compatible settings; otherwise, it will interfere with network determinism.

7 (e)X80 RIO drops (BM•CRA312•0) scanned by the controller with RIO determinism.

NOTE:

- In an RSTP ring configuration, only the devices listed below are supported:

  40 DIO devices

  31 RIO devices and one controller
- When using BMENOC0••• modules within an RSTP ring, disable the Ethernet backplane port of the BMENOC0••• module to help prevent network loops. For more information, refer to the Modicon M580 Complex Topologies System Guide.
- In an RIO network, an RSTP ring topology is mandatory.

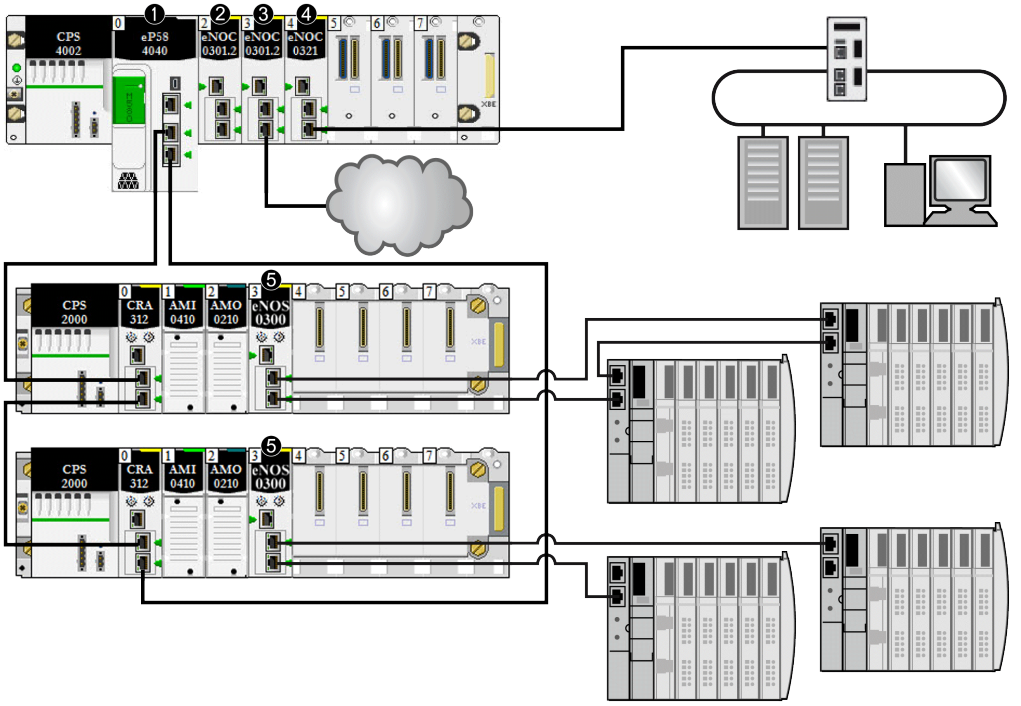
DIO Connections

High-Capacity Daisy Chain Loop

Connect distributed equipment to a high-capacity daisy chain loop through one of these:

- BMENOS0300 network option switch module in an X80 drop
- service port of a controller
- service port of a BM•CRA312•0 EIO adapter module
- service port of a BMENOC0301 / BMENOC0311/BMENOC0302(H) communication module

Use those connections to connect distributed equipment to the RIO network:



1 A controller on the main rack runs the Ethernet I/O communication server service.

2 A BMENOC0301 Ethernet communication module (Ethernet backplane connection disabled) manages distributed equipment on the device network.

3 A BMENOC0301 Ethernet communication module (Ethernet backplane connection enabled) is connected to a DIO cloud.

4 A BMENOC0321 module on the local rack provides transparency between the device network and the control network.

5 A BMENOS0300 network option switch module is connected to a DIO sub-ring.

NOTE: Diagrams and details of each topology are shown in the Selecting a Topology topic, page 69.

System Features

Introduction

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

Control Expert Software

Control Expert software is used in an M580 system.

For detailed Control Expert configuration procedures, refer to the *Installation and Configuration Guide* for the module, see the list in the Related Documents, page 11.

CCOTF Function

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

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

Time Stamping

- For Modicon X80 RIO drops on an *X Bus backplane*, page 24, time stamping is managed by a BMX ERT 1604 module installed on the RIO drop with a resolution of 1 ms. The BMXCRA31210 X80 performance EIO adapter module also manages this functionality.
- For Modicon X80 RIO drops on an *Ethernet backplane*, time stamping is managed by a BMECRA31210 X80 performance EIO adapter module installed on the RIO drop with a resolution of 10 ms.
- Inputs or outputs of X80 digital modules can be time stamped in an RIO drop with a BM• CRA 312 10 X80 EIO adapter module.
- Local variables can be time stamped in the controller.

The BMXCRA31210 and BMECRA31210 eX80 EIO adapter modules have the same resolution/accuracy for a given NTP server. The accuracy is improved if a dedicated NTP server is used instead of an M580 controller as the NTP server.

Ethernet Services

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

Service	Controllers that Support RIO	Controllers that Support DIO
Security	X	X
IPConfig	X	X
RSTP	X	X
SNMP	X	X
NTP	X	X
Switch (1)	—	X
QoS	—	X
ServicePort	X	X
Advanced Settings	—	X
(1) Enable Ethernet (ETH) and backplane ports and select their respective baud rates.		

The parameters of these services can be configured with Unity Pro 10.0 or later, or with EcoStruxure Control Expert.

- IP address (refer to the configuration topic in the *Installation and Configuration Guide* for the module, see the list in the Related Documents, page 11)

  NOTE: The BM•CRA312•0 EIO adapter modules automatically receive an IP address. You cannot change this IP address on this screen. Open the Control Expert controller configuration screen to change the IP address.
- RSTP (refer to the configuration topic in the *Installation and Configuration Guide* for the module, see the list in the Related Documents, page 11)

  SNMP (refer to the configuration topic in the *Installation and Configuration Guide* for the module, see the list in the Related Documents, page 11)
- service port (refer to the configuration topic in the *Installation and Configuration Guide* for the module, see the list in the Related Documents, page 11)
- SNTP (refer to the configuration topic in the *Installation and Configuration Guide* for the module, see the list in the Related Documents), page 11

Explicit Messaging

M580 controllers and Ethernet communication modules support explicit messaging via EtherNet/IP and Modbus TCP protocols. This feature is detailed in the *Installation and Configuration Guide* for the module, see the list in the Related Documents, page 11.

Use explicit messaging for extended diagnostics. These are the methods for explicit messaging in M580 systems:

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

  NOTE: For detailed information regarding these function blocks, refer to the *Extended* part in the EcoStruxure™ Control Expert Communication Block Library.

Standards and Certifications

Download

Click the link that corresponds to your preferred language to download standards and certifications (PDF format) that apply to the modules in this product line:

Title	Languages
Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications	• English: EIO0000002726 • French: EIO0000002727 • German: EIO0000002728 • Italian: EIO0000002730 • Spanish: EIO0000002729 • Chinese: EIO0000002731

Modules in an M580 System

What's in This Chapter

Modules and Switches 48
Modicon X80 I/O Modules 53
Distributed Equipment.....60

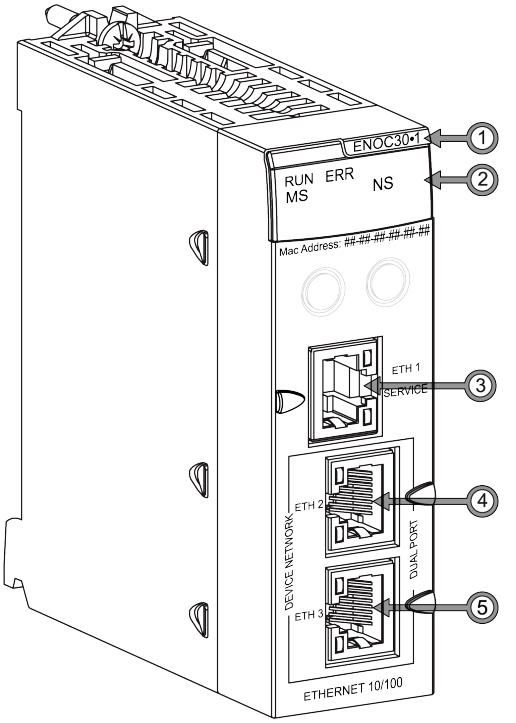
Overview

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

Modules and Switches

Ethernet Communication Modules

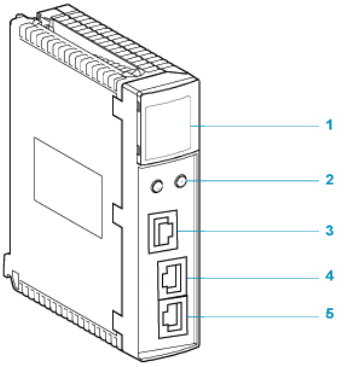
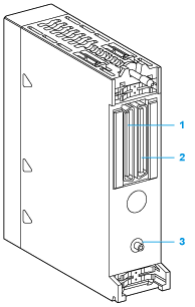
The following table shows the Ethernet communication modules that can be used on a local rack in an M580 system:

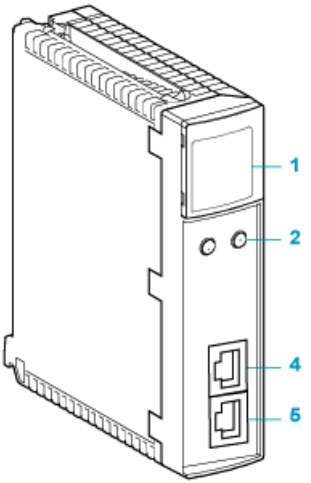
Reference	Description	Picture
BMENOC0301 (C) is a generic Ethernet communication module, and the BMENOC0311 is a comparable Ethernet communication module with additional FactoryCast capabilities.	Ethernet communication module with Web services In an M580 local rack, you can install a maximum of four BMENOC0301(C)/ BMENOC0311 modules, depending upon the controller you choose, page 75. When the Ethernet backplane connection is enabled, the module can manage distributed equipment on the device network. When the Ethernet backplane connection is disabled, the module can support distributed equipment on an isolated network only. These two modules are designed to be installed on an Ethernet backplane (connector on rear right side). For information about the BMENOC0301 (C)/BMENOC0311 modules, refer to the *Modicon M580 BMENOC03•1Ethernet Communication Module Installation and Configuration Guide*.	 **1** module name **2** LED display **3** SERVICE port (ETH 1) **4** DEVICE NETWORK port (ETH 2) **5** DEVICE NETWORK port (ETH 3)
BMENOC0302 (H) High performance Ethernet communication module	High performance Ethernet communication module with Web services An M580 rack supports up to six BMENOC0302(H) modules, depending on the type of controller you choose. For more information about the BMENOC0302(H) module, refer to the *Modicon M580 BMENOC0302 High Performance Ethernet Communication Module Installation and Configuration Guide*.	
BMENOC0321 (C)	Ethernet communication module that functions as a control network module to provide transparency between an M580 device network and the control network. In an M580 local rack, you can install only one BMENOC0321(C) module. For information about the BMENOC0321 (C) module, refer to the *Modicon M580 BMENOC0321 Control Network Module Installation and Configuration Guide*.	

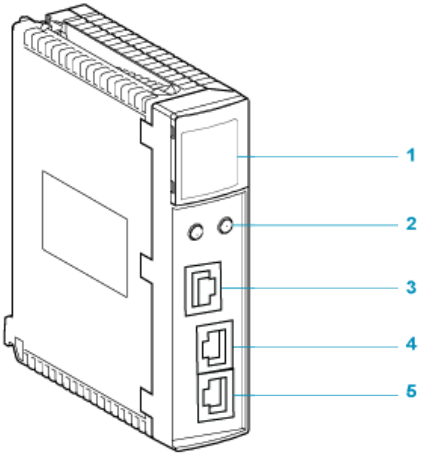
NOTE: Cover unused Ethernet ports with dust plugs.

EIO Adapter Modules

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

Reference	Description	Picture
BMECRA31210	eX80 performance EIO adapter module The BMECRA31210 module can be installed on an Ethernet backplane (connector on rear right side) to support eX80 I/O modules that require Ethernet across the backplane. The keying pin on the rear side of the module does not allow you to install this module on unsupported backplanes, page 24. Only one BM•CRA312•0 module can be installed on an eX80 RIO drop. This adapter module has a service port (3) and a time stamping feature. This module supports an extended remote rack. This adapter module supports expert modules, page 59 and CCOTF. For information about BM•CRA312•0 modules, refer to the *Modicon M580 Remote I/O Modules Installation and Configuration Guide*.	 **1** LED display **2** rotary switches **3** service port (ETH 1) **4** device network port (ETH 2) **5** device network port (ETH 3)  **1** X Bus connector (left side) **2** Ethernet connector (right side) **3** keying pin that does not allow you to install this module on unsupported backplanes

Reference	Description	Picture
BMXCRA31200	X80 standard EIO adapter module Only one BM•CRA312•0 module can be installed on an eX80 RIO drop. This adapter module does **not** have a service port or a time stamping feature. This module supports an extended remote rack. This adapter module only supports X80 analog and discrete modules, page 53 that do not require an Ethernet backplane. For information about BM•CRA312•0 modules, refer to the *Modicon M580 Remote I/O Modules Installation and Configuration Guide*.	 **1** LED display **2** rotary switches **3** service port (ETH 1) **4** device network port (ETH 2) **5** device network port (ETH 3)

Reference	Description	Picture
BMXCRA31210	X80 performance EIO adapter module Only one BM•CRA312•0 module can be installed on an X80 RIO drop. This adapter module has a service port (3) and a time stamping feature. This module supports an extended remote rack. This adapter module supports X80 expert modules, page 59 and CCOTF as well as analog and discrete modules, page 53 that do not require an Ethernet backplane. For information about BM•CRA312•0 modules, refer to the *Modicon M580 Remote I/O Modules Installation and Configuration Guide*.	 **1** LED display **2** rotary switches **3** service port (ETH 1) **4** device network port (ETH 2) **5** device network port (ETH 3)

Modicon X80 I/O Modules

Introduction

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

Unless otherwise noted in the following tables, X80 I/O modules are supported on the following racks in RIO drops:

- an X Bus rack with a BMXCRA312•0 X80 EIO adapter module
- an Ethernet rack with a BMECRA312•0 eX80 EIO adapter module

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

NOTE: Conformally coated (hardened H) versions of many of these modules are also available. Refer to the specifications for hardened equipment in the *Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications* guide.

Modicon X80 Analog Modules

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

NOTE: Debug screens are not available for analog modules in RIO drops and the parameters cannot be changed (Alignment, Filter, Offset...). If you need to modify the parameters, use the analog modules in local or local extended racks.

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

Type of Module	Module	Installation on...			
		Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
input	BMXAMI••••	+(3)	+(3)	+	+
	BMXART••••(1)	+(3)	+(3)	+	+
	BMEAHI0812(2)	+(3)	-	+(4)	-
output	BMXAMO••••	+(3)	+(3)	+	+
	BMEAHO0412(2)	+(3)	-	+(3)	-
input/output	BMXAMM0600	+(3)	+(3)	+	+

(1) The FAST task is not supported.

(2) These modules require an Ethernet backplane.

(3) Not supported in an M580 Hot Standby system.

(4) When installed in an RIO drop, use a **BM•CRA31210** (e)X80 performance EIO adapter module. These modules are **not** compatible with **BM•CRA31200** (e)X80 standard EIO adapter modules.

+ Allowed

- Not allowed

NOTE: A maximum of two analog modules are allowed on an RIO drop that contains a BMXCRA31200.2 X80 EIO adapter module. These analog modules can have a maximum of 8 channels (16 for analog I/O modules).

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

Module	Product Version	Software Version
BMXAMI0410	PV5	SV1.1
BMXAMM0600	PV5 or later	SV1.2
BMXAMO0210	PV7 or later	SV1.1
BMXART0414	PV5, PV6	SV2.0
	PV7	SV2.1
BMXART0814	PV3, PV4	SV2.0
	PV5 or later	SV2.1

NOTE: Upgrade the modules with the latest available software version.

Modicon X80 Discrete Modules

In the controller configuration screen in Control Expert, you can configure a digital I/O module channel as a **RUN** / **STOP input**by selecting this check box. This can be performed on a local I/O channel in topological I/O data type only. (This configuration is not available in Hot Standby systems).

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

Type of Module	Module	Installation on...			
		Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
input	BMXDAI••••	+(2)	+(2)	+	+
	BMXDDI••••(1)	+(2)	+(2)	+	+
output	BMXDAO••••	+(2)	+(2)	+	+
	BMXDDO••••	+(2)	+(2)	+	+
	BMXDRA••••(1)	+(2)	+(2)	+	+
	BMXDRC••••	+(2)	+(2)	+	+
input/output	BMXDDM••••	+(2)	+(2)	+	+

(1) Before installation of I/O modules that use a 125 Vdc power supply, refer to the temperature derating information in I/O module hardware guides for your platform.

(2) Not supported in an M580 Hot Standby system.

+ Allowed

- Not allowed

NOTE: Upgrade the modules with the latest available software version.

Modicon X80 Communication Modules

NOTE: The maximum number of communication modules you can install on the local rack depends upon the controller you choose, page 75.

These communication modules are supported in M580 local racks (containing a controller with Ethernet I/O communication server service) and RIO drops that contain a BM•CRA312•0 X80 EIO adapter module:

Module	Comment	Installation on...			
		Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
BMXNOM0200(1)	Only MAST task is supported. Additional restrictions are described in chapter *BMXNOM0200 Limitation and Implementation Rules* (see Modicon X80, BMXNOM0200 Serial Link Module, User Manual). Refer to the instruction to configure the BMXNOM0200 module in an X80 RIO drop (see Modicon M580, RIO Modules, Installation and Configuration Guide)	+(3)	+(3)	+(4)	+
BMXNOR0200	Only MAST task is supported.	+(3)	+(3)	-	-
BMXNGD0100	Dedicated to global data. For configuration details, refer to the BMXNOE0100 user guide (3100713•) (see Modicon M340 for Ethernet, Communications Modules and Processors, User Manual). The BMXNGD0100 module has the same global data functionality as the BMXNOE0100, but it does not support these services: I/O scanning, address server, time synchronization, bandwidth monitoring, or web pages.	+(3)	-	-	-

Module	Comment	Installation on...			
		Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
BMXEIA0100(1)	Only MAST task is supported. A maximum of 16 AS-i modules in an M580 configuration is allowed. A maximum of two AS-i modules on an RIO drop containing a BM•CRA3•• X80 EIO adapter is allowed. The following maximum number of AS-i modules on a local rack containing one of the following controllers is allowed. • BMEP581020: two • BMEP582020: four • BMEP582040: four • BMEP583020: six • BMEP583040: six • BMEP584020: eight • BMEP584040: eight • BMEP585040: eight • BMEP586040: eight A maximum of 16 AS-i modules is allowed in RIO drops in an M580 system that uses BME•585040 or BME•586040 controllers.	+(3)	+(3)	+(4)	+
BMECXM0100(2)	Connects an M580 controller on an Ethernet network to CANopen fieldbus devices. Requires an Ethernet backplane.	+(3)	-	+	-
BMXNRP0200, BMXNRP0201	Fiber cable conversion	+	+	+	+

(1) If a BMXNOM0200 module and a BMXEIA0100 module are included on the same RIO drop, only one of each module is allowed.

(2) Compatible with M580 controllers V2.00 or later only.

(3) Not supported in an M580 Hot Standby system.

(4) When installed in an RIO drop, use a **BM•CRA31210** (e)X80 performance EIO adapter module. These modules are **not** compatible with **BM•CRA31200** (e)X80 standard EIO adapter modules.

+ Allowed

- Not allowed

Modicon X80 Counting Modules

When installed in an RIO drop, use a **BM•CRA31210** (e)X80 performance EIO adapter module. These modules are **not** compatible with **BM•CRA31200** (e)X80 standard EIO adapter modules.

I/O event tasks are supported only through topological data type, not through device DDT.

