

# Freescalē MQX™ RTOS 4.0.0

## Release Notes

<b>PRODUCT:</b>	Freescalē MQX™ RTOS
<b>PRODUCT VERSION:</b>	4.0.0
<b>DESCRIPTION:</b>	Freescalē MQX™ RTOS, version 4.0.0
<b>RELEASE DATE:</b>	December 7 <sup>th</sup> , 2012

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Rev. 23  
12/2012

## Table of Contents

<b>Freescal MQX™ RTOS 4.0.0 Release Notes</b> .....	<b>i</b>
<b>1 Read Me First</b> .....	<b>2</b>
1.1 Requirements.....	2
1.2 Special instructions .....	4
<b>2 What is New?</b> .....	<b>5</b>
<b>3 Release Content</b> .....	<b>9</b>
<b>4 MQX Release Overview</b> .....	<b>12</b>
4.1 MQX RTOS PSP .....	13
4.2 MQX RTOS BSPs .....	13
4.3 MQX MFS .....	18
4.4 MQX RTCS .....	18
4.5 MQX USB Host .....	18
4.6 MQX USB Device .....	18
4.7 MQX Shell .....	19
4.8 Changing the MQX Source Files .....	19
4.9 Building the MQX Libraries .....	19
4.10 Example Applications .....	19
<b>5 Known Issues and Limitations</b> .....	<b>23</b>
5.1 Performance of Code Running in MRAM.....	23
5.2 Default Kernel Configuration of Small-RAM Devices .....	23
5.3 USB Host HUB Examples .....	23
5.4 ColdFire V1 Code Footprint in Debug Build Targets .....	23
5.5 OSBDM / OSJTAG Firmware Compatibility .....	23
5.6 Supporting “Hot Device Uninstall” in MQX I/O Subsystem .....	24
5.7 Spurious Interrupts on ColdFire Platforms .....	24
5.8 TWR-MEM Compact Flash interface issues .....	24
5.9 Idle task is required on Kinetis platforms .....	25
5.10 USB EHCI stack cannot handle cached memory .....	25
5.11 Flash Cache Disabled on TWR-K60N512 BSP – erratum e2647 .....	25
5.12 TWR-K60N512 BSP 256KB Flash boundary issue .....	25
5.13 ARP entries issue .....	25
5.14 FlexCan driver issues .....	25
5.15 ARM MDK Keil uVision Support – Issue linking the TWR-K40X256 RTCS library .....	25
5.16 Low power modes and PE generated code related issues .....	25
5.17 Keil UV4 Mixing the C99 and C++ code in one project .....	26
<b>6 Change Log</b> .....	<b>27</b>

# 1 Read Me First

This release note documents the Freescale MQX™ RTOS version 4.0.0 product released for Freescale ColdFire, PowerPC and Kinetis ARM® Cortex™ M4 processor families.

## 1.1 Requirements

### 1.1.1 Development Tools

This Freescale MQX™ RTOS Release was compiled and tested with the following development tools:

- CodeWarrior Development Studio for Microcontrollers Version 10.2 (MCU build 120413)
  - Support available for Kinetis, ColdFire and PX series of PowerPC devices
  - See build projects in `cw10` subdirectories
- Makefile support (mingw32-make version 3.8.2)
  - tested with GCC tools from CodeWarrior 10.3
  - Support available for selected Kinetis devices: TWR-K60N512, TWR-K60D100M, TWR-K70F120M. This support will be extended to other BSPs in the next release.
  - Library makefiles are located in the `<MQX_root_dir>/build/make/<board>`
  - Application makefiles are located in `<example_dir>/make/<board>`
- IAR Embedded Workbench for ARM Version 6.40.3
  - Support available for Kinetis ARM® Cortex™ M4 devices
  - See build projects in `iar` subdirectories
- ARM MDK - Keil uVision Version 4.50
  - Support available for Kinetis ARM® Cortex™ M4 devices
  - See build projects in `uv4` subdirectories
- Support of the following tools is discontinued in the MQX 4.0.0
  - CodeWarrior Development Studio for Microcontrollers Version 6.3.1
  - CodeWarrior Development Studio for ColdFire Architectures Version 7.2.2

### 1.1.2 System Requirements

The system requirements are defined by the development tools requirements. There are no special host system requirements for hosting the Freescale MQX™ RTOS distribution itself.

#### Minimum PC configuration:

As required by Development and Build Tools

#### Recommended PC configuration:

2 GHz processor – 2 GB RAM - 2 GB free disk space.

#### Software requirements:

OS: Windows XP or later

### 1.1.3 Target Requirements

The Freescale MQX™ RTOS in this release supports the evaluation boards mentioned below. There are no special requirements for the target hardware which would be out of scope of what each board requires for its operation (power supply, cabling, jumper settings etc). More details about board-specific setup for MQX applications are available in the “MQX Getting Started” document.

#### Evaluation boards supported:

- Kinetis ARM® Cortex™ M4
  - TWR-K20D50M Evaluation Board
  - TWR-K20D72M Evaluation Board
  - TWR-K21D50M Evaluation Board
  - TWR-K40X256 Evaluation Board
  - TWR-K40D100M Evaluation Board
  - TWR-K53N512 Evaluation Board
  - TWR-K60N512 Evaluation Board
  - TWR-K60D100M Evaluation Board
  - TWR-K60F120M Evaluation Board
  - TWR-K70F120M Evaluation Board
  - KwikStik - K40X256 based Evaluation Board
- ColdFire V1
  - TWR-MCF51JF Evaluation Board
- ColdFire V2
  - M52259EVB Evaluation Board
  - M52259DEMOKIT Evaluation Board
  - TWR-MCF52259 Evaluation Board
- ColdFire V4
  - TWR-MCF54418 Evaluation Board
- PowerPC:
  - TWR-PXD10 Evaluation Board
  - TWR-PXN20 Evaluation Board
  - TWR-PXS20 Evaluation Board
  - TWR-PXS30 Evaluation Board

## 1.2 Special instructions

### 1.2.1 Setup Installation instructions

Run the self-extracting MQX installer application and proceed according to instructions on screen. If not specified otherwise the MQX package will be installed to `C:\Freescale\Freescale_MQX_4_0` directory. It is recommended to install MQX to the path without spaces to avoid build problems with some tools.

Installation package contains full MQX source code base, build projects for all supported IDEs and makefiles for selected boards.

**Note:** In version 4.0 the pre-built libraries are not distributed in the MQX release package and it is needed to compile all MQX libraries for particular board **before the first use**. For detailed build instructions please refer to “*Building the MQX Libraries*” section in the “MQX Getting Started” document.

## 2 What is New?

This section describes the major changes and new features implemented in this release.

- New board support packages added:
  - TWR-K21D50M
  - TWR-PXD10 - MQX kernel was ported to e200 VLE assembly instructions
- MQX ported to new compilers and build tools:
  - Makefiles for command-line GCC build provided for selected Kinetis BSPs (TWR-K60N512, TWR-K60D100M, TWR-K70F120M). See the makefile files in the `/build/<board>/make` folder.
- Ready for new Freescale Vybrid PSP and CortexA5 processor core support.
  - The MQX 4.0 has been tested with the CortexA PSP and Freescale Vybrid BSP libraries which are available as a standalone installation package.
- Ready for new Freescale NAND Flash File System library.
  - The MQX 4.0 has been tested with the new FFS library which implements the wear leveling algorithms and support for on-chip NAND Flash controller.
  - This library enables the MFS filesystem to be installed and used on top of the NAND Flash memory devices.
  - The FFS library is available as a standalone installation package.
- RTCS stack was extended by IPv6 protocol support, functionality provided was fully tested by legacy IPv6 Silver logo test set. The IPv6 support is available in the separate installation package. Currently supported protocols and services are:
  - IPv6 IP layer, ICMPv6/ping, HTTP server
- The following board support packages were removed from the release and will be supported only as a part of MQX 3.8.1 version maintenance.
  - TWR-MCF51AG, TWR-MCF51CN, TWR-MCF51JE, TWR-MCF51MM, TWR-MCF51QM, DEMOEM, DEMOAC, EVB51JM128, M5208EVB, M52223EVB, M52233DEMO, M52235EVB, M52277EVB, M53015EVB, M5329EVB, M54455EVB and MPC8308RDB
- Consolidated source files with generic kernel implementation. Number of PSP files was reduced which results in faster library build time.
- Support of CodeWarrior Classic development environment was dropped and all library and example projects were updated to CodeWarrior 10.2.
- Pre-compiled binary libraries are no longer included in the installer. For detailed build instructions please refer to “*Building the MQX Libraries*” section in the “MQX Getting Started” document.
- The MFS read and write speed was improved leveraging the multi-sector transfer functionality and reworked SPI and SDHC drivers. Measured maximum speed is up to 10 times higher in case 32K blocks are used (~10MB read/2,5 MB write for class 10 SD Card and TWRK40D100@96Mhz board)
- RTCS TCP/IP code has been updated and throughput has been improved.

- Measured by Freescale FNET fBench tool: TCP TX~11Mbps; TCP RX~5Mbps; UDP TX ~25Mbps; UDP RX~24Mbps tested with TWRK60D100@96Mhz board at default configuration.
- New I2S & SAI audio drivers added for Kinetis processor family. Example application is provided.
- USB Audio examples updated – microphone and speaker examples are available for selected platforms.

#### RTCS Bugfixes

- The dual\_webserver example application was removed from release and current webserver application has been extended to handle two and more Ethernet interfaces instead
- FTP long file names could cause stack overwrite –file name handling corrected.
- Several PPP bugs resolved during the PPP code update (PPP PAP authentication, shutdown, reconnect etc.). New RTCS shell commands for PPP handling were introduced.
- A return value of the pseudo\_phy\_discover\_addr() in the pseudo\_phy.c source file was added.
- The HTTP server in static task setting had the hard coded priority - the static task priority value is derived from HTTPDCFG\_DEF\_SERVER\_PRIO macro now.
- The HTTP server was extended by "keep-alive" functionality.
- The RTCS\_selectall() documentation was modified to match intended functionality – the RTCS\_selectall() waits on all sockets in the system
- DNS problem was caused by disabled loopback interface in the default RTCS configuration. Fixed by proper configuration in the rtcscfg.h file.

#### Build Tools related bugfixes

- Several changes were made in the CodeWarrior projects to be compatible with the upcoming 10.3 version. E.g. use of slash in the configuration name has been removed and more compatibility changes done.
- Missing nandflash example was added to the New Project Wizard
- Performance Tool documentation link was fixed and documentation was updated.
- Invalid project paths referencing the PE\_LDD macros were removed from the PE-enabled projects.
- Fixed C++ operators new/delete to be working correctly in Keil IDE. Consolidated overriding of malloc, calloc and free functions to use memory allocation system of MQX for all compilers.

#### MFS / IO subsystem bugfixes

- Attempt to delete open file is correctly denied with MFS\_SHARING\_VIOLATION.
- The \_io\_mfs\_dir\_read() API time and date handling corrected. Added check for month value, if the value is not between valid range (from 1 to 12), the "???" string is printed out instead of month abbreviation.
- The fseek/fwrite functionality was fixed to work according to standard in case the fseek() moves position beyond EOF (the file is extended by zeros to the fseek position upon the following fwrite).
- Functionality of \_sem\_wait\_ticks fixed on ColdFire processor. The functions did not waited for expected number of ticks.



- The printf() function fixed to correctly print out the zero character and also other formatting now matches the GCC standard style.
- Corrected printing of different sized variables on big endian platforms (PPC, ColdFire)
- Shell dir command has been modified to correctly display directory content for file systems which are not current.

## USB

- Both USB Host and Device stacks were significantly re-factored and reviewed. Compatibility issues of USB Mass Storage devices which were reported for older versions were reviewed and fixed.
- USB audio examples were reworked and updated to use I2S audio driver and SD card wav file read/write.
- Fixed problem of USB Host Pipe structure list being corrupted in some circumstances when USB device was re-attached.
- The EHCI Pipe private data were not cleared properly when EHCI pipe got free.
- The USB Host stack HighSpeed HUB functionality was fixed

## Example application modifications and bugfixes

- The mutex example was changed to better demonstrate the mutex features
- Incorrect usage of feof() in hvac demos was corrected. Added condition checking for both EOF and error code to the example application.
- The mfs\_usb example was not de-allocating all resources from the heap when USB stick was unplugged. The memory leak fixed in the example application.
- The ADC potentiometer channel macro fixed in BSPs and is now used consistently in example applications. The macro was fixed to use single-ended mode on the following platforms TWR-K60F120M, TWR-K70F120M and TWR-K53N51.

## Other bugfixes

- Kinetis ADC driver was updated: ADC\_MAX\_SW\_CHANNELS was modified, adc\_max\_frq\_table[] limit values were corrected to 12MHz at 16bit resolution and to 18MHz for lower resolution modes.
- TWR-PXN20 BSP FlashX driver configuration (block size and with) was corrected to match the processor flash specification.
- The FlashX and FlexNVM functionality has been implemented for TWR-MCF51JF and TWR-K40D100M.
- Kinetis FlashX driver updated. Fixed incorrect functionality in case number of sectors was not divisible by 8. Fixed chip erase IOCTL command. Corrected problem in io\_flashx\_find\_correct\_sectors() in case a flashx\_file spreads over more than one flashx\_block.
- Several ADC driver fixes made on Kinetis platform : Accumulate functionality was modified, the ADC\_VALUE\_TYPE changed to 32 bits, the GPIO init function for TWR-K60F100M and TWR-K70F100M corrected.
- The LWGPIO driver was fixed to correctly handle PORTTH pins on MCF52259 processor.
- The functionality of \_mem\_alloc\_at() function was fixed. The issue appeared when this API was used more than once in the application code.
- The \_task\_disable\_fp(), \_task\_enable\_fp() API functions were implemented for Kinetis architecture.

- Fixed race condition in the `_lwmem_alloc_internal()` which could lead to the incorrect memory allocation in some circumstances.
- Changed size of FLASH memory from 512kB to 1MB in linker command files for TWR-K60F120M board. Changed initialization struct for FlashX driver from 2 banks to 4 banks.
- RAM vectors table feature was fixed on all Kinetis platforms for ARM Keil uVision IDE.
- The BSS section definition was fixed in the `cw10` linker command file for `twrk60n512`. The `.bss` and `.sbss` (zero initialized data) was located incorrectly in the `main_application_data` section resulting in larger flash footprint.
- The function `nfc_write_page()` did not return `NANDFLASHERR_TIMEOUT` unless the time out occurs for all pages being written. The behavior was corrected to be able to detect the error on any page being written.
- Size of ROM vector table has been corrected from `0x410` to `0x400` in the linker command file for CodeWarrior 10.2 and TWR-K60F120M BSP.

