

Enhancements to the NWRT Real Time Controller (RTC) and Radar Control Interface (RCI) Software to Support Multi-Scan Processing

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This document describes the latest enhancements to the RTC and RCI software, including support for multi scan processing. The main goal of this effort is to provide improved scan control capabilities to the operator. These capabilities include: running multiple scanning strategies without having to manually reload a single scan strategy (super stimulus) each time; the capability to window a scan (change sector boundaries) while a scan is active; the capability to change scan properties (i.e., PRT, pulse count, beam spacing, ...) dynamically.

RTC Changes

A number of changes were made to the RTC to support the multi scan capability. In addition to supporting the legacy super stimulus mode, a scan table mode has been added from which up to 10 user defined scan strategies can be loaded at one time.

For the legacy super stimulus mode, the operator sends a super stimulus message to the RTC. This message contains a set of control fields along with references to stimulus files. These stimulus files are read by the RTC and loaded into memory (stimulus stack). A typical stimulus file is several megabytes in size. A new super stimulus can be loaded only when scanning is inactive.

For the new scan table mode, the operator sends a high level scan table message which defines all of the characteristics about one or more scan strategies (up to 10). Scan strategy information are copied directly into memory and processed only when a scan is to be run for the first time. A typical scan strategy is several kilobytes in size. Prior to running each scan strategy the first time, a stimulus stack is created by the RTC software, eliminating the need to build stimulus files beforehand and making them available to read by the RTC. A new scan table can be loaded at any time; even when scanning is active.

The ADAPTS function has been enhanced to support the new scan table mode as well as supporting the existing super stimulus mode.

RCI Changes

Major modifications have been made to both the RCI server and client to support the new scan table mode. Most of the RCI server changes have been related to supporting new and modified messages. The rest of this document focuses on the RCI client changes.

System Window

The most visible changes to the "System" window are in the status displayed beneath the radar graphic object. A new status field, "Scan Mode" has been added. When scanning using a super stimulus, "SuperStim Active" is displayed to the right of the "Scan Mode"

label. When scanning using the scan table, “Scan Table Active” is displayed. When scanning is inactive, “Inactive” is displayed. When scanning using the scan table, the “Last Downloaded SuperStim” label is replaced by “Active Scan” and the status to the right of the label specifies the name of the active scan table entry.

NWRT PAR Radar Status/Control Client (Admin User: Test/Controlling)

Client: 1 -- User: Dave.Priegnitz Host: krusty.protect.nssl Security Level: 1 -- Auto Boot RTC ON

System Scan Antenna/Pedestal Transmitter History Scheduler ADAPT DSP Status

TEST

Thu Apr 29 07:10:32 CDT 2010

Transmitter
Scan Control

SuperStim
Real-Time Controller Ready

RCI Server
Moment Data Processor Ready

RCI Clients 2 active

nsslc- @NWRTPC : 101

Pedestal Position: 360.0 deg
Digital Receiver: On
WG Switch Position: Antenna
XMTR High Voltage: On
Exciter State: On
CPS Status: OK
PRT Adjust: None
ADAPT-1 Processing: Enabled

Pedestal: Enabled
Antenna: OK # 0
Transmitter: OK # 0

Maintenance Rqd: No
PFN SW Position: Short
Control Mode: Remote

Last Downloaded SuperStim: full_quad_1ms_16pul_els_0_51_and_0_9.sup
Controlling Client: Dave.Priegnitz@krusty.protect.nssl
Auto Scan Status: Inactive
Scan Mode: Inactive

Command:

```
Thu Apr 29 07:05:31 CDT 2010: Dave.Priegnitz: Start scan 1 of 1
Thu Apr 29 07:05:35 CDT 2010: Dave.Priegnitz: Transmitter control command
Thu Apr 29 07:05:30 CDT 2010: Dave.Priegnitz: Download new SuperStim -> full_quad_1ms_16pul_els_0_51_and_0_9.sup
Thu Apr 29 07:05:26 CDT 2010: Dave.Priegnitz: Request SuperStim files list
```

