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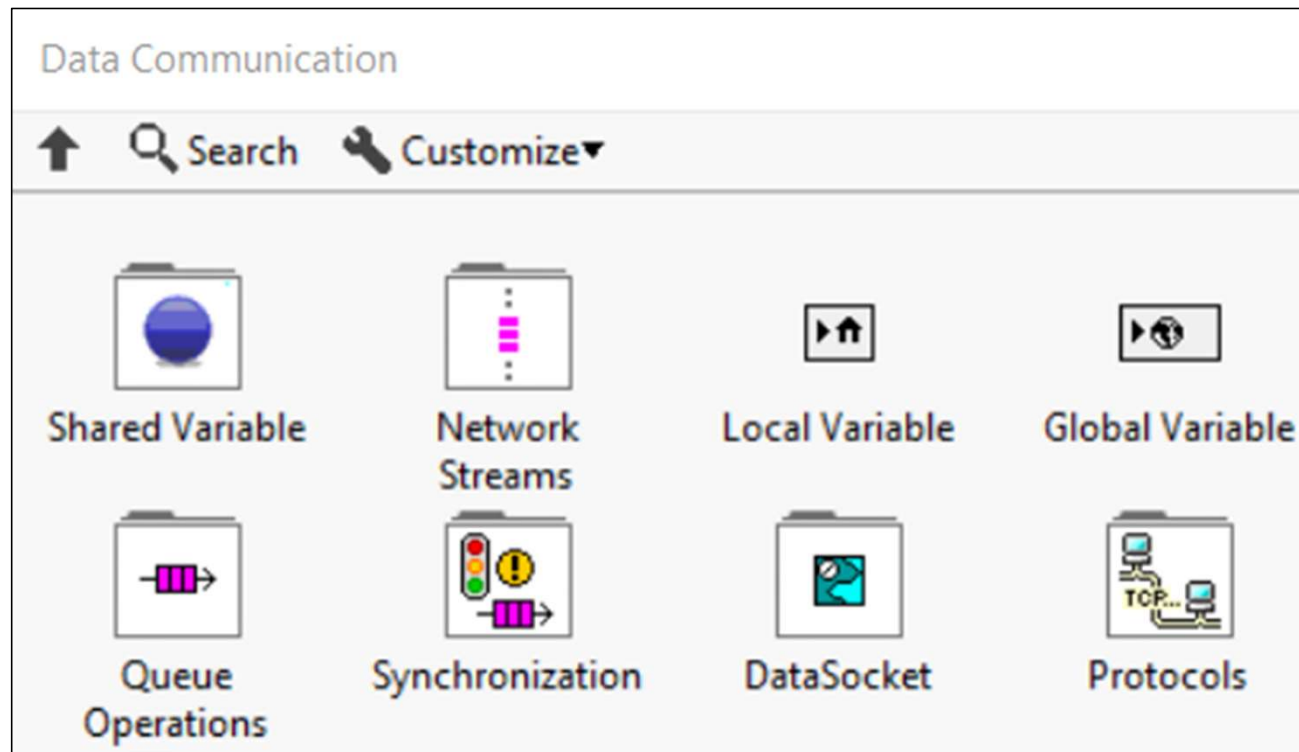
Cyber-Physical Industrial Systems