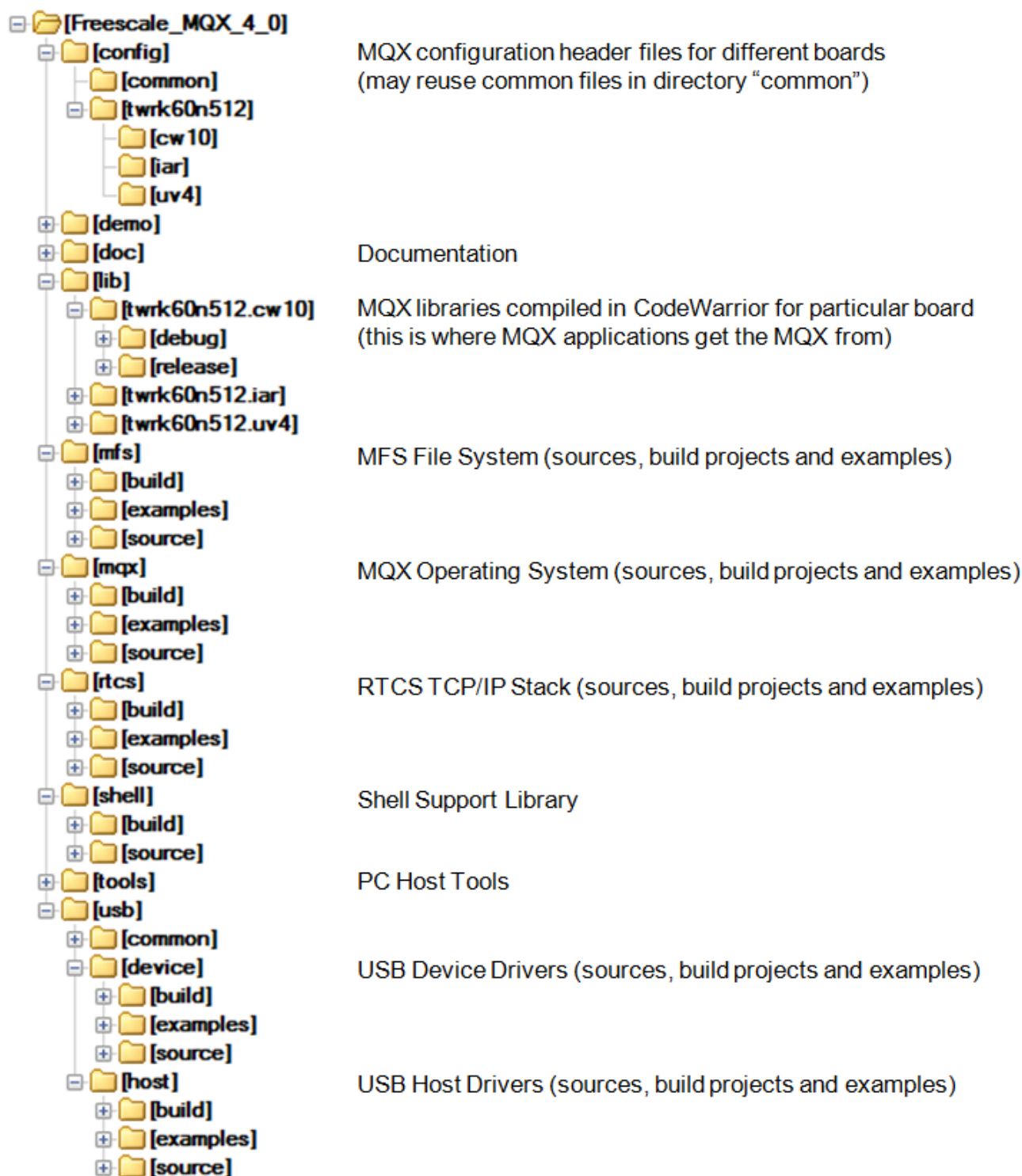
### 3 Release Content

This section gives an overview about the release content.

Deliverable	Location	Status
<b>Configuration Files and Mass-Build Projects</b>	<b>&lt;install_dir&gt;/config/...</b>	
Configuration and mass-build project for all supported boards	.../config/<board>	Updated
<b>MQX PSP, BSP Source Code and Examples</b>	<b>&lt;install_dir&gt;/mqx/...</b>	
MQX PSP source code for Kinetis/Vybrid Cortex™ M core	.../mqx/source/psp/cortex_m	Updated
MQX PSP source code for ColdFire	.../mqx/source/psp/coldfire	Updated
MQX PSP source code for PowerPC	.../mqx/source/psp/powerpc	Updated
MQX PSP build projects	.../mqx/build/<compiler>/psp_<board>	Updated
MQX BSP Source Code	.../mqx/source/bsp/<board>	Updated
MQX BSP build projects	.../mqx/build/<compiler>/bsp_<board>	Updated
MQX example applications	.../mqx/examples/...	Updated
<b>RTCS Source Code and Examples</b>	<b>&lt;install_dir&gt;/rtcs/...</b>	
RTCS source code	.../rtcs/source	Updated
RTCS build projects	.../rtcs/build/<compiler>/rtcs_*	Updated
RTCS example applications	.../rtcs/examples	Updated
<b>MFS Source Code and Examples</b>	<b>&lt;install_dir&gt;/mfs/...</b>	
MFS source code	.../mfs/source	Updated
MFS build projects	.../mfs/build/<compiler>/mfs_*	Updated
MFS example applications	.../mfs/examples	Updated
<b>USB Host Drivers Source Code and Examples</b>	<b>&lt;install_dir&gt;/usb/host/...</b>	
USB Host source code and class drivers	.../usb/host/source	Updated
HUB Class Driver	.../usb/host/source/classes/hub	Updated
Human Interface Device (HID) Class Driver	.../usb/host/source/classes/hid	Updated
Mass Storage (MSD) Class Driver	.../usb/host/source/classes/msd	Updated
Printer Class Driver	.../usb/host/source/classes/printer	Updated
CDC Class Driver	.../usb/host/source/classes/cdc	Updated
USB Host build projects	.../usb/host/build/<compiler>/usb_hdk_*	Updated
USB Host example applications (HID, MSD, HUB)	.../usb/host/examples	Updated
<b>USB Device Drivers Source Code and Examples</b>	<b>&lt;install_dir&gt;/usb/device/...</b>	
USB Device source code	.../usb/device/source	Updated
USB Device build projects	.../usb/device/build/<compiler>/usb_ddk_<board>	Updated
USB Device example applications (HID, MSD, CDC, PHDC)	.../usb/device/examples	Updated
<b>Shell Library Source Code</b>	<b>&lt;install_dir&gt;/shell/...</b>	
Shell source code	.../shell/source	Updated
Shell build projects	.../shell/build/<compiler>/shell_<board>	Updated
<b>Build tools plug-ins</b>	<b>&lt;CodeWarrior_dir&gt;/...</b>	
CW10.2 TAD and New Project wizard plugins for manual installation (CW10.3 plugins are installed directly from the IDE)	.../tools/codewarrior_extensions/...	Updated
Keil Task Aware Debugging plugin (TAD)	.../tools/keil_extensions/	Updated
IAR Task Aware Debugging plugin (TAD)	.../tools/iar_extensions/	Updated
<b>PC Host Tools</b>	<b>&lt;install_dir&gt;/tools</b>	
BSP Cloning wizard	.../tools/BSPCloningWizard/BSPCloningWizard.exe	New
TFS Make Utility	.../tools/mktfs.exe	from 3.0
Check for Latest Version tool	.../tools/webchk.exe	from 3.0
AWK interpreter (GNU General Public License)	.../tools/gawk.exe	from 3.1

SNMP code generation scripts	.../tools/snmp/*.awk	from 3.1
Timing HTML report tool (for mqx/examples/benhrmk/timing)	.../tools/timing.exe	Updated
Code size HTML report tool (for mqx/examples/benhrmk/codesize)	.../tools/codesize.exe	Updated
TAD string and configuration files	.../tools/tad	Updated
<b>Demo Applications</b>	<b>&lt;install_dir&gt;/demo</b>	
Various demo applications described in detail by step-by-step 'Lab' documents.	.../demo/...	Updated
<b>Documentation</b>	<b>&lt;install_dir&gt;/doc</b>	
User Guides and Reference Manuals for MQX RTOS, RTCS, MFS, IO Drivers, USB etc.	.../doc	Updated

The following picture shows the Freescale MQX™ RTOS directories installed to the user host computer (subdirectories reduced for clarity):



## 4 MQX Release Overview

This is MQX RTOS release done by Freescale Semiconductor. It is targeting various Freescale ColdFire microcontrollers, Kinetis ARM® Cortex™ M4 microcontrollers and Freescale Power Architecture.

The Freescale MQX™ RTOS is based on MQX version 2.50 as it was released by the company ARC International. The Freescale MQX™ RTOS release includes MQX real time kernel, core system components, integrated TCP/IP network stack - RTCS, file system – MFS and USB Host and Device stacks.

	MQX PSP+BSP Libraries	MFS Library (FAT File System)	RTCS Library (TCP/IP Stack)	Shell Library	USB Host Library	USB Device Library	UART (polled and interrupt driven)	I2C (polled and interrupt driven)	SPI (polled and dma/interrupt driven)	LWGPIO	GPIO (obsolete)	ADC, LWADC	Audio driver I2S or SAI	FLASHX	NAND flash driver	ESDHC	Compact Flash Card driver	SD Card driver (SPI or SDHC based)	RTC, IRTC (Real Time Clock)	TSS - Touch Sensing	DIU	FlexCAN / mCAN	Ethernet driver	USB Host/Device driver
<b>Vybrid</b>																								
TWRVF65GS10_A5	•	•	•	•	•	•	•		•	•		•	•			•		•					•	•
TWRVF65GS10_M4	•	•	•	•	•	•	•		•	•		•	•			•		•					•	•
<b>Kinetis</b>																								
TWRK20D50M	•	•	<sup>1)</sup>	•	•	•	•	•	•	•		•	•	•		•		•	•			•		•
TWRK20D72M	•	•	<sup>1)</sup>	•	•	•	•	•	•	•		•	•	•		•		•	•			•		•
TWRK21D50M	•	•	<sup>1)</sup>	•	•	•	•	•	•	•		•	•	•		•		•	•			•		•
TWRK40X256	•	•	<sup>1)</sup>	•	•	•	•	•	•	•	•	•	•	•		•		•	•	•		•		•
TWRK40D100M	•	•	<sup>1)</sup>	•	•	•	•	•	•	•	•	•	•	•		•		•	•	•		•		•
TWRK53N512	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•		•	•	•		•	•	•
TWRK60D100M	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•		•	•			•	•	•
TWRK60F120M	•	•	•	•	•	•	•	•	•	•		•	•	•		•		•	•			•	•	•
TWRK60N512	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•		•	•	•		•	•	•
KwikStik (K40)	•	•	<sup>1)</sup>	•	•	•	•	•	•	•	•	•	•	•		•		•	•			•		•
TWRK60F120M	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•		•	•	•
TWRK70F120M	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•		•	•	•
<b>ColdFire V1</b>																								
TWRMCF51JF	•	•	<sup>1)</sup>	•	•	•	•	•	•	•	•	•		•		•		•	•	•				•

Note: Vybrid TWR-CF65GS10 BSP and support is available separately

	MQX PSP+BSP Libraries	MFS Library (FAT File System)	RTCS Library (TCP/IP Stack)	Shell Library	USB Host Library	USB Device Library	UART (polled and interrupt driven)	I2C (polled and interrupt driven)	SPI (polled and interrupt driven)	LWGPIO	GPIO (obsolete)	ADC, LWADC	I2S	FLASHX (internal flash)	NAND flash driver	ESDHC	Compact Flash Card driver	SD Card driver (SPI or SDHC based)	RTC, IRTC (Real Time Clock)	DAC	DIU	FlexCAN / msCAN	Ethernet driver (FEC)	USB Host/Device driver
<b>ColdFire V2-V4</b>																								
M52259DEMO	•	•	•	•	•	•	•	•	•	•	•	•		•				•				•	•	•
M52259EVB	•	•	•	•	•	•	•	•	•	•	•	•		•			•	•	•			•	•	•
TWRMCF52259	•	•	•	•	•	•	•	•	•	•	•	•		•			•	•	•			•	•	•
TWRMCF54418	•	•	•	•	•	•	•	•	•	•	•		•		•	•	•	•	•				•	•
<b>PowerPC</b>																								
<b>TWR-PXD10</b>	•	•	1)	•			•	•	•	•		•		•				•	•			•		
TWR-PXS20	•	•	1)	•			•		•	•		•		•				•				•		
TWR-PXS30	•	•	•	•			•	•	•	•		•		•				•				•	•	
TWR-PXN20	•	•	•	•			•	•	•	•		•		•				•				•	•	
• New in this release																								
1) Onchip ethernet not available, RTCS can be used with PPP or custom enet driver (e.g WiFi over SPI)																								

## 4.1 MQX RTOS PSP

This version of Freescale MQX™ RTOS contains ARM® CortexM™, ARM® CortexA™, ColdFire and PowerPC Platform Support Packages. Contact the Embedded Access Inc. ([www.embedded-access.com](http://www.embedded-access.com)) for commercial-grade support and support of other Freescale platforms.

The platform-specific code from `/mqx/source/psp/<platform>` is built together with generic MQX core files. These two parts form a static library generally referred as “psp” which enables the target application to access RTOS features.

## 4.2 MQX RTOS BSPs

This release of Freescale MQX™ RTOS includes Board Support Packages for boards mentioned in the first section.

The Board-specific code from `/mqx/source/bsp/<board>` is built together with I/O driver files from `/mqx/source/bsp/io`. These two parts form a static library generally referred as “bsp”. The functions included in this library enable the board and operating system to boot up and use the I/O driver services.

The following section gives an overview about drivers supported in the MQX BSPs.

### 4.2.1 I/O Drivers Supported

The following list gives an overview about I/O drivers available in the last MQX release. Like the whole I/O subsystem, the drivers are optional part of the MQX RTOS and their installation can be enabled or disabled in the BSP startup code. In order to provide the optimal code and RAM application size the most of the drivers are disabled in the `/config/<board>/user_config.h` file by default. The drivers required by demonstration applications (in the `/demo` folder) are enabled by default.