These counting modules are supported in M580 local racks (containing a controller with Ethernet I/O communication server service) and RIO drops that contain a BM•CRA31210 (e) X80 EIO performance adapter module:

Module	Comment	Installation on...			
		Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
BMXEHC0200	No comments	+(1)	+(1)	+	+
BMXEHC0800	When configuring a BMXEHC0800 module, the dual phase counting mode function **is not** available in X80 EIO drops or when using device DDT in local racks. When configuring a BMXEHC0800.2 module the dual phase counting mode function **is** available in X80 EIO drops and when using device DDT in local racks. In this case the event feature is not available.	+(1)	+(1)	+	+
BMXEAE0300	In RIO drops: • Events are not supported. If events are needed, move the module to the local rack. • A maximum of 36 channels can be configured.	+(1)	+(1)	+	+
(1) Not supported in an M580 Hot Standby system. **+** Allowed **-** Not allowed					

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

Module	Product Version	Software Version
BMXEHC0200	PV3	SV1.1
BMXEHC0800	PV3	SV1.1

NOTE: Upgrade the modules with the latest available software version.

Modicon X80 Special Purpose Modules

These special purpose modules are supported in M580 local racks (containing a controller with Ethernet I/O communication server service) and RIO drops that contain a BM•CRA312•0 X80 EIO adapter module:

Module	Comment	Installation on...			
		Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
BMXERT1604T	Limitations for the time stamping module are described in chapter *Compatibility and Limitations* (see Modicon X80, BMXERT1604T/H Time Stamp Module, User Manual).	+(2)	+(2)	+(3)	+
PMXNOW0300	wireless multi-function access point/bridge	+(2)	+(2)	+	+
PMXCDA0400	diagnostic (machines, processes, and infrastructures)	+(2)	+(2)	+	+
PMESWT0100(1)	This is an Ethernet weighing transmitter (1 channel) and requires an Ethernet backplane.	+(2)	-	+	-
PMEUCM0302	universal communication This requires an Ethernet backplane.	+(2)	-	+	-
PMEPXM0100	Profibus DP/DPV1 master module that requires an Ethernet backplane	+(4)	+(4)	+(5)	+(5)
BMENOR2200H	Modicon M580 BMENOR2200H Advanced RTU Module				

Module	Comment	Installation on...			
		Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
BMENUA0100	Ethernet communication module with embedded OPC UA server	+(6)	-	-	-

(1) Scanned as a device by the DIO scanner in the controller.

(2) Not supported in an M580 Hot Standby system.

(3) When installed in an RIO drop, use a **BM•CRA31210** (e)X80 performance EIO adapter module. These modules are **not** compatible with **BM•CRA31200** (e)X80 standard EIO adapter modules.

(4) Not supported on a local rack in an M580 standalone system.

(5) Not supported on an EIO remote drop in an M580 Hot Standby system.

(6) Although the M580 supports three BMENUA0100, only two can be configured in Control Expert as OPC UA servers. The third BMENUA0100 must be configured as a gateway.

+ Allowed

- Not allowed

Distributed Equipment

Distributed Equipment

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

- a DIO daisy chain
- a DIO daisy chain loop

NOTE: DIO daisy chains and DIO daisy chain loops are described in *DIO Daisy Chain and DIO Daisy Chain Loop*, page 37 topic.

Distributed devices in a loop have two Ethernet ports (to maintain the ring), and they support RSTP. An example of equipment on a DIO loop is several STB islands that use STB NIP 2311 NIMs or Modicon Edge I/O NTS islands that use NTS NEC 1200 NIMs .

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

I/O Scanned Equipment	Equipment that Cannot be I/O Scanned
Altivar variable speed drives	HMI controllers
main protection and control functions (TeSys T)	—
OTB (DIO modules), STB and Edge I/O NTS	—
remote master interfaces (Profibus, CANopen, Hart)	
EtherNet/IP adapter devices	

Modicon Edge I/O in an M580 System

What's in This Chapter

Edge I/O Modules to Integrate in an M580 System 62
Edge I/O Fast Device Replacement 66

Introduction

This chapter describes how Modicon Edge I/O NTS devices interact with Modicon M580 controllers.

For more information, refer to the Modicon Edge I/O, System Planning and Installation Guide and the *Modicon Edge I/O, Deployment Guide For EcoStruxure Control Expert Classic*.

Edge I/O Modules to Integrate in an M580 System

Network Interface Modules

Supported modules:

Reference	Port	Communication protocol	Connection type
NTSNEC1200(H)	2 isolated switched Ethernet ports	EtherNet/IP Modbus TCP	RJ45
	1 USB port	USB 2.0	USB Type-C

For more information about these modules, refer to the *Modicon Edge I/O NTS Network Interface Module User Guide*.

Discrete Input Modules

Supported modules:

Reference	Number of Channels	Channel Type
NTSDDI••••(H)	4, 6, 16	4: sink / source inputs with diagnostic: 6,16: sink inputs 16: source inputs
NTSDDI••••X(H)	8, 16	8,16: sink inputs

For more information about these modules, refer to the *Modicon Edge I/O NTS Discrete Modules User Guide*.

Discrete Output Modules

Supported modules:

Reference	Number of Channels	Channel Type
NTSDDO••••(H)	2, 4, 6, 8	2: isolated source outputs 4: Source outputs with diagnostic 6, 8, 16: source outputs
NTSDDO••••X(H)	8, 16	source outputs
NTSDDO••••XA(H)	16	source outputs
NTSDRA0615	6	6 : isolated outputs

For more information about these modules, refer to the *Modicon Edge I/O NTS Discrete Modules User Guide*.

Analog Input Modules

Supported modules:

Reference	Number of Channels	Channel Type
NTSAMI••••(H)	2, 4, 8	2: isolated inputs with loop power 4: differential inputs 4, 8: inputs
NTSACI••••X(H)	8	inputs with loop power

For more information about these modules, refer to the Modicon Edge I/O NTS Analog Modules User Guide.

Analog Output Modules

Supported modules:

Reference	Number of Channels	Channel Type
NTSAMO••••(H)	2, 4	2: isolated outputs 4: outputs

For more information about these modules, refer to the *Modicon Edge I/O NTS Analog Modules User Guide*.

Counting Input/Output Modules

Supported modules:

Reference	Number of channels	Expert function	Discrete inputs	Discrete outputs
NTSEHC0120H	1	Simple counting Frequency meter Period meter Ratio meter Single phase counting Single phase event counting Dual phase counting PWM output Reflex output sub-function	6	4
NTSEHC0220	2	Simple counting Frequency meter Period meter Ratio meter Single phase counting Single phase event counting Dual phase counting PWM output Reflex output sub-function	12	8

For more information about these modules, refer to the *Modicon Edge I/O NTS Counting Modules User Guide*.

Field Device Master Modules

Supported modules:

Reference	Number of Channels	Function	Wiring	Terminal type / pitch
NTSFIO0400	Up to 4	IO-Link Master	Class A (3-wire or 4-wire)	Removable screw/ spring terminal block / 3.81 mm

Power Supply Modules

Supported modules:

Reference	Voltage	Function	Terminal Type / Pitch
NTSPFB1002H	24 Vdc	Field and Bus power supply	Removable screw/spring terminal block / 5 mm
NTSPFD1002H	24 Vdc	Field power supply	Removable screw/spring terminal block / 5 mm

Common Distributed I/O Modules

Supported modules:

Reference	Function	Terminal Type / Pitch
NTSPCM••••H	24 VDC/ 0 VDC connexion points : 8/8 24 VDC/ 0 VDC connexion points : 16/16	Removable screw/spring terminal block / 3.81 mm

Edge I/O Fast Device Replacement

Introduction

This topic provides an overview of the fast device replacement (FDR) service for Edge I/O NTS devices.

The FDR mechanism for Edge I/O NTS network interface modules (NIMs) has specific differences compared to other devices managed within an M580 control system.

For detailed information about the FDR mechanism, refer to the Modicon M580 Hardware User Guide and the Modicon Edge I/O NTS Network Interface Modules User Guide.

FDR Mechanism

The FDR mechanism of the Edge I/O NTS NIM automatically updates the configuration of the Edge I/O NTS device. Unlike the classic FDR mechanism of BM•CRA3•••0 adapter modules or STBNIP2212 modules, where the FDR server is updated by an engineering station using Schneider Electric software, the Edge I/O NTS NIM stores the running configuration cyclically. During each cycle, the Edge I/O NTS NIM device reads the contents of the M580 FDR server and updates the corresponding PRM configuration file.

The running Edge I/O NTS NIM configuration is the reference for the FDR service. The M580 FDR server is updated by the Edge I/O NTS NIM. This helps ensure that the FDR configuration is up to date, regardless of any changes made to the Edge I/O NTS NIM via the web interface or other method.

NOTE: New devices must be in factory reset condition (no password, no configuration).

For more information about resetting to factory settings, refer to the Modicon Edge I/O NTS Network Interface Module User Guide.

Planning and Designing a Typical M580 Network

What's in This Part

Selecting the Topology 69
Performance 109

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.

Selecting the Topology

What's in This Chapter

Project Life Cycle....70
Planning the Appropriate Network Topology....71
Selecting a Controller for your M580 System....75
Planning an Isolated DIO Network....79
Adding an Independent DIO Network....80
Adding an Extended DIO Network....82
Planning a Simple Daisy Chain Loop....84
Edge I/O Device Integration in M580 Topologies....89
Edge I/O Network Topologies....89
Installing a Communication Module on the Local Rack....91
Using Premium Racks in an M580 System....95
Using Fiber Converter Modules....101
Connecting an M580 Device Network to the Control Network....106

Overview

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

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

- One controller with Ethernet I/O scanner service is installed in the local rack.
- One BM•CRA312•0 eX80 EIO adapter module is installed in each RIO drop.
- Follow the rules regarding the maximum number of devices allowed (for example, 32 devices in the main ring, including the local rack, and 31 RIO drops in the RIO network), the types of cables you select, and respect Control Expert messages during programming and diagnostic checks, page 137.
- Optional elements include a maximum of six communication modules, including a maximum of four BMENOC0301(C)/BMENOC0311 module and BMENOS0300 network option switch modules, or six BMENOC0302(H) modules, and only one BMENOC0321 (C) control network module.

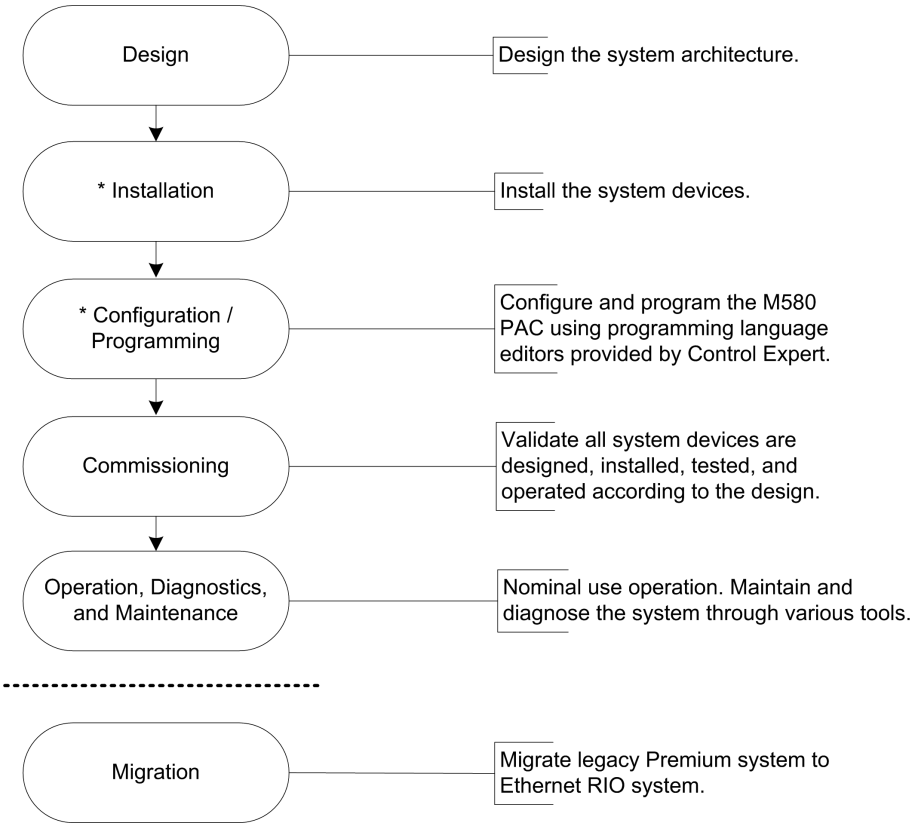
Each M580 controller supports only one Ethernet RIO network. This section helps you select the RIO network that allows improved response time for remote equipment operations.

NOTE: To use a dual-ring switch (DRS) to connect distributed equipment to the M580 network, refer to the Modicon M580 Complex Topologies, System Guide.

Project Life Cycle

Project Life Cycle

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



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

Planning the Appropriate Network Topology

Key Points when Planning a Topology

Consider these key points when you choose an M580 network topology:

- distance between two contiguous drops (and the potential need for DRSs or BMXNRP020• fiber converter modules and fiber cable on the main ring)
- ring or star network topology (A DIO cloud with distributed equipment in a star topology can communicate with an M580 network.)
- local rack configuration
- distributed equipment requirements
- isolation requirements (for example, if the local rack and the drops are on different grounding systems)
- redundancy requirements for the main ring / sub-ring connections

These points are discussed in the following paragraphs.

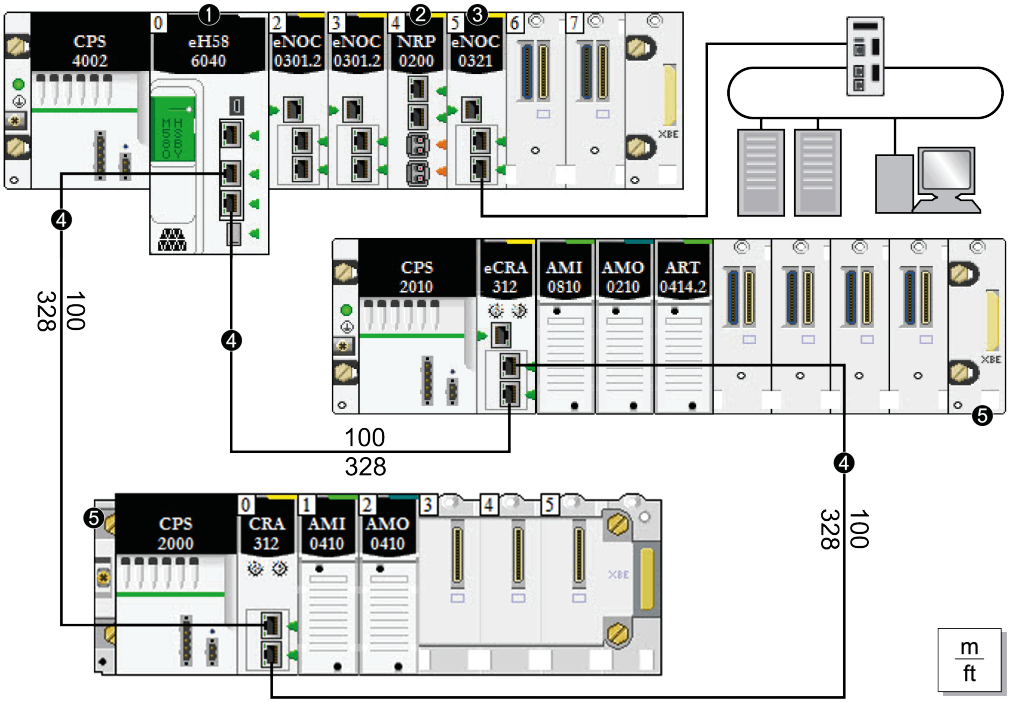
Distance Between Two Drops

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

If you are using copper cable, the maximum distance between two contiguous drops is 100 m. If the drops are more than 100 m apart, use 1 or more BMXNRP020• fiber converter modules to convert copper cable to fiber. A fiber cable can run as long as 15 km (for single-mode fiber).

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

A copper Ethernet network provides a valid solution:



NOTE: The solid line represents copper wire.

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

2 BMXNRP020• fiber converter module

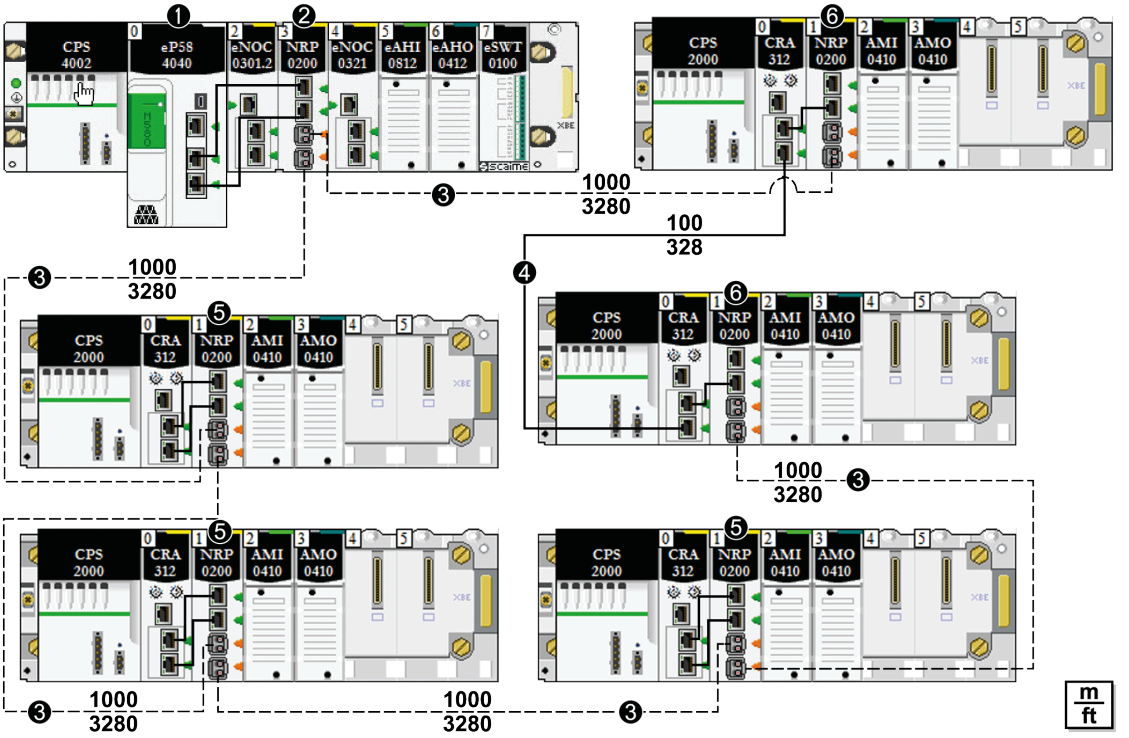
3 BMENOC0321 module on the local rack, providing transparency between the device network and the control network

4 main ring

5 RIO drop (including a BM•CRA312•0 X80 EIO adapter module) on the main ring

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

Use BMXNRP020• fiber converter modules to increase the distance between two contiguous RIO modules, including the distance between the controller and an RIO drop. To connect the fiber to the copper cables, insert a BMXNRP020• module at each end of the fiber link. Thus, two BMXNRP020• modules establish a single fiber link:



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

2 BMXNRP020• fiber converter module on the local rack connected to an RIO drop on the main ring via fiber cable

3 *(dashed line)*: fiber portion of the main ring

4 *(solid line)*: copper portion of the main ring

5 BMXNRP020• module on an RIO drop connected to the main ring via fiber cable

6 BMXNRP020• module on an RIO drop connected to the main ring via copper and fiber cable

NOTE:

- Use multi-mode fiber to connect the BMXNRP020• module to the main ring if the distance between the local rack and the RIO drop is less than 2 km.
- You cannot use BMXNRP020• modules to connect RIO or DIO sub-rings to the main ring.

