Chapter 9: EtherNet / IP

9.1 EtherNet/IP Basics

EtherNet/IP is an industrial network protocol talks Common Industrial Protocol (CIP) over Ethernet. It is most often used with Allen-Bradley Rockwell devices and industrial equipment meant to interface with those devices. EtherNet/IP uses both of the most widely deployed Ethernet standards (Internet Protocol suite and IEEE 802 project) to define the features and functions of its transport, network, data link and physical layers. EtherNet/IP uses the CIP object model framework for its communication. The object-oriented design of CIP provides EtherNet/IP with the services and device profiles needed for real-time control applications and to promote consistent implementation of automation functions across a diverse ecosystem of products.

9.1.1 Implicit vs Explicit Messaging

EtherNet/IP supports two types of communication. First is the explicit messaging which where each communication is a separate query and response. This communication is inherently slower than the implicit communication because each "packet" requires overhead information about what you need from which device. On the other hand implicit communication is where a link between devices is established initially and from that point forward all specified information is exchanged at set intervals.

Each of these communication is used for different applications and purposes. The selection of explicit or implicit messaging often depends on the choice of device, as each may support only one messaging mode. If your application requires large amounts of data, explicit messaging is the preferred choice because bandwidth is saved, as data is only requested when necessary.

The table below gives a small overview of the uses, please refer to the next page for more information.

EtherNet/IP Connection	Explicit Message Description	Implicit Message Description
Initiates Connection (Master)	Client (Controller)	I/O Scanner (Controller)
Services Connection (Slave)	Server (Field Device)	I/O Adapter (Field Device)
Messaging type	Unconnected but can be connected	Connected
Typical Use	Diagnostic / Event data	Real-time I/O data (Control)

9.1.1 Explicit Messaging Details

Explicit messaging (client/server messaging) is best used for non-real time communication which is not time critical. In this type of messaging the client (PLC / Controller) requests information from the server (Field Device) and the server sends the requested information back to the client.

Since the client request the information via TCP/IP services, the message needs to include all the information so that the server can respond explicitly to the message. The client will basically say to server, "I need this information, with this specified formatting, please send it". The server then responds with a correctly formatted message with the information.

This configuring and monitoring ability works well for non-real time messaging as the client can send a message request anytime, and the server can respond when it is available. Due to this explicit messaging requires programming in the controller for setup. You need to request the data, add handshaking, acknowledge the data, and move the data where it's needed in the controller.

Explicit Messaging (TCP/IP)

EtherNet/IP Connection	Explicit Message Description	Color Code	
Initiates Connection (Master)	Client (Controller)		
Services Connection (Slave)	Server (Field Device)		
Messaging type	Unconnected but can be connected		
Typical Use	Diagnostic/event/configuration data		

9.1.3 Implicit Messaging Details

Implicit messaging (I/O Messaging) is used for time-critical applications such as real time control. Implicit messaging is called I/O messaging it is frequently used for remote I/O applications. This communication is much more efficient than explicit messaging since but the scanner and adapter are preconfigured to know exactly (implicitly) what to expect from this communication.

Implicit messaging basically copies a set amount of data with minimal other information into the message. Both the scanner and adapter don't need to be told much since they both know what to expect in the message and what to send back. The meaning of the data is "implied" so there is no extra stuff.

Also the setup of implicit messaging is simple and quick. The scanner only needs to be setup to know what data it should receive and send, and which EtherNet/IP device it needs to connect to. After that the data is transferred at the rate you specify, typically in the 5ms to 20ms range.

Implicit Messaging (UDP)

| EtherNet/IP Connection	Implicit Message Description	Color Code
Initiates Connection (Master)	I/O Scanner (Controller)	
Services Connection (Slave)	I/O Adapter (Field Device)	
Messaging type	Connected	
Typical Use	Real-time I/O data (Control)	

9.2 EtherNet/IP Adapter Setup

The EZRack PLC supports Ethernet/IP Adapter communication. This communication is for the EZRack to act as Adapter to external device Scanner. This section will define how to setup the EZRack PLC and how to setup an Allen-Bradley PLC to act as Scanner to the EZRack PLC.