**Note:** When BSPCFG\_ driver-enabling macros are not set in the `/config/<board>/user_config.h` file, the default setting is taken from BSP-specific header file located in `/mqx/source/bsp/<board>/<board>.h`.

It is an application programmer decision to enable automatic installation of the driver in the BSP startup code (by enabling appropriate BSPCFG\_ENABLE\_XXX macro in `user_config.h`) or manually in the application code.

### TFS – Trivial Filesystem

Tiny filesystem which can be used as a simple read-only file repository instead of fully featured MFS. TFS is not installed in BSP startup code. It is a task for the application to initialize the TFS and pass a pointer to the filesystem data image. The **mktfs** tool is available (both as executable and PERL script) to generate the image from the existing directory structure. The RTCS HTTP example demonstrates use of TFS.

### I2C I/O Driver

This driver supports a polled I2C interface in master mode. If enabled in user configuration the I2C device drivers are installed during the BSP startup code as “**i2c0:**” and “**i2c1:**”. Example application is provided in the MQX source tree.

### I2S &SAI I/O Driver

This driver supports I2S interface in master mode. If enabled in user configuration the I2S device driver is installed during the BSP startup code as “**i2s0:**”. Example application is provided in the MQX source tree.

### SPI I/O Driver

The driver supports master mode of operation. If enabled in user configuration the SPI device drivers are installed during the BSP startup code as “**spi0:**” (or “**spiX:**” where X is index of the SPI module used). The SPI driver has been significantly rewritten in the MQX 4.0 and there is no distinct interrupt or polled driver type. See IO User Guide for details.

### FlexCAN Driver

This driver provides a C language API to the FlexCAN peripheral module. Example application is provided in the MQX source tree.

### msCAN Driver

This driver provides a C language API to the msCAN peripheral module. Example application is provided in the MQX source tree.

### RTC Driver

This driver provides a C language API to the Real Time Clock peripheral module and functions helping to synchronize clock time between RTC and MQX system. If enabled in user configuration, the RTC module is initialized and MQX time is renewed automatically during BSP startup. The Real Time Counter module of MCF51xxx family is supported by the RTC driver as well. Some missing features of this module (comparing it to Real Time Clock module of CFv2 and Kinetis) are emulated in the software part of driver.

### Serial I/O Driver

The standard SCI (UART) driver supports both polled and interrupt-driven modes. If enabled in user configuration, the serial devices are installed as “**ttya:**”, “**ttyb:**” and “**ttyc:**” (polled mode) and “**ittya:**”, “**ittyb:**” and “**ittyc:**” (interrupt mode) automatically during BSP startup.



### GPIO I/O Driver (obsolete)

Support of this driver has been discontinued in Freescale MQX.

This I/O driver provides a uniform interface to all GPIO pins available on a particular device. If enabled in user configuration, the GPIO driver is installed as “**gpio:**” automatically by the BSP startup. This driver was replaced by LWGPIO for all supported platforms.

### LWGPIO I/O Driver

This driver provides a C language API to all GPIO ports available on a particular device. This driver is significantly faster and have smaller footprint than GPIO driver.

### ADC Driver

This I/O driver provides a uniform interface to ADC channels. ADC uses internal PIT or other kind of timer for periodic sampling. If enabled in user configuration, the ADC driver is installed as “**adc:**” (or “**adc1:**”, “**adc2:**”) device automatically by the BSP startup.

### LWADC I/O Driver

This driver provides a C language API for uniform access to basic features of ADC peripheral.

### DAC Driver (obsolete)

The full version of this driver is provided as a part of Processor Expert driver suite.

This driver provides C language API to DAC peripheral module. It is adopted from the Freescale Processor Expert toolbox. The DAC driver is installed and used directly from the application code.

### Flash I/O Driver

This I/O driver provides a standard interface to internal or external Flash memory. If enabled in user configuration, the Flash driver (called FlashX) is installed as “**flashx:**” device automatically by the BSP startup code (“flash0”, “flash1” etc. device names are used for FlashX device installed for external Flash memory).

For devices with internal Flash memory, the FlashX driver depends on several parameters passed in a form of global symbols from application or from Linker Command File. See the driver installation code in the BSP and example application provided in the MQX source tree.

### ENET Driver

The low-level Ethernet driver is used by the RTCS TCP/IP software stack. The driver is initialized directly by the application before RTCS is first used. The RTCS Shell and HTTP examples demonstrate use of this driver.

### PCCard I/O Driver

This I/O driver provides a low-level access to the PCCard functionality using Flexbus and CPLD circuit. The CPLD code can be found in `<install_dir>/mqx/source/io/pccard/<card_name>`. If enabled in the user configuration, the PCCard device driver is installed as “**pccarda:**” automatically during the BSP startup.

### PCFlash I/O Driver

The Compact Flash Card I/O driver is installed on top of the PCCard low-level driver and enables standard disk drive operations. The MFS file system can be installed on top of this device. If enabled in user configuration, the PCFlash device driver is installed as “**pcflasha:**” automatically during the BSP startup.

### **SD Card I/O Driver**

This I/O driver implements a subset of SD protocol v2.0 (SDHC). The driver can use MQX SPI driver or MQX (e)SDHC driver to communicate with SD Card device. The driver should be installed at the application level, passing it a lower-layer driver handle. The MFS file system can be installed on top of this device.

### **(E)SDHC I/O Driver**

This I/O driver covers the (e)SDHC peripheral module and provides low-level communication interface for various types of cards including SD, SDHC, SDIO, SDCOMBO, SDHCCOMBO, MMC and CE-ATA.

### **Resistive Touch-screen Driver**

This I/O driver accesses the ADC and GPIO modules to detect touch events and acquire touch coordinates on a resistive touch-screen unit.

### **DIU Display driver**

This driver provides a generic C language API to frame buffer-based display units. The driver is initialized and used from a user-application. Since the support for MPC5125 BSP was removed in the MQX 4.0, this driver is not actively used by any BSP now.

### **IODebug driver**

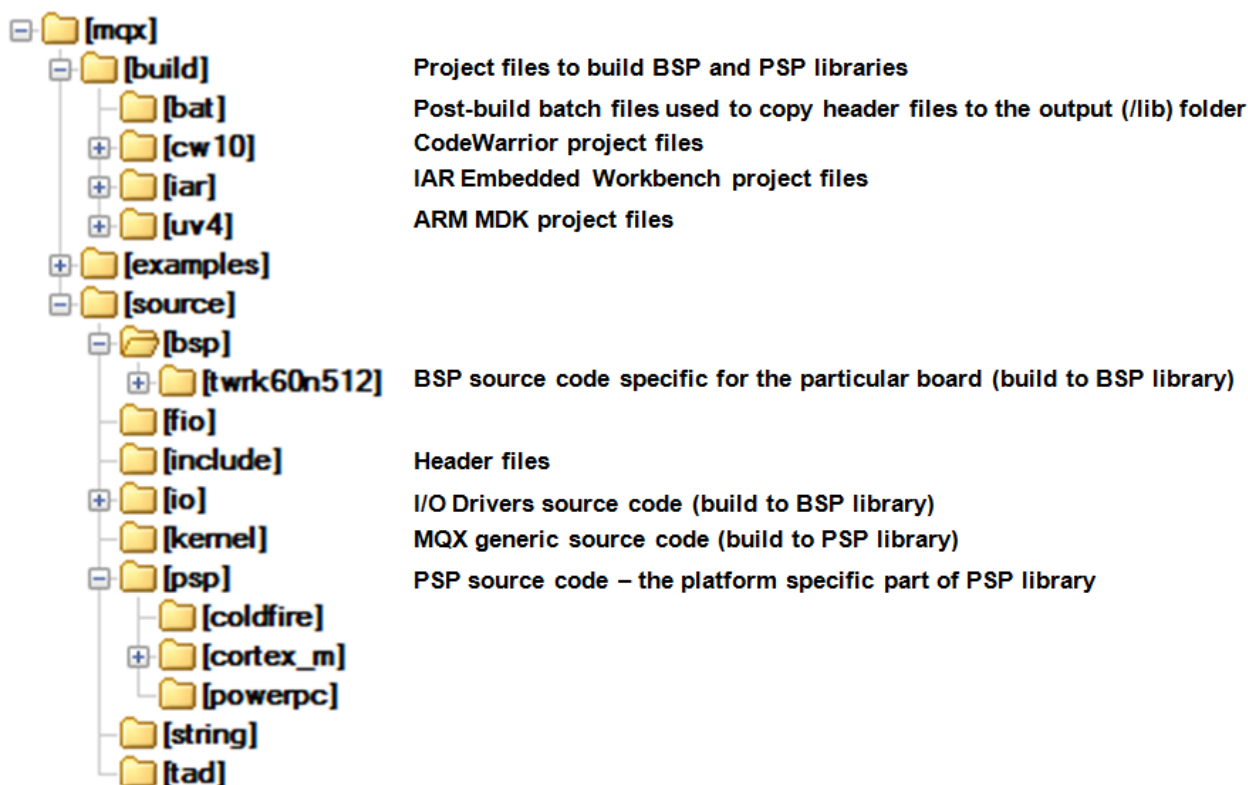
This driver allows redirecting of I/O functions (e.g. printf) to a debug probe-based communication channel. The CodeWarrior 10, IAR EWARM 6 or Keil uVision4 debugger consoles are supported. See the Getting Started document for details on how to setup and use this feature.

#### **4.2.2 Default IO channel**

One of the I/O communication devices installed by MQX BSP may be used as the standard IO channel. The default console setting for each supported development board can be found in section 4 of the “MQX Getting Started” document.

## MQX PSP and BSP Directory Structure

The RTOS files are located in the `mqx` subdirectory of the Freescale MQX™ RTOS installation. The directory structure is briefly described in the picture below.



### 4.3 MQX MFS

The MFS files from `/mfs/source` directory are built with into a static library. When linked to user application the MFS library enables the application to access FAT12, FAT16 or FAT32-formatted drives.

### 4.4 MQX RTCS

The RTCS files from `/rtcs/source` directory are built with into a static library. When linked to user application the RTCS library enables the application to provide and consume network services of the TCP/IP protocol family.

The MQX 4.0 RTCS stack is IPv6 ready to the extent of legacy Silver Logo certification, passing all required tests. The IPv6 support is available as separate update package available from Freescale.

### 4.5 MQX USB Host

This release of Freescale MQX includes the USB Host drivers and USB class drivers.

The USB HDK (Host Development Kit) files from `/usb/host/source` directory are built with into a static library. When linked to user application the USB HDK library enables the application to communicate with various USB devices attached on the USB bus.

The HDK contains the following USB class drivers:

- USB Hub class used to attach multiple devices to a single host port. If enabled at the application level, the HUB support is fully transparent. User application only needs to be modified to be ready to handle multiple USB devices simultaneously. Keyboard/Mouse example application is provided.
- Human-interface Class (HID) used to access mouse, keyboard and similar devices
- Mass storage device (MSD) Class used to access USB drives
- Communication Device Class (CDC) used as a serial communication device implementing virtual “tty” ports
- Audio Class
- PHDC for medical applications
- Basic Printer Class

### 4.6 MQX USB Device

This release of Freescale MQX includes the USB Device drivers and example applications implementing various USB devices.

The USB DDK (Device Development Kit) files from `/usb/device/source` directory are built into the static library. When linked to the user application the USB DDK library enables the application to act as a USB device supporting one or more of the following classes:

- HID (mouse functionality demonstrated)
- MSD (internal RAM area accessed as mass storage device)
- CDC COM (virtual serial line implementation)
- CDC NIC (virtual network interface card implementation)
- PHDC (medical applications)

- Audio

## 4.7 MQX Shell

The shell and command-line handling code is implemented as a separate library called Shell.

## 4.8 Changing the MQX Source Files

The Freescale MQX RTOS is distributed in the source code form. However, unless you are advanced in C programming and MQX kernel knowledge, it is recommended NOT to modify any of the source files other than compile-time configuration files. This recommendation applies to all files under “source” and “build” sub-directories in all MQX, RTCS, MFS, USB and other core components folders.

In case of creating custom board support packages or adding additional I/O drivers, there are two directories where the new files and subdirectories need to be added:

```
<install_dir>/mqx/source/bsp  
<install_dir>/mqx/source/io
```

## 4.9 Building the MQX Libraries

For more details about building MQX libraries and applications with the CodeWarrior tools see the “MQX Getting Started” document.

Upon the first use of the MQX and after any change to the compile-time user configuration file or MQX kernel source files, the MQX libraries need to be re-built to ensure the changes are propagated to the user application.

## 4.10 Example Applications

There are example „Lab“ applications in the directory:

```
<install_dir>/demo
```

The examples are accompanied with Lab guide documents – describing step-by-step how to run them on the target board. The examples were written to demonstrate the most frequently used features of the Freescale MQX™ RTOS.

In addition to these demo applications, there are simpler example applications available in MQX, RTCS, MFS and USB directories.

The following tables summarize all demo and example applications provided in this release.

### MQX Example Applications

mqx/examples/...