Errors:

```
Thu Apr 29 07:08:12 CDT 2010: EXEC: minor [155]
Thu Apr 29 07:08:12 CDT 2010: EXEC: minor [155]
Thu Apr 29 07:08:12 CDT 2010: EXEC: minor [155]
Thu Apr 29 07:09:28 CDT 2010: ORTS: minor [2008] [418] [1005] [2271] [329] [363] [1101]
```

NWRT PAR Radar Status/Control Client (Admin User: Test/Controlling)

Client: 1 -- User: Dave.Priegnitz Host: krusty.protect.nssl Security Level: 1 -- Auto Boot RTC ON

System Scan Antenna/Pedestal Transmitter History Scheduler ADAPT DSP Status

TEST

Thu Apr 29 07:06:53 CDT 2010

Transmitter
Scan Control

Real-Time Controller Scan 2 of 1

RCI Server
Moment Data Processor Ready

RCI Clients 2 active

nsslc- @NWRTPC : 101

Pedestal Position: 360.0 deg
Digital Receiver: On
WG Switch Position: Antenna
XMTR High Voltage: On
Exciter State: On
CPS Status: OK
PRT Adjust: None
ADAPT-1 Processing: Enabled

Pedestal: Enabled
Antenna: OK # 0
Transmitter: OK # 0

Maintenance Rqd: No
PFN SW Position: Short
Control Mode: Remote

Active Scan: Oversampled_VCP.sup
Controlling Client: Dave.Priegnitz@krusty.protect.nssl
Auto Scan Status: Inactive
Scan Mode: Scan Table Active

Toggle On/Off ADAPT-1 Algorithm Processing

Type: Packet Stag: NO Xmit: YES
Az: 23.8 R1: 2.4 R2: 44.0
Ez: 0.8 PRT1: 2976

Command:

```
Thu Apr 29 07:05:31 CDT 2010: Dave.Priegnitz: Start scan 1 of 1
Thu Apr 29 07:05:35 CDT 2010: Dave.Priegnitz: Transmitter control command
Thu Apr 29 07:05:30 CDT 2010: Dave.Priegnitz: Download new SuperStim -> full_quad_1ms_16pul_els_0_51_and_0_9.sup
Thu Apr 29 07:05:26 CDT 2010: Dave.Priegnitz: Request SuperStim files list
```

Errors:

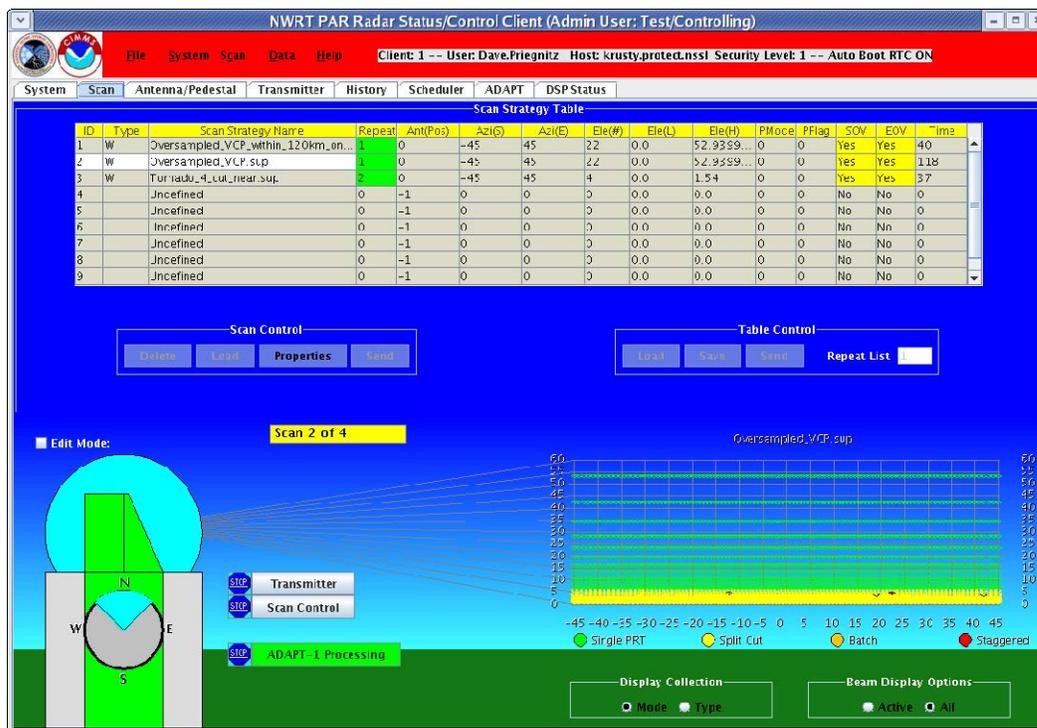
```
Thu Apr 29 07:08:12 CDT 2010: EXEC: minor [155]
Thu Apr 29 07:08:12 CDT 2010: EXEC: minor [155]
Thu Apr 29 07:08:12 CDT 2010: EXEC: minor [155]
Thu Apr 29 07:09:28 CDT 2010: ORTS: minor [2008] [418] [1005] [2271] [329] [363] [1101]
```

