RtModMon

The library RtModMon includes a function block "ModuleMonitoring":
- The FB monitors the addresses of binary modules in memory for changes.
- If changes are detected, a log entry is generated.
- Furthermore, the FB also provides information via its outputs about how many and which modules have changed.

For computational reasons, not all modules can be monitored simultaneously at runtime; only one module is checked for changes per PLC cycle and FB call!
The information regarding module changes, and therefore also the timestamps in the logbook, is not real-time information!

The use case of the FB is therefore aimed at debugging and change information, as well as non-time-critical reactions to changes in a module within the application.

The complete FB interface is described via the comments in the FB declaration; only parts of the interface are briefly discussed here:

- The function block must be called cyclically with ".enable = TRUE"; ".enable = FALSE" stops the monitoring, but retains the status and information outputs in their last state; a subsequent rising edge deletes this information and restarts the monitoring.

- ".logAllModules = FALSE" only monitors module types 17 and 18 for changes (tasks and libraries; it cannot distinguish between user library and B&R library!) – this is the recommended setting for monitoring changes to your own application!
  - ".logAllModules = TRUE" monitors ALL modules – in this case, the internal memory should be significantly increased by adjusting the constant "rtmodmon_MOD_IMAGE_MAXIDX", as significantly more computing power will then be required for the FB.

- A positive edge on ".resetCounterFlags" resets all status and information outputs of the FB.

- The output "status" signals the operating state of the FB, the possible states are declared and documented in the constants of the library.

FB interface , data types and constants

ModuleMonitoring				Check binary modules if address has changed (because of download / reload), and creates logger entries in $$arlogusr if address or binary has changed
enable	BOOL		VAR_INPUT	enables the function block
logAllModules	BOOL		VAR_INPUT	false = only tasks and libs are monitored, true = every module is monitored. ATTENTION: if true, this needs a much bigger array and computing time, please increase MOD_IMAGE_MAXIDX and rebuild!!
logNewModules	BOOL		VAR_INPUT	if true, also logger entries are generated if binaries are seen "the first time"
resetCountersFlags	BOOL		VAR_INPUT	reset "changed flags" inside ModuleOverview, counter and status outputs -> resets with positive edge, has to be set to FALSE also by application!
differenceCounter	UINT		VAR_OUTPUT	overall number of changes detected since last resetCounterFlags
ModuleOverview	ModuleInfoOverview_typ[0..rtmodmon_MOD_IMAGE_MAXIDX]		VAR_OUTPUT	Structure with binary overview -> see comments inside the type file
lastImageIdx	UINT		VAR_OUTPUT	highest index used inside the ModuleOverview structure
checkComplete	BOOL		VAR_OUTPUT	gets true FOR ONE CYCLE, if all modules out of image are checked
status	UINT		VAR_OUTPUT	FB status information
statusInfo1	DINT		VAR_OUTPUT	FB extended status information - internal FB error code
statusInfo2	UINT		VAR_OUTPUT	FB extended status information - cntidx value

ModuleInfoOverview_typ			☑	FB OUTPUT - ModuleOverview
name	STRING[10]	☐	☑	name of the binary module
changedAddr	BOOL	☐	☑	if true, module has changed address at least once since last resetCountersFlags
changedBin	BOOL	☐	☑	if true, module binary has changed at least once since last resetCountersFlags

Name	Type	Constant	Replicable	Value	Description [1]
rtmodmon_STATUS_RUNNING	UINT	☑	☐	1	FB is running and checking ONE module PER cycle
rtmodmon_STATUS_STOPPED	UINT	☑	☐	2	FB is diabled
rtmodmon_STATUS_ERR_MOLIST	UINT	☑	☐	10	Error from internal used function MO_list(), error code see statusInfos1
rtmodmon_STATUS_ERR_AREVLOGIDENT	UINT	☑	☐	12	Error from internal used function ArEventLogGetIdent(), error code see statusInfos1
rtmodmon_STATUS_ERR_AREVLOGWRITE	UINT	☑	☐	13	Error from internal function ArEventLogWrite(), error code see statusInfos1
rtmodmon_STATUS_ERR_MOINFO	UINT	☑	☐	11	Error from internal used function MO_info(), error code see statusInfos1
rtmodmon_STATUS_ERR_BUFFER_FULL	UINT	☑	☐	20	Error - more modules to monitor than size of monitoring array - increase rtmodmon_MOD_IMAGE_MAXIDX and rebuild!
rtmodmon_MOD_IMAGE_MAXIDX	UINT	☑	☐	249	SETTING: Maximum number of modules that can be checked

Logger entries

If "ModuleMonitoring.logNewModules" is set to "true", a log entry will be generated for each monitored module when the FB is started.