Name	Description
access_usr	Demonstration of memory protection between the user and privilege tasks
adc	Shows usage of the ADC driver, sampling analog values from two ADC channels.
can/flexcan	Shows usage of FlexCAN API functions to transmit and receive CAN frames.
can/mscan	Shows usage of msCAN API functions to transmit and receive CAN frames.
can/mscan_loopback	The msCAN API driver demonstration in loopback mode.

cplus	Shows simple C++ application
demo	Shows MQX multitasking and inter-process communication using standard objects like semaphores, events or messages. See lwdemo for the same example using the lightweight objects.
event	Simple demonstration of MQX events.
flashx	Demonstration of FlashX driver functionality.
flexnvm	Demonstrates use of the Flex NVM functionality on Kinetis platforms where this feature is supported.
freq_change	Show dynamic frequency change for Kinetis and ColdFire+ platforms only.
gpio	Shows usage of GPIO driver to control on-board LEDs and switches.
hello	A trivial Hello World application using a single task.
hello2	A trivial Hello World application spread across two tasks.
hmi	Demonstrates integration of the MQX application and the TouchSensing library.
i2c	Shows how to read/write data from/to external EEPROM. Additional HW setup is needed.
i2c_slave	Shows usage of the I2C driver in slave mode – emulates the external EEPROM behavior.
i2s_demo	Demonstrates use of audio I2S driver. TWR-AUDIO card is needed to run this example.
io	Demonstrates use of an alternate UART port as a console output.
ipc	UART-based inter-processor communication demonstration.
isr	Shows how to install interrupt service routine and how to chain it with the previous handler.
klog	Shows kernel events being logged and later the log entries dumped on console.
log	Shows application-specific logging feature.
lwdemo	Same as the "demo" application, but implemented using lightweight components only.
lwdemo_usr	Shows MQX multitasking and inter-process communication using user mode tasks and lightweight objects like semaphores, events or messages.
lwevent	Simple demonstration of MQX lightweight events.
lwgpio	Demonstration of LWGPIO driver usage.
lwlog	Simple demonstration of MQX lightweight log feature.
lwmsgq	Simple demonstration of MQX lightweight inter-process messaging.
lwsem	Simple demonstration of MQX task synchronization using the lightweight semaphore object.
lwsem_usr	Simple demonstration of MQX user/privilege task synchronization using the lightweight semaphore object.
lowpower	Demonstration of low power functionality on Kinetis and CF+ platforms.
msg	Simple demonstration of MQX inter-process message passing.
mutex	Simple demonstration of MQX task synchronization using the mutex object.
nil1	Yet simpler than Hello World. A void application which may be used for copy/paste to start custom application.
rtc	Shows the Real Time Clock module API. Demonstrates how to synchronize RTC and MQX time and how to use RTC alarm interrupts.
sem	Simple demonstration of MQX task synchronization using the semaphore object.
spi	Shows how to read/write data from/to external SPI EEPROM. Additional HW setup is needed.
taskat	Shows how task can be created within statically allocated memory buffer (avoid heap allocation for task stack and context).
taskq	Shows custom task queue and how the queue can be suspended and resumed.
test	Shows the self-testing feature of each MQX component.
tfs	Shows the usage of ROM-based Trivial File System in an MQX application.
timer	Simple demonstration of MQX timer component.
usermode	Memory management and dynamic task creation from user-mode tasks.
watchdog	Simple demonstration of MQX task timeout detection using the watchdog component.

## RTCS Example Applications

rtcs/examples/...

Name	Description
httpsrv	Simple web server with CGI-like scripts and web pages stored in internal flash.

shell	Shell command line providing commands for network management.
snmp	SNMP protocol example providing microprocessor state information.

## MFS Example Applications

mfs/examples/...

Name	Description
mfs_ftp	RTCS FTP demo accessing the MFS filesystem mounted on the USB mass storage. For FTP example without USB functionality, refer to RTCS Shell demo.
mfs_usb	Console shell-based example showing how to access MFS filesystem mounted on the USB mass storage.
cfcard	Console shell-based example showing the MFS filesystem used with and CFCard storage.
ramdisk	Shows use of MFS accessing the external RAM (or MRAM).
sdcard	Shows use of MFS accessing the SPI-connect SD Card.

## USB Host Example Applications

usb/host/examples/...

Name	Description
audio/microphone	Able to connect USB microphone and record the sound to SD Card (wav format)
audio/speaker	Able to connect USB speaker and play the sound from SD Card (wav format)
cdc/cdc_serial	This example demonstrates the virtual serial port capability with abstract control model. Redirects the communication from CDC device, which is connected to the board, to the serial port.
hid/keyboard	This application echoes keys pressed on the USB keyboard onto serial console.
hid/mouse	Displays USB mouse events on serial console.
hid/keyboard+mouse	Keyboard and mouse demos combined in a single application.
msd/msd_commands	Executes the standard "mass storage device" commands to the USB disk and shows the response on the serial console (see MFS examples for USB filesystem access).

## USB Device Example Applications

usb/device/examples/...

Name	Description
audio/generator	Act as USB microphone, playing out the short audio loop.
audio/speaker	Receive audio stream data from the host (PC) and play it out through I2S driver
msd/disk	Implements small storage device in internal RAM memory.
hid/mouse	Creates virtual mouse which keeps moving in square loop, 100 pixels in size.
cdc/virtual_com	Implements a virtual serial line loopback.
cdc/virtual_nic	Implements a virtual network interface cards.
phdc/bridge	Ethernet to PHDC bridge. Receives Medical Data Exchange packets or APDU's from the Continua Agent Device on the Ethernet link as passes it to the USB Continua Manager. See <a href="http://www.continuaalliance.org">http://www.continuaalliance.org</a> .

## Lab Tutorial Demos

demo/...

Name	Description
hvac	Simple implementation of console-based HVAC, with optional USB logging and FTP access.
hvac_error	Intentional error injected to the HVAC demo code to demonstrate power of TAD plug-in.
web_hvac	The HVAC demo with HTTP server implementing the GUI. Ajax-based pages demonstrate an advanced use of HTTP server.
telnet_to_serial	Simple character passing between UART console and telnet session. Shows custom "lightweight" telnet server.
security_email	Small-footprint application originally developed for MCF51CN. Example of simple SMTP client, able to send email message upon activity detected on GPIO input pins.
security_telnet	Telnet-based security monitor, displaying status of GPIO and ADC values.
security_webserver	WEB sever-based security monitor, displaying status of GPIO and ADC values.
pe_demo	This example demonstrates how to use Processor Expert to configure MQX BSP



## 5 Known Issues and Limitations

### 5.1 Performance of Code Running in MRAM

The runtime performance of the MRAM based targets is approximately 8x degraded comparing to Flash-based execution. MRAM is an external memory device connected to the ColdFire core by 8-bit data bus and having one wait-state generated for each access. In order to fetch one 32-bit value (instruction) from the MRAM memory, four accesses need to occur – each inserting one wait-state clock.

This behavior is normal by design and applies to other processors using the external memory to store executable code.

### 5.2 Default Kernel Configuration of Small-RAM Devices

The default kernel configuration of small-RAM devices is optimized in order to run the demonstration applications located in the `/demo` folder. To meet tight RAM constraints, some of MQX or RTCS features are disabled by default. Also some of the I/O drivers not used by the main demo applications are disabled.

You typically get a compile-time error message if you try to run an example application while the required kernel feature or I/O driver is missing in the library code. In order to execute some of the example applications, you first need to enable the required features in the `/config/<board>/user_config.h` file and recompile all MQX libraries.

### 5.3 USB Host HUB Examples

HUB class support is enabled in HID example applications. The applications run correctly with the USB device attached both directly, or through the hub. However, the example code is still ready to handle a single device only. Combined Mouse+Keyboard demo is able to handle one mouse and one keyboard simultaneously. Using multiple devices of the same kind attached through the hub is not supported by the example applications.

### 5.4 ColdFire V1 Code Footprint in Debug Build Targets

This release of Freescale MQX™ RTOS brings the first version of the RTCS TCP/IP stack for ColdFire V1 devices. Even with the smallest networking device supported by this MQX release (MCF51CN128), the applications are provided to demonstrate HTTP, DHCP, ICMP and SNTP protocols over the TCP and UDP. With some of these applications, the size of executable compiled without size optimizations exceeds the Flash memory available (128KB on MCF51CN128).

As a workaround, size optimizations were enabled in the “Debug” build targets of the MQX, RTCS and other libraries for the ColdFire V1 processors. All optimizations remain disabled in “Debug” build target of the application projects itself so the application code debugging is not affected.

### 5.5 OSBDM / OSJTAG Firmware Compatibility

The latest versions of the CodeWarrior, IAR and Keil tools bring a new version of the OSBDM / OSJTAG Debugger interface with improved performance and stability. This new interface requires

the firmware to be updated to the appropriate version. Refer to instructions provided in the Release Notes documents coming along with the development tools you are using.

The latest OSJTAG firmware, drivers and tools are available on following web page  
<http://www.pemicro.com/osbdm/index.cfm>

## 5.6 Supporting “Hot Device Uninstall” in MQX I/O Subsystem

With today's implementation of MQX I/O subsystem, special attention is needed to uninstall a device driver while there is one or more device files open at the application layer. In other words, the application is responsible for dealing with application tasks that have opened file handles when a device driver is being uninstalled.

A typical demonstration of the problem is USB mass storage handling:

- When USB attach event is detected, an application installs the MFS partition manager and MFS file system 'device' on top of the USB driver.
- The application runs tasks (e.g. shell) which open and access files provided by the MFS filesystem device.
- When user unplugs the USB mass storage device, the application has only a limited way to detect an opened file exists before uninstalling the MFS filesystem device.
- The file I/O functions begin to report errors when accessing the device after it is physically detached. The application code should be designed in a way that the tasks close all files affected by the detach event before the MFS filesystem driver can be uninstalled.
- When MFS filesystem device is uninstalled while open files are still accessed from other tasks, an unhandled exception may occur.

We recognize that this implementation may add additional application overhead. We are enhancing MQX I/O subsystem so the file operations will safely return error states even after the underlying device driver is uninstalled. This enhancement will simplify the application code error recovery.

## 5.7 Spurious Interrupts on ColdFire Platforms

MQX users reported accidental occurrence of spurious interrupts. Spurious interrupt occurs when interrupt source is being disabled by software while the interrupt flag is being set by hardware. As a consequence, interrupt controller loses the information about what was the source of the interrupt.

ColdFire processor documentation recommends to temporarily disable all interrupts each time any interrupt source is being masked in interrupt controller or in peripheral module register.

User application or custom user drivers need to follow this procedure to avoid spurious interrupts to occur. The interrupt-driven I2C I/O driver was updated accordingly in MQX 3.6.

## 5.8 TWR-MEM Compact Flash interface issues

Some Compact Flash cards does not work correctly with TWR-MEM and MQX CF card driver. The reasons could be following:

- An issue in the TWR-MEM CPLD code REV A causes incorrect communication with some types of cards (e.g. Kingston). A fixed CPLD firmware is available in `<install_dir>/mqx/source/io/pccardtwr_mem_pccard_cpld/` folder. The firmware can be loaded to the TWR-MEM CPLD using Altera Quartus II design tool and BLASTER connection cable.
- In some cases MQX driver incorrectly detects the card in the slot. First check if all CF related jumpers are set correctly according to the Getting Started document. If you still experience

incorrect behavior, connect two pull-up resistors between card detect pins (CF\_CD1, CF\_CD2) and 3.3V VCC.

## **5.9 Idle task is required on Kinetis platforms**

The Kinetis kernel (by design) cannot operate without an idle task. The MQX\_USE\_IDLE\_TASK configuration options must be set to 1.

## **5.10 USB EHCI stack cannot handle cached memory**

User application buffers used by USB EHCI Class drivers have to reside in un-cached memory space.

## **5.11 Flash Cache Disabled on TWR-K60N512 BSP – erratum e2647**

There is implemented workaround for erratum e2647 on MK60N512 based BSP. The workaround disables the use of the Flash cache for processors revision 1.0 (mask 0M33Z). It fixes sudden application crashes, but results in lower CPU performance (~30% performance hit). Newer processor mask sets with fixed e2647 erratum are not affected.

## **5.12 TWR-K60N512 BSP 256KB Flash boundary issue**

During TWR-K60N512 BSP testing we have experienced unexpected application crash in case the application code spans over the 256KB boundary. The issue is related to silicon revision 1.0 (mask 0M33Z) only. The TWR-K60N512 linker files are prepared in the way that the code is placed to the lower addresses and constant data are placed to higher addresses in the Flash memory.

## **5.13 ARP entries issue**

When the board is put into a busy Ethernet environment with many ARP requests, the ARP entries will cause memory fragmentation which leads to RTCSEERR\_TCPIP\_NO\_BUFFS when connect() is called.

## **5.14 FlexCan driver issues**

Several issues were identified during development of FlexCAN driver:

- On TWR-K70F120M board the TX/RX signals are not routed to elevator by default, so the FlexCAN example does not work. To enable FlexCAN operation, zero ohm resistors R22 and R23 must be soldered on TWR-K70F120M board.
- The 10 kbit baudrate doesn't generally work; FlexCAN detects bit0 errors in its own transmitted messages.

## **5.15 ARM MDK Keil uVision Support – Issue linking the TWR-K40X256 RTCS library**

The Keil uVision linker fails to link the TWR-K40X256 RTCS-based application projects. The linker failure is caused by the fact that the Keil linker tries to place also the functions which are not used in the final application. This issue was confirmed by ARM and it is possible to be solved by a workaround (using \_\_weak modifier before failing functions definition).

## **5.16 Low power modes and PE generated code related issues**

- TWRK20D50M and TWRK40X256 – the low power timer cannot wakeup the chip from LLS power mode or the wakeup leads to chip reset

- TWRMCF51JF - the switch to VLPR power mode in 2 MHz clock configuration does not work, the chip doesn't acknowledge the power mode change in PMSTAT register.
- CW10.2 Processor Expert generated low power BSP code on K60F and K70F chips contains bugs that forbid the usage of 2 MHz clock configuration and VLPR power mode. These bugs are corrected in the MQX source code and correction in PE will be released with next PE version. The problem is fixed in the CW10.3.

### **5.17 Keil UV4 Mixing the C99 and C++ code in one project**

- The Keil uVision do not allow using both C99 and C++ options at once in project setting. All MQX projects except the cplus application are set up to use C99 compiler option. If you need to mix the both C99 and C++ in one project you need to specify this options for each file.

## 6 Change Log

### Version 3.0.0 (December 5<sup>th</sup> 2008)

- This is initial release supporting the MCF52259 processor, M52259EVB and M52259DEMO boards.

### Version 3.0.1 (January 22<sup>nd</sup> 2009)

- Small enhancements throughout the whole code base of MQX kernel and other components
  - o Memory block “type” information added to all system memory allocations. TAD is now able to give detailed information about each memory block allocated by kernel or system component.
  - o Dedicated memory allocation routines in RTCS, MFS and USB simplify the memory pool usage.
- IPCFG ethernet link monitoring features and automatic IP address binding functionality was added to RTCS. The “ipconfig” shell command replaces the old “bind”, “ifbind” and “dhcp” shell commands.
- The HTTP server in RTCS was re-written to enable multiple sessions to be served by a single task. This feature brings more reliable HTTP server while maintaining low memory requirements.
- USB Host HUB class was added.
- MQX User Guide and several other documents are included in the setup package.

### Version 3.1.0 (April 3<sup>rd</sup> 2009)

- USB Device low-level driver has been implemented for MCF522xx family and example applications were created for M52259EVB and M52223EVB.
- The “usb” subdirectory of the /lib output folder was split to “host” and “device” parts.
- Added PSP, BSPs and other support files for MCF52223 and MCF52235 evaluation boards:
  - o USB Host and Device libraries were ported to M52223EVB
  - o RTCS library was ported to M52235EVB
  - o MFS and Shell libraries ported to both new boards
- USB Host HUB issue resolved with MCF52259 (excessive number of errors observed when USB devices were accessed through USB HUB). The issue was solved by implementation of SOF frame scheduler in the USB Host low-level driver. An issue with a similar impact remains on MCF5222x implementation (silicon problem, no workaround known).
- Error codes naming and numbering convention has been made more consistent across the MQX, RTCS and other libraries. Old error code names remain implemented for backward compatibility (numeric values changed).
- Kernel Data and other internal structures were optimized for size. Parts of the structures were made conditionally compiled based on the user configuration.
- TAD (CodeWarrior debugger plugin) was updated to handle renaming in internal structures.