Another change has been made regarding RCI server restarts. Up until now, the RCI client was unable to restart or reboot the RCI server using the “RCI Server” selection. In order to restart the RCI server one had to log into the server host as root and issue the restart script. Since root access to the server host is restricted, only a few individuals could do this. During operations this would usually cause a problem since someone would have to be called.

To facilitate restarting the RCI server, users can now perform this operation through the RCI client. Since communicating with the RCI server may not be possible, the RCI server restart function has been made local to the RCI client. To restart the RCI server select the “RCI Server” object. You will be prompted to verify the action. In order to prevent unauthorized restarts, access to the selection is restricted to “admin” users. To be an admin user one selects “Admin User” from the System Control drop down menu and enters a valid password.

The RCI server host reboot option has been removed since it may have undesirable consequences.

Scan Window



The “Scan” window is used to control/edit scan table processing. The top half of the window is used for editing the scan table. If the “Edit Mode” check box is selected, one can manipulate the contents of the scan table.

The “Scan Control” button group is used to manipulate individual scan table entries. To select a scan table entry move the cursor over an item in the desired row and “left click”.

The background color of the “ID”, “Type”, and “Scan Strategy Name” of the selected row becomes white. The “Delete” button removes the selected scan table entry. The “Load” button loads a user selectable scan strategy into the selected scan table position. The “Properties” button opens another window containing a detailed view of the selected scan table entry. The contents of this “Properties” window are fully editable (this is described in the next section). The “Send” button sends the selected scan to the RTC.

The “Table Control” button group is used to manipulate the entire scan Table. The “Load” button loads a user selectable group of scan strategies into the scan table. The “Save” button saves the contents of the scan table to a file. The “Send” button sends the entire scan table to the RTC. The “Repeat List” item specifies how many time the table is repeated.

Several general properties associated with a scan table entry can be modified. These include: “Repeat”, Ant(Pos), “Azi(S)”, “Azi(E)”, “Ele(L)”, “Ele(H)”, “Pmode”, “Pflag”, “SOV”, and “EOV”.

The “Repeat” property specifies how many times the entry will run when scan processing is started. If the value is “0”, the scan is not run. If the repeat count is greater than 0 the value is highlighted with a green background indicating it is active.

The “Ant(Pos)” property specifies the azimuth position (deg) of the antenna before the scan is started. The valid azimuthal positions are 0 – 360. A value of “-1” indicates that the antenna is to be left at its current position when the scan is started.

The “Azi(S)” property specifies the starting azimuthal position (deg) of the scan. The valid range is -45 to 45.