Module 3 Session 3
Data communication basics
Lecture





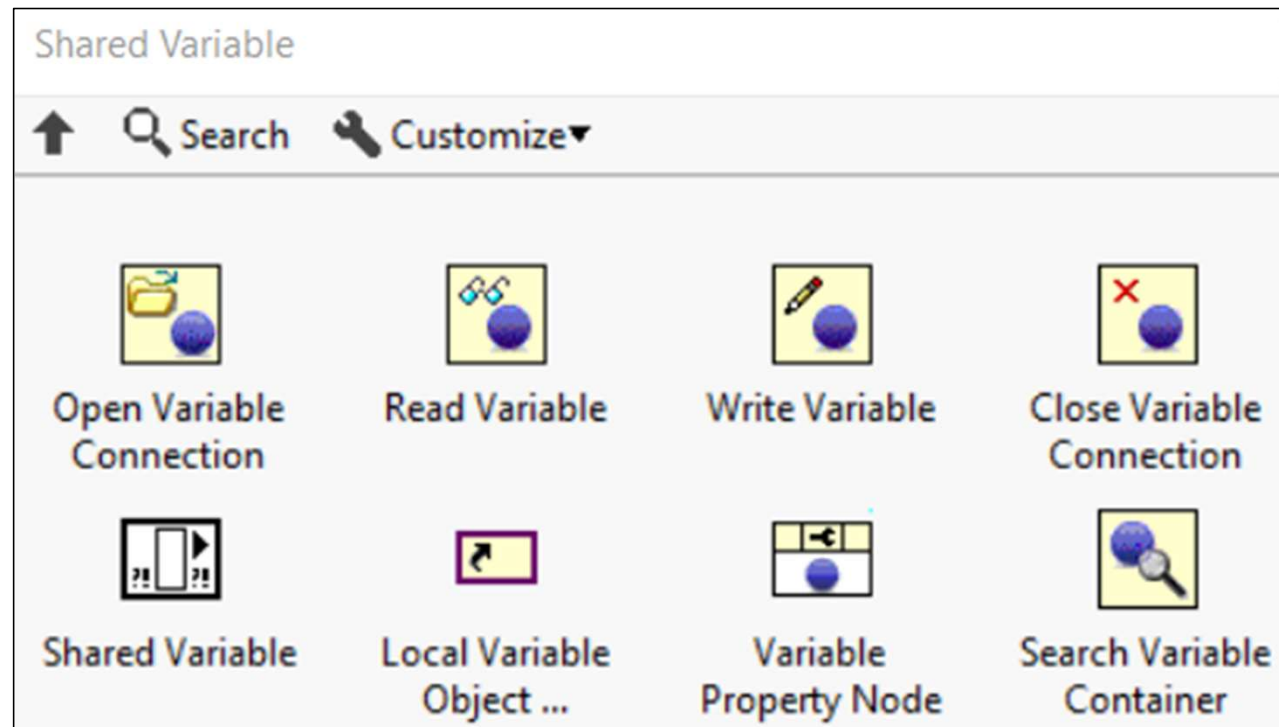
Data Communication methods



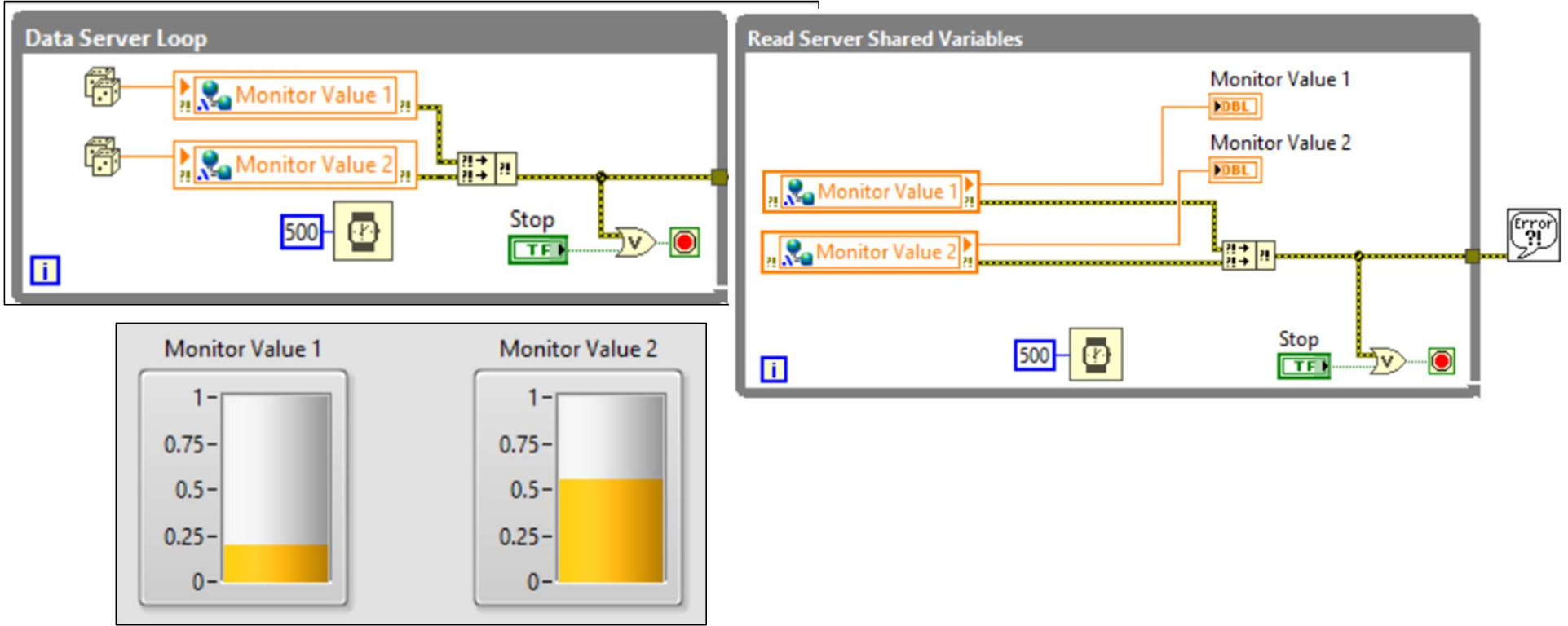
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Shared Variable functions