Using Fiber Converter Modules

Install fiber converter modules to extend the distance between the local rack and the first RIO drop on the main ring:

Step	Action
1	Install a BMXNRP020• fiber converter module on a local rack.
2	Connect the BMXNRP020• module on the local rack via copper cable to the controller.
3	Install a BMXNRP020• module on the first RIO drop on the main ring.
4	Connect the fiber cable between the BMXNRP020• module on the local rack and the BMXNRP020• module at the RIO drop. The BMXNRP020• module uses small form-factor plugs (SFPs) (transceivers) for the fiber ports. Choose single-mode or multi-mode SFPs. • Use multi-mode fiber and a (BMXNRP0200) module to connect the BMXNRP020• module to the main ring if the distance between the BMXNRP020• and the next Ethernet RIO drop is less than 2 km. • Use the single-mode fiber module (BMXNRP0201) to connect the BMXNRP020• module to the main ring if the distance between the BMXNRP020• and the next Ethernet RIO drop is between 2 km and 15 km.
5	Interlink the two copper ports of the BMXNRP020• module with the two Ethernet ports of the BM•CRA312•0 X80 EIO adapter module on the RIO drop.
6	To extend the distance between other RIO drops on the main ring, connect the BMXNRP020• module on an RIO drop to a BMXNRP020• module on the next drop. Then, follow steps 4 and 5.

Close the ring:

Step	Action
1	Interlink a copper port on the BMXNRP020• module with an Ethernet port on the BM•CRA312•0 X80 EIO adapter module on the last RIO drop.
2	Connect the BMXNRP020• module on the RIO drop via fiber cable to the BMXNRP020• module on the local rack.

Install fiber converter modules to extend the distance between RIO drops on the main ring or a sub-ring:

Step	Action
1	Install BMXNRP020• modules on the two RIO drops for which you wish to extend the distance.
2	Connect the BMXNRP020• module on one drop to the BMXNRP020• module on the next drop. The BMXNRP020• module uses small form-factor plugs (SFPs) (transceivers) for the fiber ports. Choose single-mode or multi-mode SFPs. • Use the multi-mode fiber module (BMXNRP0200) to connect the BMXNRP020• module to the ring if the distance between the BMXNRP020• and the next drop is less than 2 km. • Use the single-mode fiber module (BMXNRP0201) to connect the BMXNRP020• module to the ring if the distance between the BMXNRP020• and the next drop is in the range 2 km ... 5 km.
3	Interlink the two copper ports of the BMXNRP020• module with the two Ethernet ports of the BM•CRA312•0 on the drop.
4	To extend the distance between other RIO drops on a ring, repeat steps 1-3.

Isolation Requirements

Follow all local and national safety codes and standards.

⚠⚠DANGER

ELECTRIC SHOCK

Wear personal protective equipment (PPE) when working with shielded cables when the grounding potential is unknown.

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

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

Refer to the ground connections information in the Electrical installation guide to comply with EMC requirements.

Selecting a Controller for your M580 System

Introduction

A local rack, page 24 in an M580 system contains one controller from the BMEP58 range. Use this table to select a controller for your system:

	BME P58 •0•0 Controller reference								
Communication Capability	**1020**	**2020**	**2040**	**3020**	**3040**	**4020**	**4040**	**5040**	**6040**
maximum number of RIO drops	–	–	8	–	16	–	16	31	31
maximum number of local racks (main rack + extended rack)	4	4	4	8	8	8	8	8	8
maximum number of communication modules on the local rack(1)	2	2	2	3	3	4(3)	4	4	6(3)
Ethernet I/O scanner service	DIO	DIO	RIO, DIO	DIO	RIO, DIO	DIO	RIO, DIO	RIO, DIO	RIO, DIO
maximum number of distributed devices managed by a controller with Ethernet I/O scanner service(2)	64	128	64	128	64	128	64	64	64
maximum number of discrete I/O channels	1024	2048	2048	3072	3072	4096	4096	5120	6144
maximum number of analog I/O channels	256	512	512	768	768	1024	1024	1280	1536

– not available

(1) includes BMENOC0301 / BMENOC0311, BMENOC0302(H), BMXEIA0100, BMXNOR0200, and BMXNOM0200 communication modules

(2) includes three slots for local slave functionality

(3) Only four of these modules can be BMENOC0301 / BMENOC0311 modules.

NOTE:

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

Controller Processing Capacity

Use this table to compare for each station the total number of messages received via the Modbus message service if used (values R1, R2, or Ri) with the capacity of the station controller.

Processing of Modbus requests per controller scan cycle:

Controller Module	Messages Received
BMEP581020	16 messages/cycle
BMEP582020	24 messages/cycle

Controller Module	Messages Received
BMEP582040	24 messages/cycle
BMEP583020	32 messages/cycle
BMEP583040	32 messages/cycle
BMEP584020, BMEP584040, BMEH584040	40 messages/cycle
BMEP585040	48 messages/cycle
BMEP586040, BMEH586040	64 messages/cycle

The above table shows the maximum number of requests per cycle. The internal communucation port that sends the request can limit this maximum:

- **USB:** maximum of 4 requests
- **X Bus:** maximum of 16 requests
- **Ethernet ports:** maximum of 32 requests (including backplane ports and copper ports on the front of the module)

  NOTE: Messages per cycle represents the number of messages received per cycle from the controller master task (typical cycle of 50 to 100 ms).

Ethernet Transaction Processing Capacity

Use this table to compare for each station the total number of messages received (values Ri or Rj) and the total number of messages transmitted (values Ei or Ej) (for example, station **N**).

Use the elements below for the Ethernet connection per controller, rather than the number of transactions required by the application:

Controller Module	Ethernet Transaction Processing Capacity	Value
BMEP581020	Modbus messaging	500 transactions/s
BMEP582020 BMEP582040 BMEP583020 BMEP583040 BMEP584020 BMEP584040 BMEP585040 BMEP586040 BMEH582040 BMEH584040 BMEH586040	I/O scanning service	7,500 transactions/s

Simultaneous TCP/IP Connections

The number of simultaneous TCP/IP connections depends on the type of connection to the Ethernet network:

- 10/100BASE-TX network module port
- 10/100BASE-TX embedded controller port

This table show the number of simultaneous TCP/IP connections that are available for Ethernet communication modules and controller modules:

	Ethernet Module	**Controller**				
	BMENOC0301 / BMENOC0311/ BMENOC0302 (H)	**BMEP581020**	**BMEP582020 BMEP582040 BMEH582040**	**BMEP583020 BMEP583040**	**BMEP584020 BMEP584040 BMEH584040**	**BMEP585040 BMEP586040 BMEH586040**
client	16	16	32	48	80	80
server		32			64	96

Planning an Isolated DIO Network

Introduction

An isolated DIO network is not part of the RIO network. It is an Ethernet-based network containing distributed equipment on a copper wire running from a single port connection or on a ring running off a BMENOC0301 / BMENOC0311/BMENOC0302(H) Ethernet communication module or a BMENOS0300 network option switch module. If you use dual-port distributed equipment that supports RSTP, you can connect the equipment in a daisy-chain loop to the two device network ports on a BMENOC0301 / BMENOC0311/ BMENOC0302(H) module.

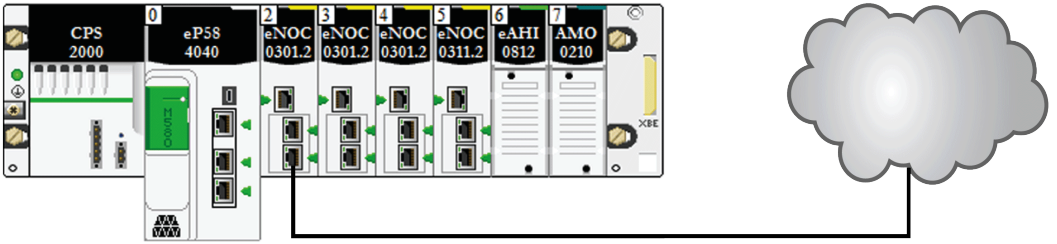
Attaching an Isolated DIO Network

To attach an isolated DIO network to an M580 system:

Step	Action
1	Disable the Ethernet backplane connection of the BMENOC0301/11/BMENOC0302(H) module (see the *Switch Properties* topic in the *Modicon M580, BMENOC0301/0311 Ethernet Communications Module, Installation and Configuration Guide*,or the *Switch Properties* topic in the *Modicon M580, BMENOC0302 High Performance Ethernet Communication Module, Installation and Configuration Guide*,or the BMENOS0300 network option switch module.
2	Connect one of the *device network ports* of the BMENOC0301 / BMENOC0311/BMENOC0302(H) or BMENOS0300 module to the DIO network. **NOTE:** If you use dual-port equipment that support RSTP, you can connect the equipment in a daisy chain loop to both *device network ports* on the BMENOC0301 / BMENOC0311/ BMENOC0302(H) modules.

Example

This graphic shows an isolated DIO network. The BMENOC0301(C) that manages the DIO cloud does not communicate with the M580 Ethernet RIO network because its Ethernet backplane port is disabled. The controller communicates with the other BMENOC0301 / BMENOC0311 modules (with backplane ports enabled) to support distributed equipment on the device network (not shown):



Adding an Independent DIO Network

Introduction

Add an *independent DIO network* if you have existing distributed equipment (which you may not want to reconfigure) to the M580 system for the purpose of communicating with the control network.

An independent DIO network is not part of the Ethernet RIO network, but it does communicate with the control network.

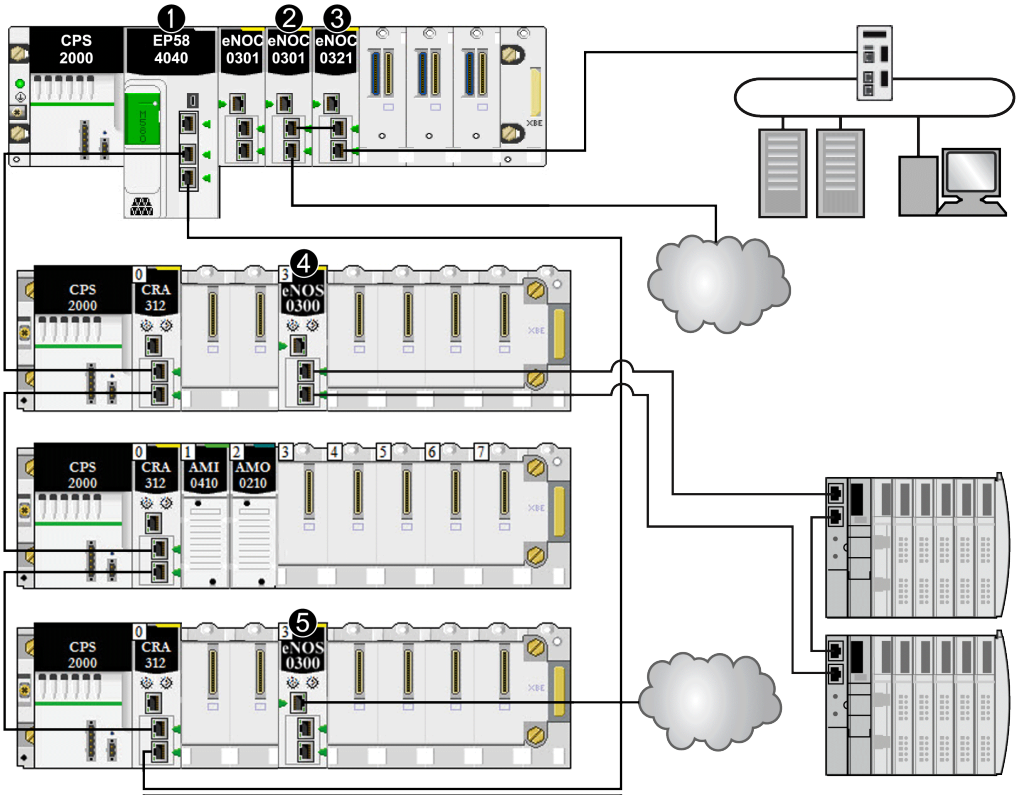
An independent DIO network is an Ethernet-based network that includes distributed equipment on a copper wire that runs from a single port connection. If you use dual-port equipment that supports RSTP, you can connect the equipment in a daisy chain loop to the device network ports on the BMENOC0301(C)/BMENOC0311/BMENOC0302(H)Ethernet communication module.

Considerations:

- There is no backplane connection to the RIO network.
- A BMENOC0301(C)/BMENOC0311/BMENOC0302(H) Ethernet communication module communicates with a BMENOC0321(C) control network module on the local rack to support communication with the M580 control network only. The Ethernet backplane port on the BMENOC0301(C)/BMENOC0311/BMENOC0302(H) module is disabled so that it does not communicate with the controller and the RIO network through the backplane. Instead, the front Ethernet ports of the two modules are interlinked.

Example

This graphic shows an independent DIO network. The BMENOC0301(C) module is interlinked with a BMENOC0321(C) control network module on the local rack. The Ethernet backplane port of the BMENOC0301(C) module is disabled so that the independent DIO network communicates with the control network only, not the device network:



1 The M580 controller connects RIO drops and distributed equipment to the main ring.

2 A BMENOC0301(C) Ethernet communication module on the local rack is connected to the independent DIO network.

3 A BMENOC0321(C) control network module on the local rack connects an independent DIO network to the M580 control network. This module also provides transparency between the device network and the control network.

4 A BMENOS0300 network option switch module on an RIO drop connects a DIO sub-ring to the main ring.

5 A BMENOS0300 network option switch module on an RIO drop connects a DIO cloud to the main ring.

Adding an Extended DIO Network

Introduction

Add an *extended DIO network* if you have existing distributed equipment (which you may not want to reconfigure) to the M580 device network. An extended DIO network is a physical and logical part of the Ethernet RIO network.

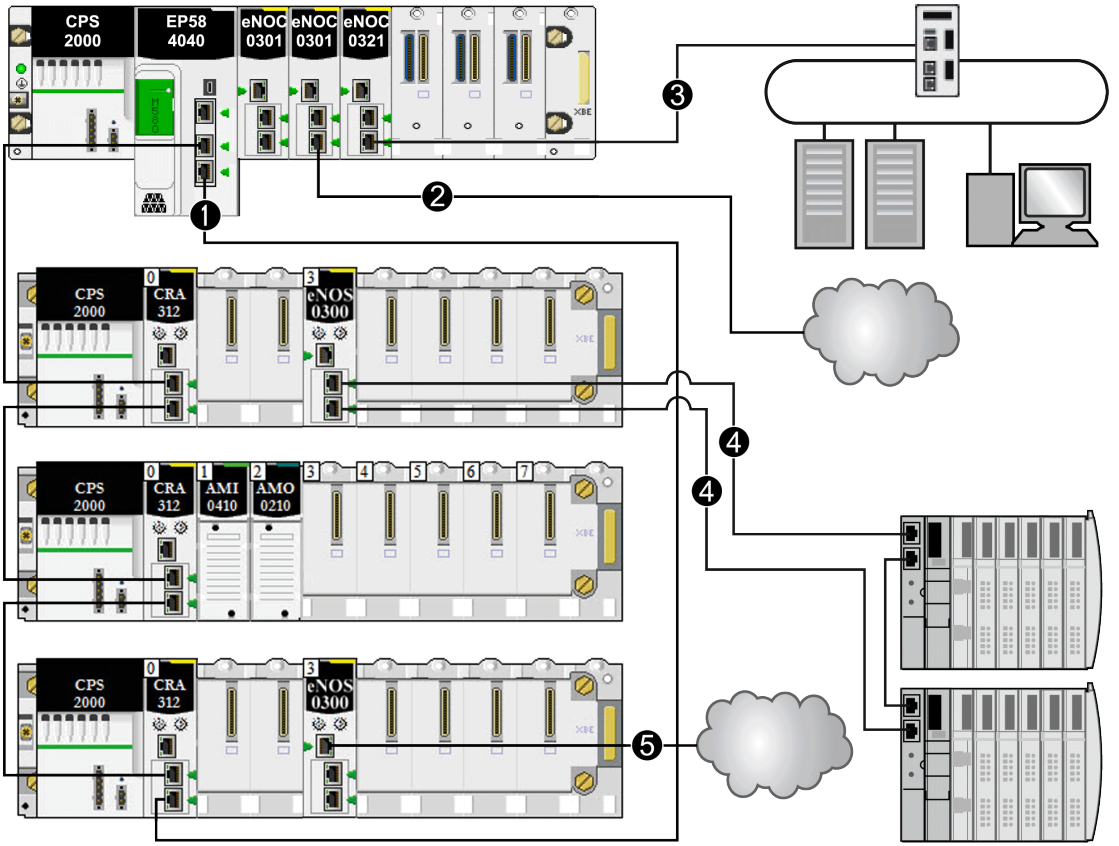
An extended DIO network is an Ethernet-based network containing distributed equipment on a copper wire that runs from a single port connection. If you use dual-port equipment that supports RSTP, you can connect the equipment in a daisy chain loop to the device network ports on the BMENOC0301(C)/BMENOC0311/BMENOC0302(H) Ethernet communication module.

Considerations:

- There is an Ethernet backplane connection to the device network.
- A BMENOC0301(C)/BMENOC0311/BMENOC0302(H) module communicates with a BMENOC0321(C) control network module on the local rack to support communication with the M580 control network. The Ethernet backplane ports on these modules are enabled so that the extended DIO network communicates with the controller and the device network through the backplane.

Example

This graphic shows an extended DIO network. The BMENOC0301(C) module communicates with the BMENOC0321(C) module on the local rack. The Ethernet backplane ports of both modules are enabled so that the extended DIO network communicates with both the device network and the control network:



1 The M580 controller connects RIO drops and distributed equipment to the main ring.

2 A BMENOC0301(C) Ethernet communication module on the local rack is connected to the independent DIO network.

3 A BMENOC0321(C) control network module on the local rack connects an independent DIO network to the M580 control network. This module also provides transparency between the device network and the control network.

4 A BMENOS0300 network option switch module on an RIO drop connects a DIO sub-ring to the main ring.

5 A BMENOS0300 network option switch module on an RIO drop connects a DIO cloud to the main ring.

Planning a Simple Daisy Chain Loop

Introduction

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

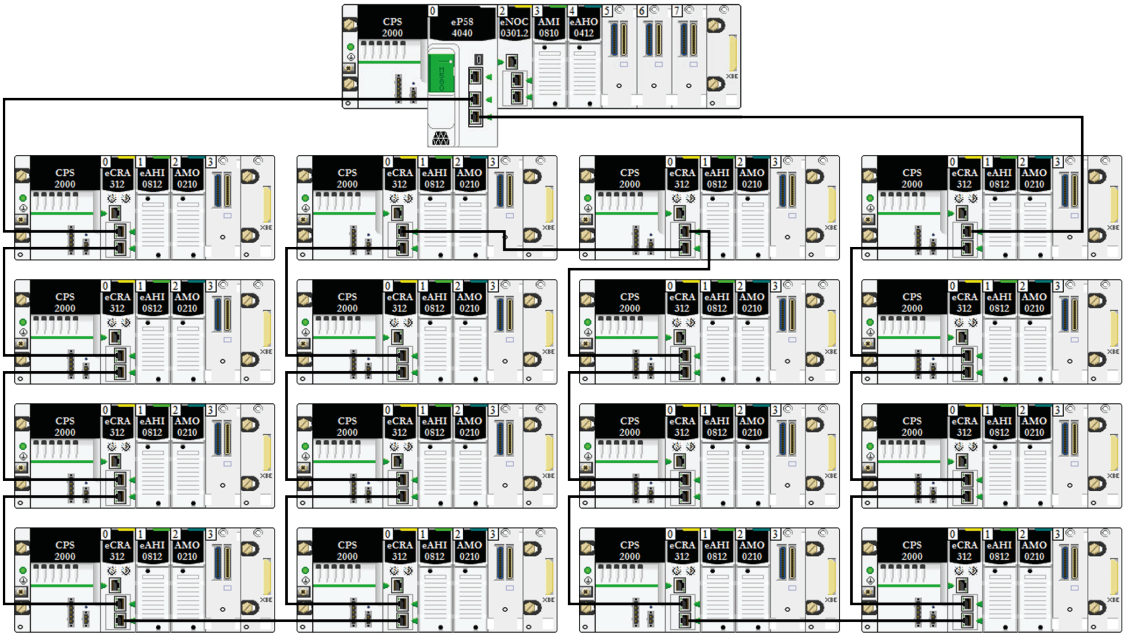
Implement a simple daisy chain loop network if only Ethernet RIO drops are included in the loop. The maximum number of RIO drops in the loop is 31. The local rack consists of a controller with Ethernet I/O scanner service.

