

DATRAN Q03 RTU - Store and Forward

Background

It is often necessary for RTUs to directly communicate with each other without the need to pass signals via the Base Station.

This is generally for one of two primary reasons;

1. Control Loop

When I/O from one site is required to make decisions about control at a separate site, such as controlling the pumps that fill a remote reservoir.

2. Comms Coverage

To improve comms coverage in an area where one or more RTUs does not have a “line of sight” communication path with the Base Station (or repeater).

Historically, this functionality has been provided by the Q37 DATRAN II Comms Module. Q37 is a DATRAN IPB expansion module that connects to the Master RTU and communicates with the Slave RTU sites via a dedicated analogue radio link. The Q37 polls each of the slave sites in a round-robin fashion and presents the I/O of each slave to the master as if it were local expansion I/O. Most of the required configuration is carried out in the Q37 module itself using HyperTerminal or some similar terminal application. The limitation of a Q37 is that it only deals with passing I/O between the master and slave RTU(s). The Base Station can not communicate directly with the Slave RTUs and can only see I/O from the slaves as they appear as a subset of the Master RTU's I/O table. This means that the Base Station cannot transmit a DLP or carry out RTU data logging operations for the Slave RTU.

Improvements

With Q03 firmware version v5.22+, new options are available so that the Master RTU can now pass messages directly from the Base Station to Slave RTUs. This allows more advanced functionality such as being able to send a DLP and facilitating “RTU data logging” at the Slave RTU.

This new functionality allows RTUs to communicate directly with each another utilising high speed data radios, digital radios or 1200bps analogue radios. Not only does this improve system flexibility it provides a powerful store and forward functionality.

Prerequisites

- Master RTU to have a Q03 processor and a spare RS232 Port
- Master to have v5.22 firmware or later
- Slave RTU to have a Q03 processor and a spare RS232 Port. It is recommended to have v5.22+ firmware to take advantage of improvements
- Q90 version 3.28
- An optional Slave radio firmware license code for the Master RTU

Master Slave Operating Modes

There are two operating modes which can be used individually or combined:

Master Slave Forwarding Mode

When in forwarding mode, the Master RTU will listen on the main radio network for any radio packets addressed to either itself, or one of its Slave RTUs. When it receives a message for one of its Slave RTUs, it will then forward that packet on to the slave radio port so that the Slave RTU can receive it, and respond. Any packets being transmitted by the Slave RTU are likewise received by the Master RTU and forwarded to the base station. When a Slave RTU is configured in this mode, the Master RTU may have some I/O registers allocated in its I/O table that correspond to the I/O at the slave site. The outputs cannot be controlled by the Master RTU, but as input information passes through the master, it is detected or “sniffed” so that the master can monitor the status of the inputs at the slave and can use this information to control “local I/O” i.e. pumps etc. if required. If the Slave site sends a Change of State, it will be acknowledged by the base.