Shared variable example





Network Streams functions

Network Streams

↑ Search Customize

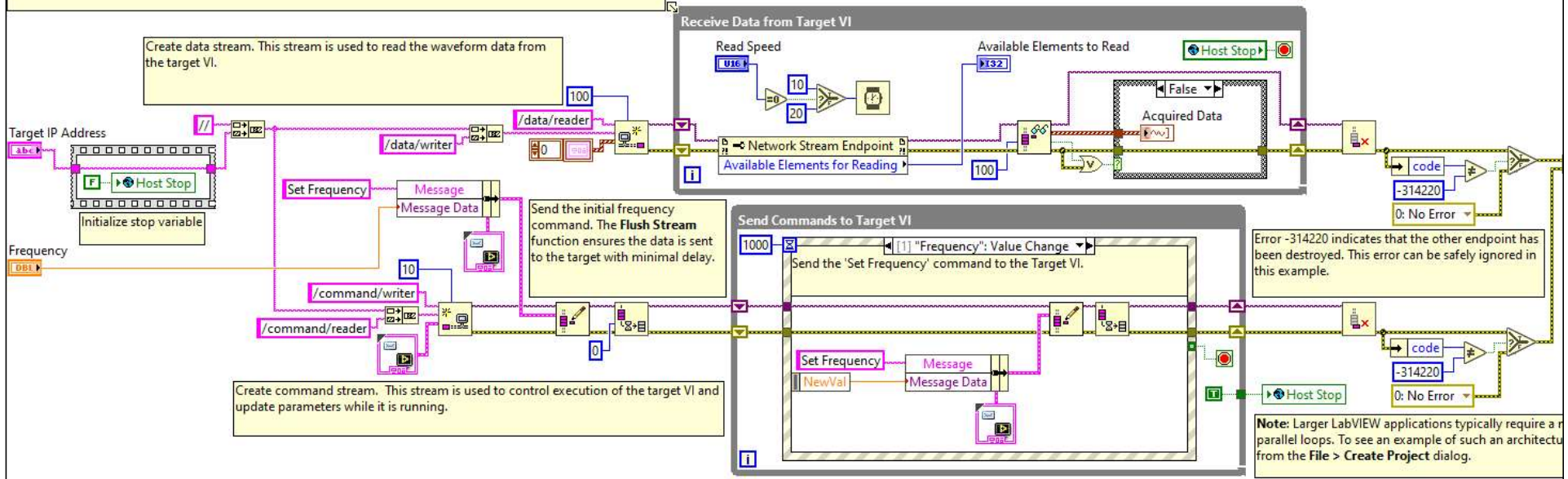
Create Writer	Write (1 Elem)	Write (N Elem)	Flush Stream	Destroy Stream Endpoint
Create Reader	Read (1 Elem)	Read (N Elem)		Network Streams ...