- Memory type information was added also to lightweight memory structures. TAD is now able to display the type information for memory blocks allocated using lightweight memory allocator.
- Lightweight memory allocator has been made the default option for all BSPs.
- The `/config/<board>/user_config.cw` files were eliminated. Such files have contained a subset of configuration options for assembler-coded files in the MQX kernel. All kernel assembler-coded files are now preprocessed using C preprocessor and make use of standard C header macros. The C-language-specific content of the header files is conditionally excluded during assembler compilation by using `__ASM__` macro.
- The assembler `vectors.cw` file in each BSP was re-coded to C syntax. A new user configuration macro (`MQX_ROM_VECTORS`) may be set non-zero to avoid vector table being copied to RAM.
- The BSP, PSP, RTCS and other library build projects were changed to be easier to understand (virtual folders inside each CodeWarrior project was updated).
- SNMPv2 code was changed to enable ROM-based MIB structures. Example application is provided demonstrating custom MIB nodes and user traps.
- Several source code files were renamed to better reflect the content, especially in the I/O driver directories.
- Added “root directory” concept to the FTP server, “rename” command added.
- SPI I/O driver added (Master mode only). Example application is available.
- Initial ADC I/O driver was added. This driver (including its API) is subject to improvement in future releases. ADC device driver usage is demonstrated in ADC example application.
- RTC API updated, example application added.
- The new IPCFG API updated and documented
- The new HTTP server API documented
- MQX I/O Driver User Guide added

### Version 3.2.0 (May 15<sup>th</sup> 2009)

- Added PSP, BSPs and other support files for TWR-MCF51CN-KIT Tower Kit with ColdFire V1 processor MCF51CN128.
  - o RTCS library was also ported to MCF51CN128 device.
- Ethernet driver significantly re-written and generalized to cover both ColdFire V1 and V2 processors. Application is now able to change some of the driver parameters dynamically, without need to recompile the driver code.
- Most of the features missing in the previous release of the ADC driver were implemented. The driver documentation is still on the to-do list.
- ADC driver partially re-written and low-level layer ported to ADC module of MCF51CN device. There are implementation differences between MCF51CNxx and MCF522xx drivers which are still to be addressed by future releases.
  - o MCF51CN driver uses internal lightweight timer component
  - o MCF522xx driver still uses PIT timer for internal timing. Implementation with lightweight timer (lower performance) is planned for future versions

- New GPIO callback-on-interrupt feature was added to GPIO driver of MCF51CN. This feature will be ported to other supported devices in future releases.
- Three new “security” demo applications were created for MCF51CN device demonstrating the ADC and GPIO drivers, network protocols and low-power mode of operation. The applications will be ported to other devices in future.

### Version 3.2.1 (May 28<sup>th</sup> 2009)

- Sparse interrupt table implemented and made a default option for small-RAM devices. This feature saves up to 1k of RAM. The TAD CodeWarrior plug-in was updated to support this feature.
- The legacy MQX Flash driver (called FlashX) was ported to support internal Flash memory of all supported devices (MCF51CNxxx, MCF522xx). The Flash driver requires Flash parameters to be passed from the application or linker command file. The linker command files were updated in all BSP. Sample application is provided.
- The GPIO driver callback-on-interrupt feature was ported to MCF52xx devices. This feature is still a subject to change in future versions. The MCF51xx driver was optimized for code size.
- Minor bug fixes in Serial driver (fflush system call implemented).
- MCF51CNxx SPI example enhanced to support both SPI EEPROM and SPI Flash devices. The example applications may be used with Memory Storey board.
- Fixed known issue with MQX Stationery as it was described in the last release notes. The MQX\_PATH named source tree is no longer used for referencing the debugger initialization file (this was causing Flash Programmer crash). Copies of debugger initialization and memory configuration files were made part of all stationery projects and are referenced using relative path only in the debugger settings.
- I/O Driver User Guide updated. The GPIO, ADC, SPI and FlashX driver description added.

### Version 3.3.0 (Aug 7<sup>th</sup> 2009)

- Added BSP for MCF52259 Tower Kit.
  - o CodeWarrior projects, demos and example applications were ported from M52259EVB to this BSP.
  - o CodeWarrior projects and the BSP also support debugging targets and running code from external MRAM memory. This is prepared for future support of Memory Storey board for the Tower Kit.
- Added PSP, BSPs and other support files for M54455EVB ColdFire V4 system. This is the first V4 device supported by Freescale MQX operating system. Few new features were added to PSP:
  - o Cache control support added. Non-cached memory pool allocation API added.
  - o Flash-to-RAM code copying enabled in startup.
  - o Startup code is now part of PSP. Two files ([CF\\_startup.c](#) and [ROMCopy.c](#)) were reused from CodeWarrior runtime library. These files were modified to support ROM-to-RAM code copying.
  - o Flash Programmer config files available in [tools/flash\\_programmer\\_scripts/config](#) directory.



- SPI driver for M54455EVB created (the DSPI module), example supports onboard SPI Flash
- Ethernet driver and RTCS were significantly re-written.
  - Device-independent part of the driver was re-written to support multiple Ethernet MAC devices of the same or even different kinds. A support for memory-optimized handling of small frames was also added.
  - Device-dependent part of the Ethernet driver was re-written to support ColdFire V1-V4 Fast Ethernet Controller module.
  - Several RTCS features were re-tested and fixed to support multiple physical controllers.
- RTCS updated
  - The `rtcs_shell` example now uses the MFS lib (with RAM-disk) and supports all FTP commands (conditional compilation)
  - Minor changes in IPCFG API to support multiple devices, potentially of different kind than ENET.
- TAD updated
  - Strings displayed in TAD moved to separate text files available inside MQX installation.
  - New Ethernet driver screen added.
  - Symbolic reader enhanced some objects (`LWsem`, `LWevent`, ...) are displayed not only with address information, but also with symbolic names.
- Several key TAD-like screen dumps implemented also on embedded application side in PSP. These functions may be used to print out the TAD-like debugging data by the application.
- Shell library updated
  - RTCS support commands changed (`ipconfig`, `netstat`).
  - MFS format command was made available (also see [mfs/examples/ramdisk](#) application)
  - Shell interface to TAD-like screens dumps added.
- Workaround for MCF5223x Ethernet PHY auto-negotiation issue implemented according to chip errata.
- FlashX driver updated:
  - Support of external Flash devices made available. Tested with external flash memory devices of M54455EVB.
  - FlashX example application modified to support external flash1 device on M54455EVB.
  - Write protect ioctl command implemented for external Flash devices.
- USB Host updated:
  - Code refactored and generally updated (MASS storage class renamed to MSD).
  - CDC class added. Example application shows how to forward characters between standard UART TTY and a virtual USB TTY device.
- I2C driver refactored and updated, eeprom example changed.



- CodeWarrior “Stationery” templates for creating new MQX projects were changed:
  - All kinds of stationery projects now have full set of libraries added to project (BSP, PSP, MFS, RTCS, USB Host, USB Device, Shell). The standard CodeWarrior linker will optimize out the unreferenced code. Feel free to remove the unused libraries from the project.
  - MQX-Only stationery is a simple “hello-world” like example.
  - MQX+MFS stationery is simple shell example working with RAM disk.
  - MQX+RTCS stationery is simple shell example with basic networking commands and telnet server.
  - MQX+RTCS+MFS stationery is a union of the two examples above.
  - USB Host is a simple application able to detect devices attached to the host port or devices attached through USB hub. You still need to refer to the USB host example applications to see how to interface attached devices.
  - The USB Device stationery is not available in this release. Please refer to the USB Device example applications.
- Device-specific sections added to this release notes document. Please read the required jumper settings for each evaluation board supported.

### **Version 3.4.0 (Sep 25<sup>th</sup> 2009)**

- Support for Register ABI (register parameter passing) was implemented
  - RegABI build targets (for both Release and Debug configurations) added in all library build projects. The binary libraries compiled with RegABI configuration get the “\_regabi” postfix.
  - Former build targets which use the Standard ABI are still maintained in the library build projects for backward compatibility. The targets were renamed to “StdABI”.
  - All example and stationery applications were reconfigured to use Register ABI and RegABI MQX libraries.
- M52277EVB BSP added
- M52233DEMO BSP added
- USB EHCI Host Support implemented
  - USB Host functionality enabled on MCF52277 and MCF54455.
- USB Device Stack reworked and enhanced
  - The USB Device Stack code has been partially rewritten to be consistent with the similar bare-metal stack available for Freescale HCS08 platform (released separately).
  - CDC class implementation examples added (virtual serial line and virtual network interface card).
  - PHDC medical class implementation examples added.
- SPI driver reworked to support all kinds of ColdFire SPI modules (SPI, QSPI and DSPI)
  - Former QSPI driver was removed from the release.
- IPC inter-processor communication files made available in the release.

- IPC Example applications provided.
- SCI-based IPC tested only.
- SPI-based SD Card Driver added
  - The driver was tested with Memory storey for Tower Kit only (MCF51CN and MCF52259 devices). Not tested with M52277EVB board.
- Bug fixed: Wrong SCI baud rate divisors calculation fixed.
- Bug fixed: Shell “dir” command file attribute filter is now applied correctly.
- Bug fixed: MFS read and write calls correctly return negative value when physical device returns access error. Please see also another known issue described in section 5.6 “Supporting “Hot Device Uninstall” in MQX I/O Subsystem”.

### Version 3.5.0 (Jan 26<sup>th</sup> 2010)

- CodeWarrior build projects location was changed. The `build/codewarrior` subdirectory was replaced by several directories depending on type and version of the CodeWarrior tool.
  - `build/cwmcu62` contains build projects for CodeWarrior Development Studio for Microcontrollers version 6.2 (ColdFire V1 projects from MQX 3.4 and earlier)
  - `build/cwmcu63` contains build projects for CodeWarrior Development Studio for Microcontrollers version 6.3 (New versions of ColdFire V1 projects)
  - `build/cwcf71` contains build projects for CodeWarrior Development Studio for ColdFire Architectures version 7.1 (ColdFire V2-V4 projects from MQX 3.4 and earlier)
  - `build/cwcf72` now contains build projects for CodeWarrior Development Studio for ColdFire Architectures version 7.2 (New versions of ColdFire V2-V4 projects)
  - The post-linker batch files were separated to `build/bat` out of the build folders to be able to reuse them between different build project versions.
  - Mass-build projects of all libraries were also moved from `config/<board>` folder to an appropriate subdirectory.
  - Build projects for the later CodeWarrior versions (`cwcf72` and `cwmcu63`) no longer support standard (on-stack) parameter passing. StdABI targets are not available in build projects.
- The code and folder structure was updated to make it ready for IAR toolset support
  - CodeWarrior-specific C and Assembler syntax was changed to be compatible with IAR compilers. Only few parts of code made conditionally compiled depending on the compiler.
  - CodeWarrior-specific portions of BSP (start-up code, memory initialization code, debugger configuration files) were moved to `cw` subfolder. The `iar` subfolder will be added by the IAR support patch in future.
- Changes in PSP
  - CPU numbering scheme was changed. The CPU is still defined in the `user_config.h` file, but uses constants pre-defined in `psp_cpudef.h` file.
  - Several new code-size compile-time configuration options were added. See updated MQX User's Guide documentation.

- Changes in MFS
  - o Dynamic read-only status checking of the physical device was added to MFS write functions as optional feature (MFSCFG\_READ\_ONLY\_CHECK). This option is useful for example with SD Card storage with write-protect switch.
- RTCS stack updated
  - o Set of RTCS iwcfg\_xxx() functions was implemented to enable application-level control of any future WiFi functionality.
  - o ARP resend and expiration timeout values were made configurable through the user\_config.h file. Especially the “expire incomplete” time needs attention as it affects the total time a send call takes when target IP address does not exist on the local subnet.
  - o Default setting for DHCP DISCOVER message was changed. Broadcast flag is set to FALSE to request unicast DHCP responses by default.
  - o Internal structure names were renamed to keep consistency with C typedef names. The structure tag names are now always the lowercase variant of the C typedef name. This change enables proper ELF file format parsing by Task Aware Debugger plugin.
  - o Bug fixed – RTCS\_selectset function now behaves as in RTCS versions prior to 3.0. The socket array is not altered by this function.
  - o RTCS\_select call enhanced to support more than one socket in the array.
- Shell library was extended by new “iwconfig” command to enable the iwcfg\_xxx() control from the Shell environment
- BSP and support for MCF51EM256-based DEMOEM board was added
  - o SCI, SPI, I2C and other standard drivers were ported to this platform
  - o ADC, RTC, FlashX were enhanced to support additional features the MCF51EM offers
- ENET Driver was updated
  - o Generic WiFi support was added into driver code for future WiFi support.
  - o ENET MAC interface structure was extended to support both generic and device-specific control commands (so-called media control commands).
  - o Set of WiFi-related media control commands was defined (setting the ESSID, encryption, ...)
  - o ENET driver initialization structure was extended by new device-dependent initialization parameter.
  - o ENET driver concept of device context locking was enhanced (from global interrupt disable to lwsem-based locking).
  - o HVAC, WEB\_HVAC, HTTPSRV and RTCS Shell example applications were made ready for WiFi functionality.
- SPI driver was updated
  - o Support for SPI16 module of MCF51EM was added.
  - o Driver code for 8-bit ColdFire V1 SPI module was internally renamed to SPI8.
  - o The SPI driver now provides uniform I/O API to SPI8, SPI16, QSPI and DSPI modules.

- Bug fixed – QSPI chip select was incorrectly asserted during driver initialization making a glitch on this signal.
- GPIO driver was extended
  - Open flags were added to control polarity of edge which triggers interrupt callback routine to be called (rising/falling edge).
  - I/O control commands were added to enable/disable interrupt callback function to be called.
- ADC driver now supports the PDB trigger module and sixteen-bit ADC module available at MCF51EM.
  - ADC driver install function was changed to accept additional device-specific initialization structure.
- SD Card driver now supports the SD Card interface available on M52277EVB. SD Card Example application was added for this board.
- Example applications
  - SD Card example application now decodes GPIO inputs for card presence and read-only switch.
  - Code-size benchmark application was added for MCF52259EVB. The application makes artificial reference to MQX kernel API functions so the kernel code-size can be analyzed from map files. A tool automating the build, map file parsing and HTML report generation is also available.
  - Timing benchmark application was added for MCF51CN, MCF52259 and MCF54455 devices. This application measures key timing parameters of the MQX kernel. HTML report generator tool is also available.
  - RTC example application enhanced to support new features available in MCF51EM.
  - SPI example application extended from EEPROM testing to general SPI-based memory device (EEPROM, Flash or serial MRAM).