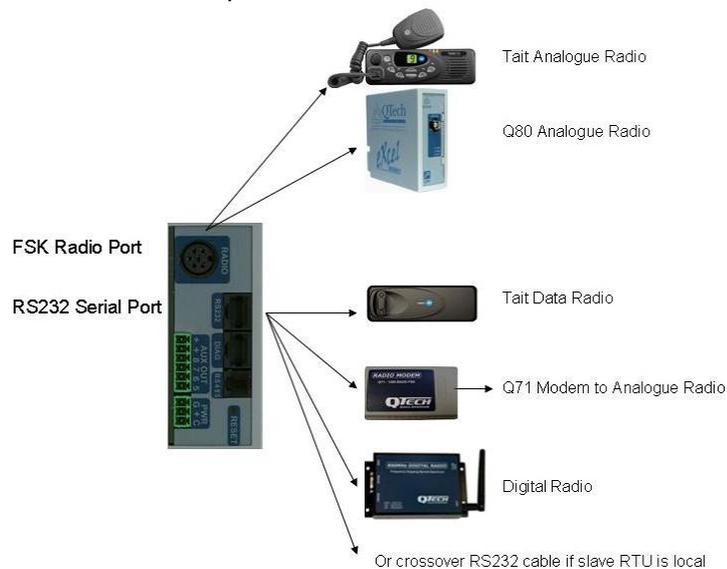
Master Slave Polling Mode

When in polling mode, the Master RTU will behave the same way as a Q37 Comms Module based system. It will periodically poll slaves to write outputs to them and read back their inputs, but it will not pass messages between the base station and the slave. Any I/O information from the Slave RTU that needs to go back to the base station will go back as a subset of the master site’s I/O schedule. If the Slave site sends a Change of State, it will be acknowledged by the Master.

Master Slave Forwarding and Polling Mode

When both modes are activated the Master RTU will poll the Slave RTUs as well as forwarding communications from the base station. In this case, there is contention over which will control the outputs of the slaves and acknowledge the Changes of State; The Base or the Master RTU. Q90 allows the user to specify which source will take precedence. This is a global setting on the Master RTU and will apply to all slaves it has configured in this manner. Q90 also allows the user to specify whether the Base or the Master RTU acknowledge Change of State packets.

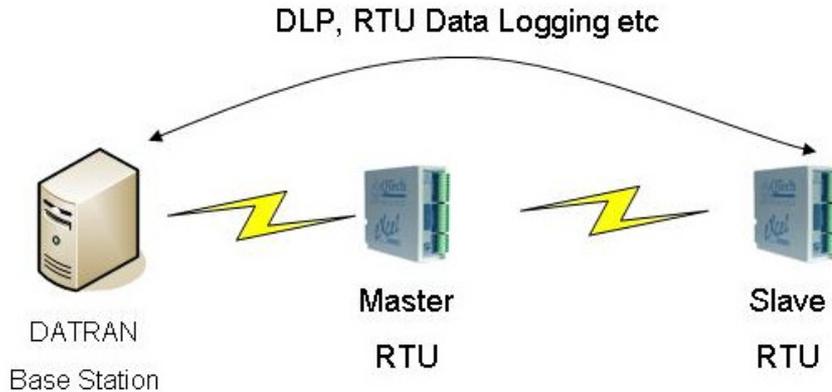
There are many communication options from the Master RTU to the Slave RTU:



The following examples demonstrate a number of configuration scenarios, all using the popular high speed 2400bps Tait data radios for slave communications.

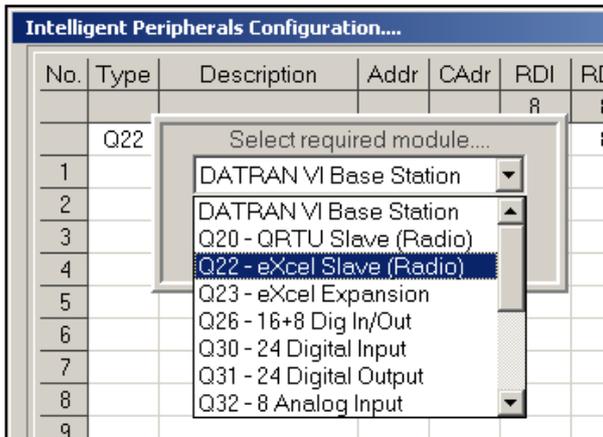
Example 1 –Master Slave Forwarding Mode

This option would generally be used where forwarding is being used to achieve a communications path to a slave that would otherwise not be possible, and the Master DLP does not need to interact with the slave site(s).