9.2.1 EZRack PLC Setup

To setup the EZRack to communicate as an Ethernet/IP Adapter follow the direction below:

1. Go to **Setup > EtherNet/IP Adapter Setup...** You will see the following screen appear:
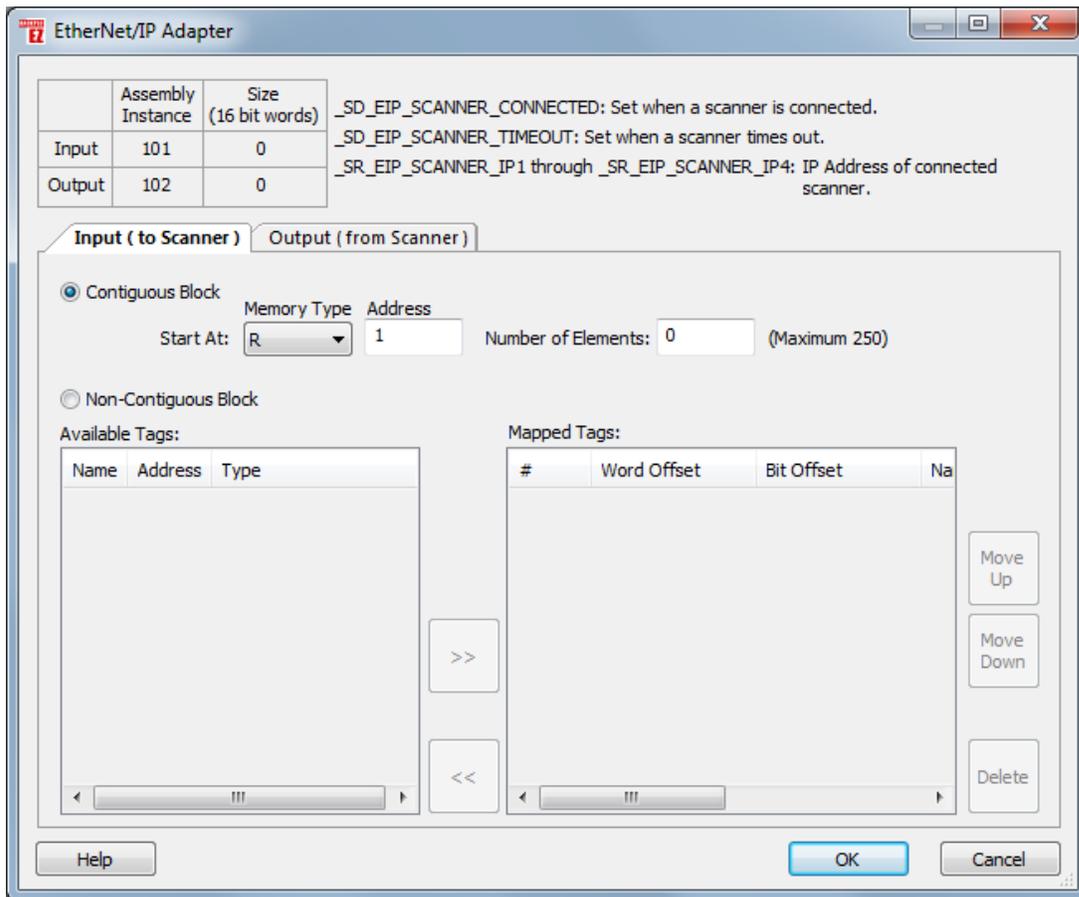
2. This screen allows you to setup which tags are to be used for the Adapter. You can either use a contiguous block of registers (example R1-R250) or you can select the registers you would like to send. The maximum number is restricted to 250 Input and 250 Output.

3. Important information for the setup of Scanner is the Connection Parameters of the Input / Output Assembly Instances and the Input / Output Word size. Make sure to setup this

information in your Allen-Bradley PLC after you have selected all tags that you will send and receive.