### **Version 3.5.1 (Feb 19<sup>th</sup> 2010)**

- Fixed bugs:
  - MCF5225x ADC driver - pin initialization was not performed properly; problem appears with “Release” targets.
  - FlashX driver was not working correctly with internal Flash memory of MCF52xx processors.
- Example applications updated
  - MFS SD Card example application demonstrates use of Partition Manager now.
  - Code-size benchmark applications and results are available for M52259EVB, M54455EVB, TWR-MCF51CN.

### **Version 3.6.0 (Jun 21<sup>st</sup> 2010)**

- The support for older CodeWarrior for ColdFire 7.1 and CodeWarrior for Microcontrollers 6.2 was removed. Build projects are available only for versions 7.2 and 6.3.

- Eclipse-based CodeWarrior 10 support is added. All library and application build projects are also available in the native CW10 format.
- MCF51AC-based DEMOAC Board Support Package added with basic set of peripheral drivers: ADC, FLASHX, GPIO, I2C, INT\_CTRL, SERIAL, SPI.
- MCF51JM-based EVB51JM128 Board Support Package added with basic set of peripheral drivers: ADC, FLASHX, GPIO, I2C, INT\_CTRL, SERIAL, SPI. A support for USB Host/Device stack is also available.
- MPC5125 BSP added. This is the first PowerPC port supported by Freescale MQX. This version includes the code released recently as MPC5125 patch to MQX 3.5.1.
  - o Basic set of I/O drivers supporting the MPC5125 peripherals is included: PSC UART, Fast Ethernet controller, DIU, msCAN and RTC.
  - o Example applications available: Standard set of MQX and RTCS examples, the “Digital Sign” demo application demonstrating the graphical DIU module of MPC5125 and the HDMI interface.
- The MQX\_SUPPRESS\_FILE\_DEF and MQX\_SUPPRESS\_STDIO\_MACROS may now be defined as 1 in user\_config.h to avoid declaration of generic FILE, FILE\_PTR types and <stdio.h> functions like read, write, printf etc.
  - o The MQX code was refactored to use the new MQX\_FILE and MQX\_FILE\_PTR types and make aliases to backward compatible FILE and FILE\_PTR types only if not suppressed.
  - o The key changes were implemented in the file fio.h in mqx/source/include.
  - o Default values of both configuration options are defined such that backward compatibility is not affected.
- The user\_config.h files and shared configuration files in /config/common directory were re-formatted and updated:
  - o All BSPCFG options related to given board are now available in individual user\_config.h files.
  - o MQX\_TASK\_DESTRUCTION and MQX\_EXIT\_ENABLED options are now set to 0 in small\_ram\_config.h file.
  - o MQX\_COMPONENT\_DESTRUCTION option was removed from the verif\_enabled\_config.h file. The default value of 1 defined in mqx\_cnfg.h is used. The ColdFire V1 processors override this option to 0 in user\_config.h to save code size.
- A new \_lwevent\_get\_signalled() API call was added to enable detecting which lwevent bits caused the active task to return from \_lwevent\_wait() call.
- Inline assembler code was eliminated where possible to simplify migration to alternative C compilers.
  - o MCF52xx and MCF51xx FlashX flashing routines were rewritten in C.
  - o The “nop” instruction primitive \_ASM\_NOP() added to compiler-specific header file and used instead of asm(nop) inline assembler statement.
  - o The “stop” instruction primitive \_ASM\_STOP(x) added to compiler-specific header file and used instead of asm(stop #(x)) inline assembler statement.
- Support for Freescale eGUI software and TWR-LCD display board has been added. See eGUI MQX demos within the Freescale eGUI package. The eGUI comes with set of low-level drivers for non-OS bare-metal operation. The drivers in MQX 3.6 enable the eGUI

package to be configured for hardware-independent “MQX” mode where all board-dependent code resides in the MQX BSP.

- Resistive Touch Screen driver added to TWR-MCF52259 and TWR-MCF51CN BSPs.
- LCD memory regions added to TWR-MCF52259 and TWR-MCF51CN linker command files in BSPs.
- GPIO pins, ADC channels and SPI channel specific for LCD and touch screen control are defined in TWR-MCF52259 and TWR-MCF51CN BSP header files.
- Inter-processor communication (IPC) over the UDP protocol was added together with an example application in RTCS.
- RTCS ipconfig shell command enhanced to be able to print immediate values of low-level PHY registers.
- Serial driver supports new open mode-flag (IO\_SERIAL\_NON\_BLOCKING) to enable accessing the serial driver in non-blocking mode. Supported by both polled and interrupt serial drivers.
- New I2C ioctl command (IO\_IOCTL\_I2C\_GET\_BUS\_AVAILABILITY) implemented to detect idle/busy condition on the bus.
- Register I/O map structures were updated to cover all supported parts and changes in I/O drivers. In addition to changes in processor specific header files, the following shared I/O map files have been changed:
  - mcf5xxx\_spi16.h ... SPI16 no-FIFO module added.
  - mcf5xxx\_usbotg.h ... ULPI control registers added.
  - mcf522x\_usbotg.h ... registers added
  - mcf51xx\_i2c.h ... I2C with/without SMB support defined
  - mcf51xx\_ftsr.h ... registers added
- Register I/O map structures of MCF54455 were expanded to cover peripherals not supported by MQX drivers (DMA timers, EPORT, PCI, RNG, SSI).
- The entire code was “untabified” (TAB characters replaced by spaces).
- Readme files created for selected example applications (GPIO, I2C, etc.).
- IPC demo application code generalized for various TTY ports availability.
- Codesize MAP-file analysis script now prints code-size statistics for RTCS, MFS and other system libraries.
- MQX I/O User Guide updated:
  - SPI, I2C, ADC, RTC and SD Card driver sections updated.
  - ESDHC, FlexCAN, DAC Driver and NAND Flash Driver sections added.
- Board-specific information related to MQX release has been moved from Release Notes into a separate document (see “MQX Getting Started” document).

#### Bugfixes in 3.6.0

- MQX Kernel:

- The `_io_fclose()` no longer locks the kernel's `IO_LWSEM` semaphore before calling the device driver's close function. This could cause a race condition with layered drivers.
  - The EWL library linking is now disabled in all MQX library projects (PSP, BSP, MFS, RTCS, ...). Having this option enabled in "Librarian" projects settings panel was causing all EWL code to be included in each MQX library. This was effectively disabling EWL function overrides from MQX code. For example the `malloc()` code was taken from EWL instead of from MQX and was causing linking issues (`malloc` is also part of C++ *new* operator implementation).
  - Handling of priority messages was fixed. In some cases a priority message could have been received from a wrong message queue.
  - Format specifier parameter is declared as `const` in the `sscanf` prototype. This avoids compiler warning messages when passing constant string as the scan format.
  - The MQX watchdog component (do not confuse this with the on-chip hardware watchdog) was fixed in `_watchdog_isr()` to expire at proper time on Coldfire V1 platforms. Potentially this also solves problems in case the watchdog uses other timer than the main BSP tick timer.
- BSPs and I/O drivers:
- EPORT interrupt level macros in MCF522xx board-specific headers in BSP are now set correctly according to the levels hardwired in the controller device. Be aware that `EPORT_EPF7` level is hardwired to non-maskable interrupt so no MQX calls may occur in the interrupt routine.
  - GPIO button pin identifiers (`BSP_SW1` and `BSP_SW2`) were fixed in M52233DEMO BSP header.
  - ADC driver functions now return more detailed error codes instead of generic `IO_ERROR` value.
  - MCF522xx interrupt initialization and unmasking functions fixed. Problem was that the code was also inadvertently unmasking other peripheral interrupt sources in the interrupt controller.
  - TWR-MCF51CN tick timer interrupt handler was fixed in BSP. Due to wrong timer interrupt acknowledge code, the MQX system tick time was one half of the configured value.
  - MCF51EM-specific code was removed from generic MCF5xxx RTC driver code.
  - I2C clock source changed from `BSP_BUS_CLOCK` to `BSP_SYSTEM_CLOCK` on all MCF52259-based boards. This fixes the problem of I2C bitrate which was 2x higher than configured.
  - Uncached memory region definitions were fixed in M54455EVB linker command files in BSP.
  - Default PLL system clocks setup was changed in M52277EVB BSP startup code. The MCF52277 processor now runs at system clock 160MHz (80MHz bus clock, 60MHz USB clock).
  - USB I/O pin initialization routine was fixed in M52277EVB BSP. The problem with pin settings made USB Host functionality unusable on M52277EVB.
  - SPI chip select control optimized for performance.
  - MCF5xxx FEC driver initialization of 2<sup>nd</sup> Ethernet interface (`ipconfig 1 init`) is no longer dependent on having 1<sup>st</sup> interface initialized.

- Compiling MCF5xxx FEC code generates error message if un-cached memory support is disabled in MQX configuration.
- MFS Filesystem:
  - The CLUSTER\_SIZE\_BYTES member of MFS\_DRIVE\_STRUCT is now extended to 32 bit to avoid size overflow in case of 65k cluster size (solves some USB memory stick problems).
  - Hidden attribute checking was fixed in MFS\_Attribute\_match() function.
  - MFS write/append performance problem was solved by avoiding unnecessary sector reading.
- SHELL Library:
  - Memory violation error fixed in the shell “help” command implementation.
- USB Host Stack:
  - USB Host HUB class enhanced to support asynchronous status inquiries.
  - USB CDC Host driver now waits for control transactions to ACM interface to complete. This fixes a problem of invalid memory access with some CDC devices.
  - KHCI USB bus control is deactivated after device is detached. This avoids problems where noise on detached bus was evaluated as a valid communication.
  - KHCI USB data bus weak pull-down resistors enabled to improve detection of reset/detach event.
  - EHCI fixed to toggle data tokens correctly when a transfer has odd number of transactions.
- Example applications:
  - Digital sign demo running on TWR-MPC5125 now runs the display task with higher priority than the network task. This fixes a problem where images were displayed after 3 minutes ARP timeout when board was not connected to network.
  - Bar-graph CGI code in HTTP Server demo now reads ADC channels properly.
  - msCAN example application fixed on TWR-MPC5125.
- Task Aware Debugger plug-in for CodeWarrior
  - The value of SR register is now displayed correctly in context of any tasks being examined.
- Other:
  - New Version Checker tool was fixed so it always runs in a single instance. Each of the TAD DLLs (current version and all backward-compatibility versions) starts an instance of the web checker tool upon CodeWarrior start. Running the tool in multiple instances was causing problems with loading the *webchk.wcp* configuration file or resulted in multiple “New Version Available” notifications being displayed.

### Version 3.6.1 (Aug 31<sup>st</sup> 2010)

- MCF51MM-based TWR-MCF51MM Board Support Package was added
  - Standard set of peripheral drivers is enabled: FLASHX, GPIO, I2C, INT\_CTRL, UART, SPI, RTC, CF card, ADC, DAC, SD card
  - New driver was added: DAC (API driver).



- USB Host and Device stacks are available. The host (KHCI) driver can be configured to include software workaround for early silicon issue of the MCF51MM device. This workaround is disabled by default.
- MCF53015-based M53015EVB Board Support Package was added
  - Standard set of peripheral drivers is enabled FLASHX, GPIO, I2C, INT\_CTRL, SERIAL, SPI, SDHC, CF card, SD card.
  - USB Host and Device stacks are available.
  - Two Ethernet interfaces are enabled in RTCS TCP/IP.
- New SDHC I/O driver covering the eSDHC peripheral module was created. This driver allows low-level access to various cards such as SD, SDHC, SDIO, SDCOMBO, SDHCCOMBO, MMC and CE-ATA. MQX currently implements upper layer for SD and SDHC card drivers only.
- HTTP server listen address can now be configured in application and may be optionally set to other value than INADDR\_ANY. This may help to run the web-server application on just one of several network interfaces.
- New TAD “Memory Blocks Summary” screen implemented for lightweight memory blocks. The screen shows memory allocation grouped by categories.
- The MQX documentation was updated:
  - MFS User Guide chapter 3.1.9 was updated (search attributes).
  - The lwevent description was updated in MQX Reference Manual.
  - The description of \_time\_diff\_xxx() function parameters corrected in MQX Reference Manual.
  - The \_RTCS\_mem\_pool setting documented in chapter 2.6 of RTCS User Guide.
  - IO Guide SPI driver description was extended by new IOCTL command.
- Release notes and Getting started documents were reorganized and extended by more detailed description of the MQX build process.
- New communication mode was implemented in SPI driver for the QSPI module. In this mode, the communication is split to smaller chunks (16 bytes) to fully leverage hardware-driven CS signal activation. Also in this mode, the CSIV bit is not controlled by the driver flush() function which is normally causing glitch on the other QSPI CS signals.

## Bugfixes

- The MFS functionality IO\_IOCTL\_FIND\_FIRST\_FILE was not working. In case the search attribute MFS\_SEAR v2CH\_NORMAL was used no files were found. Attribute matching algorithm was corrected and user manual was updated.
- MFS file write bug which appeared in MQX 3.6.0 append-file performance optimization was fixed. In case two or more files were opened simultaneously, wrong content could be written as the sector cache was not updated correctly.
- The interrupt enabling code in the GPIO driver was fixed for MCF5223x and MCF5225x devices. GPIO interrupt callbacks now work properly on these platforms.
- When the \_task\_restart() function was restarting the calling task itself, destroying task stack frame could crash the system. The behavior was fixed.
- Touch screen driver did not work properly for M5225X platforms and internal flash targets built in “Release” configuration. The driver code was fixed.