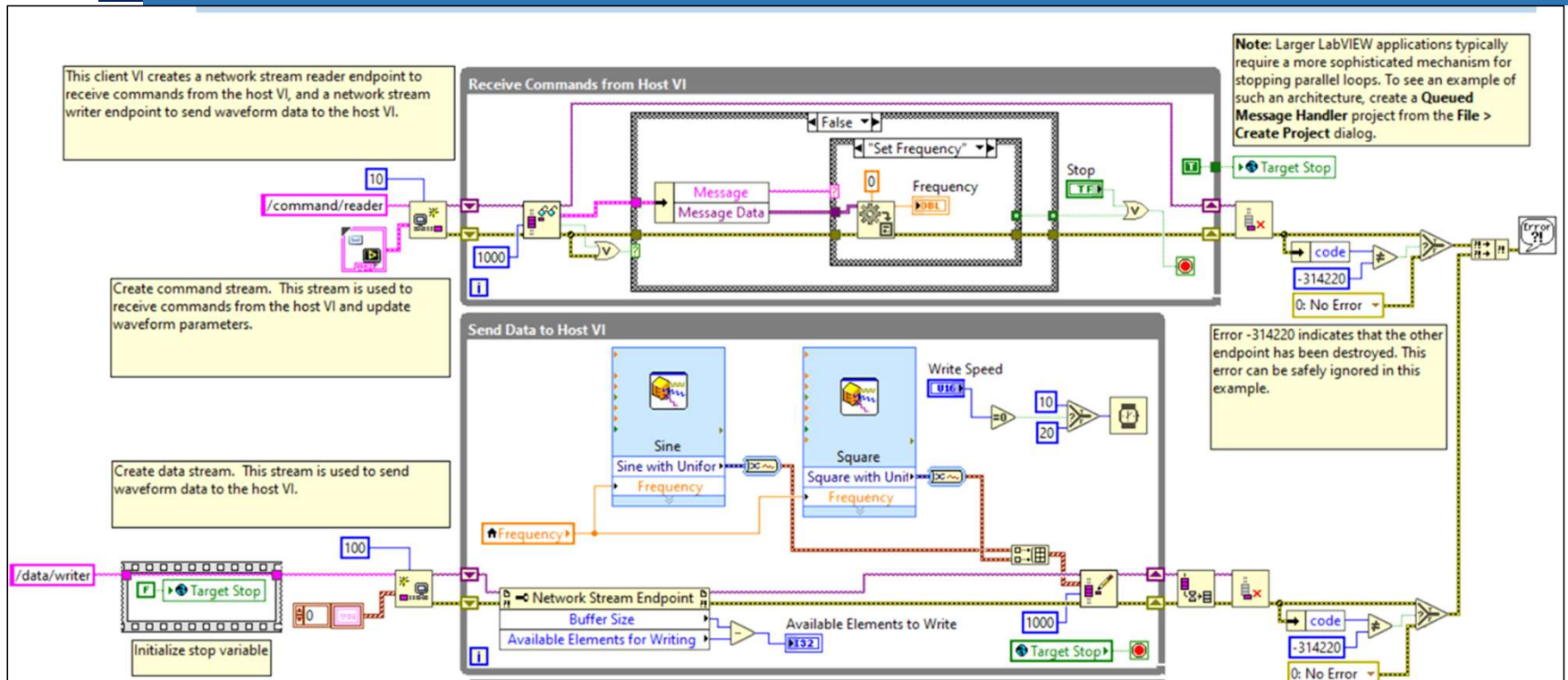
Network stream host

This host VI creates two Network Stream Endpoints...the writer endpoint will send commands to the target VI, and the reader endpoint will receive data from the target VI. Note that these endpoints can be created in any order, so it does not matter if the Target VI or the Host VI runs first. Also note that Network Streams can send/receive any data type. In the code below, the reader stream is an array of waveforms, and the writer stream is a cluster containing a string and a variant.

Note: You can use network streams properties (like the **Available Elements for Reading** property in this example) to determine how effectively data is being delivered through the network stream. If the stream writer is faster than the reader, the write buffer will fill up. If the stream reader is faster than the writer, the reader will timeout as it waits for new data.



Network stream target





Network Streams example

Available Elements to Read and Available Elements to Write.
5. Click Stop to stop the VI.

Target IP Address: localhost

Frequency: 11.6007

Acquired Data

Sine with Uniform Noise (selected)
Square with Uniform Noise

Read Speed: Slow (20 ms)

Available Elements to Read: 0

Write Speed: Slow (20 ms)