This serves to provide information about which modules are being monitored for changes (which in turn depends on the setting "ModuleMonitoring.logAllModules").
These entries are marked by "brmod_add_to_monitoring", the ASCII data contains the module name as well as other information (the other information is usually only needed for debugging purposes).

Severity	Time	ID	Area	Entered by	Origin	Description	ASCII Data
Information	2022-04-20 13:33:27,535000	1611595776	Customer	brmod_bin_and_addr_change			Test (typ:17 imgidx:7 cntidx:34) ->addr act:47404928 last:62144736 ->bin act: ver:V1.99.5 size:1816 compiled:20.4.2022_15.33.17 last: ver:V1.99.5 size:1816 compiled:20.4.2022_15.22.29
Success	2022-04-20 13:32:56,120000	537853952	Customer	brmod_add_to_monitoring			ModMon (typ:17 imgidx:8 cntidx:15) ver:V1.00 size:5488 compiled:20.4.2022_15.32.10
Success	2022-04-20 13:32:56,110000	537853952	Customer	brmod_add_to_monitoring			Test (typ:17 imgidx:7 cntidx:14) ver:V1.99.5 size:1816 compiled:20.4.2022_15.22.29
Success	2022-04-20 13:32:56,100000	537853952	Customer	brmod_add_to_monitoring			RtModMon (typ:18 imgidx:6 cntidx:13) ver:V1.00 size:3672 compiled:20.4.2022_10.52.54
Success	2022-04-20 13:32:56,089000	537853952	Customer	brmod_add_to_monitoring			runtime (typ:18 imgidx:5 cntidx:12) ver:V4.92 size:29340 compiled:2.12.2021_10.42.4
Success	2022-04-20 13:32:56,079000	537853952	Customer	brmod_add_to_monitoring			AsBrStr (typ:18 imgidx:4 cntidx:11) ver:V4.92 size:9620 compiled:2.12.2021_10.24.35
Success	2022-04-20 13:32:56,069000	537853952	Customer	brmod_add_to_monitoring			sys_lib (typ:18 imgidx:3 cntidx:10) ver:V4.92 size:20472 compiled:2.12.2021_10.42.21
Success	2022-04-20 13:32:56,058000	537853952	Customer	brmod_add_to_monitoring			ArEventLog (typ:18 imgidx:2 cntidx:9) ver:V4.92 size:17388 compiled:2.12.2021_10.20.4
Success	2022-04-20 13:32:56,048000	537853952	Customer	brmod_add_to_monitoring			astime (typ:18 imgidx:1 cntidx:8) ver:V4.92 size:24304 compiled:2.12.2021_10.35.49
Success	2022-04-20 13:32:56,038000	537853952	Customer	brmod_add_to_monitoring			AslecCon (typ:18 imgidx:0 cntidx:7) ver:V4.92 size:17432 compiled:2.12.2021_10.27.54
Success	2022-04-20 13:32:22,314000	537853952	Customer	brmod_add_to_monitoring			ModMon (typ:17 imgidx:8 cntidx:34) ver:V1.00 size:5488 compiled:20.4.2022_15.32.10
Success	2022-04-20 13:32:22,294000	537853952	Customer	brmod_add_to_monitoring			Test (typ:17 imgidx:7 cntidx:32) ver:V1.99.5 size:1816 compiled:20.4.2022_15.22.29
Success	2022-04-20 13:32:22,104000	537853952	Customer	brmod_add_to_monitoring			RtModMon (typ:18 imgidx:6 cntidx:13) ver:V1.00 size:3672 compiled:20.4.2022_10.52.54
Success	2022-04-20 13:32:22,094000	537853952	Customer	brmod_add_to_monitoring			runtime (typ:18 imgidx:5 cntidx:12) ver:V4.92 size:29340 compiled:2.12.2021_10.42.4
Success	2022-04-20 13:32:22,084000	537853952	Customer	brmod_add_to_monitoring			AsBrStr (typ:18 imgidx:4 cntidx:11) ver:V4.92 size:9620 compiled:2.12.2021_10.24.35
Success	2022-04-20 13:32:22,074000	537853952	Customer	brmod_add_to_monitoring			sys_lib (typ:18 imgidx:3 cntidx:10) ver:V4.92 size:20472 compiled:2.12.2021_10.42.21
Success	2022-04-20 13:32:22,064000	537853952	Customer	brmod_add_to_monitoring			ArEventLog (typ:18 imgidx:2 cntidx:9) ver:V4.92 size:17388 compiled:2.12.2021_10.20.4
Success	2022-04-20 13:32:22,054000	537853952	Customer	brmod_add_to_monitoring			astime (typ:18 imgidx:1 cntidx:8) ver:V4.92 size:24304 compiled:2.12.2021_10.35.49
Success	2022-04-20 13:32:22,044000	537853952	Customer	brmod_add_to_monitoring			AslecCon (typ:18 imgidx:0 cntidx:7) ver:V4.92 size:17432 compiled:2.12.2021_10.27.54

If a change is detected in a monitored module, a log entry is also generated.