Slave RTU can run a DLP	✓
Base Station can transmit DLP to Slave RTU	✓
Slave RTU can RTU Data Log	✓
Master RTU controls Slave RTU I/O	✗
Base Station controls Slave RTU I/O	✓

Once the Master Slave RTU option is unlocked with the firmware code, the first step in setting up the RTU is to add a new IPB expansion module with Q90, as you would for any other I/O module. You will need to first enter the RTU address (DIP switches) of the slave RTU you are configuring. This RTU address cannot be the same as the IPB address of any local I/O expansion modules you might have at the master RTU. It is recommended that you give the slaves addresses that are much higher than the local expansion I/O to allow for additions in the future. Select either QRTU Slave (Radio) or eXcel Slave (Radio) depending on what type of slave you have. You will then be



prompted to enter the I/O count for the slave module in the same manner as has historically been required with a Q37.

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Note – Make sure any Master RTU I/O modules are addressed lower than the slaves.

Once this configuration has been completed it is time to set up your serial port. Either the Q03 serial port, or Q22D serial port is suitable. You need to configure the RTU's RS232 serial port to use the "Slave Radio" *Device Type*. The rest of the RS232 configuration will be handled automatically by the Slave Radio configuration window. Once the serial port *Device Type* is configured as shown, click the configure button to open the Slave Radio configuration window.



Here you will see several options that relate to the configuration of the slave RTU(s). In this particular example we will want the options to be set as shown.

Address	Type	Polling	Forwarding
5	Q20	<input type="checkbox"/>	<input checked="" type="checkbox"/>

The *Communication Method* allows different devices to be used to communicate with the Slave RTU(s). At the moment, the options are Tait TM81xx Data Radio, Q71 external 1200 bps FSK modem, serial cable, QTech Digital Radio and Q22C internal FSK radio.

Poll slaves every x allows the user to specify the duration of the polling cycle for all the slaves that are configured to use polling. This is the total round-robin time for all the slaves and the Master RTU will evenly space the polling so that they are all polled within this period. In this example it will have no effect, as we are using forwarding mode only.

Outputs Controlled by: DATRAN or Master RTU. Forwarding allows the DATRAN VI base station to control the

outputs of the Slave RTU, and Polling allows the master to do the same thing. The Master RTU needs to be told which source will be controlling the outputs to the Slave RTUs when both options are enabled. In this example it will have no effect.

CoS ACKed by: DATRAN or Master RTU. Similarly, when both forwarding and polling are enabled, the Master RTU must be told whether to acknowledge Slave Changes of State itself, or to forward them to DATRAN to be acknowledged. Again in this example this has no effect.

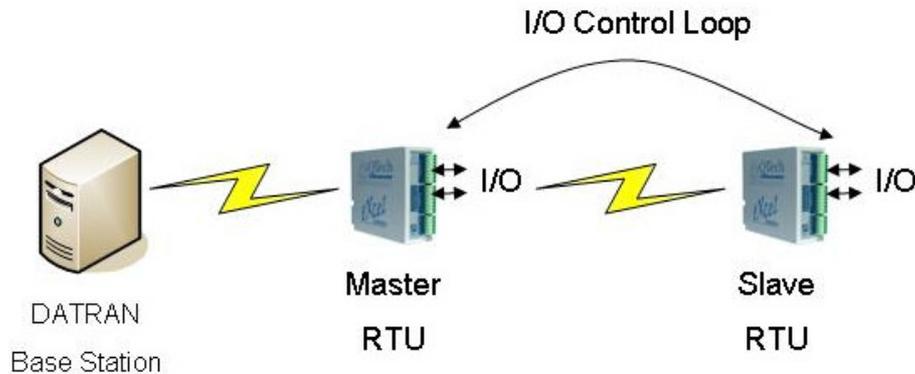
This is all that is required at the Master RTU. The Slave RTU will be configured as though it were any other normal RTU doing base comms out of a serial port using a TM81xx radio.

From the base station's point of view, these sites will be configured as two normal, separate sites. Each site will have its own comms object, and the base does not need to know in any way that the either the master or the slave are anything different.

An important point to consider is that there will be a small delay in polling the Slave RTU as the master stores up the packet and then forwards it on to the slave. Remember to allow enough time for this turn-around when setting your retry times in the slave site's comms object. The actual delay is very dependant on the system and comms speed etc, but a suggested starting point is an additional 10 seconds on top of your usual setting.