Available Elements to Write: 0

Stop

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Queue Operations functions

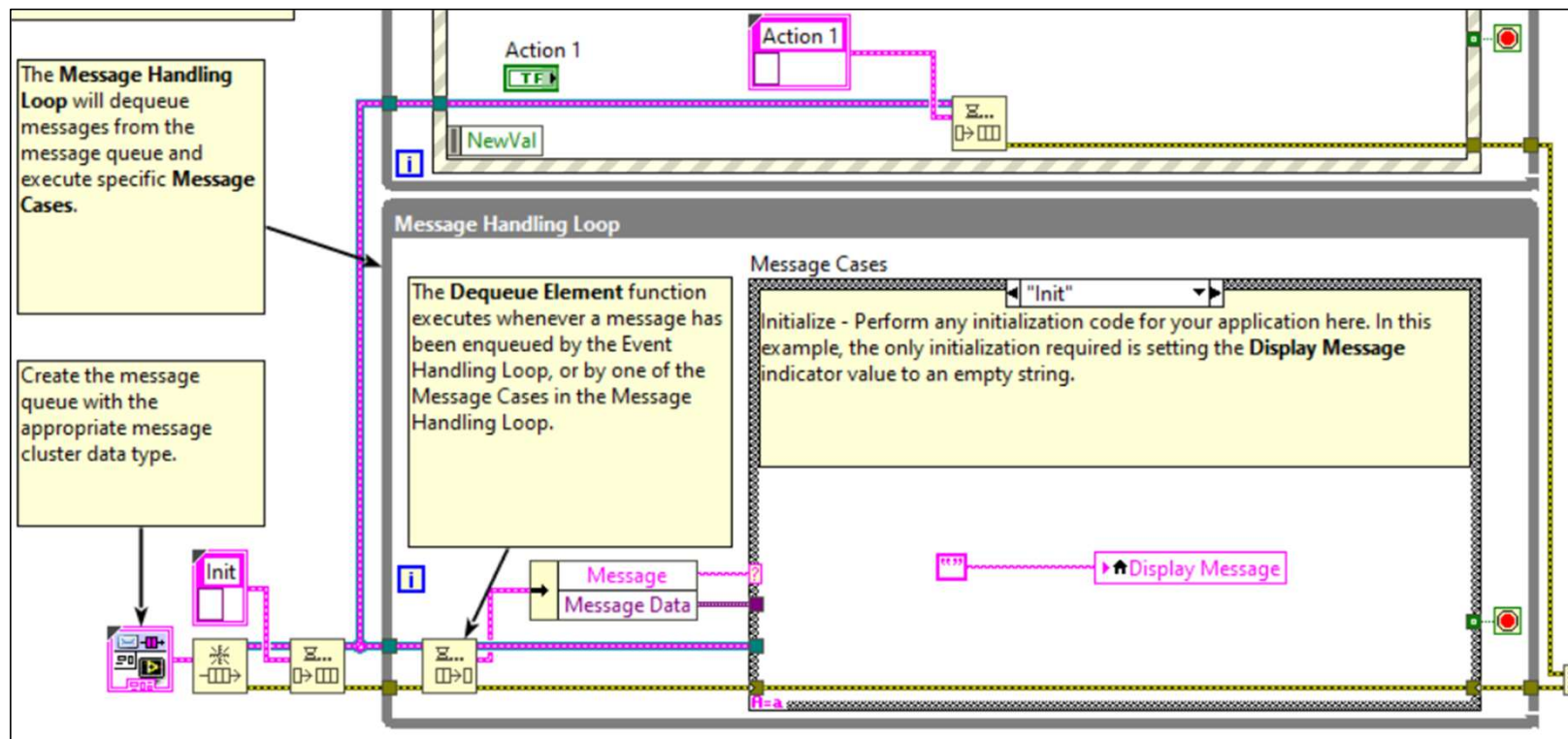
Queue Operations

↑ Search Customize

Obtain Queue	Enqueue Element	Preview Queue Element	Get Queue Status	Release Queue
Lossy Enqueue Element	Enqueue Element At ...	Dequeue Element	Flush Queue	



Queue Operations example





Other Synchronization methods

Synchronization

↑ Search Customize

Notifier Operations Queue Operations Semaphore Rendezvous Occurrences

Notifier Operations

↑ Search Customize

Obtain Notifier Send Notification Cancel Notification Get Notifier Status Release Notifier

Wait on Notification Wait on Notification ... Adv. Waiting

Semaphore

↑ Search Customize

Obtain Semaphore ... Acquire Semaphore.vi Release Semaphore.vi Release Semaphore ...

Get Semaphore Status.vi Not A Semaphore.vi

Occurrences

↑ Search Customize

Generate Occurrence Wait on Occurrence Set Occurrence

Rendezvous

↑ Search Customize

Create Rendezvous.vi Wait at Rendezvous.vi Resize Rendezvous.vi Destroy Rendezvous.vi

Get Rendezvous Status.vi Not A Rendezvous.vi

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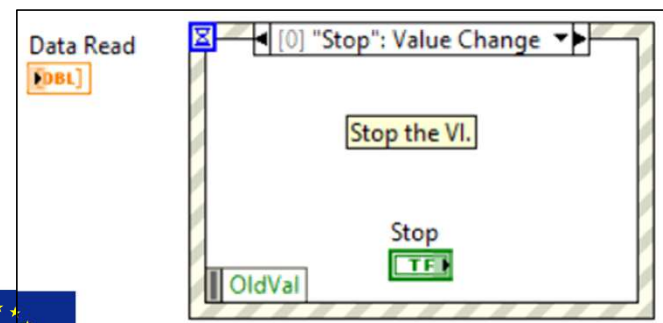
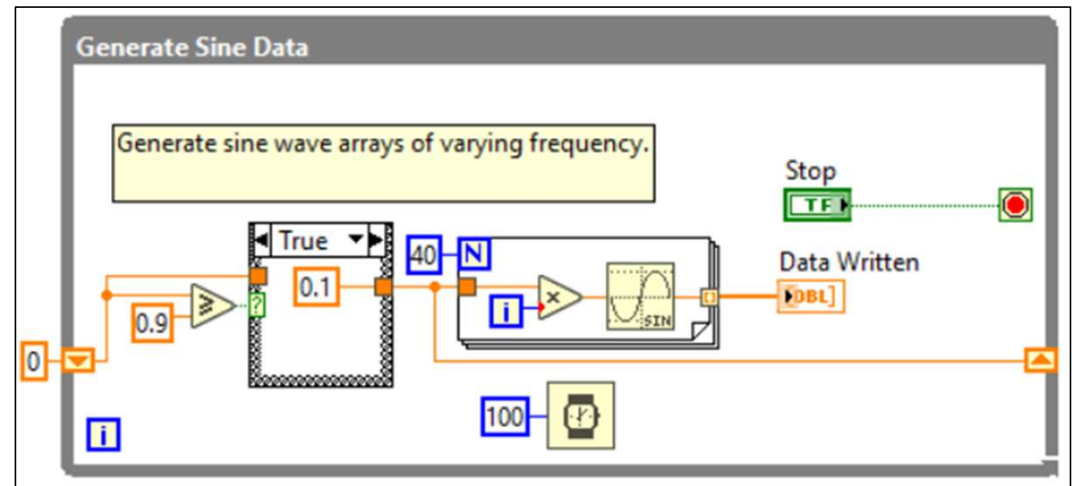