- Setting I2C baudrate did not selected the best closest achievable rate. Algorithm for baud rate calculation was changed to find closest match instead of closest-lower rate as it was before.
- FlashX driver fixed. The bug was causing writing incorrect data in case fseek() was used to navigate to the last byte of the Flash file and user wanted to overwrite it.
- Precompiled TWR-MPC5125 libraries were not included in MQX 3.6.0 release. The libraries are now part of the MQX 3.6.1 full installation package.
- New MQX projects created for MPC5125 platform were not using the MQX\_PATH variable in the access paths. This might cause mismatch in library and include search paths in the newly created projects. This option is now set properly in project stationery.
- USB DATA0/1 bit toggling fixed in the EHCI USB Host driver code. This issue was affecting the PHDC and CDC data transfers.
- USB Device example applications for high-speed data access (EHCI) were updated to use internal data buffers in fast on-chip SRAM memory. This is a temporary solution which will be replaced by generic support of high-speed data transfer in future.
- The internal bind functionality was fixed in RTCS in order to enable the same TCP port being opened on two different network interfaces.
- Task suspended/running indication bug fixed in TAD. Call history is now displayed correctly for all tasks in both classic CodeWarrior and CodeWarrior version 10.
- Default PLL system clocks setup was changed back to MQX 3.5.0 values in M52277EVB BSP startup code. The SD RAM chip setting (160MHz) was unstable and caused sporadic errors during debugging.
- The lwtimer\_create\_periodic\_queue() functionality was fixed. Timer callback was not invoked in some cases.

### Version 3.6.2 (Nov 8<sup>th</sup> 2010)

- EAR v2 version of the Freescale Kinetis ARM<sup>®</sup> Cortex M4 Platform Support Package was prepared. See known issues related to this version in sections **Error! Reference source not found.** and **Error! Reference source not found.** below.
- The Kinetis port of the Freescale MQX is supported by the IAR Embedded Workbench for ARM. The support includes:
  - The EWARM workspace files ready to be used to batch-build all MQX libraries.
  - Projects files for standard set of libraries: PSP, BSP, RTCS, MFS, USB Host and Device.
  - Project files for all example applications and demo projects. Projects are tested with on-board P&E Micro OSJTAG interface and external Segger/IAR j-link interface.
  - By default all projects are prepared for EWARM 5.50.6 and are configured for IAR j-link debugging interface. The projects are ready to be converted to EWARM 6.10 format just by opening them in the new environment. In EWARM 6.10, the debugging connection may be changed to P&E Micro OSJTAG.
  - MQX Task Aware Debugging plug-in for both EWARM 5.50 and EWARM 6.10 versions.
- MK40X256-based TWR-K40X256 Board Support Package was added

- Standard set of peripheral drivers is enabled: GPIO, I2C, INT\_CTRL, UART, SPI, RTC, ADC, SD card and FlashX.
  - USB Host and Device stacks are available.
- MK60N512-based TWR-K60N512 Board Support Package was added
  - Standard set of peripheral drivers is enabled GPIO, I2C, INT\_CTRL, SERIAL, SPI, SDHC, SD card and FlashX.
  - USB Host and Device stacks are available.
  - Ethernet interface is supported by Enet driver and RTCS TCP/IP stack.
- Changes in the generic PSP code
  - Prototypes of functions which may be in conflict between the MQX and compiler-specific `<string.h>` header files were made conditionally compiled by the `MQX_SUPPRESS_STRINGH_MACROS` configuration option. This suppression is enabled by default for IAR EWARM compiler version 6.
  - New memory allocation API function defined. The `_mem_alloc_at` and `_lwmem_alloc_at` functions enable to allocate dynamic memory block at specific address within the memory pool. This is used to implement memory “barriers” between physical RAM blocks which cannot be accessed as a continuous area. (this is the case for Kinetis platform).
  - Support for MQX exception handling implemented for sparse interrupt tables.
  - Kernel log entries added for new memory functions and low-level ENET driver functions.
- Changes in the I/O drivers code
  - New MAC-NET Ethernet module driver with hardware time-stamping support was added to support Kinetis platform.
  - RTC driver API enhanced to be able to work with MQX `DATE_STRUCT` data type directly.
  - Minor changes done in ADC and GPIO drivers towards generalizing the code across multiple platforms. No functional change.
- Changes in the USB code
  - KHCI Host code significantly rewritten to support new Register I/O maps unified across ColdFire and Kinetis families. No functional change.
- The MQX documentation was updated:
  - Reference manual was extended by description of `_lwevent_get_signalled()` and `_task_create_at()` API functions.
  - Description of interrupt-level task priorities and NMI handling were extended in the User Manual.

#### **Bug Fixes:**

- In the PSP code
  - The `_task_get_template_ptr()` and `_task_get_td()` now safely returns NULL for invalid input parameter values.
- In the RTCS code

- Compressed domain names haven't been handled correctly in the DNS client parser. Some DNS server responses were not handled properly.
- Memory leak in the DHCP functionality fixed. Memory was not de-allocated properly during address renewal process.
- DHCP client requests were not sent complete. With some servers the client was not obtaining the subnet information.
- UDP service fixed in order to receive frames to a proper socket in case the same UDP port is open by multiple network interfaces.
- In the I/O drivers code
  - ADC examples were modified to work properly also on MCF51MM, MCF51AC and MCF51CN platforms.
  - MCF52259 GPIO\_PTCPAR\_PTCPA macro values were fixed.
  - KBI Interrupt functionality was fixed in the MCF51MM GPIO driver.
  - IO\_IOCTL\_I2C\_GET\_BUS\_AVAILABILITY command implemented in I2C driver for ColdFire V3 family.
  - IO\_IOCTL\_SERIAL\_SET\_DATA\_BITS command behavior fixed in serial for ColdFire V1 family.
  - Slave functionality was fixed in DSPI driver for ColdFire families. The slave was sending additional byte after normal data block.
- Other
  - Shell "help" command was fixed to display detailed description properly.

### **Version 3.7.0 (Apr 8<sup>th</sup> 2011)**

See Section 2 "What is New?" above.

- New Board support packages:
  - MCF51AG-based TWR-MCF51AG BSP
  - MCF51JE-based TWR-MCF51JE BSP
  - MCF5208-based M5208EVB BSP
  - MCF5329-based M5329EVB BSP
  - MCF54418-based TWR-MCF54418 BSP
- Kinetis BSPs TWRK60X512 and TWRK40N256 modified:
  - Clock speed changed from 48MHz to 96MHz
  - Programmable Gain Amplifier – PGA enabled in ADC driver
  - Flash driver extended by FlexNVM functionality (EEPROM emulation)
- TWR-MPC5125 BSP was extended by:
  - USB Host and Device
  - NAND, SDHC, SD Card, SPI and I2C drivers
  - NAND boot targets and Nand Flashing targets are available. See details in MQX Getting Started document chapter TWR-MPC5125-KIT BSP.

- CodeWarrior Development Studio for Microcontrollers Version 10.1 support
  - TAD and New project wizard for Coldfire and Kinetis Platforms
  - MQX libraries, example and demo projects
- Kinetis BSP projects are CodeWarrior 10.1 Processor Expert Ready
  - Processor Expert drivers are enabled in MQX RTOS environment
  - Two BSPs with Processor Expert drivers enabled `<mqx>/build/twrk40n256_pe` and `<mqx>/build/twrk60x513_pe`
  - Example application demonstrating PE functionality `\demo\pe_demo`
  - Processor Expert drivers are supported for Kinetis platform only
- Kinetis scheduler enhanced
  - The `_int_install_kernel_isr()` call to install a non-MQX interrupt service routine into interrupt table is supported
  - The RAM-based vector table is supported.
- New smaller and faster version of GPIO driver prepared – LWGPIO driver. The driver is currently available for MCF52259 and MK40 and MK60 based BSPs only. See [doc/MQXIOUG.pdf](#) documentation and `\mqx\examples\lwgpio` example application for details. The driver will be ported to other platforms in future MQX releases.
- Serial driver was extended by new options allowing RS485 half duplex communication. New `ioctl` command for handling HW flow control (RTS/CTS signal) and SCI parity were added.
- The output directory for MQX PSP and BSP libraries has been changed – instead of `lib/<board_name>/mqx` are newly used `lib/<board_name>/psp` and `lib/<board_name>/bsp` folders. See [doc/FSL\\_MQX\\_Porting\\_Guide.pdf](#) for instructions if you are porting the project based on older MQX releases.
- `Mem_copy` and `mem_zero` functions were set to speed optimized version by default. The code is longer but up to seven times faster than original implementation.
- Byte-swapping macros optimized and unified in PSP library (`psp.h`)
- Handling of multicast packets has been simplified in RTCS, no functional change.
- Task priorities changed from 5 to 8 in several example applications. Note that task priorities below 7 have special functionality with regards to interrupt masking.
- HTTP server reworked. The server is able to operate in one of three modes: polled mode, static task pool or dynamic task created per session. See RTCS documentation for details.
- MFS USB example application modified to support multiple USB sticks simultaneously
- USB Audio Class support added into USB Host stack for KHCI based platforms. Example application prepared for ColdFire V2 and Kinetis based platforms (`usb\host\examples\audio\audio_stream`)
- TCPIP stack (RTCS) is newly available for platforms without Ethernet controller. Ready for WiFi and PPP support.
- CodeSize script and reports updated. The script is able to generate detailed reports for PSP, BSP and newly also RTCS, MFS and USB libraries
- User documentation was updated

## Bugfixes

- Management of free memory for Kinetis devices using `_mem_alloc_at` or `_lwmmem_alloc_at` allocation has been fixed. Using `_mem_alloc_at` could lead to losing part of free memory.
- USB Virtual\_com example code was fixed. Communication buffers are now allocated in un-cached memory.
- Serial driver: The `IO_IOCTL_SERIAL_TRANSMIT_DONE` command was corrected. The `IO_IOCTL_SERIAL_SET_HW_SIGNAL` and `IO_IOCTL_SERIAL_SET_PARITY` commands were implemented for all platforms
- SDHC sporadic read errors problem solved for Kinetis and MCF54418 devices. Default baud-rate has been reduced. Adaptive baudrate setting will be implemented in future MQX released.
- The MCF54418 GPIO driver interrupt related functionality has been fixed.
- The NAND ECC and back block byte handling in the MCF54418 NAND flash driver has been fixed. Wrong ECC size was defined in BSP header file.
- Several USB Host stack EHCI bug-fixes improving stack stability and compatibility with same mass storage devices (Error handling during enumeration improved, improved packet receiving algorithm)
- MFS free cluster counting has been fixed.
- ROM section setting corrected in the linker files for MCF51CN, MCF51AC and MCF51JM BSPs.
- `MFSCFG_FAT_CACHE_SIZE` set to value 2 for all configurations to improve USB Mass Storage write speed for devices with EHCI peripheral module.
- `IO_IOCTL_SERIAL_TRANSMIT_DONE` result was inverted bug was fixed
- Register definition file MCF54455 platform was corrected (`mcf5445_edma_struct`)
- QSPI baud rate calculation source code was unified across all platforms. The QWR setting was corrected.
- USB EHCI Host does not handle data properly, the packets are sometime rejected – fixed in asynchronous scheduler; the code accessing overlay area was removed
- M53015EVB board does not start without debugger – fixed in BSP initialization code for this platform
- `psp_prv.s` file kernel logging related compilation check was corrected
- HVAC and Security Webserver demo applications was updated to run on Kinetis platforms and IAR compiler
- SNMP compilation macros have been fixed. The `RTCSCFG_ENABLE_SNMP` macro was added to all SNMP related files.
- MPC5125 RTC example build error has been resolved
- LWDNS behavior was corrected for TWRK60X512 platform. Endian swapping macro was incorrectly used.
- GPIO driver – `fclose()` on Kinetis based platforms was corrected. The function incorrectly uninstalled the interrupts for other open pins.

- USB Host stack enumeration error handling has been improved. The stack is trying to re-assert transaction if error occurs.
- USB Host stack reviewed to correctly handle Big to Little endian conversion. USB MSD device class endianness problem fixed on Kinetis platform.
- ADC driver for ColdFire V1 platforms was corrected – wrong use of lwevent in conversion complete lead to incorrect signaling of the end of measurement
- Compilation errors if RTCS\_ENABLE\_IP\_REASSEMBLY was enabled were corrected
- The file lwe\_gets.c (lw event get signaled) was not included in PSP libraries for all platforms
- Function FLEXCAN\_Rx\_message() returned FLEXCAN\_NO\_MESSAGE when FlexCAN message box overrun. The function has been changed to return FLEXCAN\_MESSAGE\_OVERWRITTEN.

### **Version 3.8.0 (Dec 15<sup>th</sup> 2011)**

- New Board Support Packages added
  - TWR-K70F120M
  - TWR-K53N512
  - KwikStik (K40X256)
  - TWR-MCF51JF
  - TWR-MCF51QM
  - MPC8308-RDB
  - TWR-PXS20
- MQX, IO, RTCS, MFS and USB documentation updated. New USB User Guide documents created.
- New documents prepared to describe tool-specific settings for TAD and other MQX debugger plug-ins for CodeWarrior 10.x, IAR EWARM, ARM MDK - Keil uVision environments.
- The Kinetis port of the Freescale MQX is newly supported by the ARM MDK – Keil uVision IDE. The support includes:
  - Projects files for standard set of libraries: PSP, BSP, RTCS, MFS, USB Host and Device.
  - The uvmpw workspace files ready to be used to batch-build all MQX libraries.
  - Project files for all example applications and demo projects. Projects are tested with on-board P&E Micro OSJTAG interface and external ULINK interface.
  - All projects are prepared for uVision 4.22a and are set up for OSBDM debugging interface. The debugging connection may be changed to ULINK debugging interface – see more information in the Getting Started document.
  - MQX Task Aware Debugging plug-in.
- The CortexM PSP (Kinetis kernel) has been modified to be able to create tasks running in user (restricted) mode. The lightweight memory management, dynamic task creation, lightweight semaphore, event and message API functions were implemented to operate from user mode. This is an experimental prototype of the feature available for K60 and IAR build tools only in this version.

- HW floating point support added to Kinetis PSP. This feature is supported on the new MK70F120M platform.
- New LWGPIO Driver - smaller and faster GPIO driver was implemented for all supported platforms. MQX example applications were updated to use this driver. The support of legacy GPIO driver is discontinued and it will not be ported to future platforms.
- New IODbg IO driver was created. This driver allows redirecting I/O functions (e.g. printf) to a debug probe communication channel. The CodeWarrior 10, IAR EWARM 6 or Keil uVision4 debugger consoles are supported. See the Getting Started document for details on how to setup and use this feature.
- The FlashX driver and example application were rewritten to achieve effective operation and support of non-continuous Flash memory space used on Kinetis processors.
- I2C Slave driver functionality was re-implemented and new example applications have been created for all supported processors.
- TCHRES (Resistive touch screen) driver and example application demonstration for TWR-LCD board.
- The Ethernet boot loader example application has been created – this example application provides functionality similar to the well-known uBoot application. Only high-end platforms with external RAM are supported. Example contains implementation for both NAND and NOR flash memory devices.
- New C++ example application was created and C++ functionality was enabled on all platforms.
- Example project wizard introduced – users are able to create MQX example application projects directly from the CW10.x IDE.
- Added preliminary support for CodeWarrior 10.2 Beta. This requires manual installation of the CodeWarrior 10.2 plug-ins; see the Getting Started document for more details.
- Created Working Set Importer plug-in in the CW 10.2. It allows developers to export and import Working Sets to/from XML file. The aim of this plug-in is to let the developer to import whole set of MQX libraries required for a chosen board at once. This feature is not supported for CW10.1.
- USB Host and Device code have been modified to support both little- and big-endian USB peripheral module.
- IAR EWARM 6: Assembler-coded routines have been annotated by special CFI directives. This enables the call-stack history to be displayed properly in the IAR IDE. Use the latest EWARM TAD plugin from `<MQX install dir>\tools\iar_extensions\Embedded Workbench 6.X`.
- Kinetis register description header files have been updated to reflect the latest Reference Manual.