System Discretes:

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_SD_EIP_SCANNER_CONNECTED	SD26	Read Only	Indicates when the EtherNet/IP Adapter is connected with an EtherNet/IP Scanner.
_SD_EIP_SCANNER_TIMEOUT	SD27	Read Only	Indicates when the EtherNet/IP Adapter connection times out (after 3000 mSec)

System Registers:

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_SR_EIP_SCANNER_IP1	SR21	Read Only	This will have the IP address of the EtherNet/IP Scanner which is connected to the EZ Rack PLC.
_SR_EIP_SCANNER_IP2	SR22	Read Only	This will have the IP address of the EtherNet/IP Scanner which is connected to the EZ Rack PLC.
_SR_EIP_SCANNER_IP3	SR23	Read Only	This will have the IP address of the EtherNet/IP Scanner which is connected to the EZ Rack PLC.
_SR_EIP_SCANNER_IP4	SR24	Read Only	This will have the IP address of the EtherNet/IP Scanner which is connected to the EZ Rack PLC.

9.2.2 Allen-Bradley Setup

To setup an Allen-Bradley PLC to communicate to the EZRack PLC please use RSLogix 5000.

1. In the selected project under your Ethernet option click to Add New Module.
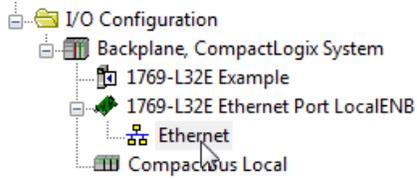
2. In the Select Module Type find the Generic Ethernet Module. Select this module and the following dialog will show up:
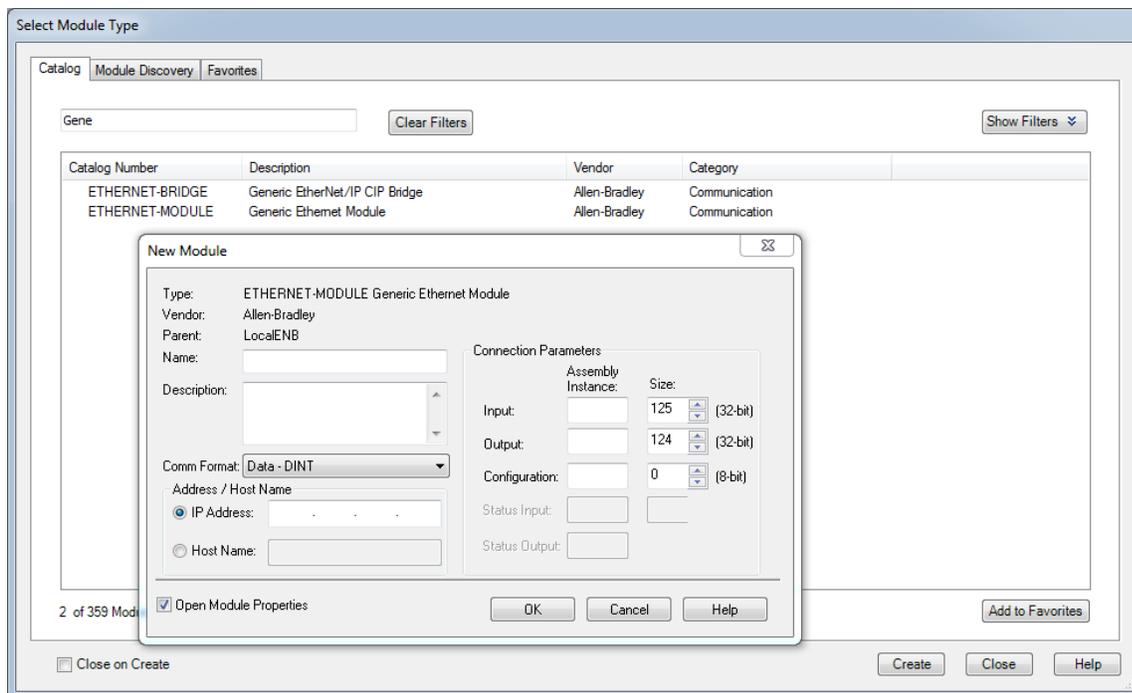
3. Add a name for your module and put in the **Comm Format as Data INT.** Also put in the IP Address of your EZRack PLC.