DataSocket functions and example

DataSocket

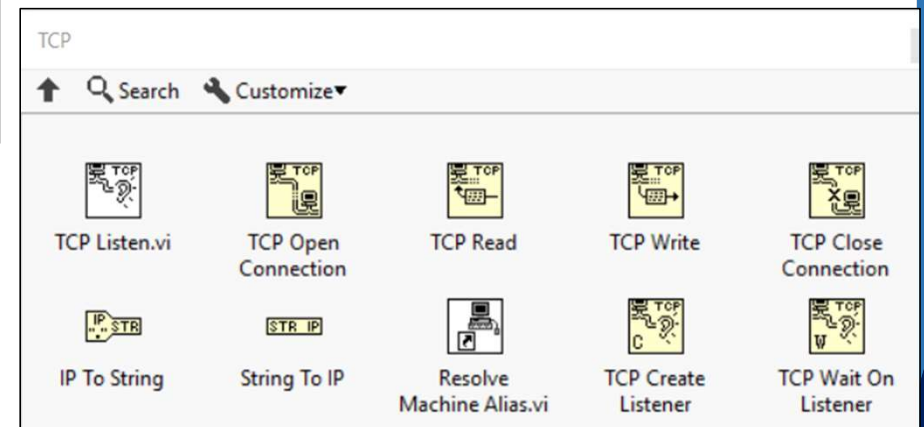
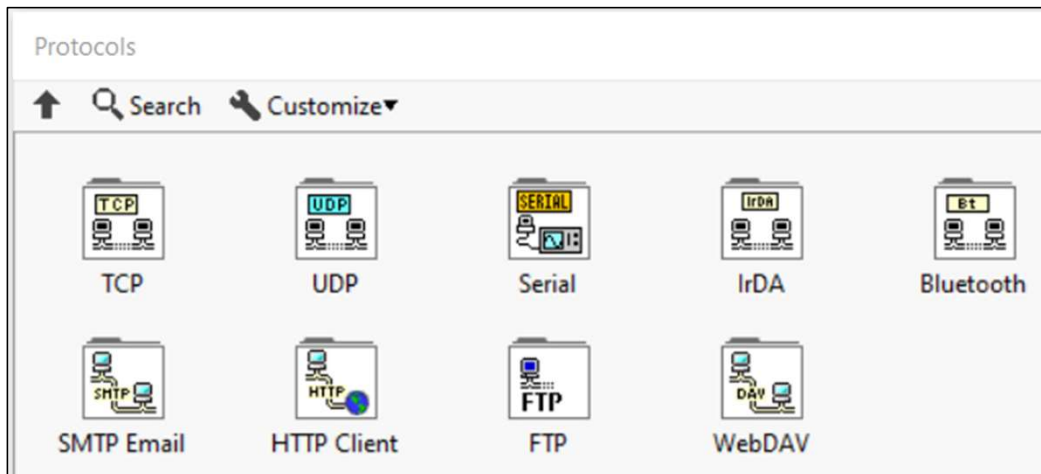
↑ Search Customize

DataSocket Read	DataSocket Write	DataSocket Select URL.vi
DataSocket Open	DataSocket Close	