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

Requirements

A simple daisy chain loop configuration provides cable redundancy that anticipates possible communication disruptions such as a broken wire or a non-operating RIO drop. Detecting a break in the main ring is discussed later in this guide, page 137.

This graphic shows a controller with Ethernet I/O scanner service in the local rack and Ethernet RIO drops on the main ring that include BM•CRA312•0 X80 EIO adapter modules:



NOTE:

- Verify that the controller in the local rack supports RIO scanning. You can also add a maximum of six communication modules, depending on the controller selection, page 75.
- A maximum of 31 remote drops is supported.
- Only copper cable can be used, so there is a maximum distance of 100 m between any two consecutive RIO modules on the main ring. If you want to extend the distance beyond 100 m, use BMXNRP020• fiber converter modules, page 101 to convert the copper cable to fiber.
- If you connect a DIO cloud to the controller on the local rack, the cloud is not part of the simple daisy-chain loop. The controller services the control logic for the DIO cloud only after it has completed the logic scan for the RIO.

Planning a Simple Daisy Chain Loop

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

Step	Action
1	Plan the local rack (including the M580 controller with Ethernet I/O scanner service and the power supply module.
2	Plan the Ethernet RIO drops. (Each drop includes a BM•CRA312•0 X80 EIO adapter module.)
3	Select a controller that supports RIO and configure the Ethernet I/O scanner service for RIO.
4	Connect the Device Network port on the controller to an Ethernet port on the adapter module at one of the drops. This completes the loop. Do not use the Service port or ETH 1 port on the controller and on the BM•CRA312•0 X80 EIO adapter modules for this connection unless in some specific conditions described in *Modicon M580, Open Ethernet Network, System Planning Guide*. The Service port may not provide full performance and features that the Device Network ports on provide. Connecting the Service port, either directly or through a switch/hub, to the Device network may affect system performance.

NOTE:

- Controllers and eX80 EIO adapter modules do not have fiber ports. Therefore, the maximum distance between the controller and the first drop and between any two contiguous drops is less than 100 m, using shielded twisted 4-pair CAT5e or greater (10/100 Mbps) cable. (Do not use twisted 2-pair CAT5e or CAT6 cables.) If you want to extend the distance beyond 100 m, use DRSs (see Modicon M580 Complex Topologies, System Guide) or BMX NRP 020•, page 101 fiber converter modules to convert the copper cable to fiber.
- The Ethernet ports are labeled on both the controller with Ethernet I/O scanner service and the BM•CRA312•0 X80 EIO adapter module. Connect these modules to the indicated ports; otherwise, system performance can be affected.

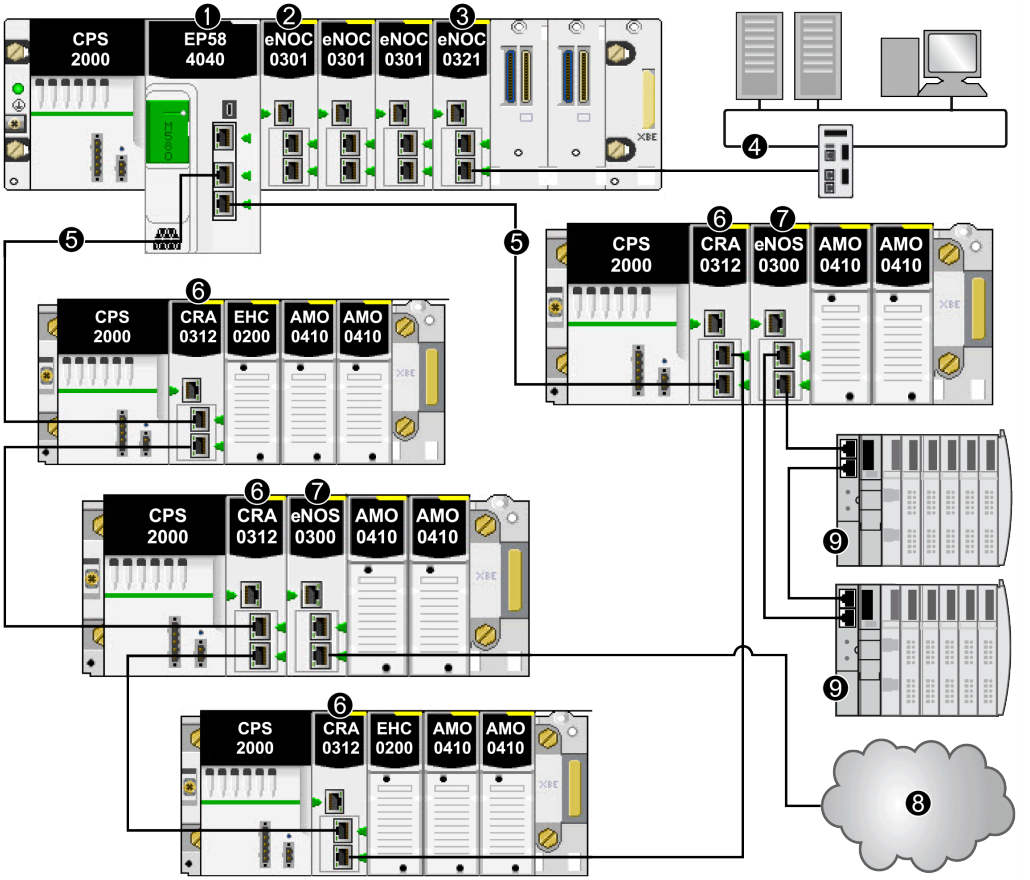
Connecting the BMENOC0321(C) Module to a Device Network

Provide network transparency between the control network and a device network:

Step	Action
1	Install one controller, up to four BMENOC0301(C)/BMENOC0311 Ethernet communication modules or six BMENOC0302(H) high performance Ethernet communication module that communicate with the controller and one BMENOC0321(C) control module on the local rack.
2	Confirm that the Ethernet backplane ports are enabled for the BMENOC0301(C)/BMENOC0311/ BMENOC0302(H) modules (up to five), the BMENOC0321(C) module, and the controller.
3	Connect the start of the main ring to the *device network port* (ETH 2 or ETH 3) of the controller.

Step	Action
4	Connect the end of the main ring to the *device network port* (ETH 2 or ETH 3) of the controller.
5	Connect the *control network port* (ETH 2 or ETH 3) of the BMENOC0321(C) module to the control network.

Sample architecture:



1 BME•58•••• controller connecting the local rack to the main ring

2 BMENOC0301(C) Ethernet communication module managing distributed equipment on the device network

3 BMENOC0321(C) control network module, providing transparency between the control network and the device network

4 control network

5 RIO main ring

6 BM•CRA312•0 (e)X80 EIO adapter module on an RIO drop on the main ring

7 BMENOS0300 module on an RIO drop

8 DIO cloud connected to the main ring via a BMENOS0300 network option switch module on an RIO drop

9 STB island in a DIO sub-ring connected to the main ring via a BMENOS0300 module on an RIO drop

Edge I/O Device Integration in M580 Topologies

Introduction

The following topics describe the integration of Edge I/O devices in an M580 system.

Edge I/O NTS devices replace STB devices. The Edge I/O catalog contains more than 100 reference devices: standard, motion, counting, high-speed counting, and HART.

An Edge I/O network is structured as follows:

- An island is composed of one or more clusters up to a maximum of 25 clusters.
- Clusters are composed of network interface modules (NIMs) or bus extender modules and slices (maximum of 32 slices).

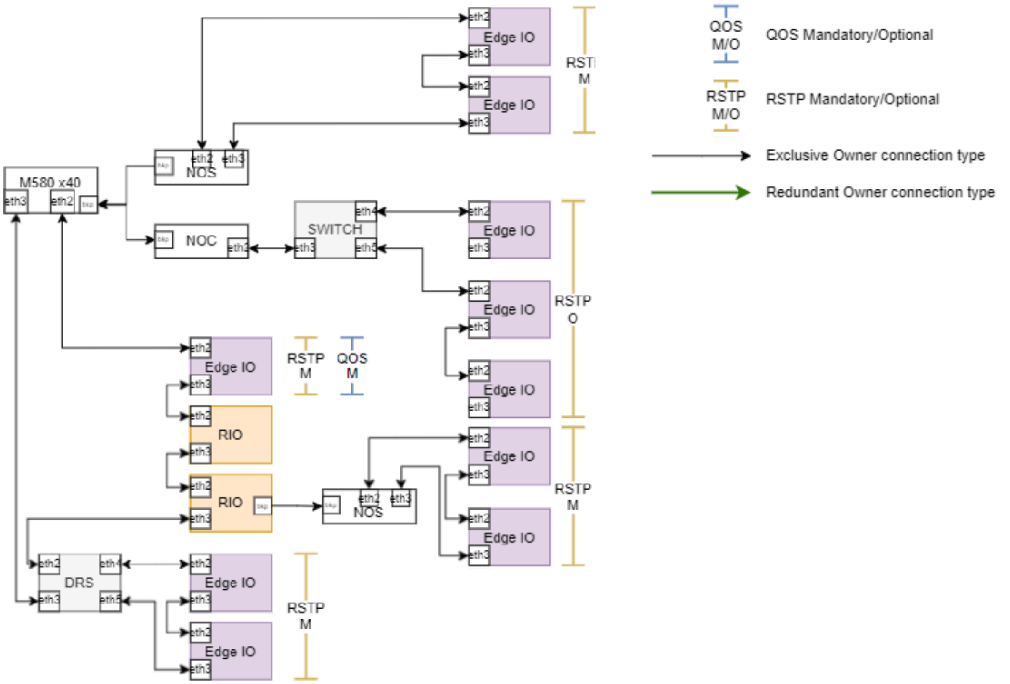
Edge I/O NTS devices can be scanned by BMENOC0301 or BMENOC0311 communication modules. For details related to software, refer to the EcoStruxure Control Expert Guidelines document.

Edge I/O Network Topologies

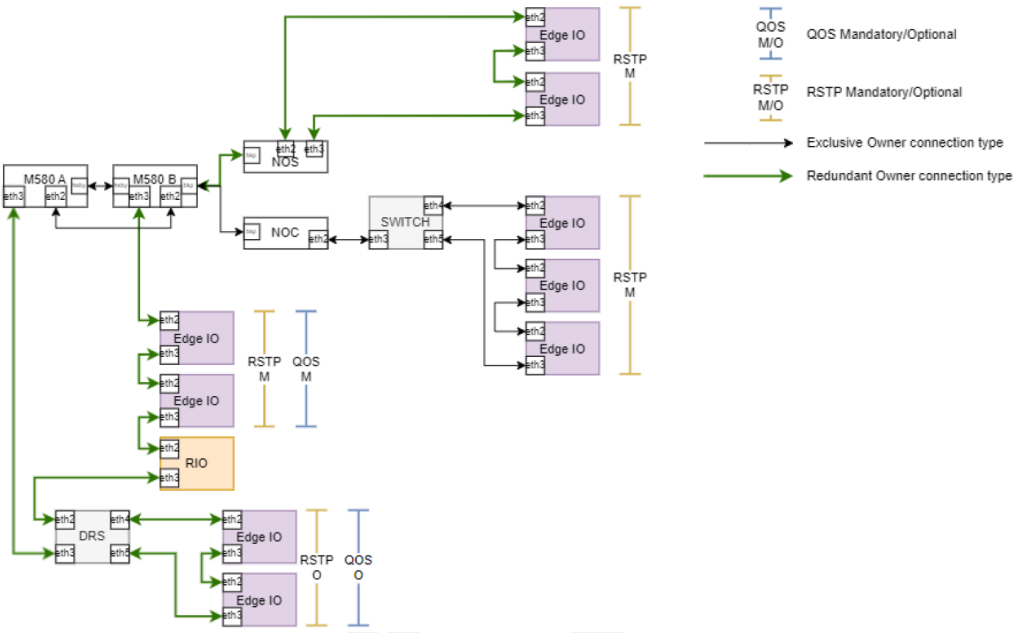
Introduction

This topic discusses frequently used M580 network topologies integrated with one or more Edge I/O islands.

- Standalone topology



- High-availability topology



For more information about these topologies, refer to the Modicon Edge I/O NTS System Planning and Installation Guide.

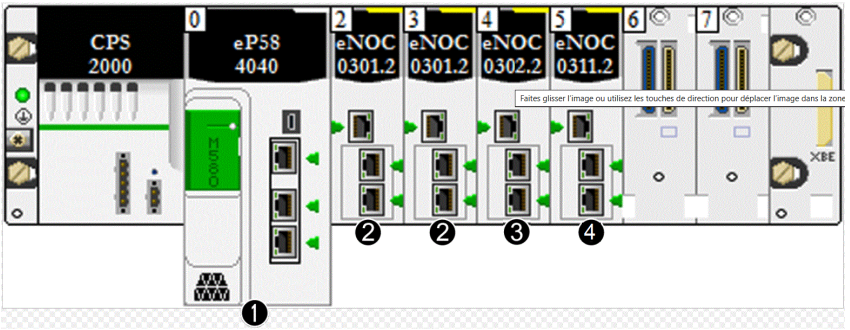
Installing a Communication Module on the Local Rack

Introduction

An M580 local rack, page 24 can contain one controller and up to six communication modules, including a maximum of four BMENOC0301(C)/BMENOC0311 Ethernetcommunication modules or six BMENOC0302(H) High performance Ethernet communication module and only one BMENOC0321(C) control network module. You can also use a maximum of three BMXNOM0200 Modbus communication modules.

NOTE: The maximum number of communication modules depends on your controller selection, page 75.

This sample local rack shows a BMEP584040 controller and four Ethernet communication modules:



1 M580 controller with Ethernet I/O scanner service

2 BMENOC0301(C) Ethernet communication module with standard Web services

3 BMENOC0302(H) High Performance Ethernet communication module with standard Web services

4 BMENOC0311 Ethernet communication module with FactoryCast Web services

The BMENOC0311 module has the capability and functionality of the BMENOC0301(C), plus access to FactoryCast services. For more information about these modules, refer to the *M580 BMENOC0301/11 Ethernet Communication Module Installation and Configuration Guide*.

For more information about BMENOC0302(H) module, refer to the *Modicon M580 BMENOC0302 High Performance Ethernet Communication Module Installation and Configuration Guide*.

For further details about other types of modules you can install, refer to the local rack topic, page 24.

Maximum Number of Communication Modules

This table shows the maximum number of communication modules you can install on the local rack, depending upon the controller you choose:

Controller	Maximum Number of Communication Modules(1)
BMEP581020	2
BMEP582020	2
BMEP582040	2
BMEP583020	3

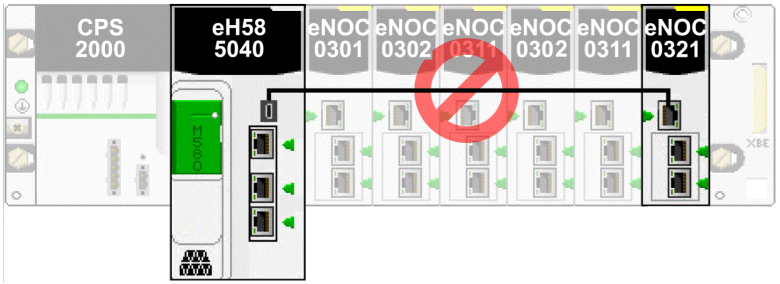
Controller	Maximum Number of Communication Modules(1)
BMEP583040	3
BMEP584020	4
BMEP584040	4
BMEP585040	6(2)
BMEP586040	6(2)
BMEH582040	2
BMEH584040	4
BMEH586040	6(2)

(1) This number includes BMENOC0301(C)/BMENOC0311/BMENOC0302(H), BMENOS0300, BMXNOM0200 modules.

(2) Only four of these modules can be BMENOC0301(C)/BMENOC0311 modules.

BMENOC0321(C) Module Interlink with the Controller

You **cannot** link the extended (service) port of a BMENOC0321(C) control network module to the embedded Ethernet port of the controller in the local rack:



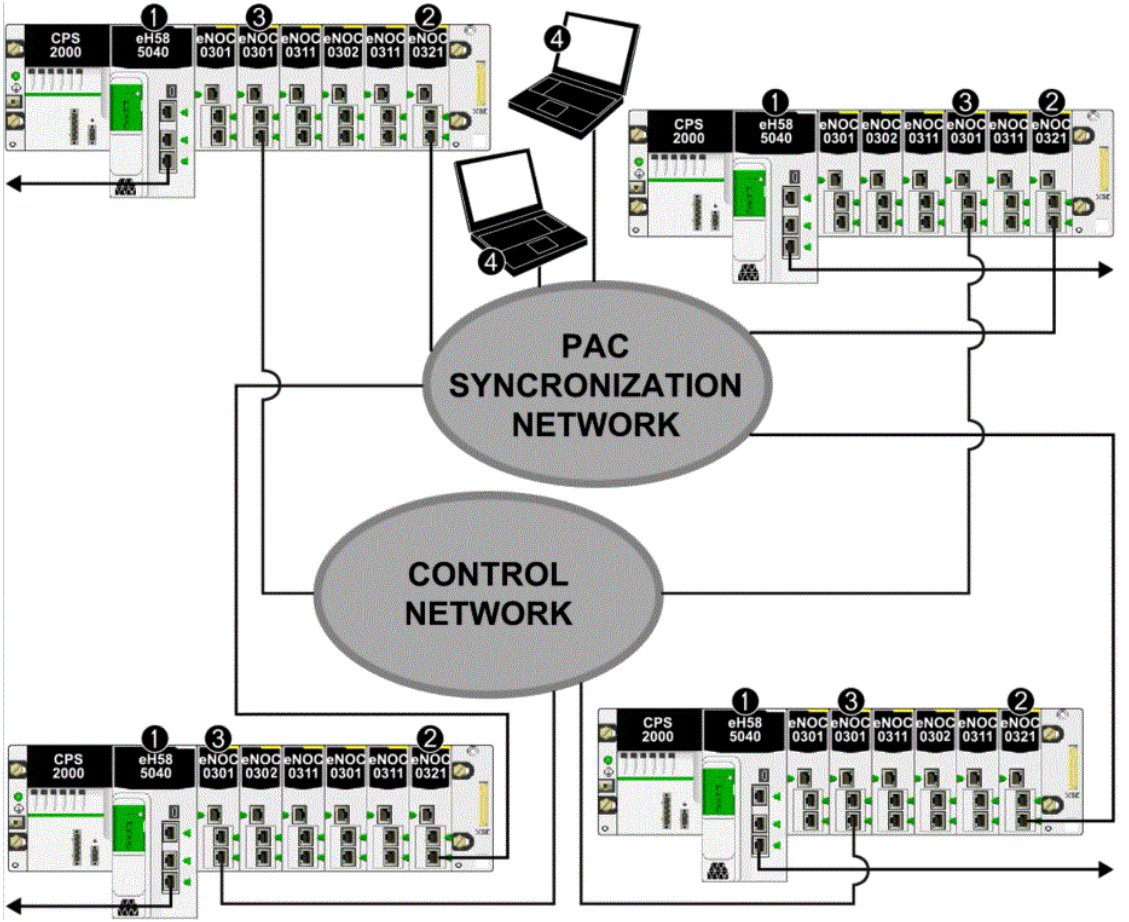
Multiple Local Racks for a Synchronization Network

You can use multiple local racks to create an isolated controller synchronization network (using messaging or scanning on an isolated DIO network (each controller managing its own device network and accessing a shared control network).

Each Ethernet local rack contains a controller with Ethernet I/O scanning and a maximum of six Ethernet communication modules, only four of which can be BMENOC0301(C)/ BMENOC0311modules or six BMENOC0302(H) modules.

The Ethernet backplane port of one of the BMENOC0301(C)/BMENOC0311/BMENOC0302 (H) modules is not enabled and connects to an isolated DIO network for the purpose of controller synchronization.