### Bugfixes:

- HTTP Server web pages which contains CGI does not work correctly in Chrome and Android browsers - Root cause for this issue was in inappropriate formatting of HTTP responses for CGI scripts and wrong Content-Length header field when the content is created dynamically.
- The `_mqx_exit()` call was eliminated from all examples (replaced by `_task_block()`) to allow stdout output channel to be flushed properly and also to enable easier debugging of example applications in case of errors.



- TFTP client cannot download file from TFTP server – incorrect use of read() fixed in the tftp shell command.
- MQX crash under ping-flood stress test of RTCS applications – Issue was caused by incorrect Ethernet TX and RX priority setting. The interrupt priority setting has been corrected (Rx and Tx interrupts need to be set at the same level) in all BSPs.
- RTC applications build fail for MPC8308.
- Task destroy does not clean lwmem-allocated blocks memory - the lwmem blocks are now freed during the owner's task destroy.
- Documentation updated for ENET\_initialize().
- MTIM timer does not run on MCF51JF and MCF51QM - new MTIM16 driver implemented for these platforms.
- Fixed GPIO IRQ functionality with on DEMOEM board.
- MQX uses old Kinetis header files - all Kinetis header files has been updated to new file revisions.
- MPC8308RDB - missing ipsum.cw in installer package added.
- Log application build fail for Kwikstikk40x256.
- I2C interrupt priority levels on Kinetis corrected - set to 5, sublevels removed.
- When selecting second alternative interface on the USB device from MQX USB host, the host stack freezes on searching pipe handles for that interface.
- SPI timing issue in DSPI driver - DSPI driver now calculates appropriate delays corresponding to the selected baud rate.
- The UART2 channel setting on the TWR-MPC5125 was fixed.
- Serial driver IO\_IOCTL\_SERIAL\_GET\_STOP\_BITS missing - functionality added to serial driver for Kinetis K40, K53, K60 and Coldfire MCF51QM, MCF51JF
- MQX does not check all registered DNS servers - fixed.
- snprintf function was fixed.
- Multiple initialization of DNS - ipcfg\_add\_dns\_ip() has been removed.
- Race condition in \_task\_get\_id\_from\_name and \_task\_get\_template\_index has been fixed.
- MPC8308 output libraries file names are incorrect – projects were re-generated with the correct name.
- Telnet performance increased by IOSOCK buffering.
- The RTCS telnet echo parameter option has been implemented.
- The MPC5125 MQX decremter initialization bug fixed.
- Incorrect pin handling in the legacy MCF5225x GPIO driver was fixed.
- Incorrect Target Settings of the MPC8308 projects fixed.
- Internal implementation of taskat function fixed.
- MPC5125 MQX FIFO corrected
- MPC5125 CodeWarrior v 9.2 New Project Stationeries were fixed
- Printf and scanf support for 64-bit numbers and %L modifier.

- Fixed printf, sscanf and scanf functions not working when using floats (%f) on Kinetis.
- Floating point libraries setting fixed for MCF52277 platform.
- MQX does not support %g %G printf() format specifiers – the missing functionality was implemented.
- ADC driver for Kinetis does not handle some input channels correctly.
- Bug in MCF51AC ADC driver provides invalid results.
- Kinetis linker map file did not make use of 32 Kbytes RAM.
- Problem in reading free space in USB stick.
- K60 pin muxing in “init\_gpio.c” for UART4 (ttye).
- TWRK60x512 cannot attach USB Keyboard.
- MPC5125 SD card driver cannot read 16GB cards.
- ENET\_shutdown() does not clean up all resources.
- Bug in RTCS select() if timeout is less than 1 millisecond.
- RTCS tick timer event scheduling fixed.
- MCF54455 RMII setting fixed.
- Interrupts pending from a bootloader before MQX starts may cause unhandled exception.
- WebHVAC application crashes on TWR-K60N512 board – the issue partially resolved by disabling Flash Cache - erratum e2647 for early silicon revisions (mask 0M33Z, see known issues for details).
- WebHVAC sporadic erratic behavior observed also with Flash Cache disabled on the early K60N512 silicon revisions (mask 0M33Z) when using IAR EWARM tools. The linker file was changed to put code to smaller addresses and constant data to higher addresses in the Flash. Application crashes not observed anymore after the change.
- Incorrect initialization of I2C2 and I2C3 peripheral drivers fixed on TWR-MCF51JF and TWR-MCF51QM.
- Issues with writing large file to USB memory stick on Cayman - fixed.
- PHDC weighscale application bug - missing reset state handler in phd\_state\_mc\_func functions array - fixed.
- \_time\_ticks\_to\_xdate() produces incorrect values - fixed.
- The ip.c file does not compile when RTCSCFG\_ENABLE\_NAT is enabled - fixed.
- Documentation of lightweight object destruction corrected.
- Nested comment in 5329 code has been removed.
- Documentation corrected – removed features which are not supported by current release (IO\_IOCTL\_SERIAL\_START\_BREAK and IO\_IOCTL\_SERIAL\_STOP\_BREAK).
- MPC5125, setting invalid MQX time when RTC is enabled - Add check of \_time\_from\_date function return value.
- TAD in IAR EWARM 6.21.4 freezes - LWMEM pools TAD screen has been fixed.

- TWR-MCF5418 demo web\_hvac cannot browse webpages from USB - Problem with memory cache. Changed MFS\_mem\_alloc\_system\_zero function - replaced \_mem\_alloc\_system\_zero with \_mem\_alloc\_system\_zero\_uncached.
- \_task\_get\_td() returning NULL when using SYSTEM\_TASK\_ID as parameter - fixed.
- Legacy GPIO driver interrupts handling corrected on MCF51 platforms.
- Bootloader example application and documentation has been updated. Line buffers were not handled correctly (function bootstrap\_ddr\_to\_nand(void))
- Serial port driver IO\_SERIAL\_HW\_FLOW\_CONTROL I/O control command fixed for interrupt mode on MCF5225x and Kinetis platforms
- USB CDC host fread() functionality fixed. The bug appeared in case application tried to read less data than received. This bug caused freezing of the CDC IN pipe.
- MCF54418 RTC driver fixed – Improved register unlock procedure is used in bsp\_rtc\_io\_init() to ensure that RTC is correctly set.
- The TWRMPC5125 timing was inaccurate (33,333 MHz oscillator vs. 32,768 MHz). Fixed the frequency values in the lcf files.
- DSPI baudrate calculation code modified - Baud rate calculation was extended by DBR setting to provide wider set of frequencies. Change is relevant for Kinetis and ColdFire processor families.
- All Kwikstikk40x256 host examples removed from release package - Kwikstik supports USB Device only.
- The MPC8308RDB I2C fixed - onboard I2C EEPROM uses 2 byte-wide memory addressing. I2C example was updated.
- TFTP client compatibility improved - TFTP read operation should ACK packets with already passed IDs and drop those with future IDs for better compatibility with some TFTP servers (www.dhcpserver.de). Timeout prolonged to 5 sec.
- Fixed PPP over UART client authentication code.
- Function ungetc() did not behave as expected. The ungetc behavior has been re-implemented. Other functions like ftell, fread, fgetc, fflush and fseek were made ungetc aware.
- Kinetis Int RAM Targets with vector table in RAM do not work correctly – problem fixed in IAR linker command file.
- Printf formatting correction - The hex formatting (%Nx) does not print leading zeros for integers - fixed.
- Incorrect usage of MQX\_USE\_SMALL\_MEM\_ZERO macro in \_mem\_zero() function for PowerPC could lead to the non optimal code generation.
- SPI baudrate was incorrect on MPC5125 due to incorrect endianness of baudrate divisor value in CCR register - fixed.

### Version 3.8.1 (Jun 29<sup>th</sup> 2012)

- New Board Support Packages added
  - TWR-K20D50M
  - TWR-K20D72M

- TWR-K40D100M
- TWR-K60D100M
- TWR-K60F120M
- TWR-PXS30
- TWR-PXN20
- Introduced new LWADC driver implemented for PX processor family. Documentation updated, new example application `mqx/examples/lwadc` has been prepared
- TWR-K70F120M BSP update
  - System cache has been enabled, resulting multiply time higher speed in IntFlash DDR data targets
  - USB High Speed (EHCI) operation has been enabled
  - Processor Expert support has been added (allowing use of PE drivers and Low Power features)
- TWR-PXS20 BSP update
  - Added LW ADC driver
- USB Host library has been updated to be able to handle both Full Speed (EHCI) and High Speed (KHCI) modules simultaneously.
- User mode support extended to Keil and CW10 toolsets for K60N512 BSP
- The Low Power features and Processor Expert support have been extended to TWR-MCF51JF and TWR-MCF51QM BSPs
- Sleep on Idle – MQX RTOS implements possibility to put processor core to the sleep mode and save energy during execution of the idle task. This feature is currently available for ColdFire and Kinetis platforms only. See details in `MQXIOUG.pdf` chapter Low Power Manager.
- Low Power Timer driver has been implemented and the functionality has been demonstrated in the `mqx/example/lowpower` application.
- SDCARD and DSPI and SDHC driver improvements
  - The clock speed of setting of communication channel (SPI, SDHC) has been corrected
  - DSPI polled driver optimized for performance, increased throughput at higher baud rates
  - CRC calculation in `sdcard_spi` driver implemented using a table, significant performance increase
  - SDCARD drivers prepared to make use of multi-sector transfers in the future (next release)
  - ESDHC driver does not use intermediate buffer for data freeing up 0.5 KB of RAM

#### Bugfixes:

- MPC5125 serial with interrupt is not working – serial driver `putc` routine has been fixed
- I2C driver on `mcf51jm` gets stuck – prepared workaround using short wait loops before reading of IIC status register

- Compiler warnings for CW10.2 - `#pragma opt_branchtailmerge off` – removed obsolete compiler macro
- User mode tests fail in the INTRAM targets – linker command file sections has been corrected
- NFC Driver - incorrect ECC status word reading - ECC status word reading fixed
- SPI example application failed for TWRPXS20 BSP chip select of connected accelerometer was disabled by pin pull-up resistor and rx buffer overflow was prevented in interrupt driver ISR
- MQX Telnet server update – incorrect ECHO handling
  - Support negotiation of binary mode.
  - Introduced new modes CR LF, CR NULL and character block binary mode.
  - Introduced new IOCTL commands to switch between modes.
  - Update demos to handle character mapping between application and telnet NVT.
- RTC for mcf5xxx - date gets out of valid range due to wrong RTC\_BASE\_YEAR
- SPI clock line is not set up during spi\_init TWR-MPC5125 BSP– BSP GPIO setting fixed, added missing IOCTL commands
- Printf for floating types compatibility issue - Differences between gnu libs and MQX representation was fixed.
- ipcfg\_bind\_staticip do not fail if the same address is present on network - IPIF\_bind() corrected
- The C library exit() function call was removed from MQX all example applications (replaced by \_task\_block()) to allow stdout output channel to be flushed properly and also to enable easier debugging of example applications in case of errors.
- In the full memory allocator, the highwater mark was updated incorrectly when an allocation was made in the pool extension area (created by \_mem\_extend()) - Now the highwater mark is updated only if block is allocated from the main pool area - so it shows valid information. The highwater mark is not available for pool extension areas.
- The TAD was fixed and updated to display all allocated memory blocks, even the ones from the memory extension areas created by \_mem\_extend() call. In the previous implementation, the TAD might have failed to display the memory blocks correctly in case the extension area was created.
- Linker Command File TWRMPC5125 modified - kernel\_data start symbol is placed automatically after statically allocated data now.
- PAP authentication fixed for PPP connection - problem has been fixed in both PAP&CHAP state machine and example application. See example readme, pap.c and chap.c files for details.
- Functionality for length modifiers (h hh and L ll) was implemented for printf(), fprintf(), sprintf(), snprintf() functions.
- No source available while debugging the TWR-PXS20 platform - All example project for have been updated with correct setting (“Generate DWARF information”)
- Solved problem with reattaching the low speed devices to MQX USB Host. The attach failed every second time because of incorrect speed handshake algorithm
- Data and instruction cache has been enabled for TWRK70F120M board in default setting

- TWRK70F120M – linker command files for intflash\_ddrdata and intflash\_sramdata have been fixed – flash (ROM) space is fully used now
- IPC UDP example was not working properly. IPC used default initialization structure because no custom one was passed. '\_task\_create' call was modified and it now correctly passes this structure to IPC initialization task.
- Bug in case Kinetis ADC fopen/fclose was called multiple times fixed in PDB initialization.
- Flashx driver on twrmcf51mm and twrmcf51je supports now 2 banks of internal flash memory.
- Kinetis serial driver now allows to set 1 or 2 stop bits using IOCTL command IO\_IOCTL\_SERIAL\_SET\_STOP\_BITS.  
Since the HW doesn't support variable number of stop bits, the second stop bit is emulated using 9bit communication with last bit set to 1.  
The 2 stop bits configuration is therefore available only in 8 bit data mode with parity disabled.
- MQX-memcpy() failed, when KEIL-optimization is enabled – mem\_copy functionality corrected and by default the MQX uses use runtime (tool provided) memcpy instead of mxq\_mem\_copy to achieve best performance
- MFS\_Get\_disk\_free\_space() - fixed free space calculation in MFS
- When ping request expires due to timeout, the associated ARP request queue is being cleared. The clearing code was fixed so it doesn't block RTCS task in case entries in the queue don't match the ping request.
- IODEBUG documentation has been added to MQX IO guide

#### **Version 4.0.0 (Dec 7<sup>th</sup> 2012)**

See Section 2 "What is New?" above.