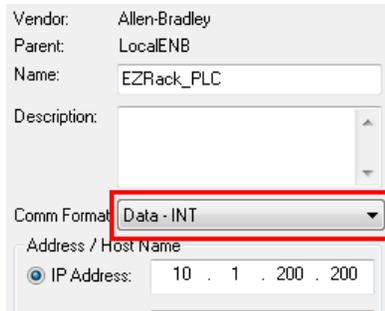
4. Copy the Connection Parameters from the EZRack PLC to the Connection Parameters of the New Module. Set the Assembly Instance Configuration to 1.
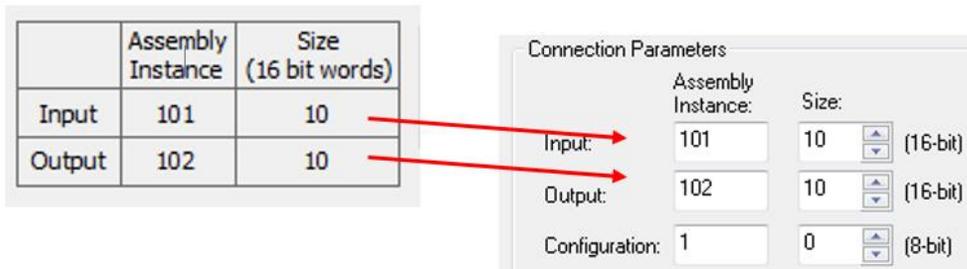
5. Click OK to create the module. In the Connection settings please use an RPI of 10 ms or more. A faster RPI does work but is not as reliable. You can also choose to use any of the other settings all function with the EZRack PLC.
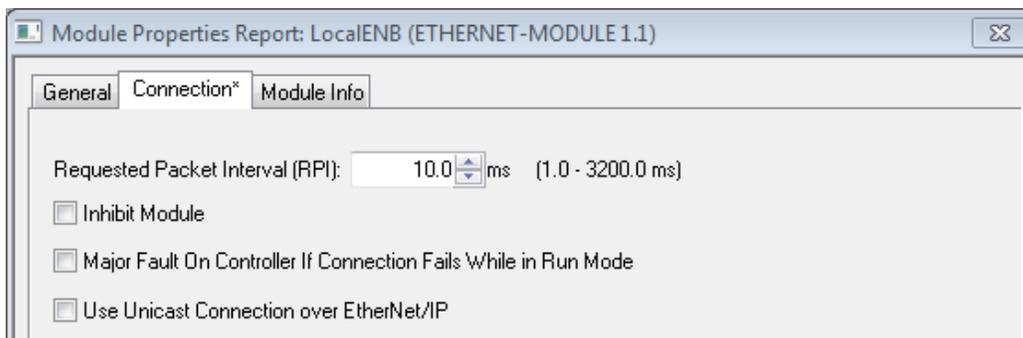
6. *After hitting apply you have created a connection between the EZRack PLC and the Allen-Bradley PLC. As soon as both projects are transfered to their respective PLCs they will communicate together and exchange the selected tag information. Note: Allen-Bradley tags will be in the Controller Tags area under the name of the Generic Ethernet Module.*

9.2.3 Troubleshooting

If the EZRack PLC and Allen-Bradley PLC are not communicating or having trouble communicating the Module Fault will inform you as to the problem. Please see table below for the options:

Error	Error Code (HEX)	Problem
Connection Request timed out.	0204	The Allen-Bradley PLC cannot connect to the EZRack PLC. Please make sure the IP address is correct and the EZRack PLC is on the same network as the Allen-Bradley PLC.
Invalid segment type	0315	The Connection Parameters information is incorrect. Please check and make sure both PLCs parameters match.