The “Azi(E)” property specifies the ending azimuthal position (deg) of the scan. The valid range is -45 to 45. NOTE: The ending azimuthal position must be larger than the starting azimuthal position.

The “Ele(L)” property specifies a lower elevation angle limit (deg) for beams processed in the scan. NOTE: The lowest elevation angle allowed by the NWRT is 0.51 deg.

The “Ele(H)” property specifies an upper elevation angle limit (deg) for beams processed in the scan. NOTE: The upper elevation angle limit must be larger than the lower elevation angle limit.

The “Pmode”, process mode, and “Pflag” properties are not currently used. They are intended to be used in the future to control downstream processing options.

The “SOV” and “EOV” properties control whether start and end of file flags are set when the scan is run. The two possible states are “Yes” or “No”. The intent of these fields are to allow the operator to treat a scan as a single “complete” entity or as a part of a composite scan. In the latter, one would set the start of volume flag to “Yes” and end of volume flag to “No” in the first part and the start of volume flag to “No” and the end of volume flag to “Yes” in the last part. NOTE: Currently the latter scenario will probably

not be handled properly by the downstream processing since the filename tag in the stimulus header will not be constant. This is something that will be handled in a future release.

Scan Properties Window

Cut	Elev	Waveform	Type	Mode	Azimuth(M)	Azimuth(I)	Range(S)	Range(E)	PRT(1)	Pulses(1)	PRT(2)	Pulses(2)
1	0.51	Short	Weather	Split Cut	Eeam	0.5	2.49	447.645	3000	16	800	64
2	0.81	Short	Weather	Split Cut	Eeam	0.5	2.49	444.045	2976	16	800	64
3	1.15	Short	Weather	Split Cut	Eeam	0.5	2.49	406.89	2728	16	800	40
4	1.54	Short	Weather	Split Cut	Eeam	0.5	2.49	368.52	2472	16	800	40
5	1.98	Short	Weather	Split Cut	Eeam	0.5	2.49	331.35	2224	16	800	40
6	2.48	Short	Weather	Split Cut	Eeam	0.5	2.49	295.38	1984	16	800	40
7	3.07	Short	Weather	Split Cut	Eeam	0.5	2.49	259.41	1744	16	800	40
8	3.75	Short	Weather	Split Cut	Eeam	0.5	2.49	227.04	1528	16	800	40
9	4.54	Short	Weather	Split Cut	Eeam	0.5	2.49	197.07	1328	16	800	40
10	5.48	Short	Weather	Split Cut	Eeam	0.5	2.49	168.3	1136	16	800	40
11	6.59	Short	Weather	Single	Eeam	0.5	2.49	144.215	976	40	0	0
12	7.9	Short	Weather	Single	Eeam	0.5	2.49	122.73	832	40	0	0
13	9.46	Short	Weather	Single	Eeam	0.5	2.49	117.945	800	40	0	0
14	11.32	Short	Weather	Single	Eeam	0.5	2.49	117.945	800	40	0	0
15	13.55	Short	Weather	Single	Eeam	0.5	2.49	117.945	800	40	0	0
16	16.22	Short	Weather	Single	Eeam	0.5	2.49	117.945	800	40	0	0
17	19.45	Short	Weather	Single	Eeam	0.5	2.49	117.945	800	40	0	0
18	23.37	Short	Weather	Single	Eeam	0.5	2.49	117.945	800	40	0	0
19	28.2	Short	Weather	Single	Eeam	0.5	2.49	117.945	800	40	0	0
20	34.25	Short	Weather	Single	Eeam	0.5	2.49	117.945	800	40	0	0
21	42.08	Short	Weather	Single	Eeam	0.5	2.49	117.945	800	40	0	0
22	52.935...	Short	Weather	Single	Eeam	0.5	2.49	117.945	800	40	0	0

Insert Cut: 1 Delete Cut: 1 Scan Time: 118.662 seconds Close

When the “Properties” button is selected a window is displayed from which an operator can modify scan specific properties. These properties include: cut elevation angle, waveform, collection type, mode, azimuthal spacing, start range, end range, PRT(s) and pulse count(s). In addition, an operator can insert new elevation cuts or delete existing elevation cuts.