If you have multiple controllers that share the same network, you can perform controller synchronization through the BMENOC0321(C) control network module. However, if the controllers do not share the same network, perform controller synchronization in this manner:



1 BMEP585040 controller with Eternet I/O scanner service connecting to the device network

2 BMENOC0321(C) control network module connecting to the control network

3 BMENOC0301(C) Ethernet communication module connecting to the controller control network

4 PC monitoring station on the control network

Using Premium Racks in an M580 System

Introduction

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

Premium rack compatibility:

	Main Local Rack	Extended Local Rack	Main Remote Rack	Extended Remote Rack
TSX RKY ••EX(C) Premium	—	X	—	—

- X: allowed
- —: not allowed

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

NOTE: Refer to the Premium hardware user guide for detailed rack information (see Premium and Atrium using EcoStruxure™ Control Expert, Processors, racks and power supply modules, Implementation Manual).

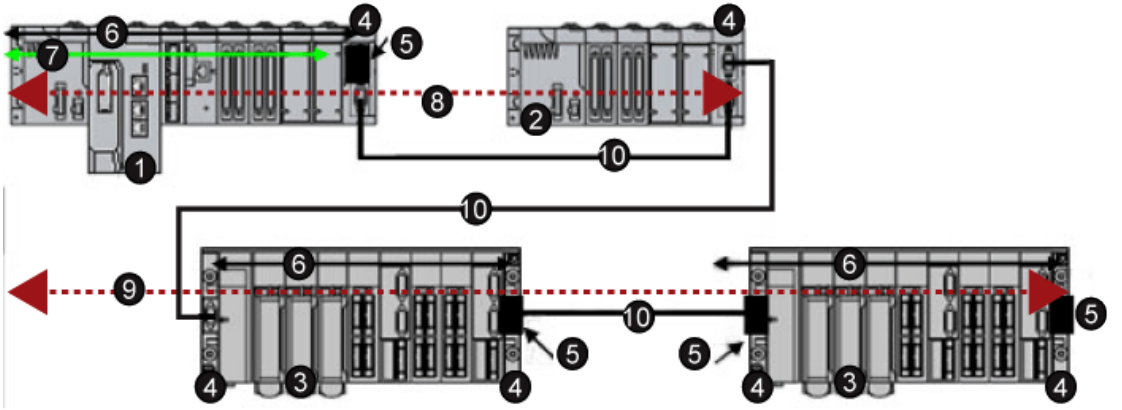
Installing Premium Racks

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

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

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

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



1 Modicon M580 main local rack

2 Modicon X80 extended local rack

3 Premium extended local rack

4 extension rack module

5 bus terminator module

6 X Bus connection on the rack

7 Ethernet connection on the rack

8 maximum X Bus cable length between the M580 main local rack (1) and the Modicon X80 extended local rack (2) is 30 m (98 ft)

9 maximum X Bus cable length between the M580 main local rack (1) and the Premium extended local rack (4) is 100 m (328 ft)

10 X Bus extension cable

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

Premium motion, communication, and safety-related modules are not supported.

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

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

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

Cable Installation

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

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

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

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

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

Follow all local and national safety codes and standards.

DANGER

ELECTRIC SHOCK

Wear personal protective equipment (PPE) when working with shielded cables when the grounding potential is unknown.

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

Maximum Rack Installation

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

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

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

Premium Analog and Digital Modules

Supported modules:

These Premium modules **are** supported in TSX RKY •EX Premium extended local racks in an M580 system:

Type of Module	Module
Analog I/O Modules	
input	TSX AEY 1600
input	TSX AEY 1614
input	TSX AEY 414
input	TSX AEY 420
input	TSX AEY 800
input	TSX AEY 810
output	TSX ASY 410
output	TSX ASY 800
terminal connector	TSX BLY 01
Digital I/O Modules	
input	TSX DEY 08D2
input	TSX DEY 16A2

Type of Module	Module
input	TSX DEY 16A3
input	TSX DEY 16A4
input	TSX DEY 16A5
input	TSX DEY 16D2
input	TSX DEY 16D3
input	TSX DEY 16FK
input	TSX DEY 32D2K
input	TSX DEY 32D3K
input	TSX DEY 64D2K
output	TSX DMY 28FK[1]
output	TSX DSY 08R4D
output	TSX DSY 08R5
output	TSX DSY 08R5A
output	TSX DSY 08S5
output	TSX DSY 08T2
output	TSX DSY 08T22
output	TSX DSY 08T31
output	TSX DSY 16R5
output	TSX DSY 16S4
output	TSX DSY 16S5
output	TSX DSY 16T2
output	TSX DSY 16T3
output	TSX DSY 32T2K
output	TSX DSY 64T2K
Special Purpose Modules	
counting	TSX CTY 2A
	TSX CTY 4A
weighing	TSX ISPY 101
safety-related module (12I 2Q 24VDC)	TSX PAY 262

Type of Module	Module
safety-related module (12I 4Q 24VDC)	TSX PAY 282
[1] The task for this module is defined for eight consecutive channels. In an M580 configuration, assign all the outputs to the same task or the four last outputs are not applied.	

NOTE: Communication, specific counting, discrete, motion, remote X Bus, and specific safety-related modules **are not** supported, as noted in the following table.

Unsupported modules:

These Premium modules **are not** supported in TSX RKY •EX Premium extended local racks in an M580 system

Type of Module	Module
communication	TSX ESY 007
	TSX ETC 100
	TSX ETC 101
	TSX ETC 101.2
	TSX ETY 110
	TSX ETY 120
	TSX ETY 4103
	TSX ETY 5103
	TSX IBX 100
	TSX IBY 100
	TSX PBY 100
	TSX SAY 100
	TSX SAY 1000
	TSX SCY 11601
	TSX SCY 21601
	TSX WMY 100
counting	TSX CCY 1128
	TSX CTY 2C
discrete	TSX DMY 28RKF
motion	TSX CAY 21 / 22 / 33 / 41 / 42
	TSX CFY 11 / 21
	TSX CSY 84 / 85 / 164 / 164 Advanced
remote X Bus	TSX REY 200

Type of Module	Module
safety-related modules	XPS-MC16
	XPS-MC32
	XPS-MF40

NOTE: Refer to the Premium discrete (see Premium and Atrium using EcoStruxure™ Control Expert, Discrete I/O modules, User Manual) and analog (see Premium and Atrium using EcoStruxure™ Control Expert, Analog Input/Output Modules, User Manual) I/O user guides for detailed module information.

Using Fiber Converter Modules

Introduction

The BMXNRP020• fiber converter module is an alternative method to using a DRS to provide fiber optic communications in an M580 system.

NOTE: To use a dual-ring switch (DRS) to connect distributed equipment to the M580 network, refer to the M580 Complex Topologies, System Guide.

You can install BMXNRP020• fiber converter modules on extended local racks and RIO drops to:

- Extend the total length of the M580 network when you have Ethernet RIO drops in separate areas of a factory that are more than 100 m apart.
- Improve noise immunity
- Resolve possible grounding issues when using different grounding methods is required between 2 sites.

When installing modules with fiber optic transceivers, take measures to help prevent dust and pollution from disrupting light production in the fiber optic cable.

NOTICE

COMMUNICATIONS INTERRUPTIONS

- Keep caps on jumpers and transceivers when not in use.
- Insert the optical cable into the transceivers carefully, respecting the longitudinal axis of the transceiver.
- Do not use force when inserting the cable into the transceivers.

Failure to follow these instructions can result in equipment damage.

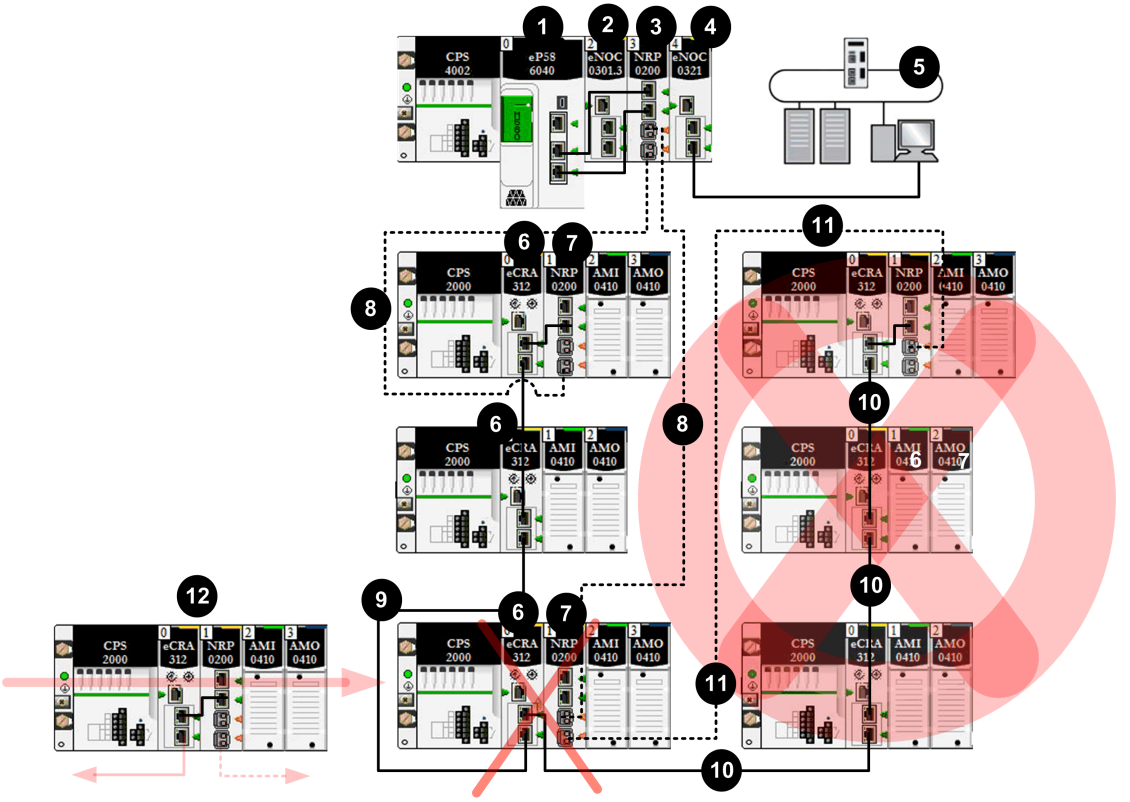
This table describes the BMXNRP020• fiber modules:

Module	Fiber Type	Use for distances...
BMXNRP0200	multi-mode	less than 2 km
BMXNRP0201	single-mode	up to 15 km

NOTE: Confirm that you connect the fiber and copper cable to the correct ports on the BMXNRP020• module. Refer to the *BMX NRP 020• M340/X80 NRP Module User Guide* for details.

NOTE: You can install BMXNRP020• modules on the main ring and sub-rings for copper-to-fiber transitions. However, you cannot use these modules to connect sub-rings **to** the main ring.

You **cannot** use BMXNRP020• modules to connect sub-rings to the main ring:



- - - - fiber cable

—— copper cable

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

2 BMENOC0301 module on the local rack, managing distributed equipment on the EIO network

3 BMXNRP0200 fiber converter module on the local rack

4 BMENOC0321 module on the local rack, providing transparency between the EIO network and the control network

5 control network

6 BM•CRA312•0 X80 EIO adapter module connecting an RIO drop to the main ring

7 BMXNRP0200 module on an RIO drop connected to the main ring via fiber cable to extend the distance between the RIO drop and the local rack

8 fiber cable portion of the main ring

9 copper cable portion of the main ring

10 **invalid** copper connection from a BM•CRA312•0 module on an RIO drop on the main ring to an RIO sub-ring

11 **invalid** fiber connection from a BMXNRP0200 module on an RIO drop on the main ring to an RIO sub-ring. You **cannot** use a BMXNRP020• module to connect a sub-ring to the main ring.

12 The BM•CRA312•0 module on this valid RIO drop is connected to the main ring via copper cable from the BM•CRA312•0 module and via fiber cable from the BMXNRP020• module. The BM•CRA312•0 module and the BMXNRP020• module are interlinked.

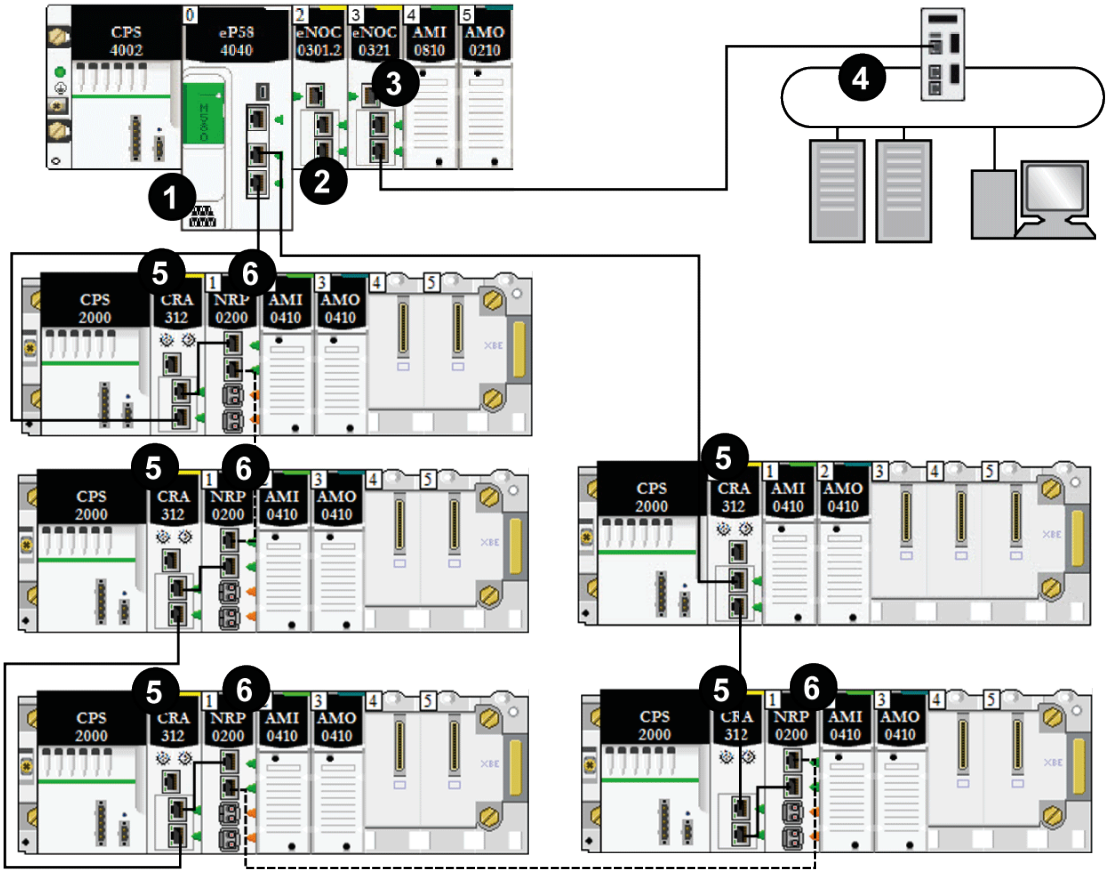
Extending Distance Between the Local Rack and an RIO Drop

The procedures for installing fiber between the local rack and a remote drop were described earlier in this manual, page 74.

The procedure for installing fiber between contiguous drops in an RIO network are described as well, page 74.

Interlinking BMXNRP020• Modules on X Bus Racks

For a system that uses X Bus racks (not Ethernet racks), interlink the copper ports of a BMXNRP020• module with the Ethernet ports of a BM•CRA312•0 X80 EIO adapter module on RIO drops:



- - - - fiber cable (used for distances greater than 100 m)

—— copper cable (used for distances less than 100 m)

1 An M580 controller with Ethernet I/O scanner service on the local rack.

2 A BMXNRP0200 module on a Modicon X80 rack converts copper cable to fiber for distances greater than 100 m.

3 A BMENOC0321 module on the local rack provides transparency between the EIO network and the control network.

4 (e)X80 drops are connected to the main ring via copper and fiber cable. BM•CRA312•0 (s)X80 EIO adapter modules connect the drops via copper cable, and BMXNRP0200 modules connect the drops via fiber cable.

5 (e)X80 drops are connected to the main ring via fiber cable using a BMXNRP0200 module.

6 (e)X80 drops are connected to the main ring via copper cable.

Diagnosing Fiber Converter Modules

To diagnose the BMXNRP020• fiber converter modules, refer to the *BMX NRP 0200/0201 M340/X80 Fiber Converter Module User Guide*.

Connecting an M580 Device Network to the Control Network

Introduction

You can connect a device network to the control network through the service port (see Modicon M580, Hardware, Reference Manual) on an M580 controller.

Do not connect the service port to the device network unless in some specific conditions described in *Modicon M580, Open Ethernet Network, System Planning Guide*.

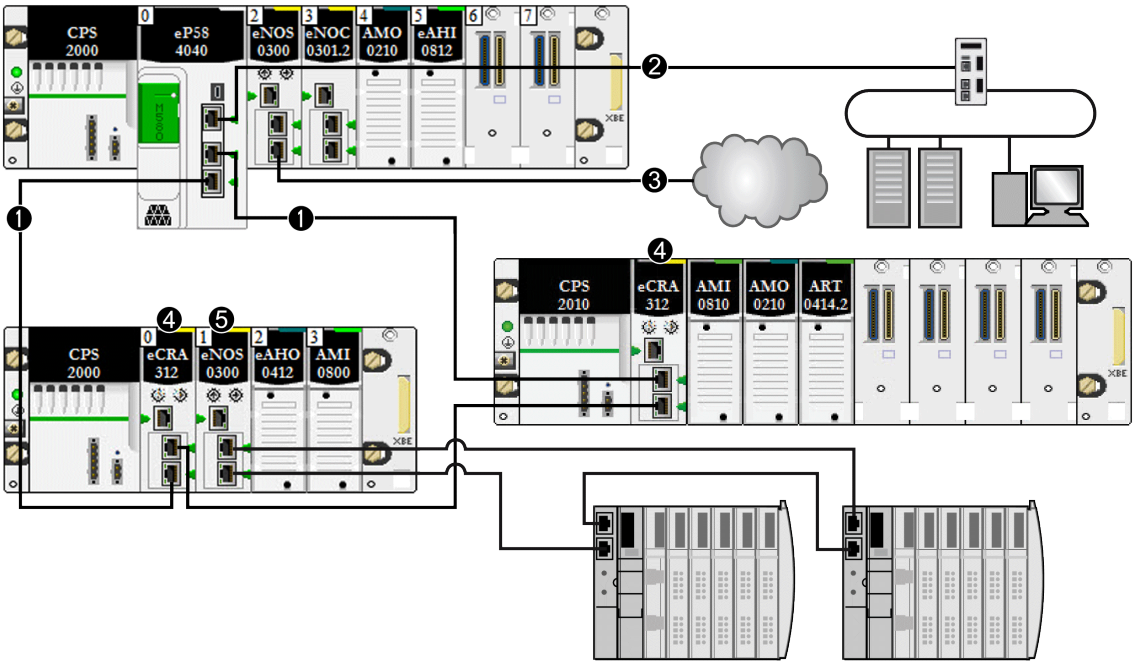
The service port may not provide full performance and features that the Device Network ports on the controller provide. Connecting the service port, either directly or through a switch/hub, to the device network may affect system performance.

You may connect additional devices to the device network using a BM•CRA312•0 EIO adapter module.

NOTE: Do not connect the service ports on different controllers together through the control network.

- If Ethernet transparency is needed between a device network and the control network, make the connection with a switch as shown in the following figure.
- If Ethernet transparency is not needed, use a BMENOC0301 / BMENOC0311/ BMENOC0302(H) Ethernet communication module and configure the module in isolated mode, page 79.

Connect an M580 system to a control network through the service port of the controller to support monitoring and communication with the device network:



1 The M580 controller is connected to the main ring. The controller manages RIO drops within the device network.

2 The service port of the controller is connected to a control network.

3 This BMENOC0301 module (with the Ethernet backplane connection enabled) manages an isolated DIO cloud.

4 RIO drops are connected to the main ring through BM•CRA312•0 X80 EIO adapter modules.

Assigning different network devices the same device name can lead to a conflict when a device receives its configuration and IP address from a DHCP server.

