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Peer-to-Peer Communications with CTC's Model 5300 Controller

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Peer-to-peer communication allows a Model 5300 controller to monitor (read) and change (write) a remote CTC controller's registers (variables) over an Ethernet network. The Model 5300 controller can act as a master or a remote on the network. CTC controller models 52xx, 51xx, and 27xx controllers with a 2717 can only act as remotes.

How are peer-to-peer communications useful in the field? You can use them to:

- Synchronize operations between multiple controllers
- Allow an HMI on the master to monitor and change functionality on a remote controller
- Provide a central point for data logging
- Add a new Model 5300 controller to an existing system with older model CTC controllers

How does it work?

Based on a high-speed communications mechanism called CTC Binary Protocol, the Model 5300 can read and update up to 50 remote registers from another Model 5300, typically within 2.5 ms of a request; and write one remote register in less than 20 ms. Register update times may vary depending on network traffic, communication settings, and how fast the remote device can fetch the requested data.

CTC Binary Protocol provides a simple way for a Model 5300 master to monitor and control functionality on remote CTC controller(s). Designated registers on the remote controller are made public and a copy of their contents is periodically transmitted across the network to the requesting controller(s). The update scan time is configurable and the registers may be read from or written to in a manner similar to regular registers or variables on the master controller. Multiple Model 5300 masters are supported on the network.

The Model 5300 can also map a group of registers from a remote controller to registers in the 5300. Up to ten register groups can be mapped, and groups can come from the same or different remote controllers. Each group can access up to 256 registers in the remote controller(s). However, a maximum of 2000 total registers can be mapped by a given master. The registers in the remote controller can be consecutive or randomly located.

Once the mapping is set up, the registers in the master controller automatically update with the remote data at the update rate (typically set to 100 ms). Writes from the master are sent out on-demand one at a time when the value is changed on the master. The master communicates to the remote controller(s) over a standard Ethernet network connecting directly to the Ethernet ports on the remote controller(s).

Reserved Registers

Registers 21000-21299 are reserved for peer-to-peer communications and are read/write registers. Each block of ten sequential registers is assigned to a designated peer node and defines the peer environment for that connection. This register block can also be used for other functions besides CTC peer-to-peer communications. For example, this register block can be used for Modbus communications, interfacing in a similar manner.

Initiating a Peer-to-Peer Session

Use the following steps to initialize the 5300 controller's peer-to-peer mechanism:

1. Write the desired number of registers (maximum of 256) to 21XX5 register.
2. Write the remote's IP address to 21XX0 - 21XX3 register.
3. Write the register to begin reading from the remote device to 21XX4.
4. Write a 1007 to register 21XX8 to select the re-mapping area.
5. Designate the location in the 23000-24999 register range you want the remote register to appear to the register 21XX9.
6. Write a 0 to the index register 21XX8 to default it back to viewing the first data item.
7. Write the scan time, typically 100 ms, to register 21XX6 to initiate the connection and begin peer-to-peer.
8. Monitor status register 21XX7 for a 1 prior to reading/writing to either the 21XX9 data area or the re-mapped area in the 23000-24999 block.

Programming Examples

Either QuickStep 2 or QuickBuilder can be used to set up a peer-to-peer communications link. A QuickStep 2 and a QuickBuilder example are provided below to show how to set up a peer-to-peer session. Be sure to check *Document No. 951-530006: Model 5300 Quick Reference Register Guide* on our web site for the latest register assignment information and any important user notes:
http://www.ctc-control.com/customer/techinfo/docs/5300_951/951-530006.pdf

Caveats on using Peer-to-Peer Communications

Be aware of the following caveats of peer-to-peer networks:

1. A node may not always be operational. Retry a transaction with the appropriate action.
2. Limit the number of hosts on your network or no devices will be listening.
3. Do not bog down the network with unnecessary traffic.

Peer-to-Peer Programming Examples

Two examples are provided to help familiarize you with peer-to-peer networking using the CTC controllers. The first example uses Quickstep2 and is based on the example given in the *Model 2217 EtherNetworking Module Installation Guide*. You can find the original at CTC's website: http://www.ctc-control.com/customer/techinfo/docs/2217IG.pdf.

The second example uses QuickBuilder.

Note the caveats listed apply to all controllers set up for peer-to-peer networking. When you design peer-to-peer programs, the following conditions apply:

- All nodes, including PCs, must have unique node numbers in order to place these values in the peer-to-peer registers (21000-21999).
- You must check the transaction status registers (24000-24999) before using the data in the peer access registers (23000-23999) or after sending data to another controller.

Peer-to-Peer Networking: Sample Quickstep2 Program

[1] INITIALIZE_MASTER

This program is used to initialize the TCP port for the Master TCP operation. A single device is polled using device ID 1 and 256 registers are read and mapped into the 23000 block. Therefore registers 23000-23255 are used, with 23000 referencing remote register #501. Make sure your remote device has at least 255 consecutive registers starting at '501;' otherwise Exception errors will occur.

Begin by doing the following:

```
        21005= 255= Set number of registers to read 255 (maximum 256)
        21000-21003= Set this to the IP address to connect to.
        21004= 501= remote start register '501'
        21008= 1003= Set index to point to protocol register
        21009= 8= CTC Binary Master UDP, 9 is TCP (think of 5300 being CTCMON or VB)
        21008= 1007= Set index to point to where to view data.
        21009= 23000= Start re-mapped area at 23000 for 255 regs.
        21008= 0= Always set the index back to 0 before begin.
        21006= 100= Set scan poll time to 100ms/block read,
        min=100ms. This also initiates polling.
------------------------------------------------------------------------
<NO CHANGE IN DIGITAL OUTPUTS>
------------------------------------------------------------------------
        store 255 to R21005_MAX_REGS
        store 192 to R21000_IP_OCT1
        store 168 to R21001_IP_OCT2
        store 1 to R21002_IP_OCT3
        store 153 to R21003_IP_OCT4
        store 501 to R21004_MOD_START_REG
        store 1003 to R21008_INDEX
        store 8 to R21009_MOD_CONFIG
        store 1007 to R21008_INDEX
        store 23000 to R21009_MOD_CONFIG
        store 0 to R21008_INDEX
        store 100 to R21006_POLL_TIME
        goto Next
```

[2] WAIT_FOR_ONLINE

Once the Master starts to poll, we must wait until it is online before proceeding.

```
------------------------------------------------------------------------
<NO CHANGE IN DIGITAL OUTPUTS>
------------------------------------------------------------------------
        if R21007_STATUS=1 goto MASTER_ONLINE
        delay 500 ms goto WAIT_FOR_ONLINE
```

[3] MASTER_ONLINE

It is ok to read and process data now since the Master is online to the remote device. If you wish to monitor another device other than unit ID 1, then change the index register 21008 to 1005 and write the desired ID to register 21009, then set 21008 back to 0 and monitor 21007 for a '1' for online state once again. Results will appear in the 23000 block.

```
------------------------------------------------------------------------
<NO CHANGE IN DIGITAL OUTPUTS>
------------------------------------------------------------------------
delay 1000 ms goto MASTER_ONLINE
```

Peer-to-Peer Networking: Sample QuickBuilder Program

The example below is a simple QuickBuilder project that uses a peer-to-peer network to read and write registers automatically in a remote CTC 2700 controller. The graphical SFC view of the project is shown below (see Figure 1). The code for each step is also included. To replicate this example, set up the project steps and then cut and paste the code into the QuickStep4 editor. Modify the registers, IP addresses, etc. as needed.

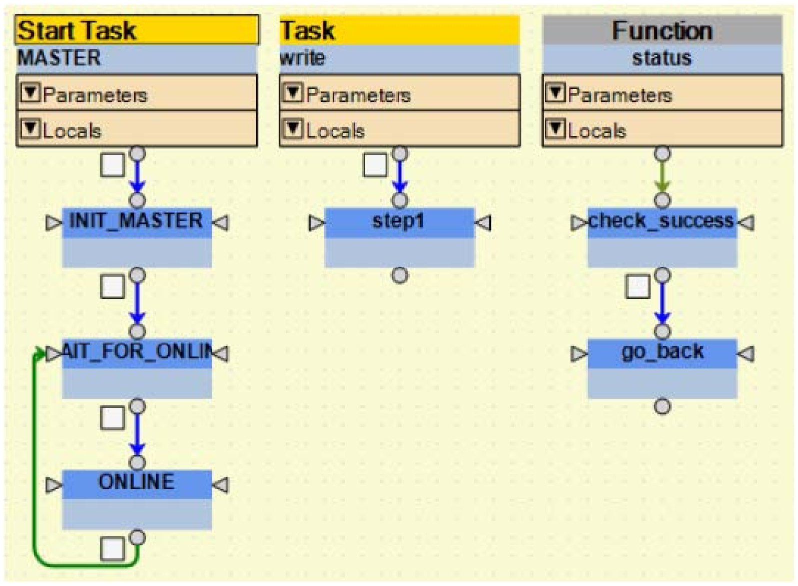


Figure 1

There are two tasks in this project (MASTER and write). This project also uses a function called *status* that checks for successful writes. The code below was copied directly from each of the steps in the QuickBuilder Step Editor. The resource listing for the project is given at the end of this example.

Start Task: **MASTER**

step: **INIT_MASTER** consists of the following comments (green print) and instructions:

/*INITIALIZE_MASTER

A single device is polled using device ID 1. 255 registers are read and mapped into the 23000 block. Therefore registers 23000-23255 are used, with 23000 referencing register #501 in the slave controller. Make sure your slave controller has at least 255 consecutive registers starting at '501;' otherwise Exception errors will occur.

Begin by doing the following:

21005= Maximum number of registers to read (255)

21000-21003= Set this to the IP address to connect to.

21004= Slave Controller start register '501'

21008= 1003= Set index to point to protocol register

21009= 2= Set protocol (8=UDP, 9=TCP,

21008= 1007= Set index to point to where to view data.

21009= 23001= Start re-mapped area at 23000 for 255 regs.

21008= 0= Always set the index back to 0 before begin.

21006= 100= Set scan poll time to 100ms/block read,

```
min=50ms. This also initiates polling.*/
begin write;
R21005_MAX_REGS =255;
R21000_IP_OCT1 =192;
R21001_IP_OCT2 =168;
R21002_IP_OCT3 =1;
R21003_IP_OCT4 =153;
R21004_MOD_START_REG =501;
R21008_INDEX =1003;
R21009_MOD_CONFIG =8;
R21008_INDEX =1007;
R21009_MOD_CONFIG =23000;
R21008_INDEX =0;
R21006_POLL_TIME =100;
```

step: **WAIT_FOR_ONLINE** consists of the following comments (green print) and instructions:

```
/* WAIT_FOR_ONLINE
Once Modbus Master starts to poll, we must wait until it is online before proceeding.*/
if R21007_STATUS==1 goto ONLINE;
delay 500 ms;
goto WAIT_FOR_ONLINE;
```

step: **ONLINE** consists of the following comments (green print) and instructions:

```
/*CONTROLLER_ONLINE
It is ok to read and process data now since controller is online to the device. If you wish to monitor another
device other than unit ID 1, then change the index register 21008 to 1005 and write the desired ID to
register 21009, then set 21008 back to 0 and monitor 21007 for a '1' for online state once again. Results will
appear in the 23001 block.*/
delay 1000 ms;
```

Start Task: **write**

step: **step1** consists of the following comments (green print) instructions:

```
/*This step writes to registers 23000-23004 on the master thus sending the same information to registers
501-505 on the slave controller.*/
R23000=1;
call status;
R23001=2;
call status;
R23002=3;
call status;
R23003=4;
call status;
R23004=5;
call status;
```

Function: **status**

step: **check_success** consists of the following comments (green print) instructions:

/*This step checks status register 21007 to ensure the register information was written to the slave.*/

when R21007_STATUS ==1 **goto** go_back;

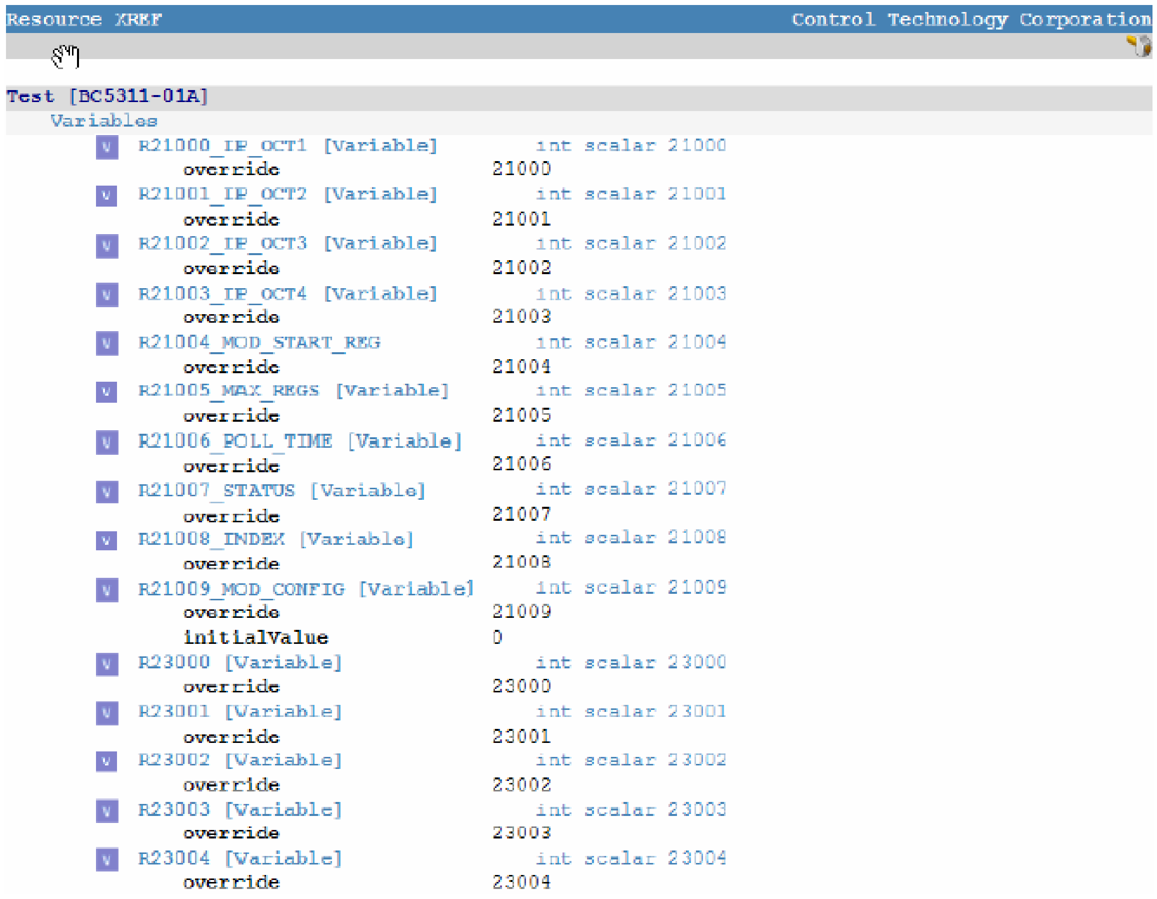
step: **go_back** consists of the following comments (green print) instructions:

/*After checking the status of register 21007 we return to the program to perform the next instruction.*/

return;

Please note: This programming example requires you to "Override" the variable register assignments with register assignments shown below (see Figure 2). This is done simply by entering the desired register number in the "Override" field of the variable's properties (a "zero" in this field enables Auto Register Assignment). For information regarding a simple, more advanced method to select specific registers, refer to *Document No. 951-530020: QuickBuilder Reference Guide*:

http://www.ctc-control.com/customer/techinfo/docs/5300_951/951-530020.pdf



```
Resource XREF                                              Control Technology Corporation

Test [BC5311-01A]
   Variables
        R21000_IP_OCT1 [Variable]          int scalar 21000
            override                   21000
        R21001_IP_OCT2 [Variable]          int scalar 21001
            override                   21001
        R21002_IP_OCT3 [Variable]          int scalar 21002
            override                   21002
        R21003_IP_OCT4 [Variable]          int scalar 21003
            override                   21003
        R21004_MOD_START_REG               int scalar 21004
            override                   21004
        R21005_MAX_REGS [Variable]         int scalar 21005
            override                   21005
        R21006_POLL_TIME [Variable]        int scalar 21006
            override                   21006
        R21007_STATUS [Variable]           int scalar 21007
            override                   21007
        R21008_INDEX [Variable]            int scalar 21008
            override                   21008
        R21009_MOD_CONFIG [Variable]       int scalar 21009
            override                   21009
            initialValue               0
        R23000 [Variable]                  int scalar 23000
            override                   23000
        R23001 [Variable]                  int scalar 23001
            override                   23001
        R23002 [Variable]                  int scalar 23002
            override                   23002
        R23003 [Variable]                  int scalar 23003
            override                   23003
        R23004 [Variable]                  int scalar 23004
            override                   23004
```

Figure 2

The previous example initiates the master controller then writes to the first five registers of the defined block. Notice that much of this program was "copied and pasted" from the QuickStep2 program. For questions regarding the functionality of this example or peer-to-peer networking, in general, e-mail customersupport@ctc-control.com or call 1- 800-282-5008.