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Connect IoT - TCP/IP Tutorial

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Connect IoT - TCP/IP Tutorial

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Overview

The TCP/IP driver serves simple devices that exchange text or fixed-size frames over a socket, such as barcode readers, scales, label printers, and test rigs with a line-based protocol. It works at the transport level only:

- A **parser** cuts the incoming byte stream into frames.
- Every frame is tested against every property of the driver definition, and an event fires when one of its trigger properties takes the frame.
- A command sends a frame built from its device ID, its parameters, and the framing tokens you configure. It can wait for one answer, the next frame that arrives, and the driver does nothing more to match an answer to its question.

A device with sessions, message identifiers, or acknowledgments of its own needs its own driver, or the SECS/GEM driver for a GEM tool.

The connection has two modes, which describe the role of the driver, not the role of the device:

mode	The driver	Use it when	What to know
Active	Connects to <code>host:port</code>	The device listens on a port	The socket closing moves the connection to <code>Disconnected</code> , and the driver reconnects
Passive	Listens on <code>host:port</code> for up to <code>maxClients</code> devices	The device connects to a host on its own, as most readers configured with a host address do	A device leaving does not change the communication state, and every command goes to every connected device

In this tutorial, you integrate a packing station, such as `Station-01`, that connects to the controller and sends one line per scanned case, ended by CR LF. For each case, the controller asks the station for the weight with `w`, logs the answer, such as `s`

12.50 kg, and acknowledges the case with OK. The tutorial is for integrators who completed the basic configuration tutorial and build Data Flow workflows.

Info

For more information, see [Connect IoT - TCPIP Driver](#).

Before You Start

- Complete [Connect IoT - Basic Configuration Tutorial](#): you need an **Automation Manager** that you can start in console mode, the **Resource** entity type enabled for Connect IoT, an integration user, and a **Resource**, such as `Station-01`.
- Make the package `@criticalmanufacturing/connect-iot-driver-tcpip` available in the Connect IoT repository.
- Choose a free port on the machine that runs the **Automation Manager**, for example `7420`.
- Prepare a stand-in for the station: a TCP terminal that connects to that port and sends and receives lines ended by CR LF. This tutorial uses `Ncat`, the command-line networking tool of the Nmap project. On Windows, install [Nmap ↗](#), which includes `Ncat`. On Linux, install `Ncat` with the package manager of your distribution. The command `ncat --crLf <manager-host> 7420` connects to the port on the host of the **Automation Manager**, and `--crLf` ends each line that you send with CR LF.

Alternative TCP Terminals

Any other TCP terminal that sends CR LF, such as PuTTY in `Raw` mode, works as well.

Automated Tests

To automate the checks for this tutorial, write a Test Orchestrator test that uses the [TCP/IP Client simulator](#), which dials a `Passive` driver, or the [TCP/IP Server simulator ↗](#), which listens for an `Active` driver.

Sequence of Steps

Step 1: Create the Automation Protocol

Go to **Business Data > Automation Protocol** and create a protocol named `TCP/IP` with the package `@criticalmanufacturing/connect-iot-driver-tcpip`, as described in [How to: Create an Automation Protocol](#). Keep the default parameter values; you set the values below for the connection in [Step 3](#).

Parameter	Value in this tutorial	Why it matters
<code>mode</code>	<code>Passive</code>	The station connects to the driver
<code>host</code>	<code>0.0.0.0</code>	In <code>Passive</code> mode, the address to listen on. In <code>Active</code> mode, the address of the device
<code>port</code>	<code>7420</code>	In <code>Passive</code> mode, <code>0</code> lets the operating system choose a port, which the driver log shows
<code>maxClients</code>	<code>1</code>	Keep <code>1</code> whenever the workflow sends commands, because a command goes to every connected device
<code>socketEncoding</code>	<code>ascii</code>	How the bytes on the socket become text before the parser reads them
<code>parserType</code>	<code>Readline</code>	How the stream is cut into frames
<code>delimiter</code>	<code>\r\n</code>	The line end of the station, removed from each frame

Choose the parser from the way the device ends a message. A wrong parser never completes a frame, so no event fires, or it splits one message into several:

Device	parserType	Parameters it reads
Ends each message with a line end or another fixed sequence	<code>Readline</code> or <code>Delimiter</code>	<code>delimiter</code>
Sends frames of a fixed size	<code>ByteLength</code>	<code>byteLengthNumber</code>
Ends a message with a pattern	<code>Regex</code>	<code>delimiter</code> , read as a regular expression, and <code>encoding</code>

Device	parserType	Parameters it reads
Stops sending at the end of a message	InterByteTimeo ut	timeoutValue , maxBufferSize

For `Readline`, `Delimiter`, and `Ready`, only the first `\r`, `\n`, and `\t` of `delimiter` are converted into control characters, so `\r\n\r\n` is not a valid delimiter, and a token such as `<ETX>` is matched as the five characters it contains. For a control character other than a line end, the `Regex` parser reads `delimiter` as a regular expression, where `\x03` names ETX, provided `socketEncoding` is a text encoding, such as `ascii`. Test such a configuration against the device before you rely on it.