⚠WARNING
UNINTENDED EQUIPMENT OPERATION In a system with multiple RIO networks, do not assign the same device name to more than one device. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

In a system with multiple RIO networks, each with its own DHCP server, assigning the same device name to equipment on different RIO networks can cause a conflict when DHCP servers assign device configurations - including IP addresses.

For example, if communications adapter on an RIO drop (DROP_1) is configured via its rotary switch with the name BMECRA001 and a second communications adapter on another RIO drop (also named DROP_1) is configured with the same name (BMECRA001), there is a potential conflict. As a consequence, a DHCP server can send a device configuration and IP address assignment to the incorrect drop.

Performance

What's in This Chapter

System Performance 109
Application Response Time 114
Communication Loss Detection Times..... 124

Introduction

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

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.

System Performance

Memory Consumption

Input and output memory specification:

Scope	Type	Maximum Value per Task*
M580 controller	input bytes per device	up to 32,768, depending on controller reference
	output bytes per device	up to 24,576, depending on controller reference
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 controller reference
	output Kbytes	up to 4, depending on controller reference
** 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 controller 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* controller reference 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 controller can process in a single scan. Design your M580 system so that the controller 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 controller 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 controller with Ethernet I/O scanner service	1
BMENOC0301(C)/BMENOC0311 Ethernet communication module	4(1)
BMENOC0302(H) High performance Ethernet communication Module	6
BMENOS0300 network option switch module	4(1)
BMENOC0321(C) control network module	1
BMXEIA0100 AS-interface module	4(2)
BMXNOR0200 Ethernet communication module	3(1, 2)

Device	Maximum per Rack
BMXNOM0200 Modbus communication module	4(1, 2) (see note below)
(1) A local rack contains an M580 controller with Ethernet I/O scanner service and a maximum of six communication modules, depending upon the controller you choose, page 75. (Only four of these communication modules can be BMENOC0301/311 modules.) While the M580 controllers and BMENOC0301 / BMENOC0311 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 controllers, refer to the controller selection table, page 75. (2) Not supported in local racks in M580 Hot Standby systems.	

Each controller 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 controller reference

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

Data Type	Maximum Capacity
input data	up to 4,000 bytes, depnding on controller reference
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 controller 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 controller 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 controller 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 controller MAST will over run.

By using the formulas (set forth below) to compute a minimum MAST time for your system, you can help 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 controller 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

Application Response Time

Introduction

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

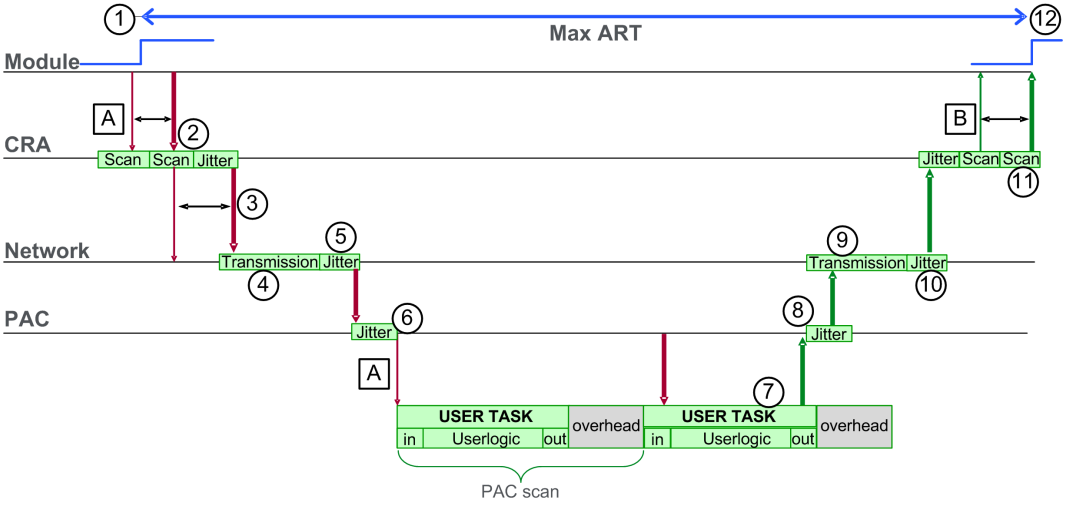
Simplified Presentation of Application Response Time

Introduction

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

Overview: ART Computation Parameters

The following diagram displays ART-related events and computation parameters. Refer to the *Design Principles of M580 Networks* appendix, page 152 for details.



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

Legend:

A	missed input scan	6	controller input jitter
B	missed output scan	7	operation of application logic (1 scan)
1	input turns ON	8	controller 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

Estimation of ART

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

- CRA->Scanner RPI

- 2 * controller_Scan (for the task)
- 8.8 ms (a constant value representing the maximum CRA processing time)

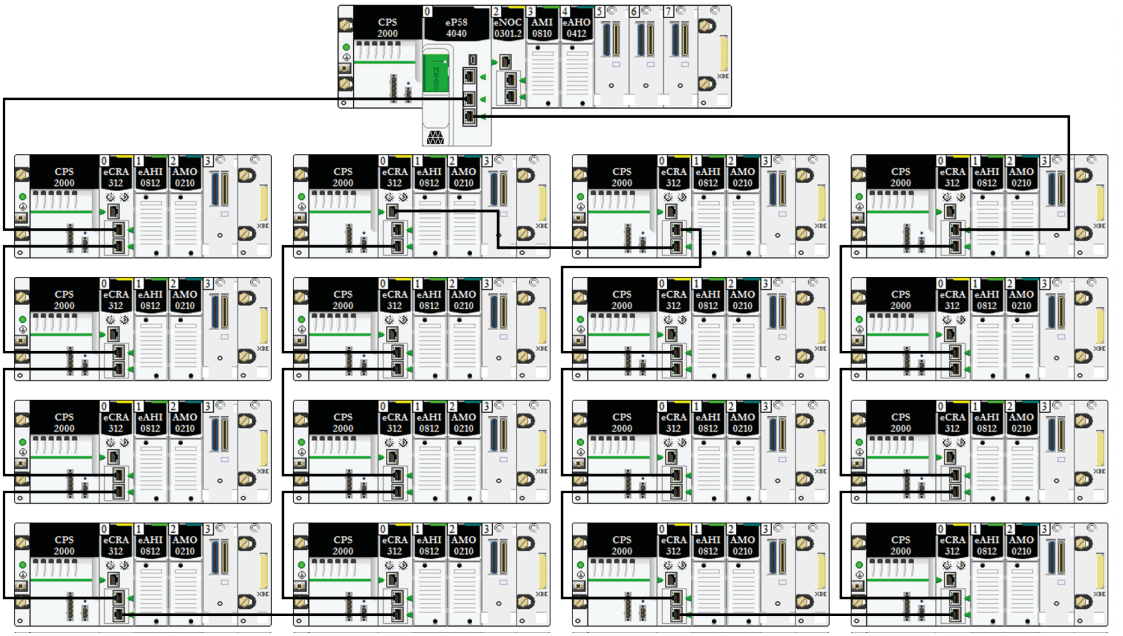
NOTE: Because the FAST task has highest priority, the ART for the FAST task is not impacted by other tasks.

ART considerations:

multitasking	The above calculation is valid for each task. However, in a multitasking situation, the controller_Scan time may be increased due to higher-priority tasks. If the MAST task is combined with the FAST task (multitasking), the controller_Scan for the MAST task may be increased significantly. The result of multitasking can be a much longer ART for the MAST task.
Hot Standby	Refer to the *Modicon M580, Hot Standby Frequently Used Architectures, System Guide* to calculate ART for Hot Standby controllers (see Modicon M580 Hot Standby Frequently Used, System Guide).
broken cable	If a cable break occurs or a cable is reconnected on the network, add an additional time period to the above ART calculation to allow for RSTP recovery. The additional time to be added equals: 50 ms + CRA->Scanner RPI.

Simplified Computation of ART for Simple Daisy Chain Loop of BM•CRA312•0 Adapter Modules in a Main Ring

This example calculates the ART from the perspective of sixteen BM•CRA312•0 X80 EIO adapter modules that are connected to the controller on the local rack through the main ring:



Recall that the formula to estimate the maximum ART is:

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

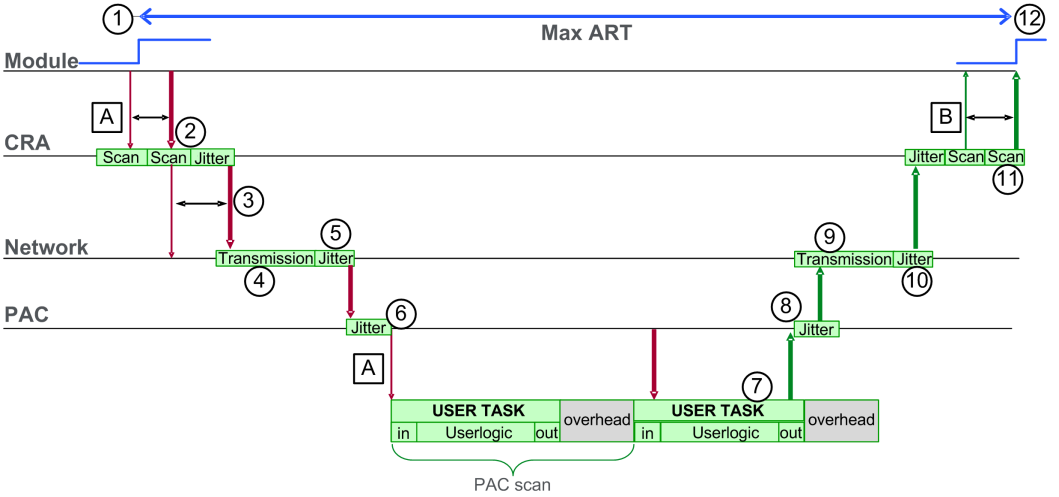
Thus, for a task with a scan time of 40 ms and a CRA->Scanner RPI of 25 ms, maximum ART is:

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

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, page 152 for details.



A: missed input scan	6: controller input jitter
B: missed output scan	7: operation of application logic (1 scan)
1: input turns ON	8: controller 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)	–	controller task. Default = 0.5 * controller period if MAST is in periodic mode. If MAST is in cyclic mode, the default value is watchdog/4).

<table>
<tr><th>ID</th><th>Parameter</th><th>Maximum value (ms)</th><th colspan="2">Description</th></tr>
<tr><td rowspan="9">4</td><td rowspan="9">network input time[2] (Network_In_Time)</td><td rowspan="9">2.496 (0.078 * 32)
NOTE: The value 2.496 ms is based upon a packet size of 800 bytes and 32 hops[1].</td><td colspan="2">The product of (network delay based on I/O packet size) * (the number of hops[1] the packet travels). The network delay component can be estimated as follows:</td></tr>
<tr><td>I/O packet size (bytes):</td><td>Estimated network delay (µs):</td></tr>
<tr><td>128</td><td>26</td></tr>
<tr><td>256</td><td>35</td></tr>
<tr><td>400</td><td>46</td></tr>
<tr><td>800</td><td>78</td></tr>
<tr><td>1200</td><td>110</td></tr>
<tr><td>1400</td><td>127</td></tr>
<tr><td>5</td><td>network input jitter (Network_In_Jitter)</td><td>6.436 ((30 * 0.078) + (32 * 0.128))
NOTE: This value is based on a packet size of 800 bytes for RIO drops and 1500 bytes for DIO traffic.</td><td colspan="2">formula: ((number of RIO drops) * (network delay)) + ((number of distributed equipment hops[1]) * network delay)</td></tr>
<tr><td>6</td><td>controller input jitter (CPU_In_Jitter)</td><td>5.41 (1 + (.07 * 63))</td><td colspan="2">controller input queue delay (owing to RIO drops and DIO traffic)</td></tr>
<tr><td>7/8</td><td>controller scan time (CPU_Scan)</td><td>–</td><td colspan="2">This is the user defined Control Expert scan time, which can be either fixed or cyclic.</td></tr>
<tr><td>9</td><td>controller output jitter (CPU_Out_Jitter)</td><td>2.17 (1 + (0.07 * 31))</td><td colspan="2">controller output queue delay.</td></tr>
<tr><td>10</td><td>network output time[2] (Network_Out_Time)</td><td>2.496</td><td colspan="2">See calculation above for Network_In_Time.</td></tr>
<tr><td>11</td><td>network output jitter (Network_Out_Jitter)</td><td>4.096 (32 * 0.128)</td><td colspan="2">Calculate in the same manner as Network_In_ Jitter without I/O frames from RIO drops.</td></tr>
<tr><td>12</td><td>CRA drop process time (CRA_Drop_Process)</td><td>4.4</td><td colspan="2">The sum of CRA queue delay and output scan time.</td></tr>
<tr><td colspan="5">1. A hop is a switch that a packet passes through on the path from a source (transmitting) device to a destination (receiving) device. The total number of hops is the number of passthrough switches along the path.

2. Network input and output times may be increased when optical fiber is used.

increase = total length of fiber cables * 0.0034 ms/km</td></tr>
</table>

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 controller scan time (controller_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 + controller_Scan/2.

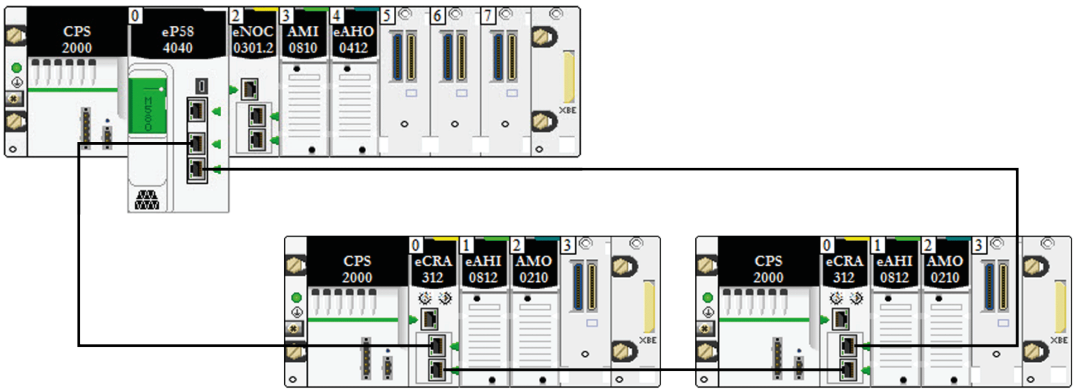
Application Response Time Examples

Introduction

The following examples are designed to help you calculate the application response time (ART) for an application.

Example: controller with Ethernet I/O Scanner Service in a Main Ring

In this example of an RIO main ring, the local rack contains a controller with Ethernet I/O scanner service. The ART is calculated from the perspective of either of the BM•CRA312•0 X80 EIO adapter modules that are associated with the MAST task in the RIO main ring:



This ART value is calculated from the perspective of the adapter module in the either of the RIO drops. Consider these application-specific elements when calculating ART:

- The maximum potential hop count is 3, which represents the maximum number of switches a packet might pass through from the adapter module to the controller with Ethernet I/O scanner service in the local rack.

  NOTE: The hop count includes all switches located along the route between the source input module and the controller, including the switches embedded in the BM•CRA312•0 X80 EIO adapter module.

- Jitter is introduced into the system only from the two main ring drops.

Given these factors, ART computation parameters include:

Parameter	Maximum value (ms)	Comments
BM•CRA312•0 process time (CRA_Drop_Process)	4.4	The sum of BM•CRA312•0 input scan time and queue delay.
BM•CRA312•0 input RPI (RPI)	–	User defined. Default = 0.5 * CPU period.
network input time (Network_In_Time)	(0.078 * 3) = 0.234	Hop-count is 3 from the BM•CRA312•0 X80 EIO adapter module in the RIO drop (3) to the controller with Ethernet I/O scanner service in the local rack (1), which includes the switches in both the BM•CRA312•0 X80 EIO adapter module and the controller with Ethernet I/O scanner service.
network input jitter (Network_In_Jitter)	(0.078 * 2) = 0.156	For delay occasioned by devices (2) and (3).
controller Ethernet I/O scanner service input jitter (CPU_In_Jitter)	(1 + (0.07 * 2)) = 1.14	To read packet
controller scan time (CPU_ Scan)	–	User defined, based on application.
controller Ethernet I/O scanner service output jitter (CPU_Out_Jitter)	1.21	controller Ethernet I/O scanner service internal queue delay
network output time (Network_Out_Time)	(0.078 * 3) = 0.234	Hop-count is 3 from the BM•CRA312•0 X80 EIO adapter module in the RIO drop (4) to the controller with Ethernet I/O scanner service in local rack (2), which includes the switches in both the BM•CRA312•0 X80 EIO adapter module and the controller with Ethernet I/O scanner service.
network output jitter (Network_Out_Jitter)	0	Does not apply. No distributed equipment is connected to the RIO network.
BM•CRA312•0 process time (CRA_Drop_Process)	4.4	The sum of the BM•CRA312•0 X80 EIO adapter module output scan time and queue delay
For an explanation of each parameter, refer to the ART Computation Parameters topic, page 118.		

Recall that the ART formula is:

ART= (2*CRA_Drop_Process) + (RPI) + (Network_In_Time) + (Network_In_Jitter) + (CPU_In_Jitter) + (2*CPU_Scan) + (CPU_Out_Jitter) + (Network_Out_Time) + Network_Out_Jitter)

Thus, for a controller scan time of 50 ms and RPI of 25 ms, maximum ART is:

max ART = (2*4.4) + 25 + 0.234 + 0.156 + 1.14 + (2*50) + 1.21 + 0.234 = 136.774 ms

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 controller with Ethernet I/O scanner service.

In addition, you can further reduce ART by using the FAST task in your Control Expert logic.

Reducing the Number of RIO Drops

When you reduce the number of RIO drops in your system, you also reduce:

- the number of hops that a packet passes through from an RIO drop to the controller with Ethernet I/O scanner service in the local rack
- the number of packets received by the controller 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
- controller with Ethernet I/O scanner service
- controller 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).

Communication Loss Detection Times

Introduction

An M580 system can detect the existence of communication loss in the following ways:

- a cable that is broken or detached, which is detected by both a controller with Ethernet I/O scanner service and a BM•CRA312•0 X80 EIO adapter module
- a BM•CRA312•0 module that has stopped communicating, which is detected by a controller with Ethernet I/O scanner service
- a controller with Ethernet I/O scanner service that has stopped communicating, which is detected by a BM•CRA312•0 module

The time required by the system to detect each type of communication loss is described on the following pages.

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 controller with Ethernet I/O scanner service and a BM•CRA312•0 (e)X80 EIO adapter module
- a controller with Ethernet I/O scanner service detects that a BM•CRA312•0 module has stopped communicating.
- a BM•CRA312•0 module detects that a controller 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 controller 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 controller 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 controller 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) + (controller scan time), where:

- MAST period / 2 = RPI for the MAST task
- RPI = the input refresh rate from the BM•CRA312•0 module to the controller
- 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*.

Controller 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 controller with Ethernet I/O scanner service within the time defined by the following formula:

Detection time = (xMultiplier x MAST period / 2) + (controller scan time), where:

- MAST period / 2 = the output refresh rate from the controller 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

M580 System Commissioning and Diagnostics

What's in This Part

Commissioning..... 128
System Diagnostics 137

Introduction

This part describes M580 system commissioning and diagnostics.

Commissioning

What's in This Chapter

Setting the Location of the Ethernet RIO Drop 128
Powering Up Modules Without a Downloaded Application 129
Downloading Controller Applications 130
Establishing Transparency between a USB and Device Network 133
Initial Start After Application Download 134
Powering Down/Powering Up Modules 135
Starting and Stopping an Application 135

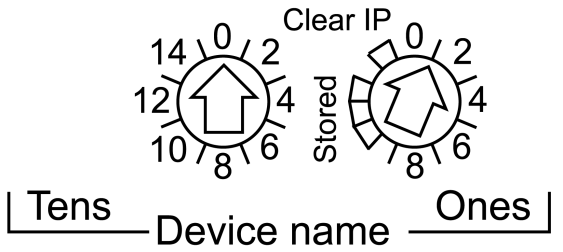
Overview

This chapter describes the commissioning process in an M580 system.