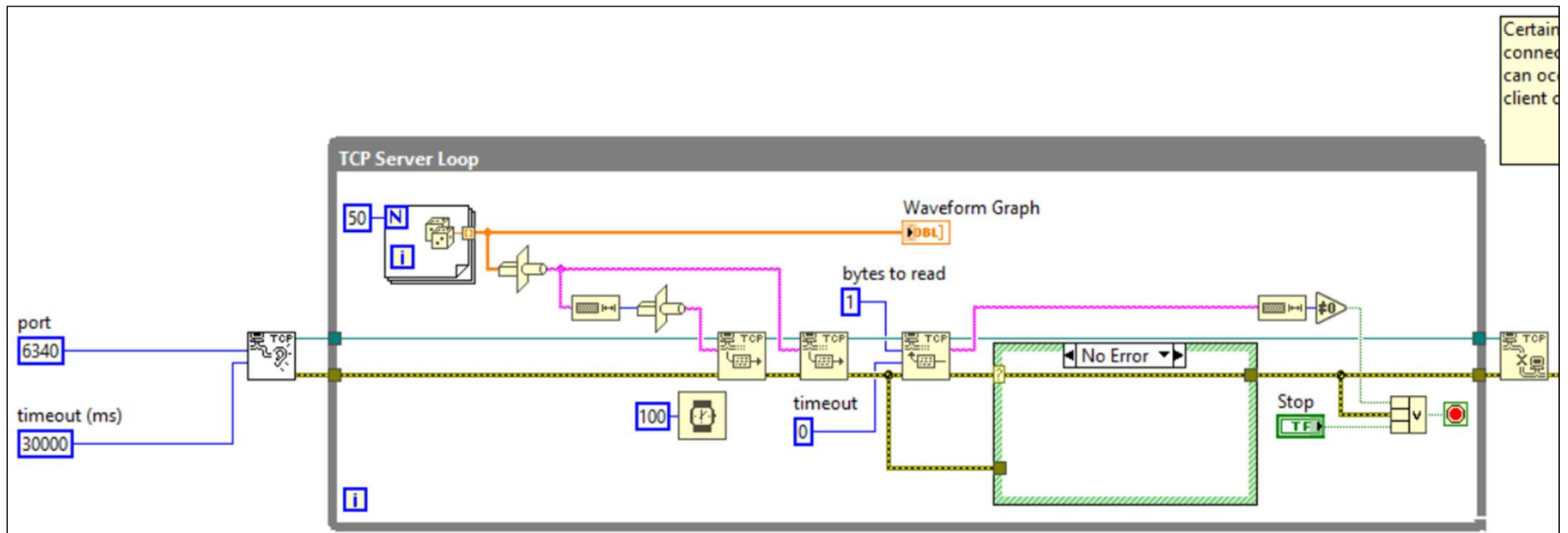
Main Internet communications protocols



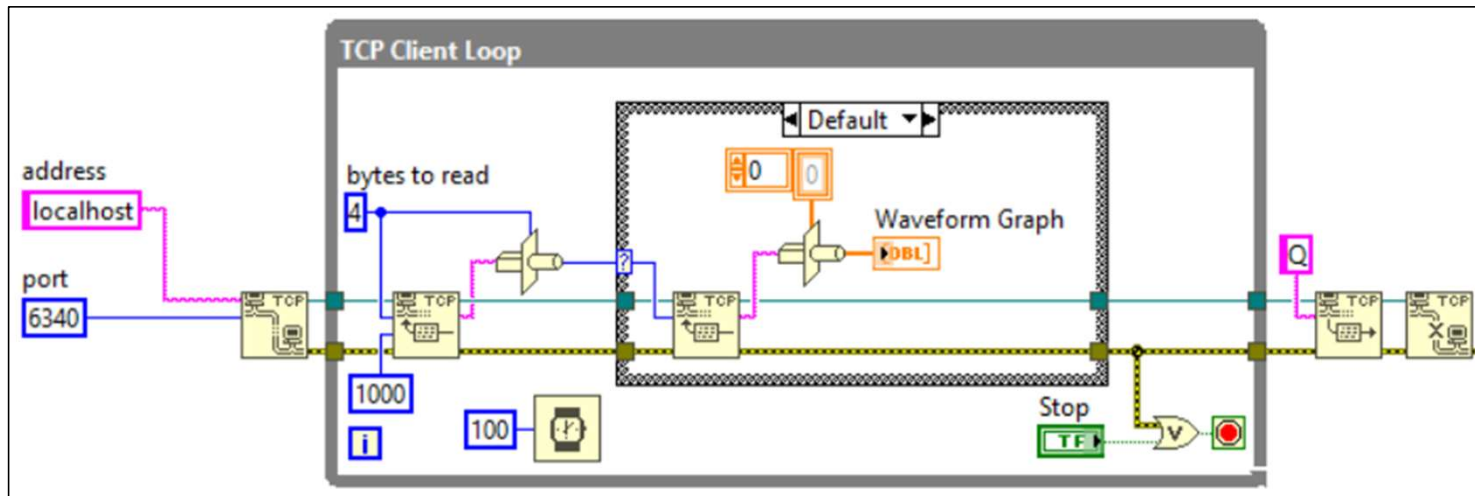
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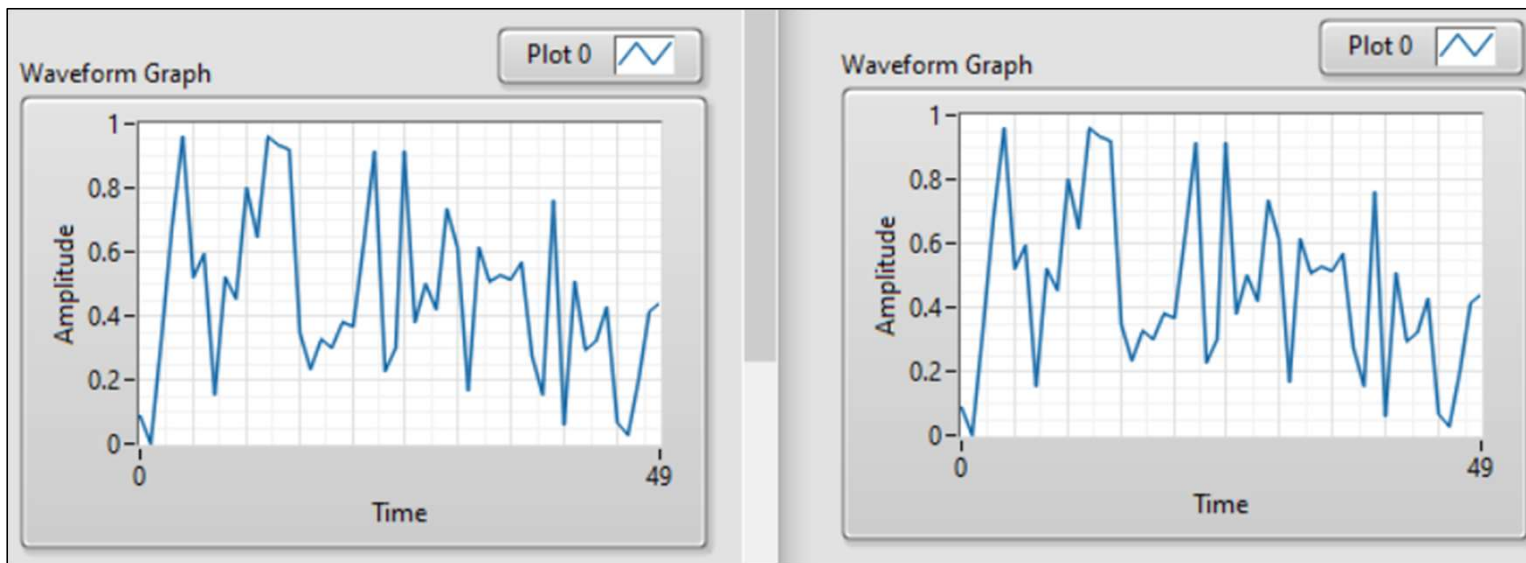
TCP Server example