Step 2: Define the Messages of the Station

The TCP/IP package ships no driver definition, so you declare every property, event, and command from the message format of the device. The `identifierType` of a property decides which frames it takes: `None` takes every frame, `Token` takes frames that start with `parserIdentifierValue`, and `RegularExpression` takes frames that match it.

1. Go to **Business Data > Automation Driver Definition** and create a definition named `Packing Station` on the `TCP/IP` protocol with the entity type `Resource`.
2. Add the property `CaseCode` of type `String`, readable and not writable, with the **Identifier Type** (`identifierType`) `Token` and the **Identifier Value** (`parserIdentifierValue`) `CASE-`.
3. Add the event `CaseScanned` with the **Event Working Mode** (`workingMode`) `AllValues`, the default, and add `CaseCode` to it with **Is Trigger** on.
4. Add the commands, with no parameters:

Name	Command (Command Device ID)	Extended data
<code>GetWeight</code>	<code>W</code>	Command Structure Behavior <code>UseCurrentCommandSettings</code> , Message End Token <code><CR><LF></code> , Convert Non Printable ASCII Chars on Send Value on, Reply Expected on, Reply TimeOut (ms) <code>5000</code>
<code>Acknowledge</code>	<code>OK</code>	Command Structure Behavior <code>UseCurrentCommandSettings</code> , Message End

Name	Command (Command Device ID)	Token <CR><LF>, Convert Non Printable Extended data ASCII Chars on Send Value on
------	-----------------------------------	--

5. Select **Create**.

With the default **Command Device ID Usage**, `AtBeginning`, each command sends its device ID followed by the end token. The driver adds nothing at the end of a frame unless you configure it, and the conversion turns `<CR><LF>` into the two control characters. Without the conversion, the station receives the six characters `<CR><LF>`, and a `\r\n` typed in **Message End Token** is sent as four characters: only the parser `delimiter` understands escapes.

With **Reply Expected** (`expectsReply`), the command waits for the next frame that arrives, whatever its content, and returns it on `reply`. That frame is not offered to the properties, so it fires no event. While the command waits, other commands are queued. When no frame arrives within **Reply TimeOut (ms)**, the command fails.

Note

A `Token` property takes only the frames of its kind. Two `None` properties on one connection both take every frame, and both their events fire for each frame. Writing a property, for example with `Set Equipment Properties`, sends nothing to the device: only a command writes to the socket.

Step 3: Create the Controller and Set the Connection

1. Create an **Automation Controller** named `Packing Station` with the **Scope** `Connect IoT`, the entity type `Resource`, and the **Workflow Type** `Data Flow`.
2. In the driver definitions step, add `Station` with the `Packing Station` definition, and keep the core task package.
3. On the `Setup` page, open the settings of the `Equipment Configuration` task, set the parameters from the table in [Step 1](#) on the **Communication Parameters** tab, and select **Save**.

Equipment Configuration Settings

GENERAL

COMMUNICATION PARAMETERS

NAME

VALUE

mode

Passive

host

0.0.0.0

port

7420

localAddress

0.0.0.0

localPort

0

family

4

maxClients

1

keepAliveTime

10000

socketEncoding

ascii

parserType

Readline

delimiter

\r\n

Name

delimiter

Description

(Parsers: Readline, Delimiter, Ready, RegularExpression) String delimiter to split incoming text. Simple string substitutions

Value

\r\n

Comments

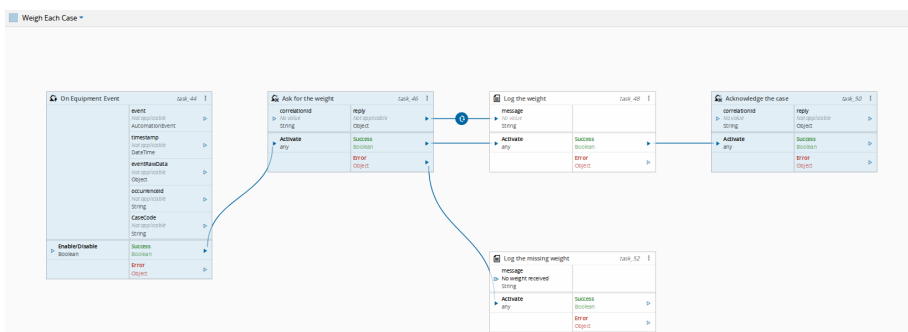
For more information, see [Create the Setup Workflow](#).