If only the address of the module in the DRAM changes, the entry is marked with "brmod_addr_change"; if the binary module has also changed in addition to the address, the marking is "brmod_bin_and_addr_change").
The case where only the address changes can occur, for example, when only a functional change is made to a library, but the library instance store remains unchanged – in this case, only the library itself is transferred. However, due to the dependency on the library, tasks that use it must be unloaded and reloaded.

The ASCII data contains the name of the module, as well as the information that has changed.

Severity	Time	ID	Area	Entered by	Origin	Description	ASCII Data
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Success	2022-04-20 13:32:56,120000	537853952	Customer	brmod_add_to_monitoring			ModMon (typ:17 imgidx:8 cntidx:15) ver:V1.00 size:5488 compiled:20.4.2022_15.32.10
Success	2022-04-20 13:32:56,110000	537853952	Customer	brmod_add_to_monitoring			Test (typ:17 imgidx:7 cntidx:14) ver:V1.99.5 size:1816 compiled:20.4.2022_15.22.29
Success	2022-04-20 13:32:56,100000	537853952	Customer	brmod_add_to_monitoring			RtModMon (typ:18 imgidx:6 cntidx:13) ver:V1.00 size:3672 compiled:20.4.2022_10.52.54
Success	2022-04-20 13:32:56,089000	537853952	Customer	brmod_add_to_monitoring			runtime (typ:18 imgidx:5 cntidx:12) ver:V4.92 size:29340 compiled:2.12.2021_10.42.4
Success	2022-04-20 13:32:56,079000	537853952	Customer	brmod_add_to_monitoring			AsBrStr (typ:18 imgidx:4 cntidx:11) ver:V4.92 size:9620 compiled:2.12.2021_10.24.35
Success	2022-04-20 13:32:56,069000	537853952	Customer	brmod_add_to_monitoring			sys_lib (typ:18 imgidx:3 cntidx:10) ver:V4.92 size:20472 compiled:2.12.2021_10.42.21
Success	2022-04-20 13:32:56,058000	537853952	Customer	brmod_add_to_monitoring			ArEventLog (typ:18 imgidx:2 cntidx:9) ver:V4.92 size:17388 compiled:2.12.2021_10.20.4
Success	2022-04-20 13:32:56,048000	537853952	Customer	brmod_add_to_monitoring			astime (typ:18 imgidx:1 cntidx:8) ver:V4.92 size:24304 compiled:2.12.2021_10.35.49
Success	2022-04-20 13:32:56,038000	537853952	Customer	brmod_add_to_monitoring			AslecCon (typ:18 imgidx:0 cntidx:7) ver:V4.92 size:17432 compiled:2.12.2021_10.27.54
Success	2022-04-20 13:32:22,314000	537853952	Customer	brmod_add_to_monitoring			ModMon (typ:17 imgidx:8 cntidx:34) ver:V1.00 size:5488 compiled:20.4.2022_15.32.10
Success	2022-04-20 13:32:22,294000	537853952	Customer	brmod_add_to_monitoring			Test (typ:17 imgidx:7 cntidx:32) ver:V1.99.5 size:1816 compiled:20.4.2022_15.22.29
Success	2022-04-20 13:32:22,104000	537853952	Customer	brmod_add_to_monitoring			RtModMon (typ:18 imgidx:6 cntidx:13) ver:V1.00 size:3672 compiled:20.4.2022_10.52.54
Success	2022-04-20 13:32:22,094000	537853952	Customer	brmod_add_to_monitoring			runtime (typ:18 imgidx:5 cntidx:12) ver:V4.92 size:29340 compiled:2.12.2021_10.42.4
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Success	2022-04-20 13:32:22,044000	537853952	Customer	brmod_add_to_monitoring			AslecCon (typ:18 imgidx:0 cntidx:7) ver:V4.92 size:17432 compiled:2.12.2021_10.27.54

Status information regarding module changes in the application

When changes are detected in modules, the total number of detected changes since the last reset is output at the ".differenceCounter" output.
In the array ".ModuleOverview", the corresponding flags are set for the modified module(s): "changedAddr" for address changes, "changedBin" for binary changes.

All status information at the outputs (including the FB status outputs!) is reset by a positive edge at the input ".resetCounterFlags".