Setting the Location of the Ethernet RIO Drop

Setting Rotary Switches

Set the location of the Ethernet RIO drop on the network with the rotary switches on the front of the BM•CRA312•0 X80 EIO adapter module before you apply power to the module and before you download the application:



The values you set are applied during a power cycle. If you change the switch settings after the module has powered up, the Mod Status LED is activated and a mismatch message is logged in the module diagnostic.

Because new values on the rotary switches are implemented only at the next power cycle, set the value before starting the module. (Valid values: 00 ... 159)

The values on the rotary switches combine with the device prefix (for example, BMECRA_*xxx* or BMXCRA_*xxx*) to create the device name (where *xxx* represents the value of the rotary switches). The preceding figure shows the Tens switch set to 0 and the Ones switch set to 01, for a device name of BMECRA_001.

NOTE:

- The rotary switches can be manipulated with a small flat-tipped screwdriver.

  NOTE: Use only the small, plastic screwdriver that ships with the module to change the switch position.
- No software is required to configure or enable the rotary switches.
- Do not use the Stored and Clear IP settings on the Ones rotary switch. (The functionality of these settings does not apply to RIO installations.)

Powering Up Modules Without a Downloaded Application

BMEP58•040 IP Address

In the absence of a valid application, a controller with Ethernet I/O scanner service uses the IP address that is based on the MAC address printed on the front of the module. You can configure the IP address in Control Expert as detailed in the *Modicon M580 Remote I/O Modules Installation and Configuration Guide* when you have downloaded an application.

BM•CRA312•0 IP Address

In the absence of an application, the BM•CRA312•0 X80 EIO adapter module unsuccessfully requests an IP address from a controller with Ethernet I/O scanner service. The adapter module then derives an IP address from the MAC address printed on the front of the module. The module continues in this cycle because it does not have a valid configuration. This `Not Configured` state is indicated by the LED display on the front of the module. There are no exchanges with the controller. Physical outputs of I/O modules in the RIO drops are in the fallback state (output set at 0).

Downloading Controller Applications

Connecting to EcoStruxure Control Expert

To download the controller application if your system **is not** configured, connect EcoStruxure Control Expert to one of these:

- the USB port on the controller module
- the service port on the controller module

To download the controller application if your system **is** configured, connect EcoStruxure Control Expert to one of these:

- the USB port on the controller module
- the service port (configured as an access port) on the controller module or any network module
- the service port on a BM•CRA312•0 X80 EIO adapter module or an RIO drop on the main ring or a sub-ring

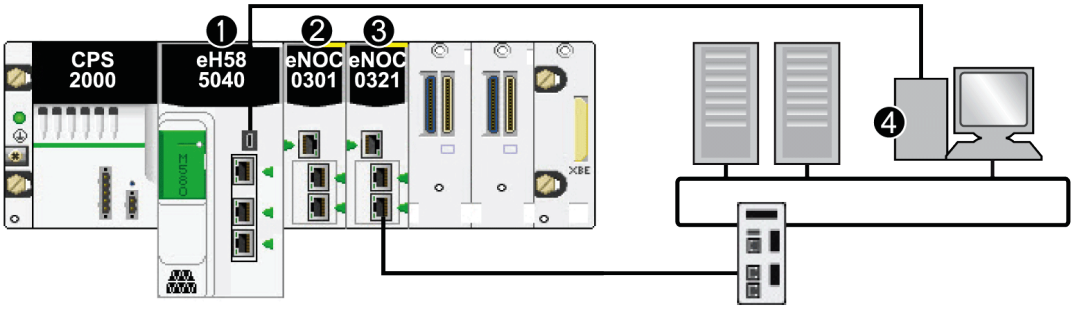
NOTE: To connect EcoStruxure Control Expert through the dual port on the controller or NOC module, configure the QoS setting on the switch that is connected to the PC.

NOTE:

- EcoStruxure Control Expert is the only tool that can download the controller application.
- If EcoStruxure Control Expert is connected to a controller that has no configuration, the default IP address of the controller is used.
- In configurations that use the IP forwarding service (the BMENOC0321(C) control network module bridging the control network to the device network via a BMENOC0301(C)/BMENOC0311/BMENOC0302(H) communication module), use the BMENOC0321(C) module's IP address to download the EcoStruxure Control Expert application to the controller.

NOTE: In configurations that use the IP forwarding service (the BMENOC0321(C) control network module bridging the control network to the device network via a BMENOC0301(C)/BMENOC0311/BMENOC0302(H) communication module), use the IP address of the BMENOC0321(C) module to download the EcoStruxure Control Expert application to the controller.

If you download the application via a BMENOC0301(C)/BMENOC0311/BMENOC0302(H) module, the BMENOC0321(C) module resets at the end of the download, which resets the connection between EcoStruxure Control Expert and the BMENOC0301(C)/BMENOC0311/BMENOC0302(H) module. This figure shows the use of the IP forwarding service in the BMENOC0301(C)/BMENOC0311/BMENOC0302(H) module to connect to the BMENOC0301(C)/BMENOC0311/BMENOC0302(H) module:



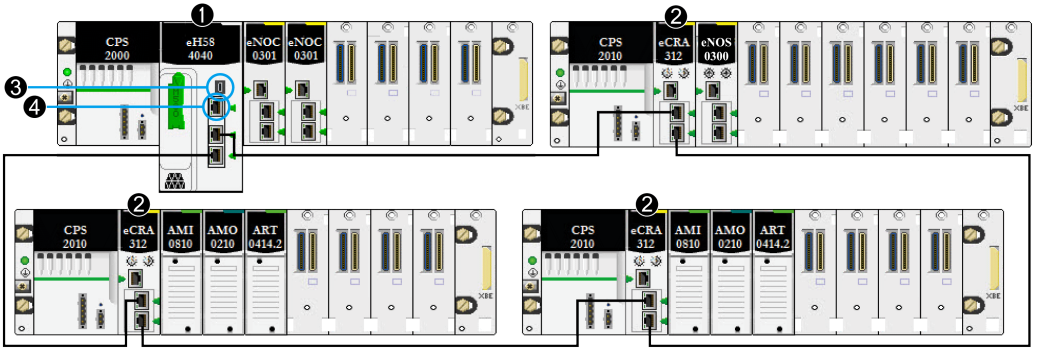
1. A controller module with the Ethernet I/O scanning service is on the local rack.
2. A BMENOC0301(C) Ethernet communication module is on the local rack.
3. A BMENOC0321(C) control network module on the local rack connects to the control network.
4. EcoStruxure Control Expert runs on a PC in the control network.

NOTE:

- EcoStruxure Control Expert is the only tool that can download the controller application.
- You can connect EcoStruxure Control Expert to any Ethernet port.
- If EcoStruxure Control Expert is connected over Ethernet to a controller that has no configuration, the IP address of the controller is used.

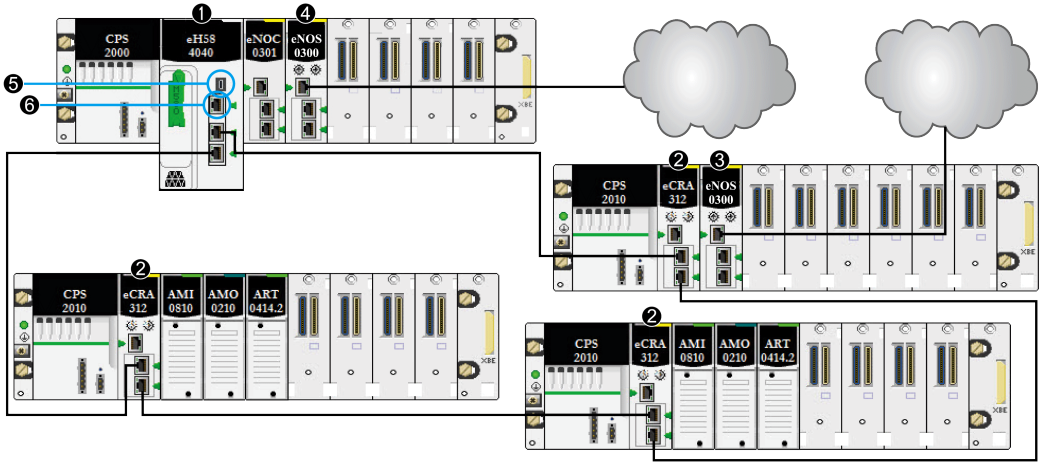
Examples

This figure shows the possible connections to EcoStruxure Control Expert when your system **is not** configured:



1. A controller runs the Ethernet I/O scanner service from the local rack.
2. Each RIO drop includes an BM•CRA312•0 X80 EIO adapter module.
3. Connect EcoStruxure Control Expert to the USB port on the controller module.
4. Connect EcoStruxure Control Expert to the SERVICE port on the controller module.

This figure shows the possible connections to EcoStruxure Control Expert when your system **is** configured:



1. A controller runs the Ethernet I/O scanner service from the local rack.
2. An RIO drop includes a BM•CRA31210 X80 EIO adapter module.
3. A BMENOS0300 module on a remote drop manages a DIO cloud.
4. A BMENOS0300 module on the local rack manages a DIO cloud.
5. Connect EcoStruxure Control Expert to the USB port on the controller.
6. Connect EcoStruxure Control Expert to the SERVICE port on the controller.

Establishing Transparency between a USB and Device Network

If your M580 system requires transparency between the PC connected to the controller's USB port (see Modicon M580, Hardware, Reference Manual) and the device network, add a persistent static route in the PC routing table.

Example of a command to address a device network with the IP address `x.x.0.0` (for Windows):

```
route add x.x.0.0 mask 255.255.0.0 90.0.0.1 -p
```

Initial Start After Application Download

Reading the Configuration

At the end of the application download, the controller configures all modules on the local rack. The controller's Ethernet I/O scanner service reads from the controller memory to get the configuration of the RIO drops declared in the Control Expert configuration. The configuration of the RIO drops is used to configure the FDR server in the controller.

At power up, each BM•CRA312•0 X80 EIO adapter module gets an IP address from the controller's DHCP server. Then it reads its configuration from the FDR server in the controller. Finally, the controller's Ethernet I/O scanner service initializes the configured I/O modules in the rack.

NOTE: Verify that the IP address on each piece of distributed equipment is correct and unique before initial start.

NOTE: If the BM•CRA312•0 module is powered up first, the IP address is derived from the MAC address printed on the front of the module. The adapter module then performs checks to see if a DHCP server becomes available to distribute an IP address.

The RUN Command

Before receiving a RUN command from the controller, all RIO drops are configured and connected to the controller with Ethernet I/O scanner service. The RUN LEDs on the BM•CRA312•0 modules blink to indicate that the controller is in the STOP state. In the RIO drops, the physical outputs remain in the fallback state (output set to 0). Input values in the controller memory image are interpreted as 0.

When the controller is in RUN state, RIO drops change from the STOP to the RUN state. The LEDs on the BM•CRA312•0 module indicate this change. Output data received from the controller are applied to physical outputs. Input images in the controller are updated with physical inputs.

NOTE: For local I/O in the controller or extended rack and for Premium I/O, there is no change in the comparison with previous versions of controllers.

Powering Down/Powering Up Modules

Warm Restart

In a power-up sequence, the BM•CRA312•0 X80 EIO adapter module performs a complete reconfiguration. (There is no backup memory in the BM•CRA312•0 module for saving the configuration.)

A warm start occurs when, after a condition-generated shutdown, the system resumes and the programs running on that system continue at the point they were at when the shutdown occurred. No data is lost in a warm start as long as the controller contains a valid configuration. When a warm start occurs in RUN mode, there is no requirement to re-execute the application program, even if there are detected errors on the RIO system (the controller with Ethernet I/O scanner service, the BM•CRA312•0 module, or I/O modules are absent or inoperable).

After the controller's Ethernet I/O scanner service restarts, it reads from the controller memory to get the configuration of RIO drops declared in the Control Expert configuration. The BM•CRA312•0 modules get the latest configuration.

Starting and Stopping an Application

Controller Transitions

Controller commands that change states:

Command	Description
`STOP CPU`	Controller tasks go to the STOP state.
`RUN CPU`	Controller tasks go to the RUN state.
`RUN Task`	The relevant tasks and the controller go to the RUN state.
`STOP Task`	The relevant task goes to the STOP state. The controller goes to the STOP state if this task was the last task in the RUN state.

NOTE:

- When the controller switches from RUN to STOP, the output modules in RIO drops associated with this task go to the configured fallback state. Input values associated with this task in the controller memory image are interpreted as 0.
- When the controller switches from STOP to RUN, data received from the controller are applied to the physical outputs associated with this task. Input images in the controller are updated with physical inputs associated with this task.
- Refer to the *Modicon M580 Hardware Reference Manual* for controller configuration options that help prevent remote commands from accessing the Run/Stop modes (see Modicon M580, Hardware, Reference Manual).

System Diagnostics

What's in This Chapter

System Diagnostics 137
Main Ring Diagnostics 142

Overview

This chapter describes system diagnostics in an M580 system.

NOTE: For diagnostics at the module level, refer to the respective module user guide.

- For the controller with Ethernet I/O scanner service, refer to the *Modicon M580 controller documentation* (see Modicon M580, Hardware, Reference Manual).
- For the BM•CRA312•0 X80 EIO adapter module, refer to the BM•CRA312•0 *user guide* (see Modicon M580, RIO Modules, Installation and Configuration Guide).
- For the BMENOC0301 / BMENOC0311 Ethernet communication module, refer to the BMENOC0301 / BMENOC0311 *user guide* (see Modicon M580, BMENOC0301/0311 Ethernet Communications Module, Installation and Configuration Guide).
- For the BMENOC0302(H) High performance Ethernet communication module, refer to the BMENOC0302(H)*user guide* (see Modicon M580, BMENOC0302 High Performance Ethernet Communication Module, Installation and Configuration Guide)

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 controller 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 / BMENOC0311 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 BMENOC0302(H) High performance Ethernet communication module, refer to the BMENOC0302(H)*user guide* (see Modicon M580, BMENOC0302 High Performance Ethernet Communication 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(C) 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 / BMENOC0311/ BMENOC0302(H) Ethernet backplane connection broken	BMENOC0301 / BMENOC0311/ BMENOC0302(H) active LED				
BMENOC0301 / BMENOC0311/ BMENOC0302(H) reset	BMENOC0301 / BMENOC0311/ BMENOC0302(H) LED	BMENOC0301 / BMENOC0311/ BMENOC0302(H) health bit (in CPU system word) I/O scanner connection status	DTM online diagnostic inoperable	yes	yes

Status of...	Module [1]	User Application [2]	Control Expert [3]	Rack Viewer [5]	Ethernet Management Tool [6]
BMENOC0301 / BMENOC0311/ BMENOC0302(H) inoperable	BMENOC0301 / BMENOC0311/ BMENOC0302(H) LED	BMENOC0301 / BMENOC0311/ BMENOC0302(H) 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 / BMENOC0311/BMENOC0302(H) is inoperable or has been reset.
4. Not applicable.
5. Use the FactoryCast rack viewer to detect if a BMENOC0301 / BMENOC0311/BMENOC0302(H) is inoperable or has been reset.
6. Use ConneXium Network Manager, HiVision, or other Ethernet network management tool to detect if a BMENOC0301 / BMENOC0311/BMENOC0302(H) is inoperable or has been reset.

Ethernet RIO Network

Confirm that each module has a unique IP address. Duplicate IP addresses can cause unpredictable module/network behavior.

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 controller or BMXCRA312•0	BMEP58•0•0 LED BM•CRA312•0 LED			
controller (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

Status of...	Module [1]	User Application [2]	Rack Viewer [5]	Ethernet Management Tool [6]
DRS cable pulled out	DRS ACT LED	DATA_EXCH block: monitor DRS (ports 5 and 6)	DRS web	yes
main ring cable broken, page 142		EIO system bit (part of CPU DDT)	DRS web (only if cable on DRS port is broken)	
single ring cable broken (see Modicon M580 Complex Topologies, System Guide)		DATA_EXCH block: monitor DRS (ports 5 and 6)	DRS web	
RIO traffic too slow (due to incorrect 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 controller 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 controller, 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 controller 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 error 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 controller 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 controller 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.

Appendices

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Frequently Asked Questions (FAQ)

What's in This Chapter

..... 145

Use the following link to access the latest FAQ document online:

https://www.se.com/us/en/faqs/home/

Detected Error Codes

What's in This Chapter

EtherNet/IP Implicit or Explicit Messaging Detected Error Codes 146
Explicit Messaging: Communication and Operation Reports 149

Overview

This chapter contains a list of codes that describe the status of Ethernet communication module messages.

EtherNet/IP Implicit or Explicit Messaging Detected Error Codes

Introduction

If a `DATA_EXCH` function block does not execute an EtherNet/IP explicit message, Control Expert returns a hexadecimal detected error code. The code can describe an EtherNet/IP detected error.

EtherNet/IP Detected Error Codes

EtherNet/IP hexadecimal detected error codes include:

Detected Error Code	Description
16#800D	Timeout on the explicit message request
16#8012	Incorrect device
16#8015	Either: • Nor resources to handle the message, or • Internal detected error: no buffer available, no link available, impossible to send to the TCP task

Detected Error Code	Description
16#8018	Either: • Another explicit message for this device is in progress, or • TCP connection or encapsulation session in progress
16#8030	Timeout on the Forward_Open request
Note: The following 16#81xx detected errors are Forward_Open response detected errors that originate at the remote target and are received via the CIP connection.	
16#8100	Connection in use or duplicate Forward_Open
16#8103	Transport class and trigger combination not supported
16#8106	Ownership conflict
16#8107	Target connection not found
16#8108	Invalid network connection parameter
16#8109	Invalid connection size
16#8110	Target for connection not configured
16#8111	RPI not supported
16#8113	Out of connections
16#8114	Vendor ID or product code mismatch
16#8115	Product type mismatch
16#8116	Revision mismatch
16#8117	Invalid produced or consumed application path
16#8118	Invalid or inconsistent configuration application path
16#8119	Non-Listen Only connection not opened
16#811A	Target object out of connections
16#811B	RPI is smaller than the production inhibit time
16#8123	Connection timed out
16#8124	Unconnected request timed out
16#8125	Parameter detected error in unconnected request and service
16#8126	Message too large for unconnected_send service
16#8127	Unconnected acknowledge without reply
16#8131	No buffer memory available
16#8132	Network bandwidth not available for data

Detected Error Code	Description
16#8133	No consumed connection ID filter available
16#8134	Not configured to send scheduled priority data
16#8135	Schedule signature mismatch
16#8136	Schedule signature validation not possible
16#8141	Port not available
16#8142	Link address not valid
16#8145	Invalid segment in connection path
16#8146	Detected error in Forward_Close service connection path
16#8147	Scheduling not specified
16#8148	Link address to self invalid
16#8149	Secondary resources unavailable
16#814A	Rack connection already established
16#814B	Module connection already established
16#814C	Miscellaneous
16#814D	Redundant connection mismatch
16#814E	No more user-configurable link consumer resources: the configured number of resources for a producing application has reached the limit
16#814F	No more user-configurable link consumer resources: there are no consumers configured for a producing application to use
16#8160	Vendor specific
16#8170	No target application data available
16#8171	No originator application data available
16#8173	Not configured for off-subnet multicast
16#81A0	Detected error in data assignment
16#81B0	Optional object state detected error
16#81C0	Optional device state detected error
Note: All 16#82xx detected errors are register session response detected errors.	
16#8200	Target device does not have sufficient resources
16#8208	Target device does not recognize message encapsulation header
16#820F	Reserved or indeterminable detected error from target

Explicit Messaging: Communication and Operation Reports

Overview

Communication and operation reports are part of the management parameters.

NOTE: Test communication function reports at the end of their execution and before the next activation. On cold start-up, confirm that all communication function management parameters are verified and reset to 0.

You can use the%S21 to examine the first cycle after a cold or warm start.

Communication Report

This report is common to every explicit messaging function. It is significant when the value of the activity bit switches from 1 to 0. The reports with a value between 16#01 and 16#FE concern errors detected by the controller that executed the function.