TCP Client example



TCP data transfer example





Simple serial communication protocols

UDP

↑ Search Customize

UDP Open	UDP Multicast Open.vi	UDP Read	UDP Write	UDP Close

Serial

↑ Search Customize

Configure Port	Write	Read	Close
Bytes at Port	Break	Set Buffer Size	Flush Buffer

IrDA

↑ Search Customize

IrDA Discover	IrDA Open Connection	IrDA Read	IrDA Write	IrDA Close Connection
IrDA Create Listener	IrDA Wait On Listener			

Bluetooth

↑ Search Customize

Open Connection	Read	Write	Close Connection
Create Listener	Wait on Listener		

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Serial communication syntax example

Setting of set points for temperature and humidity²⁾

The following string sets the set points for temperature and humidity²⁾ to 25°C and 35% relative humidity and starts control.

Send string (PC → controller)

```
zT025.0F35R1100000000000000CC
```

Response string (controller → PC)

z{ACK}CC if the string has been accepted

z{NAK}CC if the string has not been accepted because, for instance, one of the set points is beyond the input limits.





Serial communication syntax example

getinfo

Response details	Description
INI	Device Initialization Time
RTC	RTC Time
RST	Restart Counter
ERR	Error Counter
SR	Number of Sent Records
BR	Number of broken records
CF	Profile CRC Fail counter
FG	Failed GPRS counter
FL	Failed link counter
UT	UPD Timeout counter
SMS	Sent SMS Counter
NOGPS	No GPS Timer
GPS	GPS receiver state. 0 – OFF, 1 – restarting, 2 – ON but no fix, 3 – ON and operational, 4 – sleep mode
SAT	Average satellites
RS	Reset Source Identification

Example: INI:2007/8/24 10:15 RTC:2007/8/24 12:43 RST:2 ERR:11 SR:182 BR:0 CF:0 FG:0 FL:0
UT:0 SMS:2 NOGPS:0:0 GPS:3 SAT:7 RS:7

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Email and HTTP functions

SMTP Email

↑ Search Customize

Send Email

Open Handle	Close Handle	Set Recipients	Set Message	Send
Set Attachments	Clear Attachments	Set Headers	Clear Headers	Config TLS

HTTP Client

↑ Search Customize

Open Handle	GET	HEAD	Close Handle
PUT	POST	POST Multipart	DELETE
Security	Headers		

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File Transfer Protocols

FTP

↑ Search Customize

FTP Get Buffer.vi	FTP Get File.vi	FTP Get Multiple Buffers.vi	FTP Get Multiple Files.vi	FTP Get Multiple Files and ...	Intermediate FTP
FTP Put Buffer.vi	FTP Put File.vi	FTP Put Multiple Buffers.vi	FTP Put Multiple Files.vi	FTP Put Multiple Files and ...	

WebDAV

↑ Search Customize

Simple Get	Simple Put	Synchronous	Asynchronous
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WebDAV Synchronous

↑ Search Customize

Open Session	Configure SSL	Close Session
Get	Put	
Create Directory	Directory Listing	Path Info
Copy	Move	Delete

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