Step 4: Build the Workflow

Add a workflow page named **Weigh Each Case**, place the tasks below with the driver **Station** for the equipment tasks, and link them as listed:

Task	Settings to set	Inputs and outputs to link
On Equipment Event	On Equipment Event: CaseScanned	-
Execute Equipment Command, named Ask for the weight	Equipment Command: GetWeight; keep Timeout at 60000, longer than the Reply TimeOut (ms)	Success of the event to Activate
Log Message, named Log the weight	Default values	reply of Ask for the weight to message, through the converter Any To String; Success of Ask for the weight to Activate

Task	Settings to set	Inputs and outputs to link
Execute Equipment Command, named Acknowledge the case	Equipment Command: Acknowledge	Success Of Log the weight to Activate
Log Message, named Log the missing weight	Default Message No weight received, Verbosity Warning	Error Of Ask for the weight to Activate



Select **Save**. The **Timeout** of the task is the limit of the controller; keeping it longer than **Reply TimeOut (ms)** makes the driver error the one reported. **Success** of a command means the call returned: for **Acknowledge**, that the frame was written.

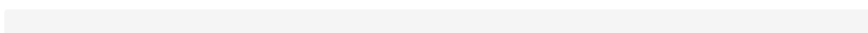
Step 5: Connect the Instance and Start the Manager

1. Connect the controller to the **Resource** **Station-01** and to your **Automation Manager**, and select the same **Resource** for the **Station** driver, as described in [How to Create a Controller Instance](#).
2. Start the **Automation Manager** in console mode.

The driver listens on port **7420**. Until the first device connects, the driver instance does not reach **Communicating**, and frames that arrive before **Communicating** are dropped.

Validate the Result

1. Connect the stand-in station:



```
ncat --crlf <manager-host> 7420
```

The console logs `Client '<id>' connected to server.`, and in **Automation > Connect IoT** the driver instance moves through `Setup` to `Communicating`.

2. Send the line `CASE-7001`. The terminal shows `W`, the weight request of the controller.
3. Send the line `S 12.50 kg` within five seconds. The console logs `S 12.50 kg`, and the terminal shows `OK`.
4. Send the line `CASE-7002`, wait more than five seconds, and then send `S 12.50 kg`. The command fails with a message that it timed out while waiting for a reply from the device, `Log the missing weight logs No weight received`, and the late answer fires no event, because it does not start with `CASE-`.
5. Close the terminal. The console logs `Client '<id>' disconnected from server.`, and the driver instance stays `Communicating`.

Troubleshooting

Symptom	Cause	Fix
No event ever fires, or two messages arrive as one	The parser does not match how the device ends a message, or <code>delimiter</code> holds a token such as <code><ETX></code>	Set <code>parserType</code> and <code>delimiter</code> from the device format; use <code>Regex</code> for other control characters
The device receives the command but does not react	The frame has no line end, or <code>\r\n</code> was typed in Message End Token	Write <code><CR><LF></code> and turn the conversion on, on the command or for the connection
A <code>reply</code> holds a message that does not answer the command	The device sent another frame first, or several devices share a <code>Passive</code> connection	Use Reply Expected only for a device that answers at once and sends nothing on its own; otherwise declare the answer as its own <code>Token</code> property and event
A device stopped sending and nothing reports it	In <code>Passive</code> mode, a device disconnecting does not change the communication state	Do not rely on the state of a <code>Passive</code> connection to detect a loss; use <code>Active</code> when the device listens

Symptom	Cause	Fix
A command reaches every reader	In <code>Passive</code> mode, a command is written to every connected socket	Keep <code>maxClients</code> at <code>1</code> , or give each device its own connection on its own port

Next Steps

For a device that listens instead of connecting, set `mode` to `Active`, `host` to the address of the device, and `port` to its port; the rest of the tutorial is the same. To send every command with the same framing, set `commandMessageEnd` and `defaultConvertNonPrintableASCIICharsOnSend` as communication parameters, and keep **Command Structure Behavior** at `UseEquipmentSetupTaskSettings`. To report the weight to MES, continue with [Connect IoT - Talking to MES Tutorial](#), and for devices that speak HTTP, see [Connect IoT - REST Client and Server Tutorial](#).



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