The “Elev” property specifies the elevation angle (deg) of the cut. The minimum allowable value is 0.51 deg and the maximum is 60.0.

The “Waveform” property specifies the waveform used. The valid values are “Short” or “Long”. The short waveform has a pulse width of 1.57 microseconds and the long waveform has a pulse width of 4.71 microseconds.

The “Type” property specifies the collection mode tag associated with the scan. The current valid values are “Weather” and “Tracking”. NOTE: Current DSP processing ignores all pulses that are not tagged as “Weather”. However, if IQ recording is active, all data are archived, regardless of their collection mode tag.

The “Mode” property specifies one of the following: “Single”, “Batch”, “Split Cut”, or “Staggered”.

The “Azimuth(M)” property specifies the azimuthal beam spacing mode. The valid

values are “Beam” and “Constant”. This property is used in conjunction with the azimuth interval property. “Beam” indicates the beams are spaced relative to the beam width at a given azimuth angle (from bore site). If, say the azimuth interval is 0.5, the beams are overlapped by one half the beam width at that azimuth. The width of the beam can be determined by dividing 1.5 by the cosine of the azimuth angle. At bore site the azimuthal beam width is 1.5 deg and at +/- 45 deg it is ~2.1 deg. An azimuth interval of 1.0 would result in no beam overlap. “Constant” indicates the beams are spaced at constant angle, regardless of the beam width.

The “Azimuth(I)” property specifies the azimuthal interval. It is used in conjunction with the azimuthal beam spacing mode. See the description for the azimuthal beam spacing mode.

The “Range(S)” property specifies the start of the first range gate (km) in the data. NOTE: This value is currently restricted in the RTC code to 10km or larger.

The “Range(E)” property specifies the range of the last range gate (km) in the data. By default, when changing “PRT(1)” it is set to the unambiguous range for that PRT.

The “PRT(1)” property specifies the first pulse repetition time for “batch”, “split cut”, and “staggered” modes and the pulse repetition time for “single” mode. For “short” waveforms the valid range of values is 800 to 3200 microseconds. For “long” waveforms the valid range is 2400 to 3200 microseconds. NOTE: The PRTs used at the NWRT are multiples of 8 so when a value is set by the user it is rounded accordingly.

The “Pulses(1)” property specifies the pulse count for the first PRT. For “staggered” mode it specifies the number of pulse pairs.

The “PRT(2)” property specifies the second pulse repetition time for “batch”, “split cut”, and “staggered” modes.

The “Pulses(2)” property specifies the pulse count for the second PRT for “batch” and “split cut” modes. It is unused for the other modes.

ADAPTS Window

To support displaying ADAPTS output from multiple active scan strategies the ADAPTS window has been modified. A new “Scan Display Option” has been defined so the user can select what they want to view. If the user is running a Super Stimulus, they should select the “Super” item in the menu. If they want to dynamically view the ADAPTS output from each scan running in the scan table they should select the “All” item. If they only want to look at the ADAPTS output from a particular scan table entry then they should select the number corresponding to the scans table position.

Running a Super Stimulus

The steps required to run a Super Stimulus has not changed. You use the same selections to load a super stimulus and start it.

Running Scans from the Scan Table

To run scans from the scan table you need to use the selections in the “Scan” window. A proper sequence of actions would be to “Load” a scan or scan table, “Send” the scan or scan table to the RTC, activate the transmitter using the “Start” button to the left of the “Transmitter” button, and then select the “Start” button to the left of the “Scan Control” button. If you want to view the beams in an active scan along with the current position make sure the edit check box is unselected. As each scan is run the active scan is highlighted in the scan table display and all beams associated with that scan are displayed graphically.

The main thing to note is: If you want to run a Super Stimulus, use the “System” window; If you want to run scans from the scan table, use the “Scan” window.