The different values of this report are indicated in the following table:

Value	Communication report (least significant byte)
16#00	Correct exchange
16#01	Exchange stop on timeout
16#02	Exchange stop on user request (CANCEL)
16#03	Incorrect address format
16#04	Incorrect destination address
16#05	Incorrect management parameter format
16#06	Incorrect specific parameters
16#07	Error detected in sending to the destination
16#08	Reserved
16#09	Insufficient receive buffer size
16#0A	Insufficient send buffer size
16#0B	No system resources: the number of simultaneous communication EFs exceeds the maximum that can be managed by the controller.
16#0C	Incorrect exchange number
16#0D	No telegram received

Value	Communication report (least significant byte)
16#0E	Incorrect length
16#0F	Telegram service not configured
16#10	Network module missing
16#11	Request missing
16#12	Application server already active
16#13	UNI-TE V2 transaction number incorrect
16#FF	Message refused

NOTE: The function can detect a parameter error before activating the exchange. In this case the activity bit remains at 0, and the report is initialized with values corresponding to the detected error.

Operation Report

This report byte is specific to each function, and specifies the result of the operation on the remote application:

Value	Operation report (most significant byte)
16#05	Length mismatch (CIP)
16#07	Incorrect IP address
16#08	Application error
16#09	Network is down
16#0A	Connection reset by peer
16#0C	Communication function not active
16#0D	• Modbus TCP: transaction timed out • EtherNet/IP: request timeout
16#0F	No route to remote host
16#13	Connection refused
16#15	• Modbus TCP: no resources • EtherNet/IP: no resources to handle the message; or an internal detected error; or no buffer available; or no link available; or cannot send message
16#16	Remote address not allowed
16#18	• Modbus TCP: concurrent connections or transactions limit reached • EtherNet/IP: TCP connection or encapsulation session in progress

Value	Operation report (most significant byte)
16#19	Connection timed out
16#22	Modbus TCP: invalid response
16#23	Modbus TCP: invalid device ID response
16#30	• Modbus TCP: remote host is down • EtherNet/IP: connection open timed out
16#80...16#87: Forward_Open response detected errors:	
16#80	Internal detected error
16#81	Configuration detected error: the length of the explicit message, or the RPI rate, needs to be adjusted
16#82	Device detected error: target device does not support this service
16#83	Device resource detected error: no resource is available to open the connection
16#84	System resource event: unable to reach the device
16#85	Data sheet detected error: incorrect EDS file
16#86	Invalid connection size
16#90...16#9F: Register session response detected errors:	
16#90	Target device does not have sufficient resources
16#98	Target device does not recognize message encapsulation header
16#9F	Indeterminable detected error from target

Design Principles of M580 Networks

What's in This Chapter

Network Determinism Parameters..... 152
RIO Network Design Principles..... 153
RIO with DIO Network Design Principles 156

Overview

This chapter describes the design principles for the following types of M580 network topologies:

- a main ring, with RIO sub-rings
- a main ring, with both RIO and DIO sub-rings

Network Determinism Parameters

Overview

This section describes factors to consider when designing a deterministic M580 network.

Network Determinism Parameters

Introduction

Determinism refers to the ability to calculate and predict application response time (ART), which is the time required for an M580 network system to detect and respond to a single input. When you calculate ART for your application, consider the following:

- An M580 architecture features a dedicated module for RIO communications.
- Each remote packet travels from an input module in the remote drop to the controller, then back to an output module in the remote drop.
- Hop count is defined as the number of switches (including switches embedded in RIO devices) that a packet passes through to reach its destination.
- Packet path impacts jitter calculations, because of potential queue delays along its path.

- For RIO ART calculations:
  - Consider the worst case, i.e., the longest path a packet may need to travel in case of a broken network cable.
  - RIO only provides recovery from a single break in the system. This remains true even if a packet is able to arrive at its destination when multiple breaks exist in the system.
  - Only count hops and jitter delays along the network path, i.e., from the perspective of the specific RIO adapter module transmitting the packet. Do not include hops and jitter for other devices in the system that are not on the network path.

RIO Network Design Principles

Overview

This section describes the design principles for M580 network topologies that consist exclusively of main rings and optional RIO sub-rings.

RIO Network Design Principles

Overview

M580 Ethernet RIO networks provide deterministic operation when the following principles are incorporated in the network design:

- **Defined Architectures:** A network topology that consists of simple daisy chain loops provides these design advantages:
  - Hop counts between the remote adapter device and the controller are limited. The smaller number of hops along the transmission path reduces the opportunity for network delays.
  - Junctions between devices in the topology also are limited, which in turn limits packet queuing delays, known as jitter.
- **Traffic Prioritization:** Jitter that is inherent in RIO traffic is further limited by using QoS to prioritize packets. When RIO packets and other traffic (for example, DIO packets, programming commands, web inquiries, diagnostics) simultaneously enter a transmission queue, Ethernet RIO traffic is transmitted first, based on its higher priority.

- **Switched Ethernet:** Switched Ethernet reduces jitter by helping data packets avoid collisions. Switched Ethernet is implemented when you use switches with the following features:
  - Store and forward: The switch receives the entire packet before forwarding it, which lets the switch prioritize packet transmissions and check for corrupted packets before re-transmission.
  - Full duplex: The switch supports the simultaneous bi-directional transmission of packets, without collisions.
  - 100 Mbps transmission speeds, which limits delay times per hop, as set forth below.

Switched Ethernet Delay Times

Switched Ethernet topologies can provide for these transmission delay times per hop:

I/O Data Size (bytes)	Estimated Delay Time (µs)(1)
128	26
256	35
400	46
800	78
1200	110
1400	127
(1) Delay times include 100 bytes of Ethernet overhead.	

Defined Architecture: Topologies

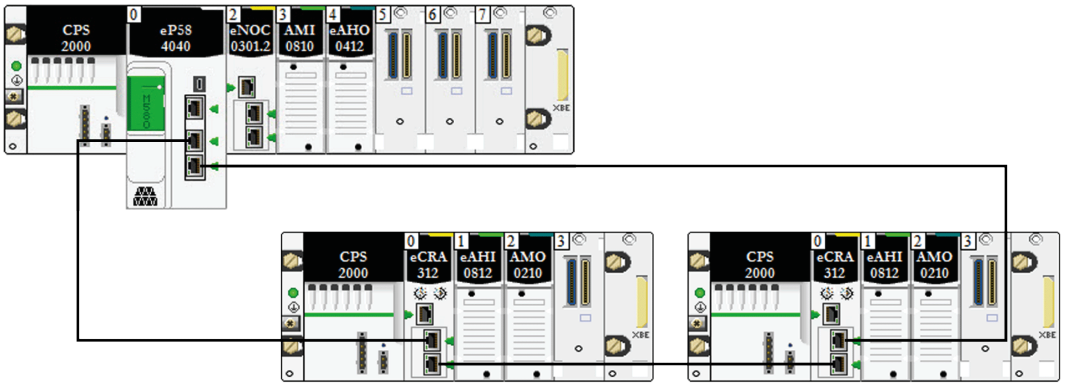
Introduction

In the following examples, the defined architectures restrict the number of hops a packet takes from an RIO drop to the controller. 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, page 154. To determine the hop count from the perspective of an RIO drop, count the number of switches from the remote drop to the controller.

Simple Daisy Chain Loop

In this example of a simple daisy chain loop topology, the controller with Ethernet I/O scanner service on the local rack is connected to the main ring. Two BM•CRA312•0 X80 EIO adapter modules connect two Ethernet RIO drops to the main ring:



These restrictions apply to the simple daisy-chain loop topology above (which consists of only the local rack and RIO drops):

- the maximum hop count = 17
- the maximum number of RIO modules:
  - one (1) controller with Ethernet I/O scanner service on the local rack
  - up to sixteen X80 EIO adapter modules (BM•CRA312•0)

  NOTE: The maximum number of RIO drops depends on the particular controller in your system. For more information, refer to the M580 controller selection table, page 75.

In this design, the traffic is transmitted through the port with the shortest path to the controller.

Defined Architecture: Junctions

Introduction

RIO, page 26 modules constitute a network junction. An RIO module joins ring traffic with RIO module traffic.

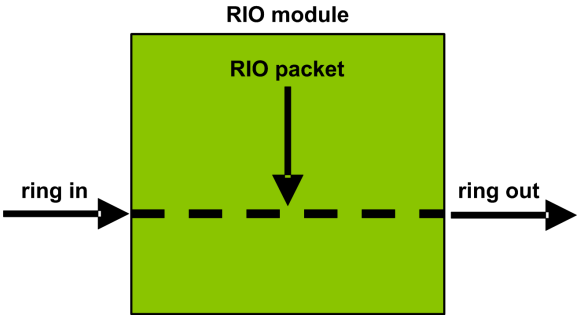
Each junction presents the queueing point, which can add delay — or jitter — to the system. If 2 packets simultaneously arrive at a junction, only 1 can be immediately transmitted. The other waits for a period referred to as “one delay time” before it is transmitted.

Because RIO packets are granted priority by the M580 network, the longest an RIO packet can wait at a junction is 1 delay time before it is transmitted by the module.

The following scenario depicts the ways in which a junction handles packets that arrive simultaneously.

RIO Module

In the following example, an RIO module originates packets for transmission and forwards packets it receives on the ring:



The RIO module handles RIO packets in the following sequence:

Time	Ring In	RIO Packet	Ring Out	Comment
T0	1 (started)	a	–	Packet “a” arrived after transmission of packet “1” begins.
T1	2	–	1	Packet “2” arrived after packet “a.”
T2	3	–	a	Packet “3” arrived after packet “2.”
T3	4	–	2	Packet “4” arrived after packet “3.”
T4	5	–	3	Packet “5” arrived after packet “4.”

RIO with DIO Network Design Principles

Overview

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

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:

- **Controller**: controller 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 controller.
- **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.

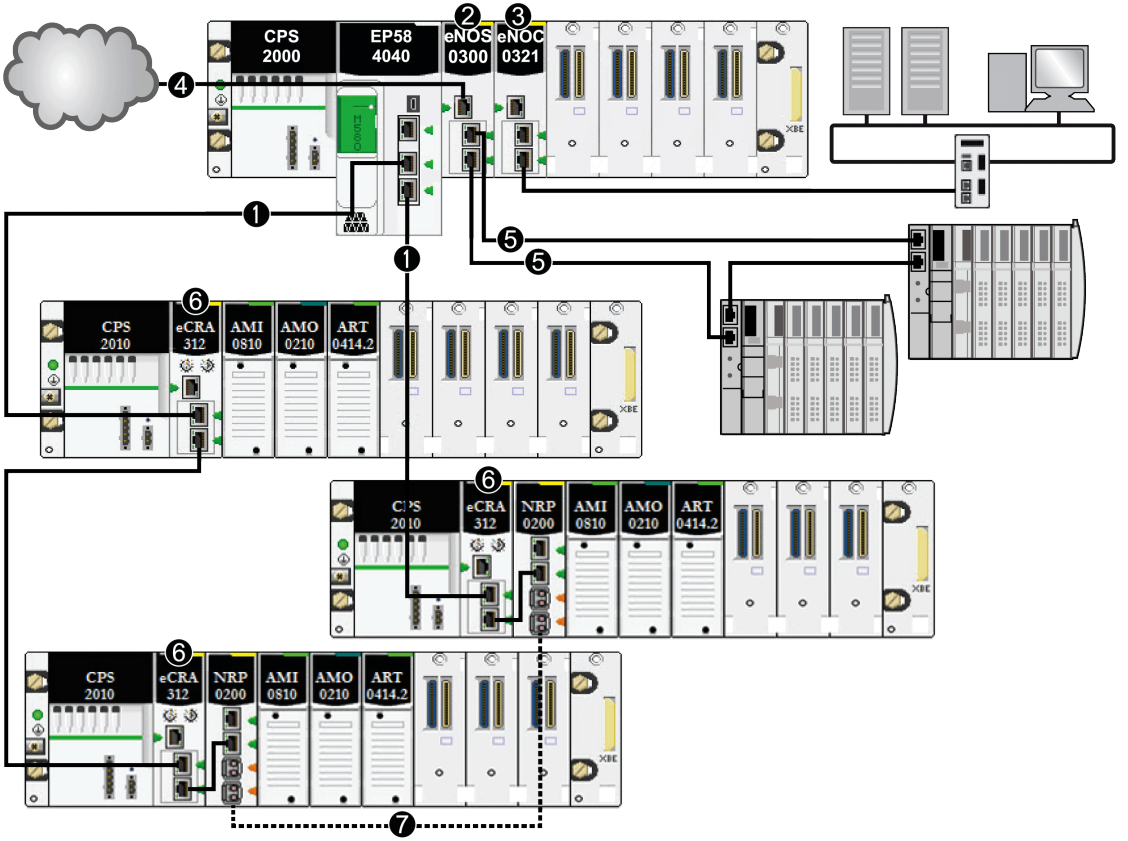
Defined Architecture: Topologies

Introduction

This topic discusses distributed equipment that is connected only to a BMENOS0300 on a local rack (not an RIO drop).

High Capacity Subsystem Example

This illustration shows a simple daisy chain loop with a BMENOS0300 module that communicates with distributed equipment:



1 A controller with Ethernet I/O scanner service is on the local rack and connected to the main ring.

2 A BMENOS0300 network option switch module on the local rack manages distributed equipment.

3 A BMENOC0321(C) control network module on the local rack creates transparency between the device network and the control network.

4 A BMENOS0300 network option switch module on the local rack manages a DIO cloud.

5 The BMENOS0300 network option switch module on the local rack manages a DIO sub-ring.

6 A BMECRA312•0 eX80 adapter module is installed on each remote drop.

7 BMXNRP020• fiber converter modlues on remote drops are connected to extend the distance between drops. (Refer to the documentation for the BMXNRP020• fiber converter module.)

NOTE: A BMENOC0301 / BMENOC0311/BMENOC0302(H) module can support distributed equipment through its Ethernet backplane connection to the controller and through its device network port(s) on the front panel, respecting the limitation of 128 devices scanned per BMENOC0301 / BMENOC0311/BMENOC0302(H) module.

In this complex M580 network topology (which consists of a main ring and multiple sub-rings), these restrictions apply:

The maximum number of...	...is...
hops in a network path	17
RIO modules in the main ring	16
distributed equipment on the network	128 per scanner; there may be several BME NOCs in the system with the controller

NOTE: To use a dual-ring switch (DRS) to connect distributed equipment to the M580 network, refer to the Modicon M580 Complex Topologies System Guide, page 10.

RIO and DIO Defined Architecture: Junctions

Introduction

An M580 network can accept the addition of DIO traffic through a BMENOS0300 network option switch module. The BMENOS0300 module can accept DIO data from these sources:

- DIO daisy chain
- DIO daisy chain loop

NOTE: Refer to the overview of typical RIO/DIO network topologies.

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* until it can be transmitted.

Because RIO packets are granted priority by the M580 network, the longest an RIO packet can wait at a junction is one delay time before it is transmitted by the device or BMENOS0300 module.

The following scenarios depict how different junction types handle DIO packets that arrive simultaneously with RIO packets.

Network Option Switch Module

A BMENOS0300 network option switch module receives a steady flow of packets from both the main ring and the distributed equipment that is connected to the BMENOS0300 module.

The BMENOS0300 module handles RIO packets in this sequence:

Time	Main Ring In	DIO Sub-ring	Main Ring Out	Comment
T0	1	a (started)	–	Packet “1” arrived after transmission of packet “a” begins.
T1	2	b	a	Packets “2” and “b” arrive simultaneously.
T2	3	c	1	Packets “3” and “c” arrive simultaneously.
T3	4	d	2	Packets “4” and “d” arrive simultaneously.
T4	5	e	3	Packets “5” and “e” arrive simultaneously.

Glossary

A

adapter:

An adapter is the target of real-time I/O data connection requests from scanners. It cannot send or receive real-time I/O data unless it is configured to do so by a scanner, and it does not store or originate the data communications parameters necessary to establish the connection. An adapter accepts explicit message requests (connected and unconnected) from other devices.

ART:

(*application response time*) The time a CPU application takes to react to a given input. ART is measured from the time a physical signal in the CPU turns on and triggers a write command until the remote output turns on to signify that the data has been received.

AUX:

An (AUX) task is an optional, periodic processor task that is run through its programming software. The AUX task is used to execute a part of the application requiring a low priority. This task is executed only if the MAST and FAST tasks have nothing to execute. The AUX task has two sections:

- IN: Inputs are copied to the IN section before execution of the AUX task.
- OUT: Outputs are copied to the OUT section after execution of the AUX task.

C

CCOTF:

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

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

determinism:

For a defined application and architecture, you can predict that the delay between an event (change of value of an input) and the corresponding change of a controller output is a finite time *t*, smaller than the deadline required by your process.

device network:

An Ethernet-based network within 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.

DHCP:

(*dynamic host configuration protocol*) An extension of the BOOTP communications protocol that provides for the automatic assignment of IP addressing settings, including IP address, subnet mask, gateway IP address, and DNS server names. DHCP does not require the maintenance of a table identifying each network device. The client identifies itself to the DHCP server using either its MAC address, or a uniquely assigned device identifier. The DHCP service utilizes UDP ports 67 and 68.

DIO cloud:

A group of distributed equipment that is not required to support RSTP. DIO clouds require only a single (non-ring) copper wire connection. They can be connected to some of the copper ports on DRSs, or they can be connected directly to the CPU or Ethernet communications modules in the *local rack*. DIO clouds **cannot** be connected to *sub-rings*.

DIO network:

A network containing distributed equipment, in which I/O scanning is performed by a CPU with DIO scanner service on the local rack. DIO network traffic is delivered after RIO traffic, which takes priority in an RIO network.

distributed equipment:

Any Ethernet device (Schneider Electric device, PC, servers, or third-party devices) that supports exchange with a CPU or other Ethernet I/O scanner service.

DRS:

(*dual-ring switch*) A ConneXium extended managed switch that has been configured to operate on an Ethernet network. Predefined configuration files are provided by Schneider Electric to downloaded to a DRS to support the special features of the main ring / sub-ring architecture.

E

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.

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.

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.

FDR:

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

FTP:

(*file transfer protocol*) A protocol that copies a file from one host to another over a TCP/IP-based network, such as the internet. FTP uses a client-server architecture as well as separate control and data connections between the client and server.

I

IP address:

The 32-bit identifier, consisting of both a network address and a host address assigned to a device connected to a TCP/IP network.

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

local rack:

An M580 rack containing the CPU and a power supply. A local rack consists of one or two racks: the main rack and the extended rack, which belongs to the same family as the main rack. The extended rack is optional.

M

main ring:

The main ring of an Ethernet RIO network. The ring contains RIO modules and a local rack (containing a CPU with Ethernet I/O scanner service) and a power supply module.

MAST:

A master (MAST) task is a deterministic processor task that is run through its programming software. The MAST task schedules the RIO module logic to be solved in every I/O scan. The MAST task has two sections:

- IN: Inputs are copied to the IN section before execution of the MAST task.
- OUT: Outputs are copied to the OUT section after execution of the MAST task.

Modbus:

Modbus is an application layer messaging protocol. Modbus provides client and server communications between devices connected on different types of buses or networks. Modbus offers many services specified by function codes.

P

PAC:

programmable automation controller. The PAC is the brain of an industrial manufacturing process. It automates a process as opposed to relay control systems. PACs are computers suited to survive the harsh conditions of an industrial environment.

Q

QoS:

(*quality of service*) The practice of assigning different priorities to traffic types for the purpose of regulating data flow on the network. In an industrial network, QoS is used to provide a predictable level of network performance.

R

RIO drop:

One of the three types of RIO modules in an Ethernet RIO network. 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

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

SNMP:

(*simple network management protocol*) Protocol used in network management systems to monitor network-attached devices. The protocol is part of the internet protocol suite (IP) as defined by the internet engineering task force (IETF), which consists of network management guidelines, including an application layer protocol, a database schema, and a set of data objects.

SNTP:

(*simple network time protocol*) See NTP.

sub-ring:

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

T

TCP/IP:

Also known as *internet protocol suite*, TCP/IP is a collection of protocols used to conduct transactions on a network. The suite takes its name from two commonly used protocols: transmission control protocol and internet protocol. TCP/IP is a connection-oriented protocol that is used by Modbus TCP and EtherNet/IP for explicit messaging.

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.

U

UTC:

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

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