Example 2 –Master Slave Polling Mode

This example is essentially a “Q37 comms module replacement” system. It is generally for use where the DLP in the Master RTU needs to be able to control outputs at the slave site.



Slave RTU can run a DLP	✓
Base Station can transmit DLP to Slave RTU	✗
Slave RTU can RTU Data Log	✗
Master RTU controls Slave RTU I/O	✓
Base Station controls Slave RTU I/O	✗

The first part of the configuration for setting up a polled slave is the same in this example as it was in example 1. First, add the Slave RTU module as an IPB expansion module. Second, set up the serial port you will be using to use the “Slave Radio” *Device Type*.

The screenshot shows the 'Configure Slave Radio functionality' dialog box. The 'Communication method' is set to 'Tait Data Radio'. 'Poll slaves every' is set to '20 seconds'. Under 'Outputs controlled by:', 'Master RTU' is selected. Under 'CoS ACKed by:', 'Datran' is selected. The 'Configured Slaves' table has one entry with Address '5', Type 'Q20', Polling checked, and Forwarding unchecked. 'Cancel' and 'OK' buttons are at the bottom.

Address	Type	Polling	Forwarding
5	Q20	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Once the configure button for the serial port is pressed, this time untick the “Forwarding” Box for the Slave RTU and tick the “Polling” Box. This will now allow the Master RTU to begin polling the Slave RTU, in this case on 20 second intervals. If there were two slaves configured, the Master RTU would poll them 10 seconds apart so that the total time to cycle through all the slaves would be 20 seconds.

The outputs that are being written out to the slave RTU will in this case be controlled by the Master RTU, and any polling that comes from the base station that is addressed to the slaves will be ignored and not forwarded by the RTU.

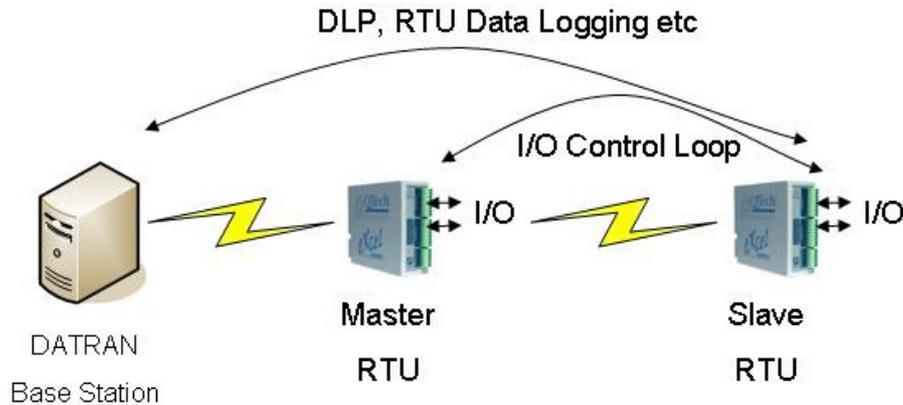
The inputs coming back from the slave will appear as expansion inputs in the master RTU, and depending on the configuration

of the DLP these can then be copied back to the base station.

Effectively this will be the same behaviour as is currently available via a Q37 comms module. The slave site in the TBD file will have no real comms object of its own, and all the formulae nodes in the slave site will point back at the I/O coming from the master site comms object.

Example 3 – Master Slave Polling and Forwarding Mode

This configuration would be suitable for sites where the DLP of the Master RTU needs I/O information from the slaves to be able to do its job correctly. Additionally, this configuration allows the base station to carry out data logging functions and transmit DLPs to the slaves. This is an incredibly powerful set of features that allows interaction between RTU sites. There are many variations to the scenario outlined below, but this one has been chosen to explain the concept.



Slave RTU can run a DLP	✓
Base Station can transmit DLP to slave RTU	✓
Slave RTU can RTU Data Log	✓
Master RTU controls Slave RTU I/O	✓
Base Station controls Slave RTU I/O	✓

As with the other two examples, the Master RTU must first have its slaves added into the IPB configuration table, and the appropriate serial port should be configured. Again, this example is based on the Slave Radio being a Tait TM81xx data radio.

Configure Slave Radio functionality

Communication method:

Poll slaves every:

Outputs controlled by: Datran Master RTU

CoS ACKed by: Datran Master RTU

Configured Slaves:

Address	Type	Polling	Forwarding
5	Q20	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

This time when the serial port configuration box is used, both the Polling AND Forwarding columns should be ticked. This will allow the Master RTU to begin polling the Slave RTUs on the specified interval, as well as passing any communications though between the Base Station and the slaves.

Whenever the master polls each slave, the response will update the master's copy of the slave's inputs.

Whenever the base station polls a slave, the master will forward the poll to the slave and the response back to the base station. The master will also inspect the poll response as it goes past and will update its copy of the slave I/O accordingly.

In this particular configuration, it is possible to have duplicate copies of the slave I/O arrive back at the base station. The first place will be directly in the comms object for the slave site. The second place the same I/O will appear as a subset of the master I/O in the master's I/O table. This duplication most likely represents wasted bandwidth and can

be overcome by limiting the master site point count so only the I/O that is native to the master site comes back from the master.

In this configuration, the outputs for the slaves are being controlled by DATRAN. This means that when the Master RTU polls the slave, it will not transmit any output information and will only request inputs. When the base station polls a slave, the Master RTU will pass the poll packet to the Slave RTU including the outputs contained in the TBD file.

If the option for Outputs controlled by Master RTU were selected, then every time the Master RTU polled a slave it would write its own copy of the slave outputs out to the slave as well as receiving the input information back as described above. When the base station polled the site, the Master RTU would modify the outgoing poll packet before forwarding it so that it contained no output information and retrieved the inputs only. This configuration is the most involved to set up, but is suitable for situations where the master DLP needs to be able to control the outputs at the slave sites. It also allows for the Master RTU to re-map I/O that is coming from one slave to make it visible at another, all while still allowing the base station to carry out RTU data logging operations and transmit DLPs to the slaves.

Note that in this configuration it is still possible for the base to indirectly control the outputs at the slaves. This can be achieved because the slave outputs all appear in the master I/O table as expansion I/O. The base station can write to these outputs in the MASTER comms object, and as long as the Master DLP is written in such a way as to copy these values from the telemetries to the reals, the value will be written out to the slave.

In the configuration shown above, when the Slave sends a Change of State packet to the Master, it will be forwarded to DATRAN to perform the acknowledgement (which will similarly be forwarded). The Master will have a look at the packet to update its own I/O table, but it won't perform the acknowledgement itself. This can be useful if you want DATRAN to keep abreast of the latest Slave I/O changes without having to poll it too frequently. However, it does increase traffic on the main channel so should only be used if DATRAN needs to be kept aware – otherwise the Master DLP can be used to send important updates or else DATRAN can poll the Slave when it needs to.

This extra configuration option was added in Q03 firmware version 5.23, released in May 2011, and has no effect in versions before that. The previous behaviour was the same as if you select the alternative “CoS ACKed by Master RTU” option. In this case the Master acknowledges any incoming Slave Changes of State, and the message is not forwarded to DATRAN. You can then use the Master DLP to trigger a Change of State if necessary, but this will appear to come from the Master itself and not the Slave.

Obsolescence – DATRAN II Comms Module Q37

A reminder that QTech's June 2010 Quantum leap newsletter announced that there was limited stock of the Q37 comms module. The full introduction of this powerful Store and Forward functionality has obsoleted the Q37 comms module. When the current stock of Q37 comms modules are sold, no further modules will be produced. This was also announced in the September 2010 Quantum